MATHEMATICS

LIST OF NEW COURSES

Sl. No	Course Code	Course Title	Credits [L: T:P:C]
1	24MA1001	Basic Mathematics and Numerical Computing	2:1:0:3
2	24MA1002	Statistical Analysis and Random Process for Bio-Technology	2:1:0:3
3	24MA1003	Calculus and Differential Equations	2:1:0:3
4	24MA1004	Linear Algebra, Transforms and Numerical Methods	2:1:0:3
5	24MA1005	Basics of Probability and Statistics	2:0:2:3
6	24MA1006	Data Analysis for Media	3:0:0:3
7	24MA3001	Mathematics for Computer Science	3:1:0:4
8	24MA3002	Foundations of Mathematics and Statistics	3:0:0:3

Course Code	Basic Mathematics and Numerical Computing	L	T	P	C
24MA1001		2	1	0	3

Course Objectives:

Enable the student to:

1. Understand the concept of matrices.
2. Identify the techniques for solving the system of linear equations.
3. Apply differentiation and integration techniques to solve bio-engineering problems.

Course Outcomes:

The student will be able to:

1. Analyse the quadratic form using orthogonal transformation of the matrix.
2. Utilize differential equation techniques to solve higher order differential equations.
3. Develop knowledge in curve fitting.
4. Solve integrals using substitution, integration by parts, and beta and gamma functions.
5. Gain knowledge in multiple integrals.
6. Evaluate differentiation and integration using numerical techniques.

Module: 1	Matrices	8 Hours

Eigen Values and Eigen Vectors of a Real Matrix - Characteristic Equation - Properties of Eigen Values and Eigen Vectors - Cayley Hamilton Theorem - Diagonalization of Matrices - Application - Page Rank Algorithm in Google Search - Image Processing (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 2	Ordinary Differential Equations	8 Hours

Basic Rules of Differentiation - Second and Higher Order Linear Differential Equations with Constant Coefficients - Method of Variation of Parameters - Modelling of Growth and Decay Problems (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 3	Solution of Linear Equations and Curve Fitting	7 Hours

Matrix Inversion - Direct Methods - Gauss Elimination - Gauss-Jordan Methods - Iteration Method - Gauss-Jacobi's Method - Methods of Least Squares - Fitting a Straight Line and a Polynomial (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 4	Integral Calculus	7 Hours

Definite and Indefinite Integrals - Substitution Rule - Techniques of Integration - Integration by Parts - Trigonometric Substitutions - Beta and Gamma Functions.

Module: 5	Multiple Integrals	7 Hours

Double Integrals - Change of Order of Integration (Cartesian Coordinates) - Double Integrals in Polar Coordinates - Area Enclosed by Plane Curves.

Module: 6	Numerical Differentiation and Integration	8 Hours

Differentiation - Newton's Forward and Backward Difference Formula – Numerical Integration - Trapezoidal Rule - Simpson's One-Third Rule and Simpson's Three-Eighth Rule.

Total Lectures	**45 Hours**
Text Book	
1.	B. S. Grewal (2017), *Higher Engineering Mathematics (44th Edition).* Khanna Publishers.
2.	T. Veerarajan (2008), *Engineering Mathematics.* McGraw-Hill, New Delhi.
Reference Books	
1.	B. V. Ramana (2010), *Higher Engineering Mathematics.* McGraw Hill, New Delhi.
2.	N.P.Bali and M.Goyal (2010), *A Textbook of Engineering Mathematics.* Laxmi Publications.
3.	E. Kreyszig (2006), *Advanced Engineering Mathematics.* John Wiley & Sons.
4.	W.E. Boyce and R.C. Di Prima (2017), *Elementary Differential Equations and Boundary Value Problems.* John Wiley & Sons.
5.	D. Poole (2005), *Linear Algebra: A Modern Introduction*. Brooks/Cole, ISBN: 978-0-538-73545-2
Recommended by Board of Studies	15-04-2024
Approved by Academic Council	11-05-2024

Course Code	Statistical Analysis and Random Process for Bio-Technology	L	T	P	C
24MA1002		2	1	0	3

Course Objectives:

Enable the student to:

1. Examine linear systems using random variables and processes.
2. Measure uncertainty using various probability distributions.
3. Analyze the data using statistical techniques.

Course Outcomes:

The student will be able to:

1. Apply probability models and solve them using discrete and continuous random variables.
2. Classify problems using probability distributions.
3. Test the hypothesis for large samples.
4. Analyze the parameters and attributes of small samples.
5. Construct the experimental designs using analysis of variance.
6. Examine the ergodicity of random processes.

Module: 1	Random Variables	8 Hours

One Dimensional Random Variables: Discrete and Continuous Random Variables - Probability Density Function - Cumulative Distribution Function. Two Dimensional Random Variables: Discrete random variables - Marginal Probability Distribution - Conditional Probability Distribution - Independent Random Variables - Application in Biochemical Engineering Problems.

Module: 2	Probability Distributions	8 Hours

Discrete Distribution: Binomial and Poisson Distribution - Poisson Distribution is a Limiting Case of Binomial Distribution - Fitting Binomial and Poisson Distributions - Continuous Distribution: Normal Distribution. Applications: Analyzing the Performance Using Practical Problems.

Module: 3	Large Sample Tests	7 Hours

Tests of Means - Variances and Proportions - Large Sample Test Based on Normal Distribution for Single Mean and Difference Means - Test for Single Proportion - Difference of Proportion - Application: Performance Analysis.

Module: 4	Small Sample Tests	8 Hours

Small Sample Test - Student's T Test - Single Mean - Difference of Two Means - F Test - Chi Square Test - Goodness of Fit - Test of Independence Attributes - Applications: Comparative Analysis and Quality Testing.

Module: 5	Design of Experiments	7 Hours

Analysis of Variance: One - Way and Two - Way Classification - Completely Randomized Design - Randomized Block Design - Simple Latin Square Design - Application: Measuring the Influences Between Factors.		
Module: 6	**Random Process**	**7 Hours**
Classification of Random Process - Stationary Process - Auto Correlation and Cross Correlation - Properties - Mean Ergodic and Cross Ergodic Process - Properties - Markov Process - Markov Chain - Classification of States of a Markov Chain - Steady State Distribution of a Markov Chain - Application in Data Analytics.		
Total Lectures		**45 Hours**

Text Book	
1.	T. Veerarajan (2016), *Probability and Random Process (with Queuing Theory and Queuing Networks) (4th Edition)*. Mc Graw-Hill Education (India) Pvt Ltd., New Delhi.
2.	T. Veerarajan (2007), *Probability, Statistics and Random Processes (2nd Edition)*, Tata McGraw Hill publishing company.
Reference Books	
1.	S. P. Gupta (2009), *Statistical Methods.* Sultan Chand and sons, New Delhi.
2.	Erwin Kreyszig (2006), *Advanced Engineering Mathematics (9th Edition)*. John Wiley & Sons.
3.	P. G. Hoel, S. C. Port and C. J. Stone (2003), *Introduction to Probability Theory*. Universal Book Stall.
4.	S. Ross (2002), *A First Course in Probability (6th Edition)*, Pearson Education India.
5.	N.P. Bali and Manish Goyal (2010), *A text book of Engineering Mathematics*. Laxmi Publications.
6.	G.JayKarns (2018), *Introduction to Probability and Statistics using R (3rd Edition)*. ISBN: 978-0-557-24979-4

Recommended by Board of Studies	15-04-2024
Approved by Academic Council	11-05-2024

Course Code	**Calculus and Differential Equations**	**L**	**T**	**P**	**C**
24MA1003		**2**	**1**	**0**	**3**

Course Objectives:

Enable the student to:
1. Gain knowledge of special functions and series.
2. Understand the concepts of differentiation and integration.
3. Formulate physical phenomena using vector spaces.

Course Outcomes:

The student will be able to:
1. Explain the concepts of expansion and convergence of functions in general form.
2. Compute surface area and volume of objects using definite integral.
3. Represent functions as infinite series in wave propagation techniques.
4. Utilize differentiation techniques to determine extreme values of functions.
5. Illustrate various integration techniques to measure physical parameters.
6. Analyze and solve ordinary and partial differential equations in Engineering contexts.

Module: 1	**Sequences and Series**	**7 Hours**
Convergence of Sequence and Series - Tests for Convergence - Power Series - Taylor's Series - Series for Exponential, Trigonometric and Logarithmic Functions. Application: Measurement Instruments Derivations (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 2	**Calculus**	**7 Hours**
Evolutes and Involutes; Evaluation of Definite and Improper Integrals - Beta and Gamma Functions and theirProperties. Applications of Definite Integrals to Evaluate Surface Areas and Volumes of Revolutions (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 3	**Fourier series**	**7 Hours**

Full Range - Change of Interval - Half Range Sine and Cosine Series - Parseval's Theorem - Harmonic Analysis - Applications: Signals and System - Continuous and Discrete Time Fourier Series (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 4	**Multivariable Calculus: Differentiation**	**8 Hours**
Jacobians – Maxima-Minima and Saddle Points Method of Lagrange Multipliers Vector Differentiation: Gradient - Directional Derivatives - Curl and Divergence. Applications: Differentiation/Partial Differentiation in Gradient Descent Algorithm - Training Method of ANN Electromagnetics - Frequency and Pulse Modulation - Control System - Stability Analysis Electromagnetics (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 5	**Multivariable Calculus: Integration**	**8 Hours**
Multiple Integration: Double and Triple Integrals (Cartesian and Polar) - Change of Order of Integration in Double Integrals - Change of Variables (Cartesian to Polar). Applications: Areas and Volumes by (DoubleIntegration) Centre of Mass and Gravity (Constant and Variable Densities) - Theorems of Green, Gauss and Stokes (Statement Only) - Orthogonal Curvilinear Coordinates - Simple Applications Involving Cubes - Sphereand Rectangular Parallelepipeds. Applications: Electromagnetic - Change of Variables - Antenna Theory and Wave Propagation (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 6	**Ordinary and Partial Differential Equations**	**8 Hours**
Ordinary Differential Equations: Second Order Linear Differential Equations with Constant Coefficients - Method of Variation of Parameters - Cauchy-Euler Equation. First Order Partial Differential Equations: Solutions of First Order Standard Types and Lagrange's Equations. Applications: Signals and Systems - System Function/Analysis-DSP-FIR/IIR Filters (For Classroom Discussions, Assignments and Term Paper Work).		
Total Lectures		**45 Hours**

Text Book	
1.	B. S. Grewal (2017), *Higher Engineering Mathematics (44th Edition).* Khanna Publishers.
Reference Books	
1.	T. Veerarajan (2008), *Engineering Mathematics.* McGraw-Hill, New Delhi.
2.	B. V. Ramana (2010), *Higher Engineering Mathematics.* McGraw Hill, New Delhi.
3.	N.P.Bali and M.Goyal (2010), *A Textbook of Engineering Mathematics.* Laxmi Publications.
4.	E. Kreyszig (2006), *Advanced Engineering Mathematics.* John Wiley & Sons.
5.	W.E.Boyce and R.C.DiPrima (2017), *Elementary Differential Equations and Boundary Value Problems.* John Wiley & Sons.

Recommended by Board of Studies	15-04-2024
Approved by Academic Council	11-05-2024

Course Code	**Linear Algebra, Transforms and Numerical Methods**	**L**	**T**	**P**	**C**
24MA1004		**2**	**1**	**0**	**3**

Course Objectives:

Enable the student to:

1. Demonstrate knowledge in matrices.
2. Classify numerical solutions of algebraic and transcendental equations.
3. Recognize the fundamental concepts of Transforms.

Course Outcomes:

The student will be able to:

1. Apply the concepts of matrices to solve complex problems in engineering and data analysis.
2. Establish numerical methods and interpolation techniques for solving algebraic and transcendental equations.
3. Solve differential equations using numerical techniques.
4. Estimate the various techniques of transforms in solving engineering problems.

5. Employ Z-transform techniques to address technical problems.
6. Execute graph theory operation to confront problems in electric circuit analysis.

Module: 1	**Matrices**	**7 Hours**
Eigenvalues and Eigenvectors - Cayley-Hamilton Theorem - Diagonalization of Matrices - Orthogonal Transformation - Reduce Quadratic Forms to Canonical Forms. Applications: Control Systems - State Variable Analysis - MIMO Wireless Communication (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 2	**Numerical Methods-I**	**7 Hours**
Solution of Algebraic and Transcendental Equations - Bisection Method - Newton-Raphson Method and Regula-Falsi Method - Finite Differences - Interpolation Using Newton’s Forward and Backward Difference Formulae. Numerical Integration:Trapezoidal Rule - Simpson’s 1/3rd and 3/8 Rules.		
Module: 3	**Numerical Methods-II**	**8 Hours**
Ordinary Differential Equations of First Order: Taylor’s Series - Euler and Modified Euler’s Methods - Runge-Kutta Method of Fourth Order - Milne’s and Adam’s Predicator - Corrector Methods. Partial Differential Equations: Solution of Laplace Equation by Liebmann Method - Solution of Poisson Equation by Bender Schmidt Method. Applications: Electron Devices - Drift and Diffusion Currents Derivation - Electromagnetics - Maxwell Equations (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 4	**Laplace Transforms, Fourier Transforms**	**8 Hours**
Laplace Transform - Definitions and Properties - Inverse LaplaceTransform - Convolution Theorem - Solving Ordinary Differential Equations. Fourier Transforms (Infinite and Finite) - Definitions and Examples. Applications: Signals and Systems-Control Systems - System Analysis, Filters, Time Response Analysis - Convolutional Neural Networks - Modulation, Demodulation Concepts of Communication Theory and Systems (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 5	**Z - Transforms**	**8 Hours**
Standard Z - Transforms - Standard Results - Shifting U_n to The Right - Multiplication by N - Inverse Z-Transforms of Standard Functions - Method of Partial Fractions - Properties - Application to Solve Difference Equations. Application: DSP - IIR and FIR Filter Design - Image Analysis - Control Systems Dimensionality Reduction (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 6	**Graph Theory**	**7 Hours**
Definitions and Operations of Graphs - Euler Graph - Hamiltonian Graph - Transportation Network. Applications: Electric Circuit Analysis - Cut Set - Tie Sets Topic (For Classroom Discussions, Assignments and Term Paper Work).		
Total Lectures		**45 Hours**

Text Book	
1.	B. S. Grewal (2017), *Higher Engineering Mathematics (44th Edition).* Khanna Publishers.
2.	Bernard Kolman, Robert C.busby, Sharo Cutler Ross (2004), *Discrete Mathematical Structures (5th Edition).* Prentice Hall of India.
Reference Books	
1.	D. Poole (2005), *Linear Algebra: A Modern Introduction.* Brooks/Cole.
2.	N.P.Bali and M.Goyal (2008), *A text book of Engineering Mathematics.* Laxmi Publications.
3.	V. Krishnamurthy, V. P. Mainra and J. L. Arora (2005), *An introduction to Linear Algebra*. Affiliated East-West press.
4.	P. Kandasamy, K. Thilagavathy, K. Gunavathi (2012), *Numerical Methods (2nd Edition).* S. Chand & Company.

Recommended by Board of Studies	15-04-2024
Approved by Academic Council	11-05-2024

Course Code	Basics of Probability and Statistics	L	T	P	C
24MA1005		2	0	2	3

Course Objectives:

Enable the student to:

1. Acquire the knowledge on the basics and application of probability and statistics.
2. Employ different probability and statistical techniques in decision making problems.
3. Evaluate the probability and statistical quantities using R programming.

Course Outcomes:

The student will be able to:

1. Measure the central tendency and dispersion of the data.
2. Apply the basic concepts of probability and distributions in decision making and develop models for ML.
3. Analyze the linear relationship between data and develop mathematical equations for interpolation.
4. Interpret the nature of samples applying hypothetical testing and propose appropriate decisions.
5. Execute statistical quality control and construct the appropriate control charts to manage the food processing and production industry.
6. Apply Design of Experiments techniques to analyze the variance for classification and block designing of experiments in food industry.

Module: 1	Preliminaries of Data Analytics	7 Hours

Measurement of Central Tendency: Mean Median and Mode - Measurement of Dispersion: Range - Quartile Deviation - Mean Deviation and Standard Deviation - Application - Survey Data Analysis - Consistency of the Product (For Classroom Discussions, Assignments and Term Paper Work).

Module: 2	Probabilistic Models	8 Hours

Axioms of Probability - Mathematical Definition of Probability - Conditional Probability -Independent Events - Theorem of Total Probability - Baye's Theorem (Statement Only) and Its Problems. Discrete Distribution: Binomial and Poisson Distribution - Continuous Distribution: Normal Distribution - Application - Decision Making - Construction of Machine Learning Model (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 3	Linear Relationship and Predictive Models	7 Hours

Correlation - Definition and Types of Correlation - Scatter Diagram - Karl Pearson's Co-Efficient of Correlation - Spearman's Rank Correlation - Regression Analysis: Lines of Regression and Regression Equations - Regression in Two Variables - Application - Measuring the Influences Between Factors - Estimation of Association Among the Variables (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 4	Testing of Hypothesis	8 Hours

Population - Sample - Type I and Type II Error - Tests of Means and Proportions - Large Sample Test Based on Normal Distribution for Single Mean and Difference Means - Test for Single Proportion - Difference of Proportion - Small Sample Test - Student's T Test - Single Mean -Difference of Two Means - F Test - Chi Square Test - Goodness of Fit - Test of Independence Attributes - Application- Comparative Analysis - Quality Testing.

Module: 5	Statistical Quality Control	7 Hours

Types of Variation - Types of Control Charts - Control Chart of Mean and Range, Sigma Chart, Control Chart of Proportion of Defectives and Number of Defectives - C- Chart - Advantages and Limitations of SQC - Application of Quality Control in Food Industry.

Module: 6	Design of Experiments	8 Hours

Analysis of Variance: One -Way and Two-Way Classification - Completely Randomized Design - Randomized Block Design - Simple Latin Square Design - Response Surface Methodology.

Total Lectures	45 Hours

List of Experiments using R:

1. Introduction to Programming in R and syntax.
2. Preparation of graphs and plots using R.
3. Compute measures of central tendency and dispersion.
4. Solving problems based on probability.
5. Probability functions of discrete and continuous distributions.
6. Applying linear regression and correlation models to dataset.
7. Hypothesis test for large samples using mean values.
8. Hypothesis test for small samples using mean values.
9. Applying Chi-square test for goodness of fit test and Contingency test to real data set.
10. Design of experiment using ANOVA (CRD) and ANOVA (RBD).

Text Book

1.	T. Veerarajan (2017), *Probability, Statistics and Random Processes (3rd Edition).* Tata McGraw-Hill, New Delhi.
2.	B. S. Grewal (2017), *Higher Engineering Mathematics (44th Edition).* Khanna Publishers.

Reference Books

1.	S.C.Gupta, V.K. Kapoor (2007), *Fundamentals of Mathematical Statistics (11th Edition).* Sultan Chand &Sons.
2.	E. Kreyszig (2015), *Advanced Engineering Mathematics (10th Edition).* John Wiley & Sons.
3.	P. G. Hoel, S. C. Port and C. J. Stone (2003), *Introduction to Probability Theory.* Universal Book Stall.
4.	S. Ross (2019), *A First Course in Probability (9th Edition).* Pearson Education India.
5.	A.Papoulis and S. Unnikrishnan Pillai (2002), *Probability, Random Variables and Stochastic Processes (4th Edition).* Mc-Graw Hill.
6.	G. JayKarns (2018), *Introduction to Probability and Statistics using R (3rd Edition).* ISBN: 978-0-557-24979-4

Recommended by Board of Studies	15-04-2024
Approved by Academic Council	11-05-2024

Course Code	**Data Analysis for Media**	**L**	**T**	**P**	**C**
24MA1006		**3**	**0**	**0**	**3**

Course Objectives:

Enable the student to:

1. Develop the skills for solving systems of equations.
2. Statistically analyse data for decision making.
3. Imbibe the application of Probability and Graph Theory.

Course Outcomes:

The student will be able to:

1. Apply matrix systems for solving simultaneous equations.
2. Compare the data sets by using graphical representations.
3. Interpret the data using statistical analysis.
4. Measure the relation between the variables.
5. Solve the problems using probabilistic modelling.
6. Analyze the network using graph algorithms.

Module: 1	**Matrices**	**9 Hours**

Introduction - Matrix Operations - The Trace and Determinant of a Matrix - Properties of Determinants (Excluding the Proof)– Solving Simultaneous Equations: Cramer’s Rule. Application of Matrices in Media (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 2	**Statistical Description of Data**	**9 Hours**

Statistical Data: Collection, Classification, and Tabulation - Scales of Measurement – Frequency Distribution - Diagrammatic Representation of Data: Bar Diagrams and Pie-Chart- Graphical Representation of Frequency Distribution: Histogram, Frequency Polygon, Frequency Curve and Ogives.

Module: 3	**Measures of Central Tendency and Dispersion**	**9 Hours**

Measures of Central Tendency: Mean, Median, Mode, Geometric Mean and Harmonic Mean. Measures of Dispersion: Range, Standard Deviation. Measures of Relation: Karl Pearson's Coefficient of Correlation - Linear Regression Equations and Rank Correlation. Application of Statistics in Media Engineering (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 4	**Probability**	**9 Hours**
Axioms of Probability - Mathematical Definition of Probability - Conditional Probability –Independent Events –Addition Law and Multiplication Law- Theorem of Total Probability - Baye's Theorem (Statement Only) and Its Problems - Application of Probability in Decision Making and Prediction for Media Engineering (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 5	**Graph Theory**	**9 Hours**
Graphs and Their Properties- Degree, Connectivity, Path, Cycle, Sub Graph, Eulerian and Hamiltonian Graphs. Trees, Rooted Trees, and Trees Sorting, Shortest Distances Minimal Spanning Tree – Kruskal and Prim's Algorithms Application Graphs in Media Engineering (For Classroom Discussions, Assignments and Term Paper Work).		
Total Lectures		**45 Hours**

Text Book	
1.	B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2.	T. Veerarajan, "Probability, Statistics and Random Processes," 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.
3.	Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 6th Edition, Pearson Education, 2009.
Reference Books	
1.	S.P.Gupta, Statistical methods, Sultan Chand & Sons, 2012.
2.	E. Kreyszig, "Advanced Engineering Mathematics," John Wiley & Sons, 2006.
3.	Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill, 8th Edition, 2019.
4.	A. Hepzibah, R. Selvamani, K. Porselvi, "Basic Engineering Mathematics," HSI Publications, Coimbatore, 2011.

Recommended by Board of Studies	
Approved by Academic Council	20-08-2024

Syllabus prepared by Dr. C. BAZIL WILFRED

Course Code	Mathematics for Computer Science	L	T	P	C
24MA3001		**3**	**1**	**0**	**4**

Course Objectives:

Enable the student to:

1. Understand the basic concepts of graph theory and its algorithms.
2. Gain knowledge of number theory and automata theory.
3. Use the basic statistical and probability measures for data science.

Course Outcomes:

The student will be able to:

1. Apply the fundamental concepts of graph theory in real time problems.
2. Implement and analyze the graph algorithms.
3. Employ the principles of number theory to address mathematical problems.
4. Design and analyze the finite-state machines and regular grammars.
5. Comprehend and implement probability principles.
6. Examine and assess data to support informed decision-making in computing.

Module: 1	**Graph theory**	**8 Hours**
Basic Terminology - Some Special Simple Graphs - Representations of Graphs - Eulerian Graphs - and Hamiltonian Graphs - Standard Theorems - Planar Graphs - Euler's Formula - Five Colour Theorem - Coloring of Graphs - Chromatic Number (Vertex and Edge) - Properties and Examples - Directed Graphs.		

Module: 2	Graph algorithm	7 Hours
Computer Representation of Graphs Connectivity - Shortest Path Algorithm and Trees - Related Basic Theorems and Results with Proof.		
Module: 3	**Number theory**	**8 Hours**
Divisibility – Primes - Fundamental Theorem of Arithmetic - Division Algorithm - G.C.D & LCM - Eulers and Fermat's Theorems - Related Basic Theorems with Proof and Related Problems.		
Module: 4	**Automata theory**	**7 Hours**
Languages – Grammars - Chomskey's Classification of Grammars - Derivation Trees - Backus-Naur Form, Finite - State Machines with Outputs - Melay and Moore Machines - Finite-State Automata - Regular Sets - Kleene's Theorem - Regular Grammars.		
Module: 5	**Probability**	**8 Hours**
Definitions and Axioms - Conditional Probability - Independent Events - Theorem of Total Probability - Baye's Theorem**.** Discrete Random Variable: Probability Mass Function and Distribution Functions. Continuous Random Variable: Probability Density Function - Cumulative Distribution Function and Properties - Binomial Distribution - Poisson Distribution and Normal Distribution - Exponential Distribution.		
Module: 6	**Statistics**	**7 Hours**
Measures of Central Tendency: Mean - Median - Mode - Geometric Mean - Harmonic Mean. Measures of Dispersion: Range - Quartile Deviation - Mean Deviation - Standard Deviation - Coefficient of Variation - Moments - Skewness and Kurtosis - Rank Correlation - Co-Efficient of Correlation and Regression Lines.		
Total Lectures		**45 Hours**

Text Book	
1.	H. Kenneth Rosen (2012), *Discrete mathematics and its applications.* Tata McGraw - Hill Edition.
2.	T. Veerarajan (2009), *Probability, Statistics and Random Processes (6th Edition).* Tata McGraw-Hill Edition.
3.	Bernard Kolman, Robert Busby C., Sharon Cutler Ross (2004), *Discrete Mathematical Structures (5th Edition).* Pearson Education.
Reference Books	
1.	H. Richard Williams (2009), *Probability, Statistics and Random Process for Engineers.* CENGAGE Learning.
2.	Narsingh Deo (2004), *Graph Theory with Application to Engineering and Computer Science.* Prentice-Hall of India Private Ltd, India.
3.	A. Handy Taha (2010), *Operations Research (6th Edition).* Prentice – Hall of India Private Limited, New Delhi.
4.	E. Kreyszig (2000), *Advanced Engineering Mathematics (8th Edition).* John Wiley and Sons (Asia) Pvt Ltd., Singapore.

Recommended by Board of Studies	15-04-2024
Approved by Academic Council	11-05-2024

Course Code	Foundations of Mathematics and Statistics	L	T	P	C
24MA3002		**3**	**0**	**0**	**3**

Course Objectives:

Enable the student to:

1. Understand the concepts of differential calculus and integral calculus.
2. Develop skills in probability and statistics.
3. Gain a strong understanding of hypothesis testing.

Course Outcomes:

The student will be able to:

1. Evaluate maxima and minima using differentiation techniques.

2. Apply the concept of integration in their engineering studies. 3. Solve real life problems using probability theory. 4. Estimate the potential applications of various statistical concepts. 5. Utilize the properties of various probability distributions in the field of biotechnology. 6. Analyze hypothesis testing of small and large sample problems using statistical techniques.		
Module: 1	**Differential Calculus**	**7 Hours**
Limits and Continuity – Differentiation - Product and Quotient Rule - Maxima and Minima of a Single Variable Functions.		
Module: 2	**Integral Calculus**	**7 Hours**
Integration of Standard Functions - Methods of Integration - Integration by Parts - Definite Integrals - Bernoulli's Formula.		
Module: 3	**Probability and distributions**	**8 Hours**
Probability - Axiomatic Definition of Probability - Independent Events – Binomial and Poisson Distributions - Normal Distribution - Properties of Normal Distribution - Importance of Normal Distribution - Normal Probability Curve - Fitting Binomial and Poisson Distributions - Problems (Proofs and Derivations are not Included).		
Module: 4	**Statistics**	**7 Hours**
Measures of Central Tendency: Mean - Median - Mode - Moments - Skewness and Kurtosis - Correlation and Regression - Rank Correlation.		
Module: 5	**Testing of hypothesis**	**8 Hours**
One Tailed and Two Tailed Tests - Tests Based on Large Samples - Proportion and Mean - Small Samples: T, F, Chi Square Distributions.		
Module: 6	**Design of Experiments**	**8 Hours**
Analysis of Variance - One Factor Classification - Two Factor Classification - Completely Randomized Design - Randomized Block Design - Latin Square Design.		
Total Lectures		**45 Hours**

Text Book	
1.	S. P. Gupta (2009), *Statistical Methods (37th Edition)*, S.Chand & Co.
2.	Manickavasagam Pillai (2002), *Algebra Volume I & II.* S. Viswanathan publishers.
Reference Books	
1.	P. Kandasamy, K. Thilagavathi and K. Gunavathy (2001), *Engineering Mathematics (Volume I)*, S.Chand & Co.
2.	T. Veerarajan (2003), *Probability, Statistics and Random Processes (2nd Edition).* Tata McGraw Hill publishing company.
3.	P. Kandasamy, K. Thilagavathi and K. Gunavathy (2009), *Numerical Methods.* S.Chand & Co.
4.	S. C. Gupta and V. K. Kapoor (2007), *Fundamentals of Mathematical Statistics.* Sultan Chand & Co.
5.	J. N. Kapoor and H. C. Saxena (2006), *Mathematical Statistics.* S.Chand & Company.

Recommended by Board of Studies	15-04-2024
Approved by Academic Council	11-05-2024

MATHEMATICS

LIST OF NEW COURSES

Sl.No	Course Code	Course Title	Credits [L:T:P:C]
1	22MA3001	Logical Reasoning and Soft Skills	0:0:2:0
2	23MA1001	Matrices, Calculus and Ordinary Differential Equations	3:0:0:3
3	23MA1002	Partial Differential Equations, Vector Spaces and Laplace Transform	3:0:0:3
4	23MA1003	Calculus and Differential Equations	3:1:0:4
5	23MA1004	Linear Algebra, Transform and Numerical Methods	3:1:0:4
6	23MA1005	Mathematics for Media Engineering	3:0:0:3
7	23MA1006	Linear Algebra, Calculus and Ordinary Differential Equations	2:0:2:3
8	23MA1007	Partial Differential Equations, Transforms and Numerical Methods	2:0:2:3
9	23MA1008	Analytical Geometry, Calculus and Linear Algebra	2:0:2:3
10	23MA1009	Differential Equations and Complex Variables	2:0:2:3
11	23MA1010	Mathematical Modelling for Media	3:0:0:3
12	23MA1011	Probabilistic Models and Networking	3:0:0:3
13	23MA1012	Vector Spaces and Laplace Transform	3:0:0:3
14	23MA1013	Multivariable Calculus and Differential Equations	3:0:0:3
15	23MA1014	Matrices, Numerical Methods and Transforms	3:0:0:3
16	23MA2001	Probability and Statistics	3:0:0:3
17	23MA2002	Discrete Structures	3:0:0:3
18	23MA2003	Probability and Statistics in Engineering	3:1:0:4
19	23MA2004	Probability and Statistics for Mechanical Engineering	2:0:2:3
20	23MA2005	Mathematics for Digital Science	3:1:0:4
21	23MA2006	Fundamentals of Statistics and Probability	3:1:0:4
22	23MA2007	Fuzzy Sets and Logic	3:1:0:4
23	23MA2008	Basics of Probability and Statistics	2:0:2:3
24	23MA2009	Numerical Mathematics and Statistics	2:0:2:3
25	23MA2010	Probability, Random Variables and Statistics	3:0:0:3
26	23MA3001	Logical Reasoning and Soft Skills	3:0:0:3
27	23MA3002	Probability and Fuzzy Sets	4:0:0:4

Course Code	LOGICAL REASONING AND SOFT SKILLS	L	T	P	C
22MA3001		0	0	2	0

Course Objectives:

Enable the student to:

1. Solve problems in elementary algebra and arithmetic reasoning
2. Train students in data extraction, verbal reasoning problems
3. Prepare students to face interview, and meet the industry expectations.

Course Outcomes:

1. Solve problems in elementary arithmetic reasoning.
2. Evaluate the logical reasoning problems.
3. Understand and interpret data from charts.
4. Analyse statements with reasoning.
5. Develop soft skills to face interviews.
1. Exercise competency matching the expectations of industry.

Module: 1	Arithmetic Reasoning	4 Hours

HCF, LCM, Ratio & Proportion, Percentage, Average, Series and Sequences, Simple & Compound Interests, Time and work.

Module: 2	Logical Reasoning	4 Hours

Odd terms in sequence, Patterns, Counting Principle, Permutations & Combinations, Probability, Logic.		
Module: 3	**Data Interpretation**	**4 Hours**
Nature of data, categories of data, Data Representation-Tabulation, Line charts, Bar- diagrams, Pie-charts.		
Module: 4	**Verbal Reasoning**	**5 Hours**
Statement- assumption – conclusion- course of action – argument - puzzles – coding and decoding.		
Module: 5	**Personality Development**	**5 Hours**
Attitude – Self-confidence - Planning - Team work – SWOT analysis – Self introduction- Communication skill - Effective team player – Adaptability- Critical thinking – Problem solving ability.		
Lab Practice Sessions: Aptitude School Training Platform		
1. Solving problems in HCF, LCM & Ratio 2. Solving problems in average, series & sequences 3. Solving problems in logical reasoning 4. Solving problems in permutation & combinations 5. Solving problems in verbal reasoning. 6. Solving problems in data interpretation		
Total Lectures		**22 Hours**

Reference Books	
1.	Aggarwal R.S., "Quantitative Aptitude," Revised Edition, S. Chand & Company Ltd., (New), 2020.
2.	Praveen R.V, "Quantity Aptitude and Reasoning," PHI, 2012.
3.	Mittal P.K, "Numerical Ability and Quantitative Aptitude: For Competitive Examinations,"Galgotia Publishers Pvt. Ltd, 2004.
4.	R.C.Bhatia, Personality Development, Ane books private ltd, Delhi, 2013.
5.	Frederick H. Wentz, Soft Skills Training: A Workbook to Develop Skills for Employment, Create Space Independent Publishing Platform; Large edition, 2012.

Recommended by Board of Studies	05 May2023
Approved by Academic Council	03 June 2023

Course Code	**MATRICES, CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS**	**L**	**T**	**P**	**C**
23MA1001		3	0	0	3

Course Objectives:		
Enable the student to: 1. Formulate physical phenomena using matrices. 2. Apply differentiation and integration techniques in engineering problems. 3. Analyse the solutions of ordinary differential equations.		
Course Outcomes:		
The student will be able to: 1. Compute the Eigen values, Eigen vectors of matrices and diagonalize the matrices. 2. Apply differentiation techniques to find extreme values of functions. 3. Apply the knowledge gained in vector differentiation techniques. 4. Demonstrate the knowledge acquired in integration. 5. Evaluate area and volume using definite integral. 6. Demonstrate knowledge in Ordinary Differential Equations.		
Module: 1	**Matrices**	**7 Hours**
Gould Index - Use of Matrix to Geography, Eigen Values, Eigen Vectors, Cayley Hamilton Theorem, Diagonalization of A Matrix, Hermitian, Unitary and Normal Matrices, Quadratic Forms, Orthogonal Transformation to Reduce Quadratic Form to Canonical Form.		

Module: 2	**Differential Calculus**	**8 Hours**
Financial Optimization Using Calculus, Linear and Nonlinear Functions, Limit Continuity, Differentiation (Definition and Simple Problems), Linearity of Differentiation, Partial Derivatives, Critical Points, Extreme Points in Nonlinear Function, Jacobians, Maxima Minima of Two Variables (Method of Lagrange's Multipliers).		
Module: 3	**Vector Differentiation**	**8 Hours**
Decision Review System in Cricket, Path of Thrown Basketball, Hit Distance Using Differentiation of Vectors, Curves in Space, Velocity and Acceleration, Scalar and Vector Point Functions, Gradient, Divergence-Curl–Physical Interpretations, Solenoidal and Irrotational Fields, Laplacian Operator.		
Module: 4	**Integral Calculus**	**6 Hours**
Blood Flow Monitoring Based on Poiseuille's Law, Integration, Definite Integral, Integration by Parts, Integration by Substitution, Integration Using Differentiation.		
Module: 5	**Multiple Integration**	**8 Hours**
Volume Under a Surface for Remote Sensing Using Double Integrals (Cartesian), Double Integrals and Triple Integrals,(Cartesian Form), Area and Volume, Beta and Gamma Functions and Their Properties		
Module: 6	**Ordinary Differential Equations**	**8 Hours**
Modelling of Velocity of a Character in a Video Game Involving Jumping Motion-Second Order and Higher Order Linear Differential Equations with Constant Coefficients- Euler's Equation - Method of Variation of Parameters.		
Total Lectures		**45 Hours**

Text Books	
1.	B.S. Grewal, "Higher Engineering Mathematics," Khanna Publishers, 44th Edition, 2017.
Reference Books	
1.	Erwin kreyszig, "Advanced Engineering Mathematics," 10thEdition, John Wiley & Sons, 2017.
2.	Ramana B.V., "Higher Engineering Mathematics," Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3.	D. Poole, "Linear Algebra: A Modern Introduction," 4 th Edition, Brooks/Cole, 2014.
4.	G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9thEdition, Pearson, Reprint, 2010.
5.	N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics," Laxmi Publications, Reprint, 4 th edition, 2014.

Recommended by Board of Studies	05 May 2023
Approved by Academic Council	03 June 2023

Course Code	**PARTIAL DIFFERENTIAL EQUATIONS, VECTOR SPACES AND LAPLACE TRANSFORM**	**L**	**T**	**P**	**C**
23MA1002		3	0	0	3

Course Objectives:

Enable the student to:

1. Impart knowledge on partial differential equations.
2. Express physical phenomena using vector spaces.
3. Provide essential concepts in Laplace Transforms.

Course Outcomes:

The student will be able to:

1. Evaluate the solutions of PDE using various techniques.
2. Analyze images using linear transformation.
3. Evaluate orthogonal and orthonormal vectors.
4. Design circuits using Laplace transforms.
5. Solve ODE using Laplace Transforms.

6. Apply methods of least squares principle for predictive analysis.		
Module: 1	**Partial Differential Equations**	**7 Hours**
Mobile Robot Path Planning Using PDE - First Order Partial Differential Equations - Solutions of First Order Standard Type and Lagrange's Equations - Solution to Higher Order Homogenous Linear Partial Differential Equations.		
Module: 2	**Vector Spaces**	**7 Hours**
Digital Image Enhancement Using Transformations - Vector Space - Linear Dependence of Vectors - Basis, Dimension - Linear Transformations (Maps), Range and Kernel of a Linear Map, Rank - Nullity Theorem - Matrix Associated with a Linear Map.		
Module: 3	**Inner Product Spaces**	**7 Hours**
Designing the Movement of Robotic Arms - Norm Definition - Properties - Inner Product Spaces, Orthogonal Vectors – Orthonormal Vectors - Orthonormal Basis - Gram-Schmidt Orthogonalization Process.		
Module: 4	**Laplace Transforms**	**8 Hours**
Building Integrated Circuits and Chips for Computers Using Laplace Transform – Transforms of Elementary Functions – Properties - Laplace Transform of Unit Step Function – Transforms of Special Functions – Laplace Transform of Periodic Function – Laplace Transform of Derivatives.		
Module: 5	**Inverse Laplace Transform**	**8 Hours**
Inverse Laplace Transform of Standard Functions – Properties – Partial Fraction Method – Convolution – Solving Ordinary Differential Equations Using Laplace Transforms.		
Module: 6	**Curve Fitting**	**8 Hours**
Predictions in ML Using Curve Fitting - Methods of Least Squares - Fitting a Straight Line and a Polynomial - Fitting a Non- Linear Function.		
Total Lectures		**45 Hours**

Text Books	
1.	B.S. Grewal, "Higher Engineering Mathematics," Khanna Publishers, 44^{th} Edition, 2017.
Reference Books	
1.	Erwin kreyszig, "Advanced Engineering Mathematics," 10^{th}Edition, John Wiley & Sons, 2017.
2.	Ramana B.V., "Higher Engineering Mathematics," Tata McGraw Hill New Delhi, 11^{th} Reprint, 2010.
3.	D. Poole, "Linear Algebra: A Modern Introduction," 4 th Edition, Brooks/Cole, 2014.
4.	N. P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics," Laxmi Publication, Reprint, 2010.
5.	P. Kandansamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods," S. Chand & Company, 2^{nd} Revised Edition, Reprint 2010.

Recommended by Board of Studies	05 May 2023
Approved by Academic Council	03 June 2023

Course Code	**CALCULUS AND DIFFERENTIAL EQUATIONS**	**L**	**T**	**P**	**C**
23MA1003		3	1	0	4

Course Objectives:

Enable the student to:

1. Demonstrate the knowledge in special functions and series.
2. Obtain area and volume using differentiation and integration techniques.
3. Formulate physical phenomena using vector spaces.

Course Outcomes:

The student will be able to:

1. Evaluate surface area and volume using definite integral.

2. Express functions as infinite series. 3. Apply differentiation techniques to find extreme values of functions. 4. Calculate gravity and mass using integration techniques. 5. Relate vector spaces to magnetic field and moving fluid. 6. Solve linear partial differential equations of first order.		
Module: 1	**Sequences and Series**	**7 Hours**
Convergence of Sequence and Series, Tests for Convergence, Power Series, Taylor's Series. Series for Exponential, Trigonometric and Logarithmic Functions. Application in Measurement and Instrumentation.		
Module: 2	**Calculus: Definite Integrals**	**7 Hours**
Evolutes and Involutes; Evaluation of Definite and Improper Integrals; Beta and Gamma Functions and Their Properties. Applications of Definite Integrals to Evaluate Surface Areas and Volumes of Revolutions.		
Module: 3	**Fourier Series**	**7 Hours**
Full Range – Change of Interval- Half Range Sine and Cosine Series, Parseval's Theorem, Harmonic Analysis- Application: Power Electronic Circuits and Electric Drives– Continuous and Discrete Time Fourier Series (For Classroom Discussions).		
Module: 4	**Multivariable Calculus: Differentiation**	**8 Hours**
Partial Derivatives. Total Derivative; Jacobians –Maxima and Minima Using Method of Lagrange Multipliers. Vector Differentiation: Gradient, Directional Derivatives, Curl, and Divergence. Applications: Differentiation/Partial Differentiation in Gradient Descent Algorithm - Training Method of ANN Electromagnetics, Frequency and Pulse Modulation, Control System – Stability Analysis, Electromagnetics (For Classroom Discussions).		
Module: 5	**Multivariable Calculus: Integration**	**8 Hours**
Multiple Integration: Double and Triple Integrals (Cartesian and Polar), Change of Order of Integration in Double Integrals. Applications: Areas and. Theorems of Green, Gauss and Stokes (Statement Only). Simple Applications Involving Cubes, Sphere and Rectangular Parallelepipeds**.** Applications: Electromagnetics – Change of Variables – Electrical Machines Design (For Classroom Discussions).		
Module: 6	**Ordinary Differential Equations**	**8 Hours**
Ordinary Differential Equations: Second Order Linear Differential Equations with Constant Coefficients, Method of Variation of Parameters, Cauchy-Euler Equation. Applications: Design of Power Electronics Circuits, Signals and Systems-System Function/Analysis-DSP-FIR/IIR Filters.		
Total Lectures		**45 Hours**

Text Books

1.	B.S. Grewal, "Higher Engineering Mathematics," 44th Edition, Khanna Publishers, 2017.

Reference Books

1.	N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics," Laxmi Publications, Reprint, 4 th edition, 2014.
2.	Erwin kreyszig, "Advanced Engineering Mathematics," 10^{th}Edition, John Wiley & Sons, 2017.
3.	B. V. Ramana, "Higher Engineering Mathematics," McGraw Hill, New Delhi, 2010.
4.	Veerarajan T., "Engineering Mathematics for first year," Tata McGraw-Hill, New Delhi, 2008.
5.	W.E.Boyce and R.C.DiPrima,"Elementary Differential Equations and Boundary Value Problems", John Wiley & Sons, 2017.

Recommended by Board of Studies	05 May 2023
Approved by Academic Council	03 June 2023

<table>
<tr><td>Course Code</td><td rowspan="2">LINEAR ALGEBRA, TRANSFORM AND NUMERICAL METHODS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>23MA1004</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td colspan="6">Course Objectives:</td></tr>
<tr><td colspan="6">Enable the student to:
1. Demonstrate knowledge in matrices.
2. Recognize the fundamental concepts of Transforms.
3. Solve numerically linear, non-linear, and differential equations.</td></tr>
<tr><td colspan="6">Course Outcomes:</td></tr>
<tr><td colspan="6">The student will be able to:
1. Construct orthonormal transformation of matrix.
2. Solve differential equations using Laplace Transforms.
3. Analyze systems using Fourier transform.
4. Apply Z transform and wavelet transform in signal analysis.
5. Evaluate linear and non-linear equations numerically.
6. Compute solutions of differential equations numerically.</td></tr>
<tr><td>Module: 1</td><td colspan="2">Matrices</td><td colspan="3">7 Hours</td></tr>
<tr><td colspan="6">Algebra of Matrices, Inverse and Rank of a Matrix; Symmetric, Skew-Symmetric and Orthogonal Matrices; Determinants, System of Linear Equations Eigenvalues and Eigenvectors; Cayley-Hamilton Theorem (Statement Only), Diagonalization of Matrices; Orthogonal Transformation. Application: Control Systems-State Variable Analysis- Wireless Communication. (For Classroom Discussions, Assignments and Term Paper Work).</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Module: 2</td><td colspan="2">Laplace Transforms</td><td colspan="3">7 Hours</td></tr>
<tr><td colspan="6">Definitions, Transform of Standard Functions, Properties, Laplace Transform of Special Functions-Unit Step Function, Dirac Delta Function, Periodic Functions. Application in Solving Series RLC Circuits (For Classroom Discussions, Assignments and Term Paper Work).</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Module: 3</td><td colspan="2">Inverse Laplace Transforms</td><td colspan="3">7 Hours</td></tr>
<tr><td colspan="6">Inverse Laplace Transform of Standard Functions, Partial Fraction Method, Convolution Theorem, Solving Ordinary Differential Equations. Application in Designing Control System -Load Model, Generator Model. (For Classroom Discussions, Assignments and Term Paper Work).</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Module: 4</td><td colspan="2">Z Transforms and Wavelet Transforms</td><td colspan="3">8 Hours</td></tr>
<tr><td colspan="6">Standard Z Transforms–Standard Results – Shifting U_n to The Right-Multiplication By N -Inverse Z-Transforms of Standard Functions-Method of Partial Fractions – Properties - Application to Solve Difference Equations. Wavelet Transform-Definition. Application: DSP - IIR And FIR Filter Design, Image Analysis-Control Systems Dimensionality Reduction. (For Classroom Discussions, Assignments and Term Paper Work).</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Module: 5</td><td colspan="2">Numerical Solution of Linear and Non-Linear Equations</td><td colspan="3">8 Hours</td></tr>
<tr><td colspan="6">Solutions of Nonlinear Equations: Bisection Method, Newton-Raphson Method. Systems of Linear Equations: Direct Methods -Gaussian Elimination Method. Iterative Methods; Gauss-Seidel Method.</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>Module: 6</td><td colspan="2">Numerical Solutions of ODE and PDE</td><td colspan="3">8 Hours</td></tr>
<tr><td colspan="6">Methods of Euler, Runge-Kutta Method of Order 4. Partial Differential Equations; Solution of Laplace Equation, Poisson Equation by Liebmann Method. Applications: Electron Devices-Drift and Diffusion Currents Derivation - Electromagnetics-Maxwell Equations. (For Classroom Discussions, Assignments and Term Paper Work).</td></tr>
<tr><td colspan="3">Total Lectures</td><td colspan="3">45 Hours</td></tr>
<tr><td colspan="6">Text Books</td></tr>
</table>

1.	B.S. Grewal, "Higher Engineering Mathematics," 44th Edition, Khanna Publishers, 2017.
Reference Books	
1.	Alexander D Poularikas, "Transforms and Applications, Handbook," Third edition, CRC press, Taylor and Francis publishing, 2018.
2.	Baidayanath Patra, "An Introduction to Integral Transforms," CRC press, Taylor and Francis publishing, 2018.
3.	Veerarajan T, "Engineering Mathematics," Tata McGraw Hill, New Delhi, 2011.
4.	M.K.Jain., Iyengar. S.R.K., Jain R.K., "Numerical Methods for Scientific and Engineering Computation," 6th Edition, New Age International, 2012.
5.	Ramana B.V., "Higher Engineering Mathematics," Tata McGraw Hill New Delhi, 11th Reprint, 2010.
Recommended by Board of Studies	05 May 2023
Approved by Academic Council	03 June 2023

Course Code	**MATHEMATICS FOR MEDIA ENGINEERING**	**L**	**T**	**P**	**C**
23MA1005		3	0	0	3

Course Objectives:

Enable the student to:

1. Demonstrate knowledge of matrices and recognize the concepts of transforms.
2. Develop knowledge of basic probability, statistics, and probability distribution concepts.
3. Recognize the fundamental concepts of graphs and networks.

Course Outcomes:

The student will be able to:

1. Solve system of equations using matrices.
2. Apply the concept of Eigen values in Transformation.
3. Recognize different types of probability models
4. Classify the problems using probability distributions
5. Measure central tendency and relation of data.
7. Apply Graph algorithms for solving network problems.

Module: 1	**Algebra of Matrices**	**9 Hours**

Matrices: Addition and Scalar Multiplication, Matrix Multiplication, Symmetric, Skew-Symmetric, Linear Systems of Equations, Rank of a Matrix, Cramer's Rule, Inverse of a Matrix, Gauss-Jordan Elimination Method.

Application of Matrix Operation in Digital Audio and Video Transmission, (For Classroom Discussions, Assignments and Term Paper Work).

Module: 2	**Determinants, Linear Systems and Eigen Value Problems**	**9 Hours**

Determinants, Eigen Values, Eigen Vectors, Applications of Eigen Value Problems, Diagonalization of a Matrix, Orthogonal Transformation to Reduce Quadratic Form to Canonical Form, Nature of Quadratic Forms. Application of Eigen Values, Eigen Vectors in Processing and Compression in Media Engineering, (For Classroom Discussions, Assignments and Term Paper Work).

Module: 3	**Probability and Random Variables**	**9 Hours**

Definitions and Axioms, Conditional Probability, Baye's Theorem-Moments Generating Functions. Discrete Random Variables; Probability Mass Function and Distribution Functions – Discrete Distributions; Binomial, Poisson Distribution.

Application of Probability and Random Variables in Mass Media Production (For Classroom Discussions, Assignments and Term Paper Work).

Module: 4	**Statistics**	**9 Hours**

Measures of Central Tendency: Mean, Median, Mode, Geometric Mean and Harmonic Mean. Measures of Dispersion: Range, Quartile Deviation, Standard Deviation, Coefficient of Variation. Measures of Relation: Karl Pearson's Coefficient of Correlation, Linear Regression Equations and Rank Correlation. Application of Statistics in Media Engineering (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 5	**Graphs and Network**	**9 Hours**
Basic Terminology, Some Special Simple Graphs. Eulerian Graphs and Hamiltonian Graphs, Planar Graphs Euler's Formula, Coloring of Graphs. Computer Representation of Graphs, Connectivity, Shortest Path Algorithms and Trees. Transportation Network. Applications of Graph Theory for Path Planning Based on Sensor Networks. (For Classroom Discussions, Assignments and Term Paper Work).		
Total Lectures		**45 Hours**

Text Books	
1.	B.S. Grewal, "Higher Engineering Mathematics," 44th Edition, Khanna Publishers, 2017.
2.	Kenneth H. Rosen, "Discrete Mathematics and its Applications," Tata McGraw –Hill, 2015
Reference Books	
1.	Erwin kreyszig, "Advanced Engineering Mathematics," 10thEdition, John Wiley & Sons, 2017.
2.	T. Veerarajan, "Probability, Statistics and Random Processes," 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.
3.	S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand &Sons, 11th Revised Edition 2007.
4.	Veerarajan T., "Engineering Mathematics for first year," Tata McGraw-Hill, New Delhi, 2008.
5.	Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science," Prentice-Hall of India Private Ltd. 2004.

Recommended by Board of Studies	05 May 2023
Approved by Academic Council	03 June 2023

Course Code	**LINEAR ALGEBRA, CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS**	**L**	**T**	**P**	**C**
23MA1006		2	0	2	3

Course Objectives:

Enable the student to:

1. Acquire knowledge on differentiation and integration techniques.
2. Develop solutions to ordinary differential equations.
3. Formulate physical phenomena using matrices.

Course Outcomes:

The student will be able to:

1. Compute the Eigen values and Eigen vectors of the matrices.
2. Evaluate definite and improper integrals.
3. Express functions as an infinite series.
4. Apply the knowledge of vector differentiation techniques.
5. Evaluate the area and volume of the given surface using integration techniques.
6. Analyse solution of ordinary differential equations.

Module: 1	**Matrices**	**6 Hours**
Eigen Values and Eigen Vectors, Cayley Hamilton Theorem, Diagonalization of a Matrix, Hermitian, Unitary and Normal Matrices, Quadratic Forms, Orthogonal Transformation to Reduce Quadratic Form to Canonical Form. Applications: Matrices in computer-aided design (CAD) (For classroom discussions, assignments, and term paper work).		

Module: 2	**Calculus**	**7 Hours**
Evolutes and Involutes; Evaluation of Definite and Improper Integrals, Beta and Gamma Functions and Their Properties. Applications: Evaluation of Surface Areas and Volumes of Revolutions. (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 3	**Fourier Series**	**8 Hours**
Convergence of Sequences and Series, Full Range, Change of Interval, Half Range Sine and Cosine Series, Parseval's Theorem, Harmonic Analysis. Application: Modelling of Vibrating Membrane Using Fourier Series (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 4	**Multivariable Calculus: Differentiation**	**8 Hours**
Limit, Continuity and Partial Derivatives, Total Derivative, Jacobians, Maxima, Minima and Saddle Points, Method of Lagrange Multipliers, Vector Differentiation: Gradient, Directional Derivatives, Curl and Divergence. Applications: Modelling of Heat Transport Equations in Mechanical Engineering (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 5	**Multivariable Calculus: Integration**	**8 Hours**
Multiple Integration: Double and Triple Integrals (Cartesian and Polar), Change of Order of Integration in Double Integrals, Evaluation of Areas and Volumes by Multiple Integration, Center of Mass and Gravity (Constant and Variable Densities). Applications: Modelling and Analysis of Fluid Flow Problems. (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 6	**Ordinary Differential Equations**	**8 Hours**
Second Order and Higher Order Linear Differential Equations with Constant Coefficients, Euler's Equation, Method of Variation of Parameters. Applications: Ordinary Differential Equations in Newton's Law of Cooling.		
Total Lectures		**45 Hours**

Lab Experiments:

1. Introduction to Python and General Syntaxes.
2. Python program to find Eigen values and Eigen vectors.
3. Python program for diagonalization of the matrices.
4. Python program for computing beta and gamma functions for numeric input.
5. Python program for computing the derivatives of functions.
6. Python program for computing the Jacobian of several variables.
7. Python program to compute the first three harmonics in Fourier series.
8. Python program for evaluating integrals.
9. Python program to find area and volume using integrals.
10. Python program to solve a second-order ordinary differential equation.

Text Book

1.	Grewal, B.S, *Higher Engineering Mathematics",* 44th Edition, Khanna Publishers, 2017.
2.	Veerarajan, T., "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.

Reference Books

1.	B. V. Ramana, "Higher Engineering Mathematics," McGraw Hill, New Delhi, 2010.
2.	N.P.Bali and M.Goyal, "A Textbook of Engineering Mathematics", Laxmi Publications, 2010.
3.	E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
4.	W.E.Boyce and R.C.DiPrima, "Elementary Differential Equations and Boundary Value Problems", John Wiley & Sons, 2017.
5.	Poole, D. *Linear Algebra: A Modern Introduction*. Brooks/Cole, 2005. ISBN: 978-0-538-73545-2

Recommended by Board of Studies	
Approved by Academic Council	25 Aug 2023

Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA1006	Linear Algebra, Calculus and Ordinary Differential Equations	CO1	3	3	3	3									3		2
		CO2	3	3	3	3									3		2
		CO3	3	3	3	3									3		2
		CO4	3	3	3	3									3		2
		CO5	3	3	3	3									3		2
		CO6	3	3	3	3									3		2

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; ”-“ – No correlation.

Syllabus is Prepared by Dr. J. CATHERINE GRACE JOHN

Course Code	Partial Differential Equations, Transforms and Numerical Methods	L	T	P	C
23MA1007		2	0	2	3

Course Objectives:

Enable the student to:

1. Acquire adequate knowledge on partial differential equations.
2. Classify numerical solutions to algebraic and transcendental equations.
3. Recognize the fundamental concepts of Transforms.

Course Outcomes:

The student will be able to:

1. Find solutions to the PDE using various techniques.
2. Apply different techniques to solve algebraic and transcendental equations.
3. Solve first-order differential equations using numerical techniques.
4. Develop knowledge in Laplace transform techniques.
5. Describe differential equations using Laplace Transforms.
6. Create knowledge of Z-transforms.

Module: 1	**Partial Differential Equations**	**7 Hours**

Solutions of First Order Partial Differential Equations, Lagrange’s Equations, Solution of Higher Order Homogenous Linear Partial Differential Equations. Applications: Deflection of Uniform Beam and Rod-Wave Propagation in Cylinders (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 2	**Numerical Methods-I**	**7 Hours**

Solution of Algebraic and Transcendental Equations – Bisection Method, Newton-Raphson Method and Regula-Falsi Method. Numerical Integration: Trapezoidal Rule and Simpson’s 1/3rd and 3/8 Rules. Application: Approximation of The Integrals. (For Classroom Discussions, Assignments, and Term Paper Work)

Module: 3	**Numerical Methods-II**	**7 Hours**

Ordinary Differential Equations of First Order: Taylor’s Series, Euler’s Methods, Runge Kutta Method of Fourth Order. Partial Differential Equations: Solution of Laplace Equation by Liebmann Method, Solution of Poisson Equation by Liebmann Method. Applications: Heat Transfer Problems (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 4	**Laplace Transforms**	**8 Hours**

Laplace Transform- Definitions and Properties, Transform of Standard Functions, Laplace Transform of Special Functions-Unit Step Function, Dirac Delta Function, Laplace Transform of Periodic Functions. Applications: Laplace Transform in System Modeling. (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 5	Inverse Laplace Transforms	8 Hours
Inverse Laplace Transform of Standard Functions, Partial Fraction Method, Convolution Theorem, Solving Ordinary Differential Equations. Application: Vibrations of Continuous Elastic Bodies, Solving Differential Equations Applications: Mathematical Modeling of Mechanical System (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 6	**Z Transforms**	**8 Hours**
Standard Z Transforms–Standard Results – Shifting Un to The Right-Multiplication by N -Inverse Z-Transforms of Standard Functions-Method of Partial Fractions, Application to Solve Difference Equations. Application: Control Systems. (For Classroom Discussions, Assignments, and Term Paper Work).		
Total Lectures		**45 Hours**

List of experiments using MATLAB:

1. Introduction to MATLAB and General Syntaxes
2. Solution of an algebraic equation using the Bisection method
3. Solution of an algebraic equation using the Newton-Raphson method.
4. Solution of an algebraic equation using the Regula Falsi method
5. Numerical integration: Trapezoidal and Simpson's rule.
6. Solving a first-order ODE using Euler's method.
7. Solving a first-order ODE using the 4th-order Runge-Kutta method.
8. To find the Laplace transform of standard functions.
9. To find the inverse Laplace transform of standard functions.
10. To find the Z transform of standard functions.

Text Book

1.	Grewal, B.S, *Higher Engineering Mathematics (44th ed.)*. Khanna Publishers, 2017.

Reference Books

1.	Ramana B.V., *Higher Engineering Mathematics (11th preprint).* Tata McGraw Hill. New Delhi, 2010. ISBN: 0-07-063419-X
2.	Bali, N. P., & Goyal, M., *A text book of Engineering Mathematics (7th ed.)*. Laxmi Publications, 2010. ISBN: 978-81-7008-992-6
3.	Alexander D Poularikas, Transforms *and Applications*, *Handbook (3rd ed.)*. CRC press, Taylor and Francis publishing, 2010. ISBN 9780367250034
4.	Kandasamy, P., Thilagavathy, K., & Gunavathi, K., *Numerical Methods (2nd ed.)*. S. Chand & Company, 2012. ISBN: 9788121914383
5.	W.E.Boyce and R.C.DiPrima, "Elementary Differential Equations and Boundary Value Problems", John Wiley & Sons, 2017.

Recommended by Board of Studies	28 July 2023
Approved by Academic Council	25 Aug 2023

Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA1007	Partial Differential Equations, Transforms and Numerical Methods	CO1	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
		CO2	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
		CO3	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
		CO4	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
		CO5	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
		CO6	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; "-" – No correlation.

Syllabus is Prepared by Dr. K. Porselvi

Course Code	ANALYTICAL GEOMETRY, CALCULUS AND LINEAR ALGEBRA	L	T	P	C
23MA1008		2	0	2	3

Course Objectives:

Enable the student to:

1. Acquire knowledge in analytic geometry, matrices, and functions.
2. Solve using differentiation, integration, and vector techniques.
3. Test the physical phenomena using MATLAB tools.

Course Outcomes:

The student will be able to:

1. Differentiate the geometry of 2D and 3D structures.
2. Compute the Eigen values and Eigen vectors of the matrices.
3. Examine the convergence of sequences and series.
4. Express functions as infinite series.
5. Calculate the area using integration techniques.
6. Relate vector spaces to magnetic fields and moving fluids.

Module: 1	Two and Three-Dimensional Geometry	7 Hours

Equation of Straight Line, Circle, Parabola, Ellipse and Hyperbola, Three-Dimensional Geometry- Straight Line, Circle – Applications to Orbits, Restricted Three-Body Problem in Orbital Mechanics. (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 2	Matrices	7 Hours

Solution of System of Linear Equations; Symmetric, Skew-Symmetric, and Orthogonal Matrices; Determinants; Eigenvalues and Eigenvectors; Diagonalization of Matrices; Cayley-Hamilton Theorem, and Orthogonal Transformation – Applications to Direct Stiffness in Finite Element Methods, Structural Vibrations and Aircraft, Spacecraft Stability. (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 3	Sequences and Series	8 Hours

Convergence of Series, Tests for Convergence; Power Series, Taylor's Series, Series for Exponential, and Logarithm Functions – Applications in Aerodynamics of Wind Turbines. (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 4	Fourier Series and Transforms	7 Hours

Full Range Series - Half Range Sine and Cosine Series, Parseval’s Theorem, Harmonic Analysis. Fourier Transform Pair – Fourier Sine and Cosine Transforms – Properties – Transforms of Simple Functions – Applications to Signal Processing in Avionics, Periodic Solutions in Restricted Three-Body Problem In Orbital Mechanics. (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 5	Multivariable Calculus –Integration	8 Hours

Multiple Integration: Double Integrals (Cartesian), Change of Order of Integral in Double Integrals, Applications: Area, Center of Mass and Gravity (Constant and Variable Densities), Triple Integrals (Cartesian) – Applications to Lift Theory in Aerodynamics. (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 6	Vector Calculus	8 Hours

Differentiation of Vectors–Curves in Space-Velocity and Acceleration-Scalar and Vector Point Functions–Gradient–Divergence-Curl–Physical Interpretations- Solenoidal and Irrotational Fields-Laplacian Operator. Integration of Vectors –Problems on Greens Theorem, Stoke’s Theorem and Gauss Divergence Theorem - Applications to Compressible and Incompressible Flow Over Aircraft Wings in Aerodynamics. (For Classroom Discussions, Assignments, and Term Paper Work).

Total Lectures	45 Hours

Lab Experiments: Programming in MATLAB

1. Starting with MATLAB, create arrays of mathematical functions.
2. Draw and analyze the geometry of a circle, parabola, and ellipse.
3. To find the stiffness of a rod using a matrix.
4. Test the diagonalization of a physical matrix.
5. Test the convergence of infinite series.
6. To find the vibration of a membrane using the Fourier series.
7. To compute the heat waves in strings.
8. Implementing pressure integration.
9. Solving dynamic problems through vector and scalar functions.
10. Computing fluid problems and plotting the output.

Text Book	
1.	Grewal, B.S., "Higher Engineering Mathematics", 44th ed.. Khanna Publishers, 2017. ISBN: 978-81-933284-9-1
Reference Books	
1.	Ramana B.V, "Higher Engineering Mathematics", 11th preprint. Tata McGraw Hill. New Delhi, 2010.
2.	Bali, N. P., & Goyal, M, "A Text Book of Engineering Mathematics", 7th ed. Laxmi Publications, 2010.
3.	Kreyszig, E, "Advanced Engineering Mathematics". John Wiley & Sons, 2006.
4.	Veerarajan, T, "Engineering Mathematics". McGraw-Hill, New Delhi, 2008.

Recommended by Board of Studies	28 July 2023
Approved by Academic Council	25 Aug 2023

Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA1008	Analytical Geometry, Calculus and Linear Algebra	CO1	3	3	2												
		CO2	3	3	2												
		CO3	3	3	2												
		CO4	3	3	2												
		CO5	3	3	2												
		CO6	3	3	2												

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; "-" – No correlation.

Syllabus is Prepared by Dr. K. PORSELVI

Course Code	DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES	L	T	P	C
23MA1009		2	0	2	3

Course Objectives:

Enable the student to:

1. Acquire knowledge in special functions.
2. Solve ordinary and partial differential equations.
3. Evaluate definite integral using complex integration.

Course Outcomes:

The student will be able to

1. Evaluate surface area and volume using a definite integral.
2. Compute solutions of first- and second-order ODEs.
3. Classify different types of higher-order ODEs and their solutions.
4. Construct harmonic and bilinear transformations.
5. Evaluate a definite integral using complex integration.

6. Apply PDE concepts to solve the boundary value problems.		
Module: 1	**Calculus**	**6 Hours**
Evaluation of Definite Maxima and Minima, Applications of Definite Integrals to Evaluate Surface Areas and Volumes of Revolutions-Partial Differentiation (Simple Problems) Taylor's Theorem for Functions of Two Variables - Applications to Thrust Estimation in Rocket Propulsion, Study of Stability at The Equilibrium Points in The Restricted Three-Body Problem.; (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 2	**Differential Equations and Special Functions**	**7 Hours**
Second Order Linear Differential Equations with Constant Coefficients, Method of Variation of Parameters, Cauchy-Euler Equation (Simple Problems); Power Series Solutions; Legendre Polynomials (Simple Problems) – Applications in Aircraft, Spacecraft Stability and Buckling Analysis (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 3	**Complex Variables**	**8 Hours**
Complex Numbers, Complex Differentiation, Cauchy-Riemann Equations, Analytic Functions and Properties, Harmonic Functions, Finding Harmonic Conjugate; Conformal Mappings, Bilinear Transformations – Complex Integration - Contour Integrals, Cauchy Integral Formula, Taylor's Series, Zeros of Analytic Functions, Singularities, Laurent's Series; Residues, Cauchy Residue Theorem, Contour Integration- Circular and Semicircular Contours With No Pole On Real Axis – Applications To Potential Flow In Two Dimensions and Aircraft, Spacecraft Stability (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 4	**Laplace Transforms**	**8 Hours**
Laplace Transform, Properties of Laplace Transform, Laplace Transform of Periodic Functions. Inverse Laplace Transform by Different Methods, Convolution Theorem. Evaluation of Integrals by Laplace Transforms – Applications to Control Systems, Solutions at The Equilateral Points (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 5	**: Partial Differential Equations**	**8 Hours**
First Order Partial Differential Equations, Solutions of First Order Standard Type and Lagrange's Equations. Solution To Higher Order Homogenous and Non-Homogenous Linear Partial Differential Equations _Modelling in One Dimensional Dynamic Problem (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 6	**Boundary Value Problems:**	**8 Hours**
Solutions of One-Dimensional Wave Equation – One-Dimensional Heat Equation – Steady State Solution - Two-Dimensional Heat Equation. Applications In One Dimensional Wave and Heat Flow in Fluid and Thermal Problems (For Classroom Discussions, Assignments, and Term Paper Work).		
Total Lectures		**45 Hours**
List of experiments using MATLAB: 1. Introduction to MATLAB and General Syntaxes. 2. To find the Taylor's series of a given function. 3. To find the solution of a second-order ODE with constant coefficients. 4. To plot the solutions of the ODE and PDE. 5. To find analytic and harmonic function. 6. To find poles and residues. 7. Laplace and inverse Laplace transforms of a standard function. 8. Plot Legendre function. 9. Solving a one-dimensional wave equation. 10. Solving one-dimensional heat flow problems.		

Text Book	
1.	1. B.S. Grewal, “Higher Engineering Mathematics”, 44th Edition, Khanna Publishers, 2017.
Reference Books	
1.	B. V. Ramana, “Higher Engineering Mathematics”, McGraw Hill, New Delhi, 2010.
2.	N.P.Bali and M.Goyal, “A Textbook of Engineering Mathematics”, Laxmi Publications, 2010.
3.	E. Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2006.
4.	W.E.Boyce and R.C.DiPrima, “Elementary Differential Equations and Boundary Value Problems”,John Wiley & Sons, 2017.
Recommended by Board of Studies	28 July 2023
Approved by Academic Council	25 Aug 2023

Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA1009	Differential Equations and Complex Variables	CO1	3	3	3										3		
		CO2	3	3	3										3		
		CO3	3	3	3										3		
		CO4	3	3	3										3		
		CO5	3	3	3										3		
		CO6	3	3	3										3		

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; ”-“ – No correlation.

Syllabus is Prepared by Dr. Sheeba Merlin G

Course Code	MATHEMATICAL MODELLING FOR MEDIA	L	T	P	C
23MA1010		3	0	0	3

Course Objectives:

Enable the student to:

1. Acquire knowledge of basic geometrical structures.
2. Develop the skills of handling and solving matrices.
3. Classify different statistical methods.

Course Outcomes:

The student will be able to:

1. Analyse different geometrical structures and understand their properties.
2. Apply matrix techniques when solving simultaneous equations.
3. Determine the eigenvalues and eigen vectors.
4. Present the data in tabular and graphical representations.
5. Identify the central tendency and dispersion of data in real time.
6. Explore the relationship between data for real-time application.

Module: 1	**Two and Three - Dimensional Geometry**	**9 Hours**

Equation of Straight Line - Circle, Parabola, Ellipse and Hyperbola – Change of Axis – Coordinate Axes and Coordinate Planes in Three Dimensions - Distance Between Two Points In 3D. Application of Geometrical Structures in Audio and Video Production (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 2	**Matrices**	**9 Hours**

Introduction - Matrix Operations - The Trace and Determinant of a Matrix - Properties of Determinants (Excluding the Proof) - Rank of A Matrix – Inverse of A Matrix – Solving Simultaneous Equations: Cramer’s Rule and Inversion Method. Application of Matrices in Media (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 3	**Eigenvalues and Eigenvectors**	**9 Hours**

Introduction To Eigenvalues and Eigenvectors – Properties and Problems – Cayley-Hamilton Theorem – Reduction to Diagonal Form – Canonical Form - Reduction of Quadratic Form to Canonical Form. Application of Eigen Values and Vectors in Media, (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 4	**Statistical Description of Data**	**9 Hours**
Statistical Data: Collection, Classification, and Tabulation - Scales of Measurement – Frequency Distribution - Diagrammatic Representation of Data: Bar Diagrams and Pie-Chart- Graphical Representation of Frequency Distribution: Histogram, Frequency Polygon, Frequency Curve and Ogives.		
Module: 5	**Measures of Central Tendency and Dispersion**	**9 Hours**
Measures of Central Tendency: Mean, Median, Mode, Geometric Mean and Harmonic Mean. Measures of Dispersion: Range, Quartile Deviation, Standard Deviation, Coefficient of Variation. Measures of Relation: Karl Pearson's Coefficient of Correlation - Linear Regression Equations and Rank Correlation. Application of Statistics in Media Engineering (For Classroom Discussions, Assignments, and Term Paper Work).		
Total Lectures		**45 Hours**

Text Book	
1.	Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Vol.I" S.Chand & Co. New Delhi, 2010.
2.	B.S. Grewal, "Higher Engineering Mathematics," 44th Edition, Khanna Publishers, 2017.
3.	T. Veerarajan, "Probability, Statistics and Random Processes," 3rd Edition, Tata McGraw-Hill,New Delhi, 2017.
Reference Books	
1.	R.S.N.Pillai, Bhagavathi, Statistics-Theory & practice, Sultan Chand & Sons, 2010.
2.	S.P.Gupta, Statistical methods, Sultan Chand & Sons, 2012.
3.	E. Kreyszig, "Advanced Engineering Mathematics," John Wiley & Sons, 2006.
4.	A. Hepzibah, R. Selvamani, K. Porselvi, "Basic Engineering Mathematics," HSI Publications, Coimbatore, 2011.

Recommended by Board of Studies	28 July 2023
Approved by Academic Council	25 Aug 2023

Articulation Matrix of COs Vs POs and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA1010	Mathematical Modelling for Media	CO1	3	3	3	3									3		2
		CO2	3	3	3	3									3		2
		CO3	3	3	3	3									3		2
		CO4	3	3	3	3									3		2
		CO5	3	3	3	3									3		2
		CO6	3	3	3	3									3		2

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; "-" – No correlation.

Syllabus prepared by Dr. C. BAZIL WILFRED

Course Code	PROBABILISTIC MODELS AND NETWORKING	L	T	P	C
23MA1011		3	0	0	3
Course Objectives:					

Enable the student to:

1. Understand the concepts of probability and randomness in real-time situations.
2. Acquire knowledge of different distributions and their applications.

3. Interpolate the concepts of graphs and networks for practical application.

Course Outcomes:

The student will be able to:

1. Classify and analyze data.
2. Model the data using probability distributions.
3. Analyze random variables and their properties.
4. Solve the problems using probability distributions.
5. Model real life situations using graph techniques.
6. Apply graph network techniques to solve problems.

Module: 1	**Probability**	**9 Hours**
Axioms of Probability - Mathematical Definition of Probability - Conditional Probability –Independent Events –Addition Law and Multiplication Law- Theorem of Total Probability - Baye's Theorem (Statement Only) and Its Problems - Application of Probability in Decision Making and Prediction for Media Engineering (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 2	**Randomness of Data**	**9 Hours**
One Dimensional Random Variables: Discrete and Continuous Random Variables - Probability Density Function - Cumulative Distribution Function. Two Dimensional Random Variables: Discrete Random Variables, Marginal Probability Distribution - Conditional Probability Distribution-Independent Random Variables -Application in Data Analytics Problems. Application of Random Variables in Data Handling in Media Engineering (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 3	**Modeling of Data**	**9 Hours**
Discrete Distribution: Binomial and Poisson Distribution – Poisson Distribution Is a Limiting Case of Binomial Distribution - Fitting Binomial and Poisson Distribution - Continuous Distribution: Normal and Exponential Distribution–Properties - Application in Broadcasting and Cloud Computing Problems in Media Engineering (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 4	**Graph Theory**	**9 Hours**
Graphs and Their Properties- Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Coloring, Coloring Maps and Planar Graphs, Definition Properties and Examples. Application Graphs in Media Engineering (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 5	**Networks and Algorithms**	**9 Hours**
Trees, Rooted Trees, and Trees Sorting, Shortest Distances Minimal Spanning Tree – Kruskal and Prim's Algorithms - Transportation Network. Application of Network Problems in Media Engineering (For Classroom Discussions, Assignments and Term Paper Work).		
Total Lectures		**45 Hours**

Text Book

1.	B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2.	T. Veerarajan, "Probability, Statistics and Random Processes," 3nd Edition, Tata McGraw-Hill,New Delhi, 2017.
3.	Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 6th Edition, Pearson Education, 2009.

Reference Books

1.	Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill, 8th Edition, 2019.
2.	Swapan Kumar Sarkar, "A Text Book of Discrete Mathematics", S.Chand & Company, 2009.

Recommended by Board of Studies	28 July 2023
Approved by Academic Council	25 Aug 2023

Articulation Matrix of COs Vs POs and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA1011	Probabilistic Models and Networking	CO1	3	3	3	3									3		2
		CO2	3	3	3	3									3		2
		CO3	3	3	3	3									3		2
		CO4	3	3	3	3									3		2
		CO5	3	3	3	3									3		2
		CO6	3	3	3	3									3		2

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; ”-“ – No correlation.

Syllabus prepared by Dr. C. BAZIL WILFRED

<table>
<tr><td>Course Code</td><td rowspan="2" colspan="2">VECTOR SPACES AND LAPLACE TRANSFORM</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>23MA1012</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Course Objectives:</td></tr>
<tr><td colspan="7">Enable the student to:
1. Acquire knowledge of power series of standard functions.
2. Analyse vector spaces.
3. Solve differential equations using the Laplace transform.</td></tr>
<tr><td colspan="7">Course Outcomes:</td></tr>
<tr><td colspan="7">The student will be able to:
1. Formulate a test for the convergence and divergence of sequences and series.
2. Analyze images using linear transformations.
3. Relate vector spaces to electromagnetic fields.
4. Construct an orthonormal basis.
5. Evaluate the Laplace transform of standard functions.
6. Apply the inverse Laplace transform to solve ordinary differential equations.</td></tr>
<tr><td>Module: 1</td><td colspan="2">Sequences and Series</td><td colspan="4">8 Hours</td></tr>
<tr><td colspan="7">Design A Calculator Software Based on Convergence of Sequence and Series, Tests for Convergence. Power Series, Taylor's Series, Sum of A Series, Evaluate Limits and Approximate Functions, Series for Exponential, Trigonometric and Logarithmic Functions</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>Module: 2</td><td colspan="2">Vector Spaces</td><td colspan="4">8 Hours</td></tr>
<tr><td colspan="7">Digital Image Enhancement Using Transformations, Vector Space, Linear Dependence of Vectors, Basis, Dimension; Linear Transformations (Maps), Range and Kernel of a Linear Map, Inverse of A Linear Transformation, Rank- Nullity Theorem, Composition of Linear Maps, Matrix Associated with A Linear Map.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>Module: 3</td><td colspan="2">Vector Calculus</td><td colspan="4">7 Hours</td></tr>
<tr><td colspan="7">Electromagnetism-Maxwell’s Equations. Differentiation of Vectors. Curves In Space. Velocity and Acceleration. Scalar and Vector Point Functions–Gradient, Divergence, Curl–Physical Interpretations. Solenoidal and Irrotational Vectors-Laplacian Operator</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>Module: 4</td><td colspan="2">Inner Product Spaces</td><td colspan="4">78 Hours</td></tr>
<tr><td colspan="7">Designing The Movement of Robotic Arms, Norm Definition- Properties. Inner Product Spaces, Orthogonal Vectors, Orthonormal Vectors, Orthonormal Basis, and Gram-Schmidt Orthogonalization Process.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>Module: 5</td><td colspan="2">Laplace Transform</td><td colspan="4">8 Hours</td></tr>
<tr><td colspan="7">Building Integrated Circuits and Chips for Computers Using Laplace Transform. Laplace Transform of Standard Functions, Properties, Laplace Transform of Unit Step Function, Impulse Function, Laplace Transform of Periodic Function and Laplace Transform of Derivatives</td></tr>
</table>

Module: 6	**Inverse Laplace Transform**	**7 Hours**
Electric Circuit Analysis Using Inverse Laplace Transform. Inverse Laplace Transform of Standard Functions, Properties, Partial Fraction Method, Convolution, Solving Ordinary Differential Equations Using Laplace Transforms.		
Total Lectures		**45 Hours**

Text Book

1.	Grewal, B. S, *"Higher Engineering Mathematics"*. 44th Edition. Khanna Publishers, 2017.

Reference Books

1.	B. V. Ramana, "Higher Engineering Mathematics," McGraw Hill, New Delhi, 2010.
2.	N.P.Bali and M.Goyal,"A Textbook of Engineering Mathematics", Laxmi Publications, 2010.
3.	E. Kreyszig, "Advanced Engineering Mathematics," John Wiley & Sons, 2006.
4.	V. Krishnamurthy, V.P. Mainra and J.L.Arora, "An Introduction to Linear Algebra", Affiliated East-West Press, Reprint 2005
5.	David C. Lay, Steven R. lay and Judi J. McDonald, "Linear Algebra and its Applications," Fifth Edition, 2006.
6.	Veerarajan T., "Engineering Mathematics for first year," Tata McGraw-Hill, New Delhi, 2008.

Recommended by Board of Studies	28 July 2023
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Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA1012	Vector Spaces and Laplace Transform	CO1	3	3	3	3									3		
		CO2	3	3	3	3									3		
		CO3	3	3	3	3									3		
		CO4	3	3	3	3									3		
		CO5	3	3	3	3									3		
		CO6	3	3	3	3									3		

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; "-" – No correlation.

Syllabus is prepared by Dr. V. JEMMY JOYCE

Course Code	MULTIVARIABLE CALCULUS AND DIFFERENTIAL EQUATIONS	L	T	P	C
23MA1013		3	0	0	3

Course Objectives:

Enable the student to:

1. Acquire knowledge in special functions and series.
2. Solve using differentiation and integration techniques.
3. Formulate physical phenomena using vector spaces.

Course Outcomes:

The student will be able to:

1. Evaluate surface area and volume using a definite integral.
2. Express functions as an infinite series.
3. Apply differentiation techniques to find the extreme values of functions.
4. Calculate gravity and mass using integration techniques.
5. Relate vector calculus with magnetic field and moving fluid.
6. Solve linear partial differential equations of first order.

Module: 1	**Sequences and Series**	**7 Hours**

Convergence of Sequence and Series, Tests for Convergence, Power Series, Taylor's Series. Series For Exponential, Trigonometric and Logarithmic Functions-Application of Power Series in Polarization Study (For Classroom Discussion, Assignments and Term Paper Work).		
Module: 2	**Calculus**	**7 Hours**
Beta and Gamma Functions and Their Properties; Applications of Definite Integrals to Evaluate Surface Areas and Volume. Application In Drug Delivery System (For Classroom Discussion, Assignments, and Term Paper Work).		
Module: 3	**Fourier Series**	**7 Hours**
Full Range – Change of Interval- Half Range Sine and Cosine Series, Parseval's Theorem, Harmonic Analysis. Application of Fourier Series in Bio Signal Processing (For Classroom Discussion, Assignments, and Term Paper Work).		
Module: 4	**Multivariable Calculus: Differentiation**	**8 Hours**
Limit, Continuity and Partial Derivatives, Total Derivative; Jacobians. Maxima, Minima, and Saddle Points; Method of Lagrange Multipliers; Gradient, Directional Derivatives, Curl, and Divergence.		
Module: 5	**Multivariable Calculus: Integration**	**8 Hours**
Multiple Integration: Double and Triple Integrals (Cartesian and Polar), Change of Order of Integration in Double Integrals, Applications: Area and Volume. Application of Calculus in Modeling of Physiological Systems (For Classroom Discussion, Assignments, and Term Paper Work).		
Module: 6	**Ordinary and Partial Differential Equations**	**8 Hours**
Ordinary Differential Equations: Second Order Linear Differential Equations with Constant Coefficients, Method of Variation of Parameters, Cauchy-Euler Equation; First Order Partial Differential Equations: Solutions of First Order Standard Types and Lagrange's Equations. Application of Differential Equations in Modelling of Physiological Systems (For Classroom Discussion, Assignments, and Term Paper Work).		
Total Lectures		**45 Hours**

Text Book	
1.	B.S. Grewal, "Higher Engineering Mathematics," Khanna Publishers, 44^{th} Edition, 2017.
Reference Books	
1.	T. Veerarajan, "Engineering Mathematics," McGraw-Hill, New Delhi, 2008.
2.	B. V. Ramana, "Higher Engineering Mathematics," McGraw Hill, New Delhi, 2010.
3.	N.P.Bali and M.Goyal,"A text book of Engineering Mathematics", Laxmi Publications, 2010.
4.	E. Kreyszig, "Advanced Engineering Mathematics," John Wiley & Sons, 2006.
5.	W.E.Boyce and R.C.Di Prima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.

Recommended by Board of Studies	28 July 2023
Approved by Academic Council	25 Aug 2023

Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
23MA1013	Multivariable Calculus and Differential Equations	CO1	3	3	3	3												
		CO2	3	3	3	3												
		CO3	3	3	3	3												
		CO4	3	3	3	3												
		CO5	3	3	2	3												
		CO6	3	3	3	3												

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; ”-“ – No correlation.

Syllabus is Prepared by Dr.V. Kavitha

Course Code	MATRICES, NUMERICAL METHODS AND TRANSFORMS	L	T	P	C
23MA1014		3	0	0	3

Course Objectives:

Enable the student to:

1. Acquire knowledge of matrices.
2. Classify numerical solutions to algebraic and transcendental equations.
3. Recognize the fundamental concepts of Transforms.

Course Outcomes:

The student will be able to:

1. Analyze quadratic form using orthogonal transformation of matrix.
2. Compare integration solution and numerical solution.
3. Solve differential equations using Laplace Transforms.
4. Categorize Z-Transform of sequence and series.
5. Apply difference equations solutions in their engineering fields.
6. Describe the different transforms techniques.

Module: 1	**Matrices**	**7 Hours**

Eigen Values and Eigenvectors; Cayley-Hamilton Theorem, Diagonalization of Matrices; Orthogonal Transformation to Reduce Quadratic Forms to Canonical Forms. Applications In Biomaterial Science and Related Case Study (For Classroom Discussion, Assignments, and Term Paper Work).

Module: 2	**Numerical Method I**	**7 Hours**

Solution of Algebraic and Transcendental Equations – Bisection Method, Newton-Raphson Method. Finite Differences, Interpolation Using Newton’s Forward and Backward Difference Formulae. Numerical Integration: Trapezoidal Rule and Simpson’s 1/3rd and 3/8 Rules. Applications In Biomechanics and Related Case Study (For Classroom Discussion, Assignments, and Term Paper Work).

Module: 3	**Numerical Methods-II**	**7 Hours**

Ordinary Differential Equations of First Order: Taylor’s Series, Euler and Modified Euler’s Methods. Runge Kutta Method of Fourth Order. Partial Differential Equations Solution of Laplace Equation by Liebmann Method, Applications in Bioinformatics, and Related Case Study (For Classroom Discussion, Assignments, and Term Paper Work).

Module: 4	**Laplace Transform**	**8 Hours**

Laplace Transform- Definitions and Properties, Laplace Transform of Periodic Functions. Inverse Laplace Transform. Solving Ordinary Differential Equations. Applications In Biomedical Signal Processing, Biomedical Optics and Biocontrol Systems and Related Case Study (For Classroom Discussion, Assignments, and Term Paper Work).

Module: 5	**Fourier Transform**	**8 Hours**

Fourier Transform Pair – Fourier Sine and Cosine Transforms – Properties – Transforms of Simple Functions– Finite Fourier Transform-Definition-Simple Problems. Applications In Bio Signal Processing and Medical Imaging and Related Case Study (For Classroom Discussions, Assignments and Term Paper Work).

Module: 6	**Z Transform, Wavelet Transform**	**8 Hours**

Standard Z Transforms–Standard Results -Inverse Z-Transforms of Standard Functions-Method of Partial Fractions – Properties - Application to Solve Difference Equations. Wavelet Transform-Definition. Applications In Bio-Signal Processing and Medical Imaging and Related Case Study (For Classroom Discussions, Assignments, and Term Paper Work).

Total Lectures		45 Hours
Text Book		
1.	B.S. Grewal, "Higher Engineering Mathematics," Khanna Publishers, 44th Edition, 2017.	
Reference Books		
1.	D. Poole, "Linear Algebra: A Modern Introduction," Brooks/Cole, 2005.	
2.	N.P.Bali and M.Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.	
3.	V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra," Affiliated East-West press, 2005.	
4.	P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods," S. Chand & Company, 2ndEdition, Reprint2012.	
5.	Kanti B. Dutta., "Mathematical Methods of Science and Engineering – Aided with MATLAB", Cengage Learning, New Delhi, 2013.	
Recommended by Board of Studies	28 July 2023	
Approved by Academic Council	25 Aug 2023	

Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
23MA1014	Matrices, Numerical Methods and Transforms	CO1	3	3	3	3												
		CO2	3	3	3	3												
		CO3	3	3	3	3												
		CO4	3	3	3	3												
		CO5	3	3	2	3												
		CO6	3	3	3	3												

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; "-" – No correlation.

Syllabus is Prepared by Dr.V. Kavitha

Course Code	PROBABILITY AND STATISTICS	L	T	P	C
23MA2001		3	0	0	3

Course Objectives:

Enable the student to:

1. Know the basic concepts of Probability.
2. Measure uncertainty using various probability distribution.
3. Analyze data with statistical methods.

Course Outcomes:

The student will be able to:

1. Apply the concept of probability in machine learning problems.
2. Analyze one dimensional and two-dimensional Random variables
3. Relate predictive analysis using probability distributions.
4. Measure the relationship between variables.
5. Construct the comparative analysis using testing of hypothesis.
6. Examine the independence of attributes.

Module: 1	Basics of Probability	7 Hours

Risk management in information security based on Probability - Definitions and axioms-independent events-conditional probability- Total Theorem - Baye's theorem- Problems-Naive Bayes Algorithm in Machine Learning.

Module: 2	Random Variables	7 Hours

Applications in Machine learning and Data Analytics problems -Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function. Two Dimensional Random Variables:

Discrete and Continuous Random variables, Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables.		
Module: 3	**Probability Distributions**	**7 Hours**
Insurance/Financial applications of probability distributions. Discrete: Binomial and Poisson. Continuous: Normal, Exponential and Gamma Distributions.		
Module: 4	**Time Series, Correlation and Regression**	**8 Hours**
Basic Statistics in business intelligence and planning, Measures of Central tendency-Time Series Components of Time Series -Measurement of Trend- Freehand or Graphic Method-Moving Average Method-Correlation and Regression –simple and multiple linear Regression– multicollinearity-Ridge Regression- Lasso Regression-Rank correlation.		
Module: 5	**Large Sample Tests**	**8 Hours**
Test for single proportion, difference of proportions, Tests for single mean, difference of means. Application-Confidence intervals of parameters- Performance analysis.		
Module: 6	**Small Sample Tests**	**8 Hours**
Student t-test, F-test and Chi-square test for goodness of fit and independence of attributes. Application-Performance analysis- Comparative analysis – Quality testing.		
Total Lectures		**45 Hours**

Text Books	
1.	T.Veerarajan, “Probability,Statistics and Random Processes”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.
2.	B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, 2017.
Reference Books	
1.	Erwin kreyszig, “Advanced Engineering Mathematics,” 10thEdition, John Wiley & Sons, 2017.
2.	S.C.Gupta , V.K. Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand &Sons, 11th Revised Edition 2007.
3.	P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory,” Universal Book Stall, 2003(Reprint).
4.	Kandasamy P., Thilagavathi K and Gunavathi K., “Engineering Mathematics”, Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
5.	S. Ross, “A First Course in Probability,” 6th Edition, Pearson Education India, 2019.

Recommended by Board of Studies	05 May 2023
Approved by Academic Council	03 June 2023

Course Code	**DISCRETE STRUCTURES**	**L**	**T**	**P**	**C**
23MA2002		3	0	0	3

Course Objectives:

Enable the student to:

1. Understand the basic concepts in sets, numbers theory and logic
2. Relate error detection system and Boolean algebra.
3. Solve optimization problems using graph theory.

Course Outcomes:

The student will be able to:

1. Solve problems using the concepts of sets, functions, and relations.
2. Apply number theory in data encryption.
3. Demonstrate the knowledge in counting techniques.
4. Establish truth values using mathematical logic.
5. Understand algebraic structures and Boolean algebra.

6. Evaluate the network problems using graph and trees.		
Module: 1	**Sets, Relation, and Function**	**7 Hours**
Vehicle Model Catalogue using Set, Operations and Laws of Sets, Cartesian Product, Binary Relation, Equivalence Relation, Functions, Bijective functions, Inverse and Composite Function.		
Module: 2	**Number Theory**	**7 Hours**
Securing Online Transaction using Number Theory-The Well-Ordering Principle, Recurrence relation, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.		
Module: 3	**Basic Counting Techniques**	**7 Hours**
CAPTCHA Creation using Counting Techniques, Mathematical Induction, Inclusion and exclusion, pigeon-hole principle, permutation and combination.		
Module: 4	**Propositional Logic**	**8 Hours**
Knowledge representation in artificial intelligence-Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers, Duality, Disjunctive and Conjunctive Normal Form.		
Module: 5	**Algebraic Structures**	**8 Hours**
Automatic Error Diagnosing System using Boolean Algebra-Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Partial Ordering Set- Lattice- Boolean Algebra.		
Module: 6	**Graphs and Trees**	**8 Hours**
Map for Online Food Delivery System Based on Graphs and Their Properties- Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Planar Graphs, Trees-properties, rooted trees, Tree sorting, Minimal spanning Tree–- Tree Traversals.		
Total Lectures		**45 Hours**

Text Books	
1.	J.P. Tremblay and R. Manohar, “Discrete Mathematical Structure and Its Application to Computer Science”, TMG Edition, Tata Mcgraw-Hill, 2015.
2.	Kenneth H. Rosen, “Discrete Mathematics and its Applications”, Tata McGraw –Hill, 2015
Reference Books	
1.	Bernald Kolman, Robert C. Busby and Sharon Culter Ross, “Discrete Mathematical structures,” 6^{th}Edition, Pearson Education, 2009.
2.	C L Liu and D P Mohapatra, “Elements of Discrete Mathematics A Computer Oriented Approach,” 3^{rd}Edition by, Tata McGraw –Hill, 2012.
3.	Schaum’s Outlines Series, Seymour Lipschutz, MarcLipson, “Discrete Mathematics,” Tata McGraw –Hill, 2013.
4.	Alexander Stanoyevitch, “Discrete Structures with Contemporary Applications,” 1^{st} Edition, CRC Press, Inc., 2011.

Recommended by Board of Studies	05 May 2023
Approved by Academic Council	03 June 2023

Course Code	**PROBABILITY AND STATISTICS IN ENGINEERING**	**L**	**T**	**P**	**C**
23MA2003		3	1	0	4
Course Objectives:					

Enable the student to:

1. Develop skills in the area of data analytics.
2. Measure uncertainty using various probability distributions.
3. Interpret engineering problems using statistical techniques

Course Outcomes:		
The student will be able to: 2. Determine the statistical measures of data. 3. Analyze the linear relationship of variables using linear in correlation and regression models. 4. Apply the concept of probability in machine learning problems. 5. Gain knowledge in randomness of data. 6. Relate predictive analysis using probability distributions. 7. Construct the comparative analysis using testing of hypothesis.		
Module: 1	**Statistics**	**7 Hours**
Frequency Distribution and Measures of Central Tendency – Mean, Median and Mode – Measures of Dispersion – Standard Deviation- Quartile Deviation- coefficient of variation. Application - Survey data analysis–Consistency of the product - Visually inspecting data to improve product quality (For classroom discussions, assignments, and term paper work).		
Module: 2	**Linear Relationship and Predictive Models**	**7 Hours**
Karl Pearson's correlation coefficients – Spearman's Rank Correlation – Lines of regression and Regression equations. Application - Strength of relation between two variables – Measuring similarity between the data – Estimation of association among the variables (for classroom discussions, assignments and term paper work).		
Module: 3	**Probability in Machine Learning**	**7 Hours**
Axioms of probability - Mathematical definition of probability - Conditional probability –Independent events –Addition law and multiplication law- Theorem of Total Probability-Baye's Theorem (statement only) and its problems. Application –Decision Making –Prediction Problems in a real life – Construction of machine learning model (for classroom discussions, assignments, and term paper work).		
Module: 4	**Random Variables**	**8 Hours**
One Dimensional Random Variables: Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function. Two Dimensional Random Variables: Discrete random variables, Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables. Application in data analytics problems (for classroom discussions, assignments, and term paper work).		
Module: 5	**Probability Distributions**	**8 Hours**
Discrete Distribution: Binomial and Poisson distribution – Poisson distribution is a limiting case of binomial distribution - Fitting binomial and Poisson distribution - Continuous Distribution: Normal and Exponential distribution–Properties. Application –Analyzing the performance practical problems – Cloud computing (for classroom discussions, assignments, and term paper work).		
Module: 6	**Decision Making Techniques**	**8 Hours**
Tests of Significance-large sample tests- Single mean- difference of two means – Single Proportion - difference of two proportion– Small sample test– Student's t test–Single mean-difference of two means- F test - Chi square test - Goodness of fit – Test of independence attributes. Application-Performance analysis- Comparative analysis – Quality testing (for classroom discussions, assignments and term paper work).		
Total Lectures		**45 Hours**

Text Books	
1.	T. Veerarajan, "Probability, Statistics and Random Processes," 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.
2.	B.S. Grewal, "Higher Engineering Mathematics," Khanna Publishers, 44th Edition, 2017.
Reference Books	
1.	S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand &Sons, 11th Revised Edition 2007.
2.	E. Kreyszig, "Advanced Engineering Mathematics," 10thEdition, John Wiley & Sons, 2015.

3.	S. Ross, "A First Course in Probability," 9th Edition, Pearson Education India, 2019.
4.	A.Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGrawHill, 2002.
5.	G.JayKarns, "Introduction to Probability and Statistics using R", Third Edition, 2018.
Recommended by Board of Studies	05 May 2023
Approved by Academic Council	03 June 2023

Course Code	**PROBABILITY AND STATISTICS FOR MECHANICAL ENGINEERING**	**L**	**T**	**P**	**C**
23MA2004		2	0	2	3

Course Objectives:

Enable the student to:

1. Acquire skills in the area of mechanical data analytics.
2. Measure uncertainty in dynamics using various probability distributions.
3. Interpret mechanical engineering problems using statistical techniques.

Course Outcomes:

The student will be able to:

1. Determine the statistical measures of data.
2. Analyze the linear relationship of variables using linear in correlation and regression models.
3. Apply the concept of probability in machine learning problems.
4. Gain the knowledge in randomness of data.
5. Model the data using probability distributions.
6. Describe the testing of hypothesis in decision making.

Module: 1	**Preliminaries of Data Analytics**	**6 Hours**
Frequency Distribution and Measures of Central Tendency – Mean, Median and Mode – Measures of Dispersion – Standard Deviation- Quartile Deviation- Coefficient of Variation. Application -Survey Data Analysis in Solid Mechanics–Visually Inspecting Data to Improve Quality of Mechanical Product (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 2	**Linear Relationship and Predictive Models**	**5 Hours**
Karl Pearson's Correlation Coefficients – Spearman's Rank Correlation – Lines of Regression and Regression Equations. Application - Strength of Relation Between Two Physical Variables – Measuring Similarity Between Dynamical Data – Estimation of Association Among the Physical Variables (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 3	**Probability –Machine Learning Models**	**8 Hours**
Axioms of Probability - Mathematical Definition of Probability - Conditional Probability – Independent Events –Addition Law and Multiplication Law- Theorem of Total Probability-Baye's Theorem (Statement Only) and Its Problems. Application –Decision Making –Construction of Machine Learning Model to Mechanical Problems (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 4	**Randomness of Data**	**8 Hours**
One Dimensional Random Variables: Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function. Two Dimensional Random Variables: Discrete Random Variables, Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables. Application In Handling Larger Dynamical Data Set to Asses Equipment Performance (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 5	**Modelling of Data**	**8 Hours**
Discrete Distribution: Binomial and Poisson Distribution – Poisson Distribution Is a Limiting Case of Binomial Distribution - Fitting Binomial and Poisson Distribution - Continuous Distribution: Normal and		

Exponential Distribution–Properties. Application –Analyzing the Performance Practical Problems – Design and Modeling MEMS and Testing (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 6	**Decision Making Techniques**	**10 Hours**

Tests of Significance-Large Sample Tests- Single Mean- Difference of Two Means – Single Proportion- Difference of Two Proportion– Small Sample Test– Student's T Test–Single Mean-Difference of Two Means- F Test - Chi Square Test – Goodness of Fit – Test of Independence Attributes. Application- Performance Analysis - Quality Testing- Determine the Root Causes of Failures and Assess the Reliability of Critical Systems (For Classroom Discussions, Assignments, and Term Paper Work).

Total Lectures	**45 Hours**

Lab Experiments: Programming in R

1. Introduction to Programming in R and Syntax
2. Preparation of graphs and plots using R.
3. Compute measures of central tendency and dispersion.
4. Applying linear regression and correlation models to a real dataset.
5. Solving problems based on probability.
6. Probability functions of discrete and continuous distributions
7. Find the expected value and variance for random variables.
8. Hypothesis testing for large samples using mean values.
9. Test of hypothesis for a small sample- t, F test.
10. Applying the Chi-Square test for goodness of fit and the contingency test to a real dataset.

Text Book

1.	Veerarajan, T., "Probability, Statistics and Random Processes". 3rd Edition. Tata McGraw- Hill, New Delhi, 2017. ISBN-10. 9780070669253.
2.	Grewal, B.S, "Higher Engineering Mathematics". 44th Edition. Khanna Publishers, 2017.

Reference Books

1.	Gupta,S.C, Kapoor, V.K., "Fundamentals of Mathematical Statistics". 11th Revised Edition. Sultan Chand &Sons, 2007.
2.	Hoel, P. G., Port, S.C and Stone, C. J, "Introduction to Probability Theory". Universal Book Stall, 2003.
3.	Ross,S, "A First Course in Probability". 9th Edition. Pearson Education India,2019.
4.	Papoulis, A and Unnikrishnan Pillai, S, "Probability, Random Variables and Stochastic Processes". Fourth Edition. McGraw-Hill.2002.
5.	JayKarns, G, "Introduction to Probability and Statistics using R". Third Edition. Lulu.com, 2018.

Recommended by Board of Studies	28 July 2023
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Articulation Matrix of COs *Vs* Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
23MA2004	Probability and Statistics for Mechanical Engineering	CO1	3	3	3	3									3		2	
		CO2	3	3	3	3									3		2	
		CO3	3	3	3	3									3		2	
		CO4	3	3	3	3									3		2	
		CO5	3	3	3	3									3		2	
		CO6	3	3	3	3									3		2	

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; "-" – No correlation.

Syllabus is prepared by Dr.R.SELVAMANI

Course Code	MATHEMATICS FOR DIGITAL SCIENCES	L	T	P	C
23MA2005		3	1	0	4

Course Objectives:

Enable the student to:

1. Acquire knowledge of the matrix and the principles of counting.
2. Understand the mathematical structures in computing.
3. Apply logic and graphs to solve problems.

Course Outcomes:

The student will be able to:

1. Apply matrix techniques when solving simultaneous equations.
2. Describe counting principles and functions.
3. Recognize algebraic structure in computation.
4. Compute the error in the transmission of the code word.
5. Conclude the truth value of propositions using logic.
6. Construct networks with the minimum resources.

Module: 1	Matrices	**8 Hours**

Introduction- Matrices– Types of Matrices - Matrix Operations -Inverse of A Matrix- Application: Solving Simultaneous Equations: Cramer's Rule - Boolean Matrix –Join, Meet, Product of Boolean Matrix – Properties of Boolean Operations – Set – Cartesian Product - Relations - Representation of Relations by Matrix -Properties.

Module: 2	Combinatorics	**9 Hours**

Counting Principle – Sum and Product Rule– Tree Diagram - The Pigeonhole Principle – Applications of Pigeonhole Principle- Permutations and Combinations with and Without Repetition- Functions - Injection and Surjection, Composition -Permutation Functions.

Module: 3	Algebraic Structures	**10 Hours**

Binary Operations – Properties –Semigroups- Group –Subgroup - Examples - Binary Set - Encoding Function- Code Word –Hamming Distance- Error Detection- Parity Check Code - Group Codes-Examples.

Module: 4	Logic	**9 Hours**

Proposition – Conditional Statements - Truth Tables of Compound Proposition – Precedence of Logical Operators – Logic and Bit Operations – Propositional Equivalences – Tautology, Logical Equivalences – Applications of Propositional Logic: Translating English Sentences.

Module: 5	Graph Theory	**9 Hours**

Graphs – Terminology of Graphs – Representing Graphs – Isomorphic Graphs –Paths - Euler Paths and Circuits – Hamiltonian Paths and Circuits – Labeled Trees– Undirected Trees – Minimal Spanning Trees (Definition, Examples and Theorems Statement Only).

Total Lectures	**45 Hours**

Text Books

1.	Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures," 6th Edition, Pearson Education, 6th edition 2015.
2.	Kenneth H. Rosen, "Discrete Mathematics and its Applications," Tata McGraw Hill, 8th Edition, 2019.

Reference Books

1.	J.P. Tremblay and R. Manohar, "Discrete Mathematical Structure and Its Application to Computer Science," TMG Edition, Tata McGraw-Hill, 2015.
2.	Susanna S. Epp, "Discrete Mathematics with Applications", 4th Edition, Wadsworth Publishing Co.Inc, 2010.

3.	Jayant Ganguly, "A Treatise on Discrete Mathematical Structures", Sanguine-Pearson, 2010.
4.	Thomas Koshy, "Discrete Mathematics with Applications", Elsevier, 2005, Reprint 2008.
5.	Swapan Kumar Sarkar, "A Text Book of Discrete Mathematics", S.Chand & Company, 2009.

Recommended by Board of Studies	28 July 2023
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Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA2005	Mathematics for Digital Science	CO1	3	3	3	3									3		2
		CO2	3	3	3	3									3		2
		CO3	3	3	3	3									3		2
		CO4	3	3	3	3									3		2
		CO5	3	3	3	3									3		2
		CO6	3	3	3	3									3		2

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; "-" – No correlation.

Syllabus is Prepared by Dr. S Jebasingh

Course Code	FUNDAMENTALS OF STATISTICS AND PROBABILITY	L	T	P	C
23MA2006		3	1	0	4

Course Objectives:

Enable the student to:
1. Acquire basic principles of Statistics.
2. Develop the skills of prediction and forecasting analysis.
3. Use different probability models in decision making problems.

Course Outcomes:

The student will be able to:
1. Recognize the different types of presentation of data.
2. Measure the central tendency and dispersion of the data.
3. Analyze the linear relationship.
4. Identify the different methods of time series analysis and forecasting.
5. Utilize the concepts of probability.
6. Apply the probability models to fit the data.

Module: 1	**Representation of Data**	**9 Hours**

Statistics: Definition, Scope, and Significance – Collection, Classification, and Tabulation of Data – Frequency Distribution: Discrete and Continuous - Scales of Measurement: Nominal, Ordinal and Interval - Diagrammatic and Graphical Representation - Application - Visually Inspecting Data to Improve Product Quality (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 2	**Preliminaries of Data Analytics**	**9 Hours**

Measurement of Central Tendency: Mean Median and Mode – Measurement of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, and Its Coefficients – Testing of Consistency - Application - Survey Data Analysis–Consistency of The Product (For Classroom Discussions, Assignments and Term Paper Work).

Module: 3	**Linear Relationship and Predictive Models**	**9 Hours**

Correlation – Definition and Types of Correlation – Scatter Diagram - Karl Pearson's Co-Efficient of Correlation - Spearman's Rank Correlation – Repeated Ranks - Regression Analysis: Lines of Regression and Regression Equations - Regression in Two Variables - Application - Measuring the Influences Between Factors - Estimation of Association Among the Variables (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 4	Forecasting	9 Hours
Meaning and Components of Time Series – Measurement of Secular Trend: Graphic Method, Semi-Average Method, Moving Average Method, and Method of Least Squares - Measurement of Seasonal Variations: Simple Average Method – Application - Models in Forecasting - Prediction Making Based on Data Set (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 5	**Probabilistic Models**	**9 Hours**
Axioms of Probability - Mathematical Definition of Probability - Conditional Probability –Independent Events- Theorem of Total Probability - Baye's Theorem (Statement Only) and Its Problems. Discrete Distribution: Binomial and Poisson Distribution-Continuous Distribution: Normal Distribution- Application - Decision Making - Construction of Machine Learning Model (For Classroom Discussions, Assignments and Term Paper Work).		
Total Lectures		**45 Hours**

Text Book	
1.	T. Veerarajan, "Probability, Statistics and Random Processes," 3nd Edition, Tata McGraw-Hill, New Delhi, 2017.
2.	B.S. Grewal, "Higher Engineering Mathematics," Khanna Publishers, 44th Edition, 2017.
Reference Books	
1.	S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand &Sons, 11th Revised Edition 2007.
2.	E. Kreyszig, "Advanced Engineering Mathematics," 10thEdition, John Wiley & Sons, 2015.
3.	P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory," Universal Book Stall, 2003.
4.	S. Ross, "A First Course in Probability," 9thEdition, Pearson Education India, 2019.
5.	A.Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGrawHill, 2002.
6.	G.JayKarns, "Introduction to Probability and Statistics using R", Third Edition, 2018.

Recommended by Board of Studies	28 July 2023
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Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
23MA2006	Fundamentals of Statistics and Probability	CO1	3	3	3	2										2	3
		CO2	3	3	3	2										2	3
		CO3	3	3	3	2										2	3
		CO4	3	3	3	2										2	3
		CO5	3	3	3	2										2	3
		CO6	3	3	3	2										2	3

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; "-" – No correlation.

Syllabus is prepared by Dr. VIJILA M

Course Code	FUZZY SETS AND LOGIC	L	T	P	C
23MA2007		3	1	0	4

Course Objectives:

Enable the student to:

1. Acquire knowledge of fuzzy sets and fuzzy logic
2. Understand fuzzy operations, fuzzy numbers, and fuzzy equations.
3. Apply fuzzy systems and fuzzy controllers in the digital sciences.

Course Outcomes:

The student will be able to:

1. Recognize the different types of fuzzy sets. 2. Identify the operations of fuzzy sets. 3. Solve the problems using fuzzy arithmetic operations. 4. Differentiate between classical logic and fuzzy logic. 5. Develop fuzzy expert systems. 6. Create rule-based fuzzy systems.		
Module: 1	**Fuzzy Sets**	**9 Hours**
Introduction- Crisp Sets- An Overview- Fuzzy Sets and Types- Fuzzy Sets and Basic Concepts- Alpha Cuts- Representation of Fuzzy Sets. Operations On Fuzzy Sets- Types of Operations- Fuzzy Complements		
Module: 2	**Operations**	**9 Hours**
Fuzzy Intersections and T-Norms – Axioms – Examples of T-Norms: Standard Intersection, Algebraic Product, Bounded Difference, Drastic Difference, Fuzzy Union, and T-Co-Norms – Axioms – Examples of T- Co-Norms – Standard Union, Algebraic Sum, Bounded Sum, and Drastic Sum.		
Module: 3	**Fuzzy Arithmetic**	**9 Hours**
Fuzzy Numbers- Linguistic Variables- Arithmetic Operations on Intervals-Arithmetic Operations on Fuzzy Numbers: Addition, Subtraction, Multiplication, and Division- Lattice of Fuzzy Numbers- Fuzzy Equations.		
Module: 4	**Fuzzy Logic**	**9 Hours**
Logic - An Overview-Multi Valued Logics-Fuzzy Propositions - Fuzzy Quantifiers - Linguistic Hedges- Inference from Conditional Fuzzy Propositions – Inference from Conditional and Qualified Propositions – Inference from Quantified Propositions.		
Module: 5	**Approximate Reasoning & Fuzzy Systems**	**9 Hours**
Approximate Reasoning - Fuzzy Expert Systems – An Overview – Fuzzy Implications – Axioms – Selection of Fuzzy Implications – Multi Conditional Approximate Reasoning – Interval Valued Approximate Reasoning. Fuzzy Controllers - An Overview- Fuzzification - Defuzzification - Fuzzy Rule Base- Fuzzy Inference- Defuzzification Methods: Center of Area Method, Center of Maxima Method, and Mean of Maximum Method - Fuzzy Neural Networks- Fuzzy Automata.		
Total Lectures		**45 Hours**

Text Book	
1.	George J. Klir and Bo Yuan "Fuzzy Sets and Fuzzy Logic, Theory and Applications," Prentice – Hall of India, Pvt. Ltd., New Delhi, 2005.
Reference Books	
1.	James J. Buckley, Esfaniar Eslami., "An Introduction to Fuzzy Logic and Fuzzy Sets," (3rd Edition), Springer-Verlag, 2011.
2.	Ganesh M., "Introduction to Fuzzy sets and Fuzzy Logic," (1st Edition), Prentice Hall of India Pvt., Ltd., 2006.
3.	H J Zimmermann, Hans Jurgen Zimmerman, "Fuzzy Set Theory- and Its Applications," Springer-Verlag, 2001.
4.	Timothy J. Ross., "Fuzzy Logic with engineering applications," 3rd Edition, John Wiley, 2010.
5.	Michal Baczynski and Balasubramaniam Jayaram, "Fuzzy Implictions," Springer Verlag, Heidelberg, 2008.

Recommended by Board of Studies	28 July 2023
Approved by Academic Council	25 Aug 2023

Articulation Matrix of COs *Vs* Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA2007	Fuzzy Sets and Logic	CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
		CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
		CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
		CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
		CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
		CO6	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; ”-“ – No correlation.

Syllabus is Prepared by Dr. M. SELVARATHI

Course Code	Basics of Probability and Statistics	L	T	P	C
23MA2008		2	0	2	3

Course Objectives:

Enable the student to:
1. Acquire basic principles of Statistics.
2. Use different probability models in decision making problems.
3. Analyze data with statistical techniques using R.

Course Outcomes:

The student will be able to:
1. Measure the central tendency and dispersion of the data.
2. Apply the basic concepts of probability.
3. Analyze the linear relationship.
4. Classify the problems using probability distributions and apply appropriate distributions. Measure the central tendency of the data.
5. Compare the relationship between variables using correlation and regression analysis.

Module: 1	Preliminaries of Data Analytics	7 Hours

Measurement of Central Tendency: Mean Median and Mode – Measurement of Dispersion: Range, Quartile Deviation, Mean Deviation and Standard Deviation– Application - Survey Data Analysis–Consistency of The Product (For Classroom Discussions, Assignments and Term Paper Work).

Module: 2	Probabilistic Models	8 Hours

Axioms of Probability - Mathematical Definition of Probability - Conditional Probability –Independent Events- Theorem of Total Probability - Baye’s Theorem (Statement Only) and Its Problems. Discrete Distribution: Binomial and Poisson Distribution-Continuous Distribution: Normal Distribution- Application - Decision Making - Construction of Machine Learning Model (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 3	Linear Relationship and Predictive Models	7 Hours

Correlation – Definition and Types of Correlation – Scatter Diagram - Karl Pearson’s Co-Efficient of Correlation - Spearman’s Rank Correlation – Regression Analysis: Lines of Regression and Regression Equations - Regression in Two Variables - Application - Measuring the Influences Between Factors - Estimation of Association Among the Variables (For Classroom Discussions, Assignments, and Term Paper Work).

Module: 4	Testing of Hypothesis	8 Hours

Population – Sample –Type I and Type II Error - Tests of Means and Proportions – Large Sample Test Based on Normal Distribution for Single Mean and Difference Means. Test For Single Proportion, Difference of Proportion. Small Sample Test - Student’s T Test - Single Mean-Difference of Two Means-F Test- Chi Square

Test-Goodness of Fit - Test of Independence Attributes – Application- Comparative Analysis - Quality Testing.		
Module: 5	**Statistical Quality Control**	**7 Hours**
Types of Variation - Types of Control Charts - Control Chart of Mean and Range, Sigma Chart, Control Chart of Proportion of Defectives and Number of Defectives, C- Chart, Advantages and Limitations of SQC- Application of Quality Control in Food Industry.		
Module: 6	**Design of Experiments**	**8 Hours**
Analysis of Variance: One-Way and Two-Way Classification. Completely Randomized Design - Randomized Block Design - Simple Latin Square Design - Response Surface Methodology.		
Total Lectures		**45 Hours**

Text Book

1.	T. Veerarajan, "Probability, Statistics and Random Processes," 3nd Edition, Tata McGraw-Hill, New Delhi, 2017.
2.	B.S. Grewal, "Higher Engineering Mathematics," Khanna Publishers, 44th Edition, 2017.

Reference Books

1.	S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand &Sons, 11th Revised Edition 2007.
2.	E. Kreyszig, "Advanced Engineering Mathematics", 10thEdition, John Wiley & Sons, 2015.
3.	P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory," Universal Book Stall, 2003.
4.	S. Ross, "A First Course in Probability", 9thEdition, Pearson Education India, 2019.
5.	A.Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGrawHill, 2002.
6.	G.JayKarns, "Introduction to Probability and Statistics using R", Third Edition, 2018.

Recommended by Board of Studies	28 July 2023
Approved by Academic Council	25 Aug 2023

Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA2008	Basics of Probability and Statistics	CO1	3	3	3	2										2	3
		CO2	3	3	3	2										2	3
		CO3	3	3	3	2										2	3
		CO4	3	3	3	2										2	3
		CO5	3	3	3	2										2	3
		CO6	3	3	3	2										2	3

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; "-" – No correlation.

Syllabus is prepared by Dr. VIJILA M

Course Code	NUMERICAL MATHEMATICS AND STATISTICS	L	T	P	C
23MA2009		2	0	2	3

Course Objectives:

Enable the student to:

1. Solve algebraic equations, interpolation, and numerical integration.
2. Recognize splines.
3. Solve differential equations using numerical techniques.

Course Outcomes:

The student will be able to:

1. Find the roots of algebraic equations by using different methods.
2. Interpolate the data.

3. Evaluate the definite integrals using numerical integration. 4. Compute the spline functions. 5. Solve ordinary differential equations using numerical techniques. 6. Describe the partial differential equations solutions using numerical techniques.		
Module: 1	**Solving Algebraic Equations and Interpolation**	**9 Hours**
Nested Multiplication - Simple Numerical Problems Using Taylor's Series- Representation of Numbers in Different Bases. Bisection Method- Convergence of Bisection Method-Newton's Method-Geometry of Newton's Method-Polynomial Interpolation - Newton Interpolating Polynomial - Calculating Newton Interpolating Formula Using Divided Difference-Lagrange Interpolating Polynomial – Applications to Shape Function In FEM, Solving Kepler's Equation in Orbital Mechanics.		
Module: 2	**Numerical Integration and Splines**	**8 Hours**
Trapezoidal Rule - Romberg Algorithm-Simpson's Rule-Gaussian Quadrature Formulas. First Degree Spline–Examples-Second Degree Splines–Natural Cubic Splines– Applications to Aircraft Wing Structural Design.		
Module: 3	**Ordinary Differential Equations**	**6 Hours**
Taylor Series Methods-Euler's Method -Runge-Kutta Method of Order 4-Adams-Bashforth Method-A Predictor-Corrector Scheme – Application to Buckling of Structures, Solving Perturbed Equations of Motion in Orbital Mechanics.		
Module: 4	**Partial Differential Equations**	**7 Hours**
Parabolic Problems-Finite Difference Method- Explicit Method-Crank- Nicolson Method- Hyperbolic Problems-Wave Equation Model Problems-Numerical Solution-Elliptic Problems-Helmholtz Equation Model Problems-Gauss-Seidal Iterative Method- Application in Heat Transfer Methods.		
Module: 5	**Distributions and Statistics**	**7 Hours**
Discrete Distributions; Binomial, Poisson Distribution. Continuous Random Variables and Their Properties. Distributions; Normal, Exponential and Gamma. – Basic Statistics, Measures of Central Tendency: Moments, Skewness and Kurtosis; Correlation and Regression – Rank Correlation. Curve Fitting by The Method of Least Squares. Applications of Inventory Management in Aircraft Industries. (M/C Learning)		
Module: 6	Test of Significance	**6 Hours**
Test of Significance: Large Samples, Tests for Single Mean, Difference of Means, and Difference of Standard Deviations. Small Samples: T-Test, F-Test and Chi-Square Test for Goodness of Fit and Independence of Attributes. Applications In Health Monitoring and Failure Analysis of Aircraft Components.		
List of experiments using MATLAB 1. Solving an algebraic equation using the bisection method. 2. Solving algebraic equations using Newton's method. 3. Creating Lagrange Interpolating polynomials and constructing a divided difference table. 4. Numerical integration using the Gaussian quadrature method. 5. Numerical integration using Simpson's 1/3 rd rule and Simpson's 3/8 th rule. 6. Finding the solution of the ODE using the R-K method. 7. Solving an ODE using Taylor's method. 8. Computing binomial and poisson distributions. 9. Finding exponential and gamma distributions. 10. Computing correlation and regression.		
Total Lectures		**45 Hours**
Text Book		
1.	Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Cengage Learning Brooks/Cole Publishing Company, California, 2012.	

2.	T.Veerarajan,"Probability, Statistics and Random Processes", 2ndEdition,TataMcGraw-Hill,New Delhi, 2010.
Reference Books	
1.	Erwin Kreyszig, "Advanced Engineering Mathematics," 9th Edition, John Wiley & Sons, 2006.
2.	N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics," Laxmi Publications, Reprint, 2010.
3.	P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory," Universal Book Stall, 2003.
4.	Kandasamy. P., Thilagavathy K., "Numerical Methods", S. Chand & Co. Ltd., 2010.
5.	Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
Recommended by Board of Studies	28 July 2023
Approved by Academic Council	25 Aug 2023

Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA2009	Numerical Mathematics and Statistics	CO1	3	3	3	3											
		CO2	3	3	3	3											
		CO3	3	3	3	3											
		CO4	3	3	3	3											
		CO5	3	3	2	3											
		CO6	3	3	3	3											

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; "-" – No correlation.

Syllabus is Prepared by Dr.V. Kavitha

Course Code	PROBABILITY, RANDOM VARIABLES AND STATISTICS	L	T	P	C
23MA2010		3	0	0	3

Course Objectives:

Enable the student to:

1. Acquire basic concepts of Probability.
2. Measure uncertainty using various probability distributions.
3. Analyze the data with statistical methods.

Course Outcomes:

The student will be able to:

1. Explore the basic concepts of probability.
2. Solve problems with discrete and continuous random variables.
3. Understand the concepts of two-dimensional random variables and solve problems.
4. Classify the problems using probability distributions and apply appropriate distributions.
5. Measure the central tendency of the data
6. Compare variables using correlation and regression.

Module: 1	Probability	7 Hours
Definitions and Axioms, Conditional Probability - Independent Events - Theorem of Total Probability - Baye's Theorem, Applications in System Identification and Machine Learning and Related Case Study (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 2	**One Dimensional Random Variables**	**7 Hours**
Discrete Random Variable: Probability Mass Function and Distribution Functions. Continuous Random Variable: Probability Density Function - Cumulative Distribution Function and Properties-Applications in Bio-Signal Processing and Related Case Study (For Classroom Discussions, Assignments, and Term Paper Work).		

Module: 3	Two Dimensional Random Variables	7 Hours
Two Dimensional Random Variables: Discrete and Continuous Random Variables, Cumulative Distribution Function- Marginal Probability Distribution - Conditional Probability Distribution - Independent Random Variables- Medical Imaging Applications and Related Case Study (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 4	**Probability Distributions**	**8 Hours**
Binomial Distribution, Poisson Distribution and Normal Distribution. Exponential - Moments Generating Functions and Its Properties, Applications of Probability Distribution in Bioinformatics and Related Case Study (For Classroom Discussions, Assignments, and Term Paper Work).		
Module: 5	**Statistics I**	**8 Hours**
Measures of Central Tendency: Mean, Median, Mode, Geometric Mean, and Harmonic Mean. Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation, Biostatistics for Biomedical Practitioners, and Related Case Study (For Classroom Discussions, Assignments and Term Paper Work).		
Module: 6	**Statistics II**	**8 Hours**
Moments - Skewness and Kurtosis - Rank Correlation, Co-efficient of Correlation and Regression Lines, Machine Learning Applications and Hypothesis Testing to Biological and Medical Systems (For Classroom Discussions, Assignments and Term Paper Work).		
Total Lectures		**45 Hours**

Text Book	
1.	T.Veerarajan, "Probability, Statistics and Random Processes", 2ndEdition, Tata McGraw-Hill, New Delhi, 2010.
Reference Books	
1.	E. Kreyszig, "Advanced Engineering Mathematics," John Wiley & Sons, 2006.
2.	P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory," Universal Book Stall, 2003.
3.	S. Ross, "A First Course in Probability", Pearson Education India, 2002.
4.	W. Feller, "An Introduction to Probability Theory and its Applications," Vol. 1, Wiley, 1968.
5.	S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics, Sultan Chand &Sons, 10th Revised Edition, 2000.

Recommended by Board of Studies	28 July 2023
Approved by Academic Council	25 Aug 2023

Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA2010	Probability, Random Variables and Statistics	CO1	3	3	3	3											
		CO2	3	3	3	3											
		CO3	3	3	3	3											
		CO4	3	3	3	3											
		CO5	3	3	2	3											
		CO6	3	3	3	3											

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; "-" – No correlation.

Syllabus is Prepared by Dr.V. Kavitha

Course Code	LOGICAL REASONING AND SOFT SKILLS	L	T	P	C
23MA3001		3	0	0	3
Course Objectives:					
Enable the student to:					

1. Solve problems in elementary algebra and arithmetic reasoning. 2. Train students in data extraction, verbal and non-verbal reasoning problems. 3. Prepare students to face interviews and meet the industry expectations.		
Course Outcomes:		
1. Solve problems in elementary arithmetic reasoning. 2. Evaluate the logical reasoning problems. 3. Analyse statements with verbal reasoning. 4. Apply non-verbal reasoning for exploring the problems. 5. Understand and interpret data from charts. 8. Develop interview soft skills and expertise in line with the standards of the industry.		
Module: 1	**Arithmetic Reasoning**	**7 Hours**
HCF and LCM – Ratio & Proportion – Percentage – Average – Series and Sequences–Simple and Compound Interests – Time and work – Counting Principle – Permutations and Combinations – Probability – Partnership Problems.		
Module: 2	**Logical Reasoning**	**7 Hours**
Number series – Letters and symbol series – Logical Problems – Statement and Assumptions –Statement and Arguments–Statement and Conclusion– Course of Action – Cause and Effect.		
Module: 3	**Verbal Reasoning**	**7 Hours**
Series Completion – Logical Sequence of Words – Coding-Decoding – Syllogism – Puzzle Test – Blood relations – Direction Sense Test.		
Module: 4	**Non-Verbal Reasoning**	**8 Hours**
Series – Analogy – Classification – Analytical Reasoning – Embedded Images – Completion of incomplete pattern – Figure matrix.		
Module: 5	**Data Interpretation**	**8 Hours**
Nature of data – Categories of data – Data Representation – Tabulation – Line charts – Bar Diagrams – Pie Charts.		
Module: 6	**Personality Development**	**8 Hours**
Attitude – Self-confidence - Planning - Team work – SWOT analysis – Self introduction- Communication skill - Effective team player – Adaptability- Critical thinking – Problem solving ability.		
Total Lectures		**45 Hours**

Reference Books	
1.	Aggarwal R.S., “Quantitative Aptitude,” Revised Edition, S. Chand & Company Ltd., (New), 2020.
2.	R. S. Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S. Chand & Company Ltd., 2018.
3.	Peeyush Bhardwaj, The Hand on guide to Analytical and Reasoning & Logical Reasoning, Arihant Publications (India) Ltd, 2015.
4.	Praveen R.V, “Quantity Aptitude and Reasoning,” PHI, 2012.
5.	R.C.Bhatia, Personality Development, Ane books private ltd, Delhi, 2013.

Recommended by Board of Studies	05 May 2023
Approved by Academic Council	03 June 2023

Course Code	**PROBABILITY AND FUZZY SETS**	**L**	**T**	**P**	**C**
23MA3002		4	0	0	4
Course Objectives:					
Enable the student to: 1. Acquire knowledge on probability distributions and fuzzy logic methods.					

2. Understand the fuzzy controllers. 3. Apply Simulation techniques in problem solving.		
Course Outcomes:		
The student will be able to: 1. Recognize the meaning of conditional probability and Baye's theorem. 2. Solve problems using probability distributions. 3. Identify different operations on fuzzy sets. 4. Differentiate classical logic and fuzzy logic. 5. Develop fuzzy expert systems.		
Module: 1	**Probability**	**12 Hours**
Definition of Probability, Axioms of Probability, Addition Theorem of Probability, Mutually Exclusive Events, Independent Events, and Conditional Probability - Theorem of Total Probability - Baye's Theorem.		
Module: 2	**Probability Distributions**	**12 Hours**
Probability Distributions: Discrete and Continuous Distributions – Binomial Distribution – Poisson Distribution – Normal Distribution – Gamma Distribution – Exponential Distribution - Simulation – Monte Carlo Technique – Random Number Generation -Testing of Random Numbers.		
Module: 3	**Classical To Fuzzy Sets**	**12 Hours**
Introduction- Crisp Sets- An Overview- Fuzzy Sets and Types- Fuzzy Sets and Basic Concepts- Alpha Cuts- Representation of Fuzzy Sets. Operations On Fuzzy Sets- Types of Operations - Fuzzy Complements, Fuzzy Union, Fuzzy Intersection, Cartesian Product - Fuzzy Numbers - Linguistic Variables.		
Module: 4	**Fuzzy Logic**	**12 Hours**
Classical Logic - An Overview-Multi Valued Logic- Fuzzy Propositions - Fuzzy Quantifiers - Linguistic Hedges-Inference from Conditional Fuzzy Propositions – Inference from Conditional and Qualified Propositions – Inference from Quantified Propositions - Fuzzy Relations.		
Module: 5	**Fuzzy Systems**	**12 Hours**
Fuzzy Controllers - An Overview- Fuzzification - Defuzzification - Fuzzy Rule Base- Fuzzy Inference- Defuzzification Methods: Center of Area Method, Center of Maxima Method, and Mean of Maximum Method - Fuzzy Neural Networks- Fuzzy Automata, Natural Language Processing.		
Total Lectures		**60 Hours**

Text Book	
1.	Veerarajan, T. (2017), Probability, Statistics and Random Processes, Tata McGraw Hill, New Delhi.
2.	George J. Klir and Bo Yuan (2015), Fuzzy Sets and Fuzzy Logic, Theory and Applications, Prentice – Hall of India Pvt. Ltd., New Delhi.
Reference Books	
1.	Kevin P Murphy (2012), Machine Learning: A Probabilistic Perspective, The MIT Press.
2.	S.C.Gupta , V.K. Kapoor (2007), Fundamentals of Mathematical Statistics, Sultan Chand &Sons.
3.	H J Zimmermann (2001) "Fuzzy Set Theory- and Its Applications", Springer-Verlag.
4.	Timothy J. Ross (2010) "Fuzzy Logic with engineering applications", 3rd Edition, John Wiley.

Recommended by Board of Studies	28 July 2023
Approved by Academic Council	25 Aug 2023

Articulation Matrix of COs *Vs*Pos and PSOs

Course Code	Course Name	Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
23MA3002		CO1	3	3	3	3									3	3	2
		CO2	3	3	3	3									3	3	2

	Probability and Fuzzy Sets	CO3	3	3	3	3									3	3	2
		CO4	3	3	3	3									3	3	2
		CO5	3	3	3	3									3	3	2
		CO6	3	3	3	3									3	3	2

Note: 3 – High correlation; 2 – Medium correlation; 1 – Low correlation; ”-“ – No correlation.

Syllabus is Prepared by Dr.P. XAVIER

MATHEMATICS

LIST OF NEW COURSES

Sl.No	Course Code	Course Title	Credits [L:T:P:C]
1	21MA4001	Research Methodology	3:0:0:3
2	21MA4002	Research and Publication Ethics	1:0:0:1
3	21MA2001	Probability Theory and Random Processes	3:0:0:3
4	22MA1001	Basic Mathematics and Numerical Computing using Python	2:0:2:3
5	22MA2001	Business Mathematics	3:0:2:4
6	22MA2002	Business Statistics with R	3:0:2:4

21MA4001	RESEARCH METHODOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce various concept of Research Methodology
2. To familiarize the scholars with research problem formulation
3. To gain insights into research and IPR related information

Course Outcomes:

At the end of this course, scholars will be able to

1. Review the current research based on literature survey
2. Identify a research gap, define research problem, formulate hypothesis and methodology for research
3. Use various mathematical techniques and statistical tools for research
4. Publish literature review article in a reputed journal
5. Understand the significance of IPR
6. Cognize the role of IPR and the need of patenting

MODULE 1: RESEARCH PROBLEMS

Introduction, Types of problems, Basic and Applied, Criteria for selecting the Problems, Techniques Involved in Defining The Problems, Selecting the Problems, Formulation of Research Problems

MODULE 2: LITERATURE REVIEW

Introduction, Research Process, Literature Review, Method of research and Experimental Design, Need For Research Design, Different Research Design, Types of Sample Design, Measurement and scaling Techniques

MODULE 3: MEASURES OF CENTRAL TENDENCY

Introduction, Statistics for Research, Measures of Central Tendency, Mean, Median, Mode, Mean deviation about Mean, Mean Deviation about median and Mode

MODULE 4: ANALYSIS AND INTERPRETATION OF DATA

Introduction of Analysis, Dispersions, Skewness, Correlation, Rank Correlation, Regression, Types of Regression, Problems

MODULE 5: SOURCE OF ERROR IN MEASUREMENT

Testing the Hypothesis, Manuscript, General Format, Chapter Format, Tables and Figures, Referencing, Report Presentation, Research Ethics

MODULE 6: INNOVATION AND IPR

Nature of intellectual property, Process of patenting and development, Procedure for grants of patents, Patenting under PCT, Patent information and databases, IPR of biological systems, IPR and computer software, IP and Traditional knowledge

REFERENCES

1. Kothari C.R. Research Methodology, Methods and Techniques 2 nd Edition , New Age International (P) Ltd, publishers, New Delhi
2. Abdul RahimF, Thesis Writing : Manual for all Researchers, New Age International (2007)
3. Ranjit Kumar , ‘ Research Methdology , Sage Publications, London, New Delhi(2006)
4. Panner Selvam R,Research Methodology Prentice Hall of India , New Delhi (2004)
5. GeoffreyR.Marczyk , ‘ Essential of Research Design and Methodology’ Wiley (2005)
6. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

21MA4002	RESEARCH AND PUBLICATION ETHICS	L	T	P	C
		1	0	0	1

Course Objectives:

1. To familiarize the scholars to publication ethics
2. To introduce the scholars to a few tools that will assist them in minimizing the similarity index
3. To give insight on various journal metrics and search indexes useful for research

Course Outcomes:

At the end of this course, scholars will be able to

1. Understand the importance of publication ethics
2. Identify and avoid various types of ethical issues while publishing papers and writing reports
3. Use various tools that are helpful in checking similarity index
4. Infer about open access publication and be able to use various search indices
5. Grade the reports and articles in order to minimize the similarity index
6. Categorize the journals based on their quality and metrics

MODULE 1: PHILOSOPHY AND ETHICS

Introduction to philosophy: definition, nature and scope, concept, branches; Ethics: definition, moral philosophy, nature of moral judgements and reactions

MODULE 2: SCIENTIFIC CONDUCT

Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP), Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data

MODULE 3: PUBLICATION ETHICS

Publication ethics: definition, introduction and importance, Best practices / standards setting initiatives and guidelines: COPE, WAME, Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behaviorand vice versa, types, Violation of publication ethics, authorship and contributorship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals

MODULE 4: OPEN ACCESS PUBLISHING

Open access publications and initiatives, SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies, Software tool to identify predatory publications developed by SPPU, Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, SpringerJournal Suggester, etc.

MODULE 5: PUBLICATION MISCONDUCT

Subject specific ethical issues, FFP, authorship, Conflicts of interest, Complaints and appeals: examples and fraud from India and abroad, Use of plagiarism software like Turnitin, Ouriginal (Urkund) and other open source software tools

MODULE 6: DATABASES AND RESEARCH METRICS

Indexing databases, Citation databases: Web of Science, Scopus, Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, CiteScore, Metrics: h-index, g index, i10 index, altimetric

REFERENCES

1. Bird, A. (2006). Philosophy of science**.** Routledge. MacIntyre, Alasdair (1967) A Short History of Ethics. London.
2. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865
3. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On Being a Scientist.' A Guide to Responsible Conduct in Research: Third Edit On. National Academies Press.
4. Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10. Retrieved from httos://www.nieiys.nih. ov/research/resources/bioethics/whatis/index.cfm Beall, J. (2012). Predatory publishers are competing open access. Nature, 489(7415), 179—179. https://doi.org/10.1038/489179a
5. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019),ISBN:978-81-939482-1-7. http://www.insaindia res.in/pdf/Ethics Book.pdf

21MA2001	PROBABILITY THEORY AND RANDOM PROCESSES	L T P C 3 0 0 3

Course Objectives:

1. To impart knowledge on Probability.
2. To measure uncertainty using various probability distributions.
3. To analyze the concepts of random processes.

Course Outcomes:

The student will be able to

1. Recognize probability models.
2. Solve the problems using discrete and continuous random variables.
3. Classify the problems using probability distributions.
4. Analyze the problems using statistical averages.
5. Determine the characteristics of random processes.
6. Identify the classification of random processes.

Module 1: Probability **7 Lectures**

Definitions and axioms, - conditional probability; Independent events-Theorem of Total Probability-Baye's Theorem; Application: Bayes' classifier - pattern recognition- Communication -Entropy concept(for classroom discussions, assignments and term paper work).

Module 2: Random Variables **7 Lectures**

Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function. Two Dimensional Random Variables: Discrete and Continuous random variables, function of one Random variable. Applications: Linear IC, ADC concept - Digital Communications- Delta modulation, quantization error. (for classroom discussions, assignments and term paper work).

Module 3: Probability Distributions **7 Lectures**

Discrete: Binomial and Poisson. Continuous: Normal, Exponential and Gamma Distributions- problems. Applications: Communication - noise calculations/derivations in AM, FM, PM, PCM. (for classroom discussions, assignments and term paper work).

Module 4: Statistical Averages **8 Lectures**

Moment Generating Function (MGF)-Properties of MGF. Tchebycheff Inequality, central limit theorem (without proof) – problems. Applications: MIMO, Wireless communication. (for classroom discussions, assignments and term paper work).

Module 5: Random Processes **8 Lectures**

Definition-Basic concepts and examples, Strict and wide sense stationaries, ergodicity - Second Order processes. Autocorrelation function and its properties-Power Spectral Density function. (Theorems statement only). Applications: Signals and systems-CTFT,DTFT concepts. (for classroom discussions, assignments and term paper work).

Module 6: Special Random Processes **8 Lectures**

Gaussian Process-Poisson process-Markov Process (theorems statement only)-Properties. Applications: MIMO, Wireless communication, Digital Communication. (for classroom discussions, assignments and term paper work)

Text Book:

1. Veerarajan T., "Engineering Mathematics (for semester III)", Tata McGraw-Hill, New Delhi, 2010.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003(Reprint).
3. S. Ross, "A First Course in Probability", 6th Ed., Pearson Education India, 2002.
4. H. Stark and J. Woods, "Probability and Random Processes with Applications to Signal Processing," 3rd Edition, Pearson Education, 2002.
5. A.Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill, 2002.

6. S.C.Gupta, V.Kapoor, “Fundamentals of Mathematical Statistics”, Tenth revised edition, Sultan Chand & Sons, 2000.

22MA1001	BASIC MATHEMATICS AND NUMERICAL COMPUTING USING PYTHON	L 2	T 0	P 2	C 3

Course Objective:

1. To impart knowledge on matrices.
2. To solve problems using differentiation and integration techniques.
3. To apply Python programs to solve bio-engineering problems.

Course Outcomes:

The student will be able to

1. Analyze the quadratic form using orthogonal transformation of the matrix.
2. Solve the ordinary differential equations.
3. Develop knowledge in curve fitting.
4. Evaluate integrations using beta and gamma functions.
5. Gain knowledge in multiple integrals.
6. Evaluate differentiations and integrations using numerical techniques.

Module 1: Matrices **8 Lectures**

Eigen values and Eigen vectors of a real matrix – Characteristic equation - Properties of Eigen values and Eigen vectors – Cayley Hamilton theorem – Diagonalization of matrices – nature of quadratic forms Application **-** Page Rank Algorithm in Google Search- Image processing.

Module 2: Ordinary differential Equations **8 Lectures**

Basic rules of differfntiation. Second and higher order linear differential equations with constant coefficients, Method of variation of parameters **-** Modelling of growth and decay problems.

Module 3: Solution of Linear Equations and curve fitting **7 Lectures**

Matrix Inversion- Gauss Elimination, Gauss- Jordan Methods, Iteration Methods- Gauss-Jacobi’s Method, Gauss Seidal Methods. Methods of Least squares, fitting a Straight line and a Polynomial,

Module 4: Integral Calculus **7 Lectures**

Definite and indefinite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric substitutions **-** Beta and Gamma functions.

Module 5: Multiple Integrals **7 Lectures**

Double integrals – Change of order of integration (Cartesian coordinates) – Double integrals in Polar coordinates **-** Area enclosed by plane curves.

Module 6: Numerical Differentiation and Integration **8 Lectures**

Differentiation -Newton’s forward and backward difference formula, Integration-Trapezoidal Rule and Simpson’s 1/3rd rule, and Simpson’s 3/8rd rule.

List of Experiments using Python:

1. Introduction to Python and general Syntaxes.
2. Write a Python program to find Eigen values and Eigen vectors of a given matrix.
3. Write a Python program to find the diagonal form of the given matrix.
4. Write a python program to solve second-order ordinary differential equations.
5. Write a python program to plot the solution of the ODE.
6. Solving system of equations using Gauss- Jacobian Iteration Method.
7. Fit the data in a straight line and parabola.
8. Write a python program for computing Beta and gamma functions for numeric input.
9. Write a python program for evaluating (i) integrals (ii) Area of Curves.
10. Find the integration of a function using Simpson’s Rules.

Text Books:

1. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, 2017.
2. G.B. Thomas and R.L. Finney, “Calculus and Analytic geometry”, 9thEdition, Pearson, Reprint, 2002.

Reference Books

1. Veerarajan T, “Engineering Mathematics”, Tata McGraw Hill, New Delhi, 2015.
2. Kandasamy P., Thilagavathi K and Gunavathi K., “Engineering Mathematics”, S. Chand & Co., New Delhi, 2013.
3. S. Narayanan and Manicavachagam Pillai T.K., “Calculus Vol I, II and III” S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai 2009.
4. E. Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2006.
5. Kandasamy P., “Numerical Methods”, S.Chand and Co, Reprint 2010.

22MA2001	BUSINESS MATHEMATICS	L	T	P	C
		3	0	2	4

Course Objectives:

1. To impart knowledge on progressions, financial methods, derivatives and integration in decision making.
2. To acquire the knowledge to represent business models using set theory, matrices and Linear Programming Problem.
3. To develop the skills of quantitative aptitude and reasoning.

Course Outcomes:

The student will be able to

1. Recognize the progression techniques in solving finance problems.
2. Determine the solutions to financial transactions.
3. Represent the business problems using set theory.
4. Construct and solve business problems using matrix methods and LPP.
5. Relate the differentiations and integrations techniques in business.
6. Solve arithmetic and logical reasoning problems.

Module 1: Progressions **7 Lectures**

Numerical sequence and series - Arithmetic progression – Sum of n terms of an A.P- Geometric progression - Sum of n terms of G.P - Relationship between Arithmetic Mean and Geometric Mean -Summations and applications of progressions in solving finance problems.

Module 2: Finance **10 Lectures**

Simple and Compound Interests - Depreciation - Effective rate of Interest - Present value - Future value - Perpetuity- Annuity- Sinking Funds – Valuation of Bonds- Calculating of EMI- Calculations of Returns - Discounting of Bills - True Discount – Bankers discount - Banker’s Gain.

Module 3: Set Theory and Matrices **10 Lectures**

Sets: Types of sets - Operations on sets - Relations and Functions - Matrices: Types of matrices - Operations of matrices – Determinants - Inverse of a matrix - Cramer’s rule - Matrix Inversion method - Linear Programming Problem: Formulation - Graphical method of solving LPP.

Module 4: Applications of Derivatives and Integration **10 Lectures**

Differentiation of algebraic functions: e^x and logx - Increasing and decreasing functions -Second order derivatives - Maxima and Minima - Cost function to marginal costs and revenue function to marginal revenue - Integration concepts - Integration by substitution method -Integration by parts - Marginal costs to cost function and marginal revenue to revenue function.

Module 5: Arithmetic ability and Logical reasoning **8 Lectures**

Ratio and proportion – Surds and Indices - Logarithms - Average - Percentage- Profit and Loss -Number series- Time and work- Factorial notation -Permutation and Combination - Odd man out and Series - Coding and decoding- Direction sense test - Blood relations - Decision making.

List of Experiments using Excel:

1. Solving A.P and G.P of a sequence and series.
2. Find the simple and Compound interest.
3. Calculation of EMI.
4. Finding the Annuities.

5. Calculate the discounting of bills.
6. Operations of sets using excel.
7. Performing Matrix operations and evaluation of Determinants.
8. Solving linear simultaneous equations using Cramer's rule and Matrix inversion method.
9. Performing LPP graphically in excel.
10. Calculation of Permutation and Combination.

Text Books:

1. Navanitham P.A, "Business Mathematics & Statistics", Jai Publishers, Trichy, 2017.
2. Aggarwal R.S., "Quantitative Aptitude", Revised Edition, S. Chand & Company Ltd., 2017

Reference Books:

1. J.K. Singh, "Business Mathematics", Himalaya Publishing House, 2015.
2. N Sundaresan and Jayaseelan, "Introduction to Business Mathematics", Sultan Chand & Co Ltd, New Delhi, 2010.
3. Sanchetti D.C and Kapoor V.K, "Business Mathematics", Sultan Chand & Co Ltd, New Delhi, 2014.
4. Ranganath G.K, Sampangiram C.S and Rajaram Y, "A Text book of Business Mathematics", Himalaya Publishing House,2014.
5. Jayaprakash Reddy R, "Business Mathematics", APH Publishing Corporation, 2012.
6. Praveen R.V, "Quantity Aptitude and Reasoning", PHI Learning Pvt. Ltd, New Delhi, 2016.

22MA2002	BUSINESS STATISTICS WITH R	L	T	P	C
		3	0	2	4

Course Objectives:

1. To acquire knowledge of different statistical methods.
2. To impart knowledge on probability and apply them in different business environments.
3. Ability to represent and analyze data using R programming.

Course Outcomes:

The student will be able to

1. Present the data in tabular and graphical representations.
2. Determine the central tendency and dispersion to associate the data in real time.
3. Model the data using probability distributions.
4. Analyze the relationship between the business parameters.
5. Construct the regression lines to predict and analyze the future.
6. Examine the trends and forecast the business developments.

Module 1: Statistical description of data **8 Lectures**

Statistical data: Collection, classification and tabulation - Scales of measurement – Frequency distribution - Diagrammatic representation of data: Bar diagrams and Pie-chart- Graphical representation of frequency distribution: Histogram, Frequency Polygon, Frequency curve, Ogives - Survey and presentation from local firms.

Module 2: Measures of Central Tendency and Dispersion **10 Lectures**

Mathematical averages – Mean, Median and Mode – Combined Arithmetic Mean - Positional Measures - Quartiles, Deciles and Percentiles – Importance of measures of dispersion – Range – Coefficient of range – Inter-quartile range - Quartile deviation - Average deviation- Standard deviation – Variance - Coefficient of variation – Decision making on performance of parameters for business problems.

Module 3: Probability and Theoretical distributions **9 Lectures**

Axioms and definition of probability - Independent and dependent events; mutually exclusive events- Total and Compound Probability-Probability distributions - Discrete: Binomial and Poisson distribution- Continuous: Normal distribution- Probability distribution in business management.

Module 4: Measurement of relationship and Prediction analysis **9 lectures**

Simple Correlation – Properties of correlation - Scatter diagram - Karl Pearson's co-efficient of Correlation - Spearman's Rank Correlation – Simple linear regression - Regression lines - Method of studying regression-

Properties of regression lines and coefficients- Problems in regression of two variables - Measuring the influences between factors.

Module 5: Analysis of Time Series and Index numbers **9 Lectures**

Meaning and applications of Time series – Components - Measuring secular trend: Graphic method, Semi-averages and Moving averages - Measuring Seasonal variations: Simple averages and Moving averages method - Index numbers -Problems involved in construction of Index numbers- Unweighted: Simple aggregate and average of price relative Index numbers.

List of Experiments in R programming:

1. Basic R operations and concepts.
2. Constructing frequency table and diagrammatic presentation.
3. Draw the graphical representation of data- Histogram and Ogives.
4. Calculate measures of Central Tendency – Mean, median and mode.
5. Calculate the positional measures – quartiles, deciles and percentiles.
6. Compute the measures of Dispersion.
7. Solving problems based on probability
8. Computing correlation coefficient and fitting simple linear regression.
9. To analyze the Time series.
10. Calculate the Index numbers.

Text Books:

1. Navanitham P.A, “Business Mathematics & Statistics”, Jai Publishers, Trichy, 2017.
2. T. Veerarajan, “Probability, Statistics and Random Processes”, 3rd Edition, Tata McGraw-Hill,New Delhi, 2017.

Reference Books:

1. R.S.N.Pillai, Bhagavathi, Statistics-Theory & practice, Sultan Chand & Sons, 2010.
2. S.P.Gupta, Statistical methods, Sultan Chand & Sons, 2012.
3. J.Joseph Francis, Business Statistics, Cengage learning publishers Ltd, 2014.
4. S.C.Gupta, V.K. Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand &Sons, 10th Revised Edition 2000.
5. N. Bajpai, “Business Statistics”, Pearson Education, New Delhi, 2013.
6. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, 2017.

MATHEMATICS

LIST OF NEW COURSES

Sl.No	Course Code	Course Title	Credits [L:T:P:C]
1	21MA1001	Basic Mathematics	2:0:0:2
2	21MA1002	Linear Algebra and Numerical Methods	3:0:0:3
3	21MA1003	Fundamentals of Engineering Mathematics	3:0:0:3
4	21MA3001	Research Methodology and Biostatistics	3:0:0:3
5	21MA3002	Mathematical Foundations	4:0:0:4
6	21MA3003	Optimization Techniques	4:0:0:4
7	21MA3004	Combinatorics of Tiling	3:0:0:3
8	21MA3005	Statistical Data Analytics using Excel	3:1:0:4
9	21MA3006	Representation Theory	3:1:0:4
10	21MA3007	Lie Groups and Lie Algebra	3:1:0:4

21MA1001	BASIC MATHEMATICS	L T P C 2 0 0 2

Course Objectives:
1. Understand the basic operations in matrices.
2. Develop the skills in the methods of solving differentiation and integration.
3. Acquire the knowledge in the concepts of probability and statistics.

Course outcome:
The student will be able to
1. Represent and solve the problems using matrices.
2. Have the proficiency of solving algebraic functions.
3. Learn the techniques in Differentiation and Integration.
4. Understand the basic concepts of probability.
5. Solve the problems related to discrete data.

Module 1: Matrices and Determinants **5 Lectures**
Introduction - Operations on Matrices - The trace and the determinant of a matrix – Properties of determinants (excluding the proof) - Solving the system of equations using Cramer's rule – Inverse of a matrix - Rank of a matrix.

Module 2: Partial Fractions **5 Lectures**
Proper and improper fractions, Proper fractions with linear factors, Proper fractions with repeated linear factors, Proper fractions with quadratic factors, Improper fractions.

Module 3: Differentiation **5 Lectures**
Differentiation from the first principle -Rules of differentiation- Methods of Differentiation: Implicit differentiation, Logarithmic differentiation. Simple problems.

Module 4: Integration **5 Lectures**
Integral calculus– Integration of standard functions - Partial fraction (Simple algebraic functions only) – Integration by parts - Bernoulli's formula.

Module 5: Probability **5 Lectures**
Definition of Probability, Axioms of Probability, and Addition theorem of Probability, Mutually Exclusive Events, Independent Events, and Conditional Probability (related problems).

Module 6: Statistics **5 Lectures**
Frequency distribution, Graphical Representation of Data, Measures of Central Tendency: Arithmetic Mean, Median and Mode, Geometric Mean, Harmonic Mean, Measures of Dispersion: Range, Standard Deviation, and Quartile Deviation. (Only for Discrete data).

Text books:

1. Grewal B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, New Delhi, 2012.
2. HepzibahChristinal A, Selvamani R, and Porselvi K, "Basic Engineering Mathematics", HIS Publications, Coimbatore, 2011.
3. Lecture Notes on Basic Mathematics for Engineering", Department of Mathematics, Karunya University, Karunya Nagar, Coimbatore, 2013.

Reference books:

1. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
2. T.Veerarajan, "Probability, Statistics and Random Processes", 2nd Edition,Tata McGraw-Hill, New Delhi, 2010.
3. S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 10th Revised Edition, 2000.

21MA1002	LINEAR ALGEBRA AND NUMERICAL METHODS	L	T	P	C
		3	0	0	3

Course Objectives:

1. Demonstrate knowledge in matrices.
2. Classify numerical solutions of algebraic and transcendental equations.
3. To apply the numerical techniques of interpolation in various intervals.

Course Outcomes:

The student will be able to

1. Analyze quadratic form using orthogonal transformation of matrix.
2. Use the different numerical methods for solving algebraic equations
3. Use the numerical techniques of interpolation in various intervals in real life situations.
4. Compare integration solution and numerical solution.
5. Gain the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
6. Solve partial differential equations using numerical techniques.

Module 1: Matrices **7 Lectures**

Algebra of matrices, Inverse and rank of a matrix; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Cayley-Hamilton Theorem, Diagonalization of matrices; Orthogonal transformation to reduce quadratic forms to canonical forms. Application: control systems-state variable analysis-MIMO wireless communication. (for classroom discussions, assignments and term paper work).

Module 2: Solutions of algebraic and transcendental equations **7 Lectures**

Bisection Method-Bisection, Convergence of Bisection Method-Newton's method, Geometry of Newton's method, Regula-Falsi method, Convergence Analysis.

Module 3: Polynomial Interpolation **7 Lectures**

Newton interpolating polynomial, Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Errors in polynomial interpolation.

Module 4: Numerical Integration **7 Lectures**

Trapezoidal rule, Error analysis, Recursive Trapezoidal, Romberg Algorithm, Simpson's 1/3rd and 3/8 rules, Gaussian Quadrature Formulas.

Module 5: Ordinary differential equations **7 Lectures**

Ordinary differential equations of first order: Taylor's series, Euler and modified Euler's methods. RungeKutta method of fourth order. Milne's and Adam's predicator-corrector methods.

Module 6: Partial Differential Equations **7 Lectures**

Partial differential equations Solution of Laplace equation by Liebmann method, Solution of Poisson equation by Liebmann method, differential Equation by Bender Schmidt method, Crank Nicholson method. Applications: Electron Devices-Drift and diffusion currents derivation - Electromagnetics-Maxwell Equations. (for classroom discussions, assignments and term paper work).

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.

Reference Books:

1. D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.
2. V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press, 2005.
3. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", 2nd Edition, S. Chand & Company, Reprint 2012.

4. M.K.Jain., Iyengar. S.R.K., Jain R.K., “Numerical Methods for Scientific and Engineering Computation”, 6th Edition, New Age International, 2012.
5. Ward Cheney and David Kincaid, “Numerical Mathematics and Computing”, Cengage Learning Brooks/Cole Publishing Company, California, 2012.

21MA1003	FUNDAMENTALS OF ENGINEERING MATHEMATICS	L T P C 3 0 0 3

Course Objectives:

1. Understand the basic operations in matrices.
2. Develop the skills in the methods of solving differentiation and integration.
3. Acquire the knowledge in the concepts of probability.

Course outcome:

The student will be able to

1. Solve the problems related to trigonometry.
2. Represent and solve the problems using matrices.
3. Have the proficiency of solving algebraic functions.
4. Learn the techniques in Differentiation and Integration.
5. Understand the basic concepts of probability.
6. Solve the problems related to discrete data.

Module 1:Trigonometry **5 Lectures**

Expansions of sinnθ, cosnθ and tannθ. Hyperbolic functions–Separating real and imaginary parts, De Moivre’s Theorem and its applications (Simple Problems only).

Module 2: Matrices and Determinants **5 Lectures**

Introduction - Operations on Matrices - The trace and the determinant of a matrix – Properties of determinants (excluding the proof) - Solving the system of equations using Cramer’s rule – Inverse of a matrix - Rank of a matrix.

Module 3: Partial Fractions **5 Lectures**

Proper and improper fractions, Proper fractions with linear factors, Proper fractions with repeated linear factors, Proper fractions with quadratic factors, Improper fractions.

Module 4: Differentiation **5 Lectures**

Differentiation from the first principle -Rules of differentiation- Methods of Differentiation: Implicit differentiation, Logarithmic differentiation. Simple problems.

Module 5: Integration **5 Lectures**

Integral calculus– Integration of standard functions - Partial fraction (Simple algebraic functions only) – Integration by parts - Bernoulli’s formula.

Module 6: Probability **5 Lectures**

Definition of Probability, Axioms of Probability, and Addition theorem of Probability, Mutually Exclusive Events, Independent Events, and Conditional Probability (related problems).

Text books:

1. Grewal B.S., “Higher Engineering Mathematics”, 42nd Edition, Khanna Publishers, New Delhi, 2012.
2. HepzibahChristinal A, Selvamani R, and Porselvi K, “Basic Engineering Mathematics”, HIS Publications, Coimbatore, 2011.
3. Lecture Notes on Basic Mathematics for Engineering”, Department of Mathematics, Karunya University, Karunya Nagar, Coimbatore, 2013.

Reference books:

1. Kreyszig E., “Advanced Engineering Mathematics”, 8th Edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
2. T.Veerarajan, “Probability, Statistics and Random Processes”, 2ndEdition,Tata McGraw-Hill, New Delhi, 2010.
3. S.C.Gupta, V.K. Kapoor, “Fundamentals of Mathematical Statistics, Sultan Chand &Sons, 10th Revised Edition, 2000.

21MA3001	RESEARCH METHODOLOGY AND BIOSTATISTICS	L T P C 3 0 0 3

Course Objectives:

1. Understand basic principles of research.
2. Knowledge in Qualitative and quantitative research.
3. Apply statistical analysis in research.

CourseOutcomes:

The student will be able to:

1. Understand objectives and mode of research.
2. Formulate research problems.
3. Categorize different types of research.
4. Construct data for research analysis.
5. Visualize and analyse data using statistical tools.
6. Analyse linear relationship between data.

Module 1: Introduction to Research **5 Lectures**

Meaning of research; purpose of research; types of research – application, objectives and mode of enquiry perspective; application of research; steps in research process; conceptualization of research – from ideas to action: reviewing the literature, formulating the research problem, identifying variables and constructing the hypothesis.

Module 2: Qualitative Research **5 Lectures**

Qualitative Research Designs – key features, uses and limitations, types – case studies, ethnographic research, narrative research, action research.

Module 3: Quantitative Research **5 Lectures**

Quantitative Research Designs–key features, uses and limitations, Experimental and non-experimental research; Mixed research design – key features, uses and limitations; Cross-sectional and longitudinal studies, Epidemiological methods.

Module 4: Data collection and Sampling method **10 Lectures**

Research methods– Methods of collecting the data in qualitative and quantitative research – primary and secondary data, construction of the research tools, reliability and validation of research tools, pilot testing. Sampling design– principles of sampling, sampling terminology, types of sampling and calculating the sample size. Ethical issues in data collection.

Module 5: Statistical data analysis **10 Lectures**

Editingandcodingthedata;Organizationofdata-classification,meaningandobjectives,typesofclassification;Tabulation–partsofatable,generalrulesoftabulation,typesoftables;Representationofdata – Diagrammatic and graphical representation, significance of diagrams and graphs, general rules for constructing diagrams, types of diagrams and graphs; Format of research report, different referencing system and writing the bibliography.

Module 6: Regression and correlation analysis **10 Lectures**

Measures of Central Tendency, Measures of Dispersion, Standard Error, t-distribution, Chi-square distribution and F-distribution, Types of correlation and application, Types of regression and application.

Text books:

1. Ranjit Kumar, “Research Methodology: a step-by-step Guide for Beginners”, Third Edition, SAGE Publications, New Delhi, 2011.
2. S.P.Gupta, “Statistical Methods”, Sultan Chand & Sons, 43rd Edition, 2014.

Reference Books:

1. Kothari, C.R., “Research Methodology, Methods and Techniques”, Second Revised Edition, New Age International Publishers, New Delhi. 2004.
2. Beverley Moriarty, “Research Skills for Teachers–From Research Question to Research Design”, Allen & Unwin Publishers, Australia, 2018.
3. Rajendra Kumar, C, “Research Methodology”, APH Publishing Corporation, New Delhi, 2008.
4. Douglas C.Montgomery, “Introduction to Statistical Quality Control”, Sixth Edition, John Wiley & Sons, Inc., 2009.
5. S.M.Shukla and S.P.Sahai, “Statistical Methods”, Sahitya Bhawan Publications, 2017.

21MA3002	MATHEMATICAL FOUNDATIONS	L T P C 4 0 0 4

Course Objective:

1. Understand the basic principles of Statistics.
2. To develop the skills of the students in the area of Probability and Statistics.
3. To formulate physical phenomena using vector spaces and linear modeling.

Course Outcome:

The student will be able to

1. Develop the technique, methodology in statistical modeling.
2. Examine their knowledge gathered in the subject to life sciences.
3. Utilize the concepts of probability.
4. Analyze the probability models to fit the data.
5. Apply different methods to find the solution of system of linear Algebraic Equation.
6. Relate vector spaces with magnetic field and moving fluid.

Module 1: Statistics **7 Lectures**

Collection, classification and tabulation of data – Frequency distribution: Discrete and Continuous - Scales of measurement: Nominal, Ordinal and Interval - Diagrammatic and Graphical representation and measures of central tendency–measures of dispersion – Test of Consistency.

Module 2: Measurement of linear relationship and prediction **8 Lectures**

Correlation — Scatter diagram - Karl Pearson's co-efficient of correlation - Spearman's rank correlation – Repeated ranks - Regression Analysis: Lines of regression and regression equations – Multiple correlation and regression.

Module 3: Probability **7 Lectures**

Axioms of probability - Mathematical definition of probability - Conditional probability –Independent events – Addition law and multiplication law - Theorem of Total Probability - Baye's Theorem (statement only) and its problems.

Module 4: Models in Probability **7 Lectures**

Discrete Distribution: Binomial and Poisson distribution – Poisson distribution is a limiting case of binomial distribution - Fitting binomial and Poisson distribution - Continuous Distribution: Normal distribution - Independent random variables.

Module 5: Linear Algebra **8 Lectures**

Eigen values, Eigen vectors, Cayley Hamilton Theorem, Diagonalization of a matrix, orthogonal transformation to reduce quadratic form to canonical form.

Module 6: Vector Spaces **8 Lectures**

Definitions and examples – elementary properties-Subspaces-Linear Transformation- Differentiation of vectors – Curves in space-Velocity and acceleration-Scalar and Vector point functions–Gradient–Divergence-Curl–Solenoidal and irrational fields.

Text Books:

1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2008.
2. Grewal B.S., "Higher Engineering Mathematics", 42^{nd} Edition, Khanna Publishers New Delhi, 2012.

Reference Books:

1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2008.
2. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.
3. Veerarajan, T., Probability, Statistics and Random Processes, Tata McGraw Hill, 2^{nd} Edition, 2009.
4. D. Poole, "Linear Algebra: A Modern Introduction", 2^{nd} Edition, Brooks/Cole, 2005.
5. Springer C.E, "Tensor and Vector Analysis with Applications to Differential Geometry", Dover Publications. Inc., New York, 2012.

21MA3003	OPTIMIZATION TECHNIQUES	L T P C 4 0 0 4

Course objective:

To provide the student with the concept and an understanding of basic concepts in

1. Linear and Non-linear programming models and Job sequencing.

2. Game Theory, Integer programming and Network techniques.
3. Application of everything learnt in real life.

Course outcome:

The students will be able to

1. Understand the importance of optimization and to formulate and solve linear programming problems.
2. Assess and articulate the Non-linear Programming and application.
3. Construct and Demonstrate the basic concepts of PERT- CPM and their application.
4. Compose the findings of Integer Programming problem.
5. Formulate, analyze the game theory problems.
6. Acquire the knowledge of Job Sequencing.

Module 1: Linear Programming **8 Lectures**

Engineering applications of optimization – classification of optimization problems- Linear programming: Formulation of LPP, Solution to LPP by simplex method and Dualtiy and Dual and simplex method

Module 2: Integer programming **8 Lectures**

Construction of Integer programming problem- Differentiating between the simplex and Integer programming problem solution -Cutting plane algorithm, Branch and bound technique,

Module 3: Job Sequencing **8 Lectures**

Sequence of 2 machines, 3 machines and m machines and n jobs. Sequence of two jobs in m machines using Graphical method.

Module 4: Network Techniques **8 Lectures**

Network diagram-Critical Path Method- PERT- probability of achieving completion date- crash time- cost analysis.

Module 5: Game theory **8 Lectures**

Game theory: Two-person zero-sum games, Maximum- minimum principle, Games without saddle points, Mixed strategies, Graphical method.

Module 6: Nonlinear Programming **8 Lectures**

Lagrangian method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Geometric programming – Introduction of Genetic Algorithm

Reference Books:

1. S. S. Rao, "Engineering Optimization – Theory and Practice", NAI publishers, 2013.
2. R. Panneerselvam, "Operations Research", Prentice Hall of India Private Limited, NewDelhi, 2005.
3. Kalymanoy Deb, "Optimization for Engineering Design", Prentice Hall of India Private Ltd., New Delhi, 2003.
4. P.K.Gupta and D.S. Hira, "Practical Problems in Operations Research" – Sultan Chand & Sons, New Delhi, 2008.
5. Ravindran, Philips and Solberg, "Operations Research Principles and Practice", John Wiley & Sons, New Delhi, 2000.

21MA3004	COMBINATORICS OF TILING	L	T	P	C
		3	0	0	3

Course Objectives: To provide the students with the concepts and the understanding in

1. Classification of tiling.
2. Non-periodic and Aperiodic tiling.
3. Computing using tiles.

Course Outcomes:

1. To understand tiles, patch of tiles and infinite tiling.
2. To classify tiling with topological properties.
3. To examine coloring of tiling.
4. To study construction of aperiodic tiling.
5. To construct Wang aperiodic tiling.
6. To compute using wang tiles.

Module 1: Introduction to Tiling **7 lectures**

Topology of tiles, Patch of tiles, Tiling, Symmetry, Transitivity and regularity, Symmetry group of tiling, Tiling by regular polygons, Edge to edge tiling, Regular tiling, Uniform tiling, Archimedian tiling, Laves tiling.

Module 2: Topololgy of Tiling **7 lectures**

Duality, Normal tiling, Euler theorem for tiling, Homeogonal tiling, Homeohedral tiling, Homeotoxal tiling, Tilings with transitivity property, Isogonal tiling, Isohedral tiling, Isotoxal tiling.

Module 3: Coloring of Tiling **7 lectures**

Colored tilings, Perfect coloring of tiling, K-coloring of regular tilings by square, triangle and hexagon, Polyiamonds, Polyominoes, Polyhexes, Monohedraltilings by n-iamonds, n-ominoes, n-hexes.

Module 4: Aperiodic tiling **8 lectures**

Aperiodic tile set, Aperiodic tiling, Construction of Robinson aperiodic tiles and tiling, 3x3 and 7x7 block, Construction of Penrose aperiodic tiles and tiling, Construction of Amman aperiodic tiles and tiling.

Module 5: Wang Aperiodic tiling **8 lectures**

Wang Tiles, Aperiodic set of Wang tiles, Wang tiling, Wang theorem, Flow chart for decidability of tiling problem, Aperiodic Wang tiling using smallest set of 16 Wang tiles.

Module 6: Computing by tiles **7 lectures**

Arithmetic operation using tiling, Set of Wang tiles for addition of unequal integers, Step by step construction of the tiling, Fibonacci series using Wang tiles and its construction.

Text Book:

1. Branko Gruenbaum, G.C. Shephard, Tilings and Patterns, W.H. Freeman Company, Newyork, 1986.

Reference Books:

1. John H.Conway, Heidi Burgiel, Chaim Goodman-Strauss, The Symmetries of Things, 2008, CRC Press.
2. Craig S Kaplan, Introductory Tiling Theory For Computer Graphics, Morgan & Claypool publishers, 2009.
3. Robert Fathauer, Tessellation: Mathematics, Art and Recreation, CRC Press, 2020.
4. Marjorie Senechal, Quasicrystals and geometry, Cambridge University Press, 1996.
5. Alan Tucker, Applied Combinatorics, John Willey & Sons Publishing, 2017.

		L	T	P	C
21MA3005	**Statistical Data Analytics using Excel**	**3**	**1**	**0**	**4**

Course Objectives:

1. Demonstrate knowledge in Statistical tools.
2. Build Models using Probability theory.
3. Analyze the observed data using sampling techniques.

Course Outcomes:

The student will be able to

1. Understand the basics in statistics.
2. Visualize the data.
3. Measure the relationship between data variables.
4. Understand probability and simulating data.
5. Execute the test of hypothesis for large samples.
6. Analyze the Variances.

Module 1: Central Tendency and Measures of Dispersion **7 Lectures**

Mean, Median, Mode, Geometrical mean, Harmonic mean, Range, Quartile Deviation, Mean Deviation, Decile, Percentile, Moments, skewness and Kurtosis.

Module 2: Data Visualization Methods **7 Lectures**

Bar Chart, Pie Chart, Histogram, Time Series Plots, Box plots, Scatter Plots and its inferences.

Module 3: **Sampling Techniques for Data Collection** **7 Lectures**

Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second-degree parabolas - Table of Categorical variables, Random Samples, Sorting data, Randomization in Experiments**.**

Module 4: Probability **7 Lectures**

Definitions, Axioms, Conditional Probability, Properties, Total Probability and Bayes Theorem, Simulating random data, simulating from other distributions, Probability Calculations, Binomial, Normal approximation to Binomial.

Module 5: Estimation procedures by confidence intervals and hypothesis testing 7 Lectures

Performance analysis of algorithms using Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means - Confidence interval for single proportion**,** Confidence interval for comparing proportions.

Module 6: Statistical inference methods for decision making 7 Lectures

Small samples: t-test, F-test and Chi-square test for goodness of fit and independence of attributes. Sampling Distributions, Central limit theorem, interference for regression, Multiple Regression, Model building, Variable selection, one way analysis of variances.

Reference Books:

1. Introduction to the Practice of Statistics, Seventh Edition, by D.S. Moore, G.P. McCabe and B. Craig (2010).
2. T.Veerarajan, "Probability,Statistics and Random Processes", 2nd Edition, Tata McGraw-Hill, New Delhi, 2010.
3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
5. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010.
6. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003(Reprint).
7. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
8. S. Ross, "A First Course in Probability", 6th Edition, Pearson Education India, 2002.

21MA3006	Representation Theory	L	T	P	C
		3	1	0	4

Course Objectives:

1. Understand Representation theory of finite groups.
2. Analyze Character Theory.
3. Classify Irreducible Representations.

Course Outcomes:

The student will be able to

1. Understand basic concepts of linear Representations.
2. Examine Tensor product.
3. Analyze Character of a representation.
4. Examine Induced Representations.
5. Demonstrate irreducible Representations of groups.
6. Analyze basic properties of integers.

Module 1: Generalities on linear Representations 8 Lectures

Definitions-Basic examples-regular representation-permutation representations- sub representations -projection-Maschke's theorem.

Module 2: Tensor product of two Representations 7 Lectures

Irreducible representation-definition-Tensor product of two representations-symmetric squares and alternating squares.

Module 3: Character Theory 7 Lectures

The character of a representation- Schur's Lemma-Orthognality relations for characters-Decomposition of the regular representation.

Module 4: **Induced Representations 8 Lectures**

Abelian subgroups-product of two groups-induced representations-definition-example-existence and uniqueness.

Module 5: Irreducible Representations 8 Lectures

Irreducible representations of cyclic group C_n - Irreducible representations of dihedral group D_n-Symmetric group.

Module 6: Group Algebra 7 Lectures

Representations and Modules- Decomposition of C[G] –Fourier Inversion Formula-basic properties of integers.

Reference Books:

1. Serre J P, "Linear Representations of Finite Groups" , Springer,1996.

2. Prasad A, “Representation Theory”, Cambridge University Press, 2018.
3. Musili. C. “Representations of Finite Groups” Hindustan Book Agency,1993.
4. Anupam Singh, “Representation Theory of Finite Groups”, IISER,2009.
5. Sagan B, “The Symmetric Group”, 2nd Edition, Springer (2001).
6. Fulton W and Harris J, “Representation Theory”, 1st Edition, Springer (2004).

21MA3007	Lie Groups and Lie Algebra	L T P C 3 1 0 4

Course Objectives:
1. Understand Lie Groups and Algebra.
2. Analyze representation theorems.
3. Classify root space.

Course Outcomes:
The student will be able to
1. Understand basic concepts of Lie Algebra
2. Examine normalizers and centralizers.
3. Analyze solvable and nilpotent algebra.
4. Examine decompositions theorems.
5. Demonstrate representations theorems.
6. Analyze root systems.

Module 1: Lie Groups **7 Lectures**
Definition of a matrix Lie group, Examples of matrix Lie groups, Compactness, connectedness, simple connectedness, The polar decomposition for SL(n, R) and SL(n,C), Lie groups.

Module 2: Lie Algebra and subalgebra **7 Lectures**
Definition and examples of Lie algebras, classical Lie algebras, derivations of a Lie algebra, abelian Lie algebra, Lie subalgebras, ideals and homomorphisms. Module Normalizers and centralizers of a Lie subalgebra, representations of lie algebras (definition and some examples), automorphisms of a Lie algebra.

Module 3: Solvable and nilpotent algebra **7 Lectures**
Solvable algebra, Solvable radical, nilpotent algebra, Engel’s Theorem, semisimple Lie algebra, Lie’s Theorem, Jordan-Chevalley decomposition (existence and uniqueness), Cartan trace criterion for solvability, Killing form and criterion for semisimplicity.

Module 4: Decomposition Theorems **7 Lectures**
Simple ideals, inner derivations, abstract Jordan-Chevalley decomposition, Lie algebra modules, Schur’s Lemma, Casimir elements of a representation, Weyl’s Theorem for preservation of Jordan-decomposition.

Module 5: Representation’s theorems **7 Lectures**
Representation of sl(2, C): weights, highest weight, maximal vectors, classification of irreducible modules, toral and maximal toral subalgebra, root space decomposition and properties of roots.

Module 6: Root systems **7 Lectures**
Abstract root systems, Weyl group, root strings, bases and their existence, Weyl chambers, Classification of rank 2 root systems.

Reference books:
1. B. C. Hall, Lie groups, Lie Algebras and representations: An elementary introduction, Springer (Indian reprint, 2004).
2. S. C. Bagchi, S. Madan, A. Sitaram and U. B.T iwari, A first course on representation theory and linear Lie groups, University Press (2000).
3. J, E. Humphreys, Introduction to Lie Algebras and Representation Theory, Graduate Text in Mathematics, Springer-Verlag, 1980.
4. N. Jacobson, Lie Algebras, Wiley-Interscience, New York, 1962.
5. J. P. Serre, Lie Algebras and Lie Groups, Benjamin, New York, 1965.

MATHEMATICS

LIST OF NEW COURSES (2020)

Sl. No	Course Code	Course Title	Credits [L:T:P:C]
1	19MA3032	Essential Mathematics for Data Science with R	3:0:2:4
2	20MA1001	Analytic Geometry, Calculus and Linear Algebra	3:0:2:4
3	20MA1002	Differential Equation and Complex Variables	3:0:2:4
4	20MA1003	Mathematics for Data Science and Machine Learning	2:0:2:3
5	20MA1004	Mathematical Modelling for Engineering Problems	2:0:2:3
6	20MA1005	Mathematical Foundations of Computing	3:1:0:4
7	20MA1006	Calculus, Vector Spaces and Laplace Transform	3:1:0:4
8	20MA1007	Elementary Mathematics	2:0:0:2
9	20MA1008	Elementary Statistics and Computer Applications	2:0:2:3
10	20MA1009	Calculus and Differential Equations	3:0:0:3
11	20MA1010	Linear Algebra, Transforms and Numerical Methods	3:0:0:3
12	20MA1011	Linear Algebra and Calculus	3:0:2:4
13	20MA1012	Mathematical Transforms, Fourier Series and Vector Calculus	3:0:2:4
14	20MA1013	Calculus and Differential Equations for Robotic Engineering	2:0:2:3
15	20MA1014	Linear Algebra, Transforms and Numerical Methods for Robot Control	2:0:2:3
16	20MA1015	Basic Mathematics for Biotechnology	2:0:2:3
17	20MA1016	Numerical Computing Using MATLAB	2:0:2:3
18	20MA1017	Basics of Calculus and Linear Algebra	3:0:2:4
19	20MA1018	Transforms and Differential Equations	2:0:2:3
20	20MA1019	Mathematics for Data Science and Machine Learning in Civil Engineering	3:0:2:4
21	20MA1020	Mathematical Modelling for Civil Engineering Problems	3:0:2:4
22	20MA1021	Multivariable Calculus and Differential Equations	3:1:0:4
23	20MA1022	Matrices, Transforms and Numerical Methods	3:1:0:4
24	20MA1023	Statistical Methods	1:0:2:2
25	20MA2001	Numerical Mathematics and Statistics	3:0:2:4
26	20MA2002	Applied Computational Mathematics	2:0:2:3
27	20MA2003	Simulation of Numerical Mathematics	2:0:2:3
28	20MA2004	Partial Differential Equations, Probability and Statistics	3:1:0:4
29	20MA2005	Discrete Structures	3:1:0:4
30	20MA2006	Probability and Stochastic Processes	3:0:0:3
31	20MA2007	Probability and Statistics	3:0:2:4
32	20MA2008	Probability, Statistics and Random Process for Robotic Engineering	3:0:2:4
33	12MA2009	Probability and Statistics Using R Programming	2:0:2:3
34	20MA2010	Business Mathematics	3:0:2:4
35	20MA2011	Mathematics for Finance	3:0:2:4
36	20MA2012	Business Statistics with R	3:0:2:4
37	20MA2013	Statistical Methods for Finance	3:0:2:4
38	20MA2014	Mathematics for Digital Sciences	3:1:0:4
39	20MA2015	Fundamentals of Statistics and Probability	3:1:0:4
40	20MA2016	Statistics and Probability for Data Science	3:1:0:4
41	20MA2017	Discrete Mathematics	3:1:0:4

42	20MA2018	Fuzzy sets and Logic	3:1:0:4
43	20MA2019	Optimization Techniques	3:1:0:4
44	20MA2020	Calculus for Data Science	3:1:0:4
45	20MA2021	Linear Algebra for Data Science	3:1:0:4
46	20MA2022	Statistical Modelling	3:1:0:4
47	20MA2023	Probability, Random Variables and Statistics	3:1:0:4
48	20MA2024	Basics of Probability and Statistics	2:0:2:3
49	20MA2025	Statistical Data Analysis and Reliability Engineering	2:0:2:3
50	20MA2026	Numerical Mathematics and Computing	3:1:0:4
51	20MA3001	Probability and Biostatistics	3:1:0:4
52	20MA3002	Operations Research Techniques	3:0:0:3
53	20MA3003	Statistical Methods for Food Science	3:0:0:3
54	20MA3004	Computational Design Lab for Food Science	0:0:3:1.5
55	20MA3005	Mathematics for Machine Learning	4:0:0:4

19MA3032	ESSENTIAL MATHEMATICS FOR DATA SCIENCE WITH R	L	T	P	C
		3	0	2	4

Course Objectives

1. To learn the basic concepts of statistics in relation to Data science.
2. To equip students in data acquisition, processing and management.
3. Ability to represent and analyze data using R programming

Course Outcomes

Students will be able to

1. describe the data and analyze the data
2. analyze the relation between the attributes of data
3. develop skills to gather and process data from different sources
4. transform data from one type to another type
5. acquire knowledge in R programming
6. visualize and analyze data using R programming

Module 1: Statistics (8 Lectures)

Measures of Central tendency- Moments, skewness and Kurtosis - Correlation and regression – Rank correlation.

Module 2: Introduction to core concepts and technologies (7 Lectures)

Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Module 3: Data collection and management (7 Lectures)

Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources

Module 4: Data analysis (8 Lectures)

Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Module 5: Data visualization (8 Lectures)

Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

Module 6: Applications of Data science (7 Lectures)

Applications of Data Science, Technologies for visualization, recent trends in various data collection and analysis techniques

List of Experiments using R:

1. Introduction to Programming in R and syntax.
2. Preparation of Boxplots using R.
3. Applying multiple linear regression model to real dataset; computing and interpreting the multiple coefficient of determination.
4. Fitting the following probability distributions: Binomial distribution, Normal distribution and Poisson distribution.
5. Hypothesis test for large and small samples using mean values.
6. Comparison of Two population variances.
7. Applying Chi-square test for goodness of fit test and Contingency test to real dataset.
8. Performing ANOVA for real dataset for completely randomized design, Randomized Block design, Latin square Design.

Reference Books:

1. Gupta S.P., “Statistical Methods”, 33rd edition, Sultan Chand & Co., 2004.
2. S.C. Gupta, V.K. Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand &Sons, 10th Revised Edition 2000.
3. Veerarajan T, “Engineering Mathematics”, Tata McGraw Hill, New Delhi, 2011.
4. T.Veerarajan, “Probability, Statistics and Random Process” Tata Mc Graw Hill, Second edition, 2009.
5. Cathy O’Neil and Rachel Schutt, “Doing Data Science, Straight Talk from the Frontline. O’Reilly”, 2014. ISBN: 978-1-449-35865-5.
6. Joel Grus, “Data Science from Scratch, O’Reilly,” 2015, ISBN: 978-1-491-90142-7.
7. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, “Mining of Massive Datasets”. v2.1, Cambridge University Press, 2014. ISBN : 9781139924801.
8. Davy Cielen. Arno D.B Meysman, Mohamed Ali, “Introducing Data Science”, Dreamtech Press, 2016. ISBN: 978-93-5119-937-3.
9. 5. John W. Foreman, “Using Data Science to Transform Information into Insight – Data Smart”, Wiley, 2014. ISBN: 978-81-265-4614-5.

20MA1001	Analytic Geometry, Calculus and Linear Algebra	L	T	P	C
		3	0	2	4

Course objectives

1. Demonstrate knowledge in analytic geometry, matrices and functions.
2. Solve using differentiation, integration and vector techniques.
3. Test the physical phenomena using MATLAB tools.

Course Outcomes

The student will be able to

1. Understand the geometry of 2D and 3D structures.
2. Relate matrices to solve dynamic problems.
3. Express functions as infinite series.
4. Apply Fourier series and transform techniques to find values of physical variables.
5. Calculate area and volume using integration techniques.
6. Make use of vector space concepts in magnetic field and moving fluid.

Module 1: Two- and three-dimensional geometry **9 Lectures**

Equation of straight Line, Circle, Parabola, Ellipse and Hyperbola – Change of Axis – Three-dimensional geometry, Straight line, Circle – Applications to orbits, restricted three-body problem in orbital mechanics.

Module 2: Matrices **7 Lectures**

Solution of System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation – Applications to direct stiffness in finite element methods, structural vibrations and aircraft, spacecraft stability.

Module 3: Sequences and Series **4 Lectures**

Convergence of series, tests for convergence; Power series, Taylor's series, series for exponential, and logarithm functions – Applications in aerodynamics of wind turbines.

Module 4: Fourier series and Transforms **7 Lectures**

Full range series - Half range sine and cosine series, Parseval's theorem, Harmonic analysis. Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity, Harmonic Analysis – Applications to signal processing in avionics, periodic solutions in restricted three-body problem in orbital mechanics.

Module 5: Multivariable Calculus –Integration **10 Lectures**

Multiple Integration: Double integrals (Cartesian), change of order of integral in double integrals, Change of variables (Cartesian to polar), Applications: area, Center of mass and Gravity (constant and variable densities), Triple integrals (Cartesian) – Applications to lift theory in aerodynamics.

Module 6: Vectors **10 Lectures**

Differentiation of vectors–Curves in space-Velocity and acceleration-Scalar and Vector point functions–Gradient–Divergence-Curl–Physical interpretations- Solenoidal and irrotational fields-Laplacian operator. Integration of vectors –problems on Greens theorem, Stoke's theorem and Gauss divergence theorem, orthogonal curvilinear coordinates - Applications to compressible and incompressible flow over aircraft wings in aerodynamics.

List of experiments using MATLAB

1. Starting with MATLAB creating arrays-Mathematical functions.
2. Draw and analyze the geometry of circle, parabola and ellipse.
3. To find stiffness of a rod using matrix.
4. Test the diagonalization of a physical matrix.
5. Test the convergence of infinite series.
6. To find vibration of a membrane using Fourier series.
7. To compute the heat waves in strings.
8. Implementing pressure integration.
9. Solving dynamic problems through vector and scalar functions.
10. Computing fluid problems and Plotting the output.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9thEdition, Pearson, Reprint, 2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9thEdition, John Wiley & Sons, 2006.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint,2010.
4. D. Poole, "Linear Algebra: A Modern Introduction", 2ndEdition, Brooks/Cole, 2005.
5. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
6. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

20MA1002	Differential Equations and Complex Variables	L T P C 3 0 2 4

Course Objective:

1. Demonstrate knowledge in special functions.
2. Solving ordinary and partial differential equations.
3. Evaluate definite integral using complex integration.

Course Outcome:

The student will be able to

1. Evaluate surface area and volume using definite integral.
2. Understands solution of first and second order ODE.
3. Classify different types of higher order ODE and their solution.
4. Construct harmonic and bilinear transformations.
5. Evaluate definite integral using complex integration.
6. Apply MATLAB tools to solve mathematical problems.

Module 1: Calculus **7 Lectures**

Evaluation of definite Maxima and minima, Asymptotes, Curve tracing integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions-,Partial Differentiation(simple Problems} Taylor's theorem for functions of two variables - Applications to thrust estimation in rocket propulsion, study of stability at the equilibrium points in the restricted three-body problem.

Module 2: Differential equations and special functions **7 Lectures**

Solution of first order ordinary differential equations - Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation(simple problems); Power series solutions; Legendre polynomials(simple problems) – Applications in aircraft, spacecraft stability and buckling analysis.

Module 3: Complex Variables **10 Lectures**

Complex numbers, De-Moivre's theorem and applications - Differentiation, Cauchy-Riemann equations, analytic functions and properties, harmonic functions, finding harmonic conjugate; Conformal mappings, bilinear transformations – Complex integration - Contour integrals, Cauchy-Goursat theorem, Cauchy Integral formula, Liouville's theorem (Statement only)and Maximum-Modulus theorem(statement only); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem, Contour integration- Circular and semi circular contours with no pole on real axis – Applications to potential flow in two dimensions and aircraft, spacecraft stability.

Module 4: Laplace Transforms **8 Lectures**

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transforms – Applications to control systems, solutions at the equilateral points.

Module 5: Partial Differential Equations **7 Lectures**

First order partial differential equations, solutions of first order standard type and Lagrange's equations. Solution to higher order homogenous and non-homogenous linear partial differential equations _modelling in one dimensional dynamic problem.

Module 6: Boundary value Problems: **6 Lectures**

Solutions of one-dimensional wave equation – One-dimensional heat equation – Steady state solution -two-dimensional heat equation. Applications in one dimensional wave and heat flow in fluid and thermal problems.

List of experiments using MATLAB:

1. Introduction to MATLAB and general Syntaxes.
2. To find Taylor's Series of a given function.

3. To find the solution of second order ODE with constant coefficients.
4. To plot the solution of ODE and PDE.
5. To find analytic and harmonic function.
6. To find poles and residues.
7. Laplace and inverse Laplace transforms of standard function.
8. Plot Legendre function.
9. Solving one-dimensional wave equation.
10. Solving One-dimensional Heat flow problems.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson,
2. Reprint, 2002.
3. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
4. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
5. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

20MA1003	Mathematics for Data Science and Machine Learning	L	T	P	C
		2	0	2	3

Course Objective:

4. Develop the skills of the students in the area of data analytics.
5. Outline the basic principles of relationship and predictive analysis in machine learning problems.
6. Provide the basic concept of probability distribution, statistical inference and also apply R software to visualize the data.

Course Outcomes:

The student will be able to

1. Determine the statistical measures of data.
2. Analyze the linear relationship of variables using linear in correlation and regression models.
3. Apply the concept of probability in machine learning problems.
4. Adapt the knowledge of randomness of data.
5. Model the data using probability distributions.
6. Develop the knowledge in decision making.

Module 1: Preliminaries of Data Analytics **6 Lectures**

Frequency distribution and measures of central tendency- mean, median and mode–measures of dispersion–standard deviation-mean deviation-quartile deviation and its coefficients- coefficient of variation – Application - Survey data analysis–Consistency of the product - Visually inspecting data to improve product quality.

Module 2: Linear Relation and Predictive Models **5 Lectures**

Karl Pearson's correlation coefficients – Spearman's Rank Correlation – Repeated Rank Correlation-Lines of regression and Regression equations - Application - Strength of relation between two variables – Measuring similarity between the data –Estimation of association among the variables.

Module 3: Probability – A tool in Machine Learning **8 Lectures**

Axioms of probability-Mathematical definition of probability - Conditional probability –Independent events –Addition law and multiplication law- Theorem of Total Probability-Baye's Theorem (statement only) and its problems - Application –Decision making –Prediction Problems in a real life – Construction of machine learning model.

Module 4: Randomness of Data **8 Lectures**

One Dimensional Random Variables: Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function. Two Dimensional Random Variables: Discrete random variables, Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables -Application in data analytics problems.

Module 5: Modeling of Data **8 Lectures**

Discrete Distribution: Binomial and Poisson distribution – Poisson distribution is a limiting case of binomial distribution - Fitting binomial and Poisson distribution - Continuous Distribution: Normal and Exponential distribution–Properties -Application –Analyzing the performance practical problems – Cloud computing.

Module 6: Decision Making Techniques **10 Lectures**

Tests of Significance-large sample tests- Single mean-difference of two means – Single Proportion -difference of two proportion– Small sample test– Student's t test–Single mean-difference of two means-F test-Chi square test-Goodness of fit – Test of independence attributes–Application-Performance analysis-Comparative analysis – Quality testing.

Lab Experiments: Programming in R

1. Introduction to Programming in R and syntax.
2. Preparation of graphs and plots using R.
3. Compute measures of central tendency and dispersion.
4. Applying linear regression and correlation model to real dataset.
5. Solving problems based on probability.
6. Probability functions of discrete and continuous distribution.
7. Find expected value and variance for random variables.
8. Hypothesis test for large samples using mean values.
9. Test of hypothesis for small sample- t, F test.
10. Applying Chi-Square test for goodness of fit and contingency test to real dataset.

Text Books:

1. T.Veerarajan, "Probability, Statistics and Random Processes", 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

References:

1. S.C.Gupta , V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand &Sons, 11th Revised Edition 2007.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2015.
3. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
4. S. Ross, "A First Course in Probability", 9th Edition, Pearson Education India, 2019.
5. A.Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill, 2002.
6. G.JayKarns, "Introduction to Probability and Statistics using R", Third Edition, 2018.

20MA1004	**Mathematical Modelling for Engineering Problems**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

Course Objective:

1. To develop knowledge of the mathematical tools used in engineering problems.
2. To apply variational techniques in dynamical problems.
3. To interpret engineering problems using numerical techniques.

Course Outcomes:

The student will be able to

1. Apply the mathematical tools - matrices into fields of engineering appropriately.
2. Design and solve the engineering problems using variational techniques.
3. Construct the differentiation model to develop solutions in the fields of physical phenomena.

4. Recognize and find solution for real time technical problems using ordinary differential equations.
5. Make use of mathematical principles in solving linear and nonlinear vibration problems.
6. Solve inverse problems in continuum mechanical systems.

Module 1: Mathematical Modeling Tool – Matrices **7 Lectures**

Matrices – Matrices Operations – Related Matrices – Rank of a Matrix – Linear Transformation – Eigen values – Eigen vector – Properties of Eigen Values – Cayley-Hamilton Theorem – Reduction to Diagonal Form –Application - Page Rank Algorithm in Google Search –Confusion Matrix in Data Analytics – Image Processing – Cryptography.

Module 2: Variational Calculus **8 Lectures**

Tangents and Normals (Cartesian Curves)–Partial Derivatives –Homogenous Functions – Total Derivative – Change of Variables – Jacobians.

Definite Integrals – Applications – Areas of Cartesian Curves – Area of Polar Curves – Volumes of Revolution – Surface Areas of Revolution.

Module 3: Vector Calculus **8 Lectures**

Scalar and Vector point functions – Gradient of Scalar and Vector Point Functions – Interpretation of Divergence – Integration of Vectors - Line Integrals – Surface Integrals – Volume Integrals – Green's Theorem - Stoke's Theorem – Gauss Divergence Theorem (No proof included).

Module 4: Higher Order Differential Equations in Dynamic Problems **8 Lectures**

Linear Differential Equations –Rules for Finding the Complementary Function – Rules for Finding Particular Integral – Simple Harmonic Motion – Oscillations of a Spring – Oscillatory Electrical Circuit – Electro- Mechanical Analog – Deflection of Beams – Whirling of shaft (Only Problems).

Module 5: Mathematical modelingof Physical Systems **7 Lectures**

Motion of a Particle in Gravitational Field: Vertical Projectile Problem, Free Fall with Air Resistance, Plane Projectile Problem, More General Ballistic Problems. One-Dimensional Mechanical Vibrations: Linear Oscillator, Forced Linear Vibrations and Resonance. Nonlinear Oscillators, Nonlinear Vibrations and Resonance, Nonlinear Electrical-Mechanical Systems.

Module 6: Inverse Problems and Integral Models **7 Lectures**

Sliding Particle and Abel's Equation. Sliding Chain. Models of Computerized Tomography: Radon Transform, Inverse Scattering Problems Models of Continuum Mechanical Systems: Eulerian and Lagrangian Coordinates, Mass, Momentum and Energy Conservation.

Lab Experiments: Programming in Python

1. Write a python program for (i) matrix operations (ii) Eigen values and Eigen vectors of a given matrix (iii) to diagonalise the given square matrix.
2. Write a python program for application of diagonalization of matrices in engineering.
3. Write a python program for computing the (i) derivatives of functions (ii) Jacobian of several variables.
4. Write a python program for evaluating of (i) integrals (ii) Area of Curves (iii) Volume of rotation and the 3D View of the Surfaces.
5. Write a python program to find the motion of a boat across a stream.
6. Write a python program to find the velocity of escape from the earth.
7. Write a python program to find the charge in a condenser plate at time t in a L-C circuit, L-C-R Circuit, L-C Circuit with emf, L-C-R Circuit with emf.
8. Write a python program to find the deflection of beams under given stress.
9. Write a python program to find the linear and nonlinear vibration of mechanical systems.
10. Write a python program to solve Inverse Scattering Problems in continuum models.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
2. Hritonenko, Yatsenko, "Applied Mathematical Modelling of Engineering Problems", Kluwer Academic Publishers, ISBN 978-1-4613-4815-3 I, 2003.

Reference Books:

1. Erwin kreyszig, “Advanced Engineering Mathematics”, 10thEdition, John Wiley & Sons, 2015.
2. P. Kandasamy, K. Thilagavathy, K. Gunavathi, “Numerical Methods”, S. Chand & Company, 2ndrevised Edition, Reprint2007.
3. Veerarajan T., “Engineering Mathematics for first year”, Tata McGraw-Hill, NewDelhi.
4. N.P. Bali and Manish Goyal, “A text book of Engineering Mathematics”, LaxmiPublications, Reprint, 2010.
5. David Beazley and Brian K Jones, “Python Cooking: Recipes For Mastering Python 3”, O’Reilly Media, Inc , CA 95472, Third Edition, 2013.

20MA1005	Mathematical Foundations of Computing	L	T	P	C
		3	1	0	4

Course Objectives:
1. To formulate physical phenomena using matrices.
2. To apply differentiation and integration techniques.
3. To analyze periodic signals using Fourier series.

Course Outcomes:
The student will be able to
1. Solve linear systems of equations using matrices.
2. Find the Eigen values, Eigen vectors of matrices and diagonalize the matrices.
3. Apply differentiation techniques to find extreme values of functions.
4. Demonstrate knowledge in integration.
5. Evaluate area and volume using definite integral.
6. Express periodic functions as a series of sine and cosine functions.

Module 1: Linear Algebra: Matrices, Determinants, Linear Systems 7 Lectures
Controlling Traffic Networks using Linear Algebra, Matrices: Linear Systems of Equations, Row Echelon Form, Rank of a Matrix, Determinants, Cramer’s Rule, Inverse of a Matrix, Gauss-Jordan Elimination method- Leontief input-output model.

Module 2: Linear Algebra: Matrix Eigen value Problems 9 Lectures
Gould Index - use of Matrix to Geography, Eigen values, Eigen vectors, Cayley Hamilton Theorem, Diagonalization of a matrix, Hermitian, Unitary and Normal Matrices, bilinear and quadratic forms, orthogonal transformation to reduce quadratic form to canonical form.

Module 3: Differential Calculus 8 Lectures
Financial Optimization using Calculus, Linear And Nonlinear Functions, Limit continuity, differentiation (definition and simple problems), Linearity of differentiation, partial derivatives, critical points, extreme points in nonlinear function, Jacobians, Maxima Minima of single variable.

Module 4: Integral Calculus 5 Lectures
Blood Flow monitoring based on Poiseuille’s Law, Integration, definite integral, Integration by parts, Integration by substitution, Integration using differentiation.

Module 5: Multiple Integration 8 Lectures
Volume under a Surface for Remote Sensing using Double integrals (Cartesian), change of order of integration in double integrals, Area. Triple Integrals, volume. Beta and Gamma functions and their properties.

Module 6: Fourier series 8 Lectures
Audio and Video Compression using Fourier Series, Full range, Half range Fourier sine and cosine series, Parseval’s theorem, Harmonic analysis.

Text Books:
1. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 44thEdition, 2017.

Reference books:
1. R. Bronson, “Matrix methods: An introduction”, Gulf Professional Publishing, 1991.

2. David C. Lay, Steven R. Lay and Judi J. McDonald "Linear Algebra and its Applications", Fifth Edition. Pearson, 2006.
3. C. D. Meyer, "Matrix analysis and applied linear algebra", Vol. 71, Siam, 2000.
4. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9thEdition, Pearson, Reprint, 2002.
5. Erwin kreyszig, "Advanced Engineering Mathematics", 9thEdition, John Wiley & Sons, 2006.
6. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
7. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2010.
8. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
9. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
10. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2ndEdn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).

20MA1006	Calculus, Vector Spaces and Laplace Transform	L	T	P	C
		3	1	0	4

Course Objectives:

1. To impart knowledge on definite integral techniques.
2. To formulate physical phenomena using vector spaces.
3. To provide essential concepts in Laplace Transforms.

Course Outcomes

The student will be able to

1. Evaluate surface area and volume using definite integral.
2. Demonstrate knowledge in expansion and convergence of functions.
3. Analyze images using linear transformation
4. Relate vector spaces with magnetic field and moving fluid.
5. Find orthogonal and orthonormal vectors
6. Analyze circuit design using the properties of Laplace transform.

Module 1: Calculus **8 Lectures**

Performance evaluation of Computer Systems - Evolutes and involutes; Evaluation of definite and improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Sequences and series **8 Lectures**

Design a Calculator Software based on Convergence of sequence and series, tests for convergence; Power series, Taylor's series, Applications of Taylor series - sum of a series, evaluate limits and approximate functions, series for exponential, trigonometric and logarithm functions.

Module 3: Vector spaces **8 Lectures**

Digital image enhancement using transformations, Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, Inverse of a linear transformation, rank- nullity theorem, composition of linear maps, Matrix associated with a linear map.

Module 4: Vector Differentiation **7 Lectures**

Decision Review System in Cricket, Path of thrown basketball, hit distance using Differentiation of vectors–Curves in space-Velocity and acceleration - Scalar and Vector point functions–Gradient–Divergence-Curl–Physical interpretations- Solenoidal and irrotational fields-Laplacian operator.

Module 5: Inner product spaces **6 Lectures**

Designing the movement of Robotic arms, Norm definition- properties -Inner product spaces, orthogonal vectors – orthonormal vectors- orthonormal basis- Gram-Schmidt orthogonalization process.

Module 6: Laplace Transforms **8 Lectures**

Building integrated circuits and chips for computers using Laplace transform-Properties-Laplace transform of periodic functions-Laplace transform of unit step function, Impulse function-Inverse Laplace transform – Convolution.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. V. Krishnamurthy, V.P. Mainra and J.L. Arora, "An introduction to Linear Algebra", Affiliated East–West press, Reprint 2005.
2. David C. Lay, Steven R. Lay and Judi J. McDonald "Linear Algebra and its Applications", Fifth Edition. Pearson, 2006.
3. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint,2002.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
5. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole,2005.
6. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
7. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2010.
8. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010.

20MA1007	**Elementary Mathematics**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

Course objectives:

1. Acquire the knowledge of straight lines and circle.
2. Understand the process of calculus and matrices.
3. Develop problem solving skills in agriculture.

Course outcomes:

The student will be able to

1. Identify the different forms of straight lines.
2. Determine intersection of straight lines.
3. Relate the circle equations with agricultural problems.
4. Recognize the methods of calculus.
5. Apply integral calculus to find area.
6. Represent and solve agricultural problems using matrix.

Course Descriptions:

Straight lines: Distance formula, section formula (internal and external division), Change of axes (only origin changed), Equation of co-ordinate axes, Equation of lines parallel to axes, Slope-intercept form of equation of line, Slope-point form of equation of line, Two point form of equation of line, Intercept form of equation of line, Normal form of equation of line, General form of equation of line, Point of intersection of two straight. Lines, Angles between two straight lines, Parallel lines, Perpendicular lines, Angle of bisectors between two lines, Area of triangle and quadrilateral. Circle: Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points (x_1, y_1) & (x_2,y_2), Tangent and Normal to a given circle at given point (Simple problems),Condition of tangency of a line $y = mx + c$ to the given circle $x_2 + y_2 = a_2$.

Differential Calculus: Definition of function, limit and continuity, Simple problems on limit, Simple problems on continuity, Differentiation of x^n , e^x , sinx&cosx from first principle, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it), Differentiation by substitution method and simple problems based on it, Differentiation of Inverse Trigonometric functions. Maxima and Minima of the functions of the form y=f (x) (Simple problems based on it).

Integral Calculus : Integration of simple functions, Integration of Product of two functions, Integration by substitution method, Definite Integral (simple problems based on it), Area under simple well-known curves (simple problems based on it).

Matrices and Determinants: Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order, Properties of determinants up to 3rd order and their evaluation.

Reference Books

1. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (sixth revised Edition), S. Chand & Co., New Delhi, 2006.
2. Veerarajan T., "Engineering Mathematics", second edition, Tata McGraw-Hill, New Delhi, 2009.
3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44^{th} Edition, 2017.
4. Erwin kreyszig, "Advanced Engineering Mathematics", 9^{th}Edition, John Wiley & Sons, 2006.
5. Lecture Notes on Basic Mathematics to Engineering, 2013, Karunya University.

20MA1008	Elementary Statistics and Computer Applications	L	T	P	C
		2	0	2	3

Course Objective:

1. Acquire the knowledge on statistics and computer applications.
2. Understand the process of making decisions using statistical methods.
3. Develop the computational skills.

Course outcome:

1. Calculate the basic statistical measures for an experiment.
2. Apply the probability in solving Mendelian problems.
3. Apply the tests of significance and analyze the data.
4. Develop the experiments using experimental design methods.
5. Prepare and present a document, data and presentations using Microsoft tools.
6. Write programs using basic and visual basic programs.

Course Descriptions:

Basic concepts: Introduction to statistics, limitations of statistics. Variable statistics, types and sources of data, classification and tabulation of data, construction of frequency distribution, tables, graphic representation of data, simple, multiple component and percentage, bar diagram, pie diagram, histogram, frequency polygon and frequency curve average and measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles, for raw and grouped data.

Dispersion: Range, standard deviation, variance, coefficient of variation for raw and grouped data. Probability: Basic concept, additive and multiplicative laws. Theoretical distributions, binominal, poison and normal distributions, sampling, basic concepts, sampling vs. complete enumeration parameter and statistic, sampling methods, simple random sampling and stratified random sampling.

Tests of Significance: Basic concepts, tests for equality of means, and independent and paired t-tests, chi-square test for application of attributes and test for goodness of fit of Mendalian ratios. Correlation: Scatter diagram, correlation co-efficient and its properties, regression, fitting of simple linear regression, test of significance of correlation and regression coefficient.

Experimental designs: Basic concepts, completely randomized design, randomized block design, latin square designs, factorial experiments, basic concepts, analysis of factorial experiments up to 3 factors – split plot design, strip plot design, long term experiments, plot size, guard rows.

Computer application: Introduction to computers and personal computers, basic concepts, operating system, DOS and Windows, MS Word- Features of word processing, creating document and tables and printing of document, MS Excel-Concept of electronic spreadsheet, creating, editing and saving of spreadsheet, inbuilt statistical functions and formula bar, MS Power point-preparation, presentation of slides and slide show. Introduction to programming languages, BASIC language, concepts, basic and programming techniques, MS Office, Win Word, Excel, Power point, introduction to multi-media and its application. Visual basic-concepts, basic and programming techniques, introduction to internet.

Practical: Construction of frequency distribution table and its graphical representation. Histogram, frequency polygon, frequency curve, bar chart, simple, multiple, component and percentage bar charts, pie chart, mean, mode for row and grouped data, percentiles, quadrille, and median for row and grouped data, coefficient of variation, ‘t’ test for independent, will equal and unequal variants, paired ‘t’ test, chi-square test for contingency tables and theoretical ratios, correlation and linear regression. Studies on computer components – Basic language, visual basic, programming techniques, MS Office, Excel, power point.

References:

1. Gupta, S. C. and Kapoor, V. K. 2014. Fundamentals of Mathematical Statistics. Sultan Chand and Sons. New Delhi.
2. Nageswara Rao, G. 2007.Statistics for Agricultural Sciences. B.S. Publications, Hyderabad.
3. Rangaswamy, R.1995. A Textbook of Agricultural Statistics. New Age International Publishing Limited, Hyderabad.
4. Gupta, V., 2002. Comdex Computer Kit. Dream Tech Press, NewDelhi.
5. Parmar, A. Mathur, N. DeeptiP .U. and Prasanna, V. 2000.Working with WINDOWS AHandson Tutorials. Tata Mc Graw Hill Publishing Co., New Delhi.
6. Bandari, V. B., 2012. Fundamentals of Information Technology. Pearson Education, New Delhi.
7. Fundamentals of Computers. 2011. Pearson Education-ITL ESL, New Delhi.

20MA1009	Calculus and Differential Equations	L T P C 3 0 0 3

Course Objectives

1. Demonstrate knowledge in special functions and series.
2. Solve using differentiation and integration techniques.
3. Formulate physical phenomena using vector spaces.

Course Outcomes

The student will be to

1. Evaluate surface area and volume using definite integral.
2. Express functions as infinite series.
3. Apply differentiation techniques to find extreme values of functions.
4. Calculate gravity and mass using integration techniques.
5. Relate vector spaces with magnetic field and moving fluid.
6. Solvelinear partial differential equations of first order.

Module 1: Sequences and Series **7 Lectures**

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions. Application: Measurement instruments derivations; (for classroom discussions, assignments and term paper work).

Module 2: Calculus **7 Lectures**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties. Applications of definite integrals to evaluate surface areas and volumes of revolutions. (for classroom discussions, assignments and term paper work).

Module 3:Fourier series **7 Lectures**

Full range – change of interval- Half range sine and cosine series, Parseval’s theorem, Harmonic analysis-Application: Signals and System – Continuous and Discrete time Fourier series.(for classroom discussions, assignments and term paper work).

Module 4: Multivariable Calculus: Differentiation **8 Lectures**

Limit, continuity and partial derivatives. total derivative; Tangent plane and normal line; Jacobians – Maxima, minima and saddle points Method of Lagrange multipliers Vector Differentiation: Gradient, directional derivatives, curl and divergence.
Applications :Differentiation/partial differentiation in Gradient Descent Algorithm - Training method of ANN Electromagnetics, Frequency and Pulse Modulation , Control System – Stability Analysis Electromagnetics (for classroom discussions, assignments and term paper work).

Module 5: Multivariable Calculus: Integration **8 Lectures**
Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and Stokes(statement only), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds**.** Applications: Electromagnetic –change of variables – Antenna theory and wave propagation. (For classroom discussions, assignments and term paper work).
Module 6: Ordinary and Partial Differential Equations **8 Lectures**
Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Ordinary Differential Equations: Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation; First order partial differential equations: solutions of first order standard types and Lagrange's equations.
Applications: Signals and Systems-system function/analysis-DSP-FIR/IIR Filters. (for classroom discussions, assignments and term paper work).
Text Books:
1. B.S. Grewal, "Higher Engineering Mathematics", 44^{th}Edition, Khanna Publishers, 2017.

Reference Books:
1. T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.
2. B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill, New Delhi, 2010.
3. N.P.Bali and M.Goyal,"A Textbook of Engineering Mathematics", Laxmi Publications, 2010.
4. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
5. W.E.Boyce and R.C.DiPrima, "Elementary Differential Equations and Boundary Value Problems",John Wiley & Sons, 2017.

20MA1010	Linear Algebra, Transforms and Numerical Methods	L T P C 3 0 0 3

Course Objectives:
1. Demonstrate knowledge in matrices.
2. Classify numerical solutions of algebraic and transcendental equations.
3. Recognize the fundamental concepts of Transforms.

Course Outcomes:
The student will be able to
1. Analyze quadratic form using orthogonal transformation of matrix.
2. Compare integration solution and numerical solution.
3. Solve differential equations using Laplace Transforms.
4. Describe the different transform techniques.
5. Demonstrate knowledge in different types of graph.
6. Construct networks with maximum capacity.

Module 1: Matrices **7 Lectures**

Algebra of matrices, Inverse and rank of a matrix; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Cayley-Hamilton Theorem, Diagonalization of matrices; Orthogonal transformation to reduce quadratic forms to canonical forms. Application: control systems-state variable analysis-MIMO wireless communication. (For classroom discussions, assignments and term paper work).

Module 2: Numerical Methods-I **7 Lectures**

Solution of algebraic and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

Module 3: Numerical Methods-II **7 Lectures**

Ordinary differential equations of first order: Taylor's series, Euler and modified Euler's methods. RungeKutta method of fourth order.Milne's and Adam's predicator-corrector methods. Partial differential equations Solution of Laplace equation by Liebmann method, Solution of Poisson equation by Liebmann method, differential Equation by Bender Schmidt method, Crank Nicholson method. Applications: Electron devices-Drift and diffusion currents derivation - Electromagnetics-Maxwell Equations. (For classroom discussions, assignments and term paper work).

Module 4: Laplace Transforms, Fourier Transforms **8 Lectures**

Laplace transform- Definitions and Properties, Laplace transform of periodic functions. Inverse Laplace transform, convolution theorem, Solving Ordinary differential equations. Fourier transforms (infinite and finite) – definition- examples. Applications: Signals and Systems-Control Systems - System analysis, Filters, time response analysis-Convolutional Neural Networks-modulation, demodulation concepts of communication theory and systems. (For classroom discussions, assignments and term paper work).

Module 5: Z Transforms, Wavelet Transforms **8 Lectures**

Standard Z transforms–Standard results – Shifting U_n to the right-Multiplication by n -Inverse Z-transforms of standard functions-Method of Partial fractions – properties - Application to solve Difference equations. Wavelet transform-definition.Application: DSP - IIR and FIR filter design, image analysis- control systems dimensionality reduction. (For classroom discussions, assignments and term paper work).

Module 6: Graph Theory **8 Lectures**

Definitions and operations of Graphs, Euler graph, Hamiltonian graph, Transportation network, coloring of graphs; Applications: Electric circuit analysis-cut set, tie sets topic. (for classroom discussions, assignments and term paper work).

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44thEdition, Khanna Publishers, 2017.
2. Bernard Kolman, Robert C.busby, Sharo Cutler Ross, "Discrete Mathematical Structures", 5th Edition, Prentice Hall of India, 2004.

Reference Books:

1. D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.
2. N.P.Bali and M.Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.
3. V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press,2005.
4. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", 2ndEdition, S. Chand & Company, Reprint2012.

20MA1011	**Linear Algebra and Calculus**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

Course Objectives

1. To develop knowledge of the mathematical tools used in engineering problems.
2. To formulate physical phenomena using vector spaces.
3. To interpret engineering problems using numerical techniques and programming in python.

Course Outcomes:

At the end of the course, the student will be able to

1. Apply the mathematical tools - matrices into fields of engineering appropriately.
2. Decompose Matrices for analyzing mathematical models.
3. Relate vector spaces with engineering problems.
4. Apply numerical techniques in solving engineering problems.
5. Construct the differentiation model to develop solutions in the fields of physical phenomena.
6. Evaluate integrals for various applications in engineering problems.

Module 1: Matrices **8 Lectures**

Matrices – Matrices Operations -Rank of a Matrix – Linear Transformation – Eigen values – Eigen vector – Properties of Eigen Values – Cayley-Hamilton Theorem – Reduction to Diagonal Form-orthogonal transformation to reduce quadratic form to canonical form. — Related Matrices – (definitions only)Spread of a matrix, Jordan normal form, Weyr canonical form, Positive definite and Positive semi definite matrices, Triangular, Tridiagonal matrices, Block and Sparse matrices, Hessian and Toeplitz matrices.

Applications: Dimensionality reduction, feature selection, Page Rank Algorithm in Google Search – Confusion Matrix in Data Analytics – Image Processing – Cryptography. (for classroom discussions, assignments and term paper work).

Module 2: Matrix Decomposition **8 Lectures**

Cholesky decomposition, QR Decomposition, PolarDecomposition. Applications: Data mining, Controller design, signal processing (for classroom discussions, assignments and term paper work).

Module 3: Computational Techniques **8 Lectures**

Curve Fitting – Principles of Least Squares – Straight Line – Parabola – Fitting of the curve $y = ax^b$, $y = ae^{bx}$ and $y=ab^x$ – Solution of Algebraic and Transcendental Equation –Newton-Raphson Method – Solution of Linear Simultaneous Equation – Gauss Elimination Method – Gauss-Seidal Method – Determination of Eigen Values by Power Method.Applications:Problems relating to the concerned engineering field,linear regression in machine learning (for classroom discussions, assignments and term paper work).

Module 4: Vector space **7 Lectures**

Vector Space-Linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, Inverse of a linear transformation, , composition of linear maps, Matrix associated with a linear map-Normed vector space–definition, examples- Euclidean distance. Applications: KNN Classification in Machine learning (for classroom discussions, assignments and term paper work).

Module 5: Differential Calculus **7 Lectures**

Differentiating a function- Algebra of derivatives-the derivative as a slope- The chain rule and its application- Extreme values of function- The mean value theorem.Applications: Maximum power transfer theorem, electric circuit transient analysis, back propagation in ANN, continuous system representation using differential equation, Circuit breaker analysis.(for classroom discussions, assignments and term paper work).

Module 6: Integral Calculus **7 Lectures**

Integral of general function, Integral of monotonic function, Integral of powers and polynomials, Properties of integrals-Indefinite Integrals – Double and triple integrals-area integral and volume integral. Applications: RMS and average value of the waveform, design of filters.(for classroom discussions, assignments and term paper work).

Lab Experiments: Programming in Python

1. Write a python program for matrix operations.
2. Write a python program for Eigen values and Eigen vectors of a given matrix.
3. Write a python program for to diagonalise the given square matrix.
4. Write a python program for matrix decomposition.

5. Write a python program for curve fitting.
6. Write a python program for Newton Raphson method.
7. Write a python program for finding Euclidean distance.
8. Write a python program for evaluating derivatives of standard functions.
9. Write a python program for evaluating of 3D View of the Surfaces.
10. Write a python program evaluating of (i) integrals (ii) Area of Curves.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44thEdition, 2017.
2. Veerarajan T, "Engineering Mathematics for Semester I and II.", Tata McGraw Hill Publishing Co., New Delhi, 2017.

Reference Books:

1. Erwin kreyszig, "Advanced Engineering Mathematics", 10thEdition, John Wiley & Sons, 2015.
2. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", S. Chand & Company, 2nd revised Edition, Reprint2007.
3. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", LaxmiPublications, Reprint, 2010.
4. D. Poole, "Linear Algebra: A Modern Introduction", 2ndEdition, Brooks/Cole, 2005.
5. David S.Watkins, "Fundamentals of Matrix Computations", John Wiley & Sons, Singapore. 2004.

20MA1012	Mathematical Transforms, Fourier Series and Vector Calculus	L	T	P	C
		3	0	2	4

Course Objectives

1. To introduce the concepts of Laplace transform.
2. To gain knowledge on Fourier series, Fourier Transform and Vector Calculus.
3. To develop skills of students in MATLAB programming to solve mathematical problems.

Course Outcomes:

At the end of the course, the student will be able to

1. Transform continuous time signal into S- domain functions.
2. Find the Fourier series expressions for the various periodic signals.
3. Find the Fourier transform for the various non periodic signals.
4. Use Vector Calculus for various applications.
5. Apply Z-Transform and Wavelet Transform in engineering problems.
6. Represent various systems using differential equations and solve the equations.

Module 1: Laplace Transform **8 Lectures**

Transforms of elementary functions–Properties of Laplace transforms–Transforms of periodic functions–Transforms of integrals-Multiplication by t^n- Division by t –Evaluation of Integrals by Laplace transforms-Inverse transforms of standard functions **-** Method of Partial fractions–properties–Convolution theorem–Application to solve Differential Equations in electromagnetic field.Applications: Solving differential equations, transfer function of a system, stability analysis (for classroom discussions, assignments and term paper work).

Module 2: Fourier series **8 Lectures**

Euler's formula–Conditions for a Fourier expansion–Functions having points of discontinuity–Change of Interval–Even and odd functions. Half range Fourier series: – Typical waveforms –Half wave Rectifier, Full wave Rectifier, Saw-toothed wave, Triangular wave- Complex form of Fourier series–Harmonic analysis. Applications: Signal and image processing, analysis of periodic signals, power electronics circuit analysis (for classroom discussions, assignments and term paper work).

Module 3: Fourier Transform **8 Lectures**

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions–Convolution theorem – Parseval's identity. Application to solve Transmission line problems.Applications:

Analysis of non-periodic signals, signal and image processing (for classroom discussions, assignments and term paper work).

Module4:Z Transform, Wavelet Transform **7 Lectures**

Standard Z transforms–Standard results – Shifting $U_n$to the right-Multiplication by n -Inverse Z-transforms of standard functions**-**Method of Partial fractions – properties Application to solve Difference equations.Wavelet transform-definition.Applications: To find response of Discrete time systems, Data, Analysis of signals (for classroom discussions, assignments and term paper work).

Module 5: Vector Differentiation **7 Lectures**

Differentiation of Vectors – Velocity and Acceleration – Scalar and Vector point functions - Gradient and directional derivative, Divergence and curl - irrotational and Solenoidal fields. Applications: Analysis of electromagnetic fields (for classroom discussions, assignments and term paper work).

Module6: Vector Integration **7 Lectures**

Line Integrals, Green's theorem in the plane, Surface integrals, GaussDivergence and Stoke's Theorems (Statements only) - Verification**.**Applications: Analyzing electric and magnetic fields. (For classroom discussions, assignments and term paper work).

List of Experiments: Programming in MATLAB

1. Starting with MATLAB creating arrays-Mathematical functions.
2. To find Laplace Transform of standard functions.
3. To find Inverse Laplace Transform.
4. To compute first three harmonics.
5. To find Fourier Transform of standard functions.
6. To find Z Transform and wavelet Transform.
7. To find gradient, directional derivative.
8. To find divergence and curl of vector functions.
9. To check Solenoidal, Irrotational vectors.
10. To evaluate vector integration.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44thEdition, 2017.
2. Veerarajan T, "Engineering Mathematics for Semester I and II.", Tata McGraw Hill Publishing Co., New Delhi, 2017.

Reference Books:

1. Erwin kreyszig, "Advanced Engineering Mathematics", 10thEdition, John Wiley & Sons, 2015.
2. Veerarajan T, "Engineering Mathematics for Semester I and II.", Tata McGraw Hill Publishing Co., New Delhi, 2017.
3. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", LaxmiPublications, Reprint, 2010.
4. Soman K.P and Ramachandran K.I., "Insight into wavelets from Theory to practice", PHI learning Pvt. Limited, 2010.
5. Mark A Pinsky, "Introduction to Fourier Analysis and Wavelets", Thomson Learning Academic Resource center, 2000.

20MA1013	Calculus and Differential Equations for Robotic Engineering	L	T	P	C
		2	0	2	3

Course Objectives

1. To provide knowledge in multivariable calculus and ODE.
2. To understand the concepts of PDE and its applications.
3. To develop skills of students in python programming.

Course Outcomes

The student will be to

1. Apply the concepts of multivariable calculus.
2. Solve Ordinary Differential Equations.
3. Determine power series solutions using special functions.
4. Compute the solution of PDEs using various techniques.
5. Relate Fourier analysis to robot kinematics and motion planning.
6. Perform Vibration Analysis of Robots using wave and solve heat equations.

Module 1: Multivariable calculus **7 Lectures**

Partial derivatives – Homogeneous functions and Euler's theorem– Total derivative – Differentiation of implicit functions – Change of variables – Jacobians– Lagrange's method of undetermined multipliers.
Applications: Solution to problems on robot dynamics using differential calculus.(for classroom discussions, assignments and term paper work).

Module 2: Ordinary Differential Equations **8 Lectures**

Ordinary Differential Equations: Second order linear differential equations withconstantcoefficients, method of variation of parameters, Cauchy-Euler equation.Application of ODE for mathematical modeling of systems. (For classroom discussions, assignments and term paper work).

Module 3: Special functions **6 Lectures**

Power series solutions: Legendre polynomials, Besselfunctions of the first kind and their properties.Application of Bessel functions in wave propagation and static potentials.(For classroom discussions, assignments and term paper work).

Module 4: Partial Differential Equations **6 Lectures**

First order partial differential equations, solutions of first order standard type and Lagrange's equations. Solutions to higher order homogenous and non-homogenous linear partial differential equations.Application of PDE in modelling and control of manufacturing systems and articulated robots (for classroom discussions, assignments and term paper work).

Module 5: Fourier series **8 Lectures**

Euler's formula–Conditions for a Fourier expansion–Functions having points of discontinuity–Change of Interval–Even and odd functions. Half range Fourier series: – Typical waveforms – Complex form of Fourier series–Harmonic analysis.Application of Fourier analysis for Robot Kinematics and Motion Planning. (For classroom discussions, assignments and term paper work).

Module 6: Boundary value problems **10 Lectures**

Solutions of one-dimensional wave equation – One-dimensional equation of heat conduction – Steady state solution of two-dimensional heat equation (Cartesian coordinates only).Application: Vibration Analysis of Robot Structures using Wave Equations (for classroom discussions, assignments and term paper work).

Lab Experiments: Programming in Python

1. Write a python program for computing the derivatives of functions.
2. Write a python program for computing the partial derivatives of functions.
3. Write a python program for computing the Jacobian of several variables.
4. Write a python program to solve second order ODE with constant coefficients, X= e^{ax}, x^n
5. Write a python program to solve second order ODE with constant coefficients, X= sinax, cosax, e^{ax}sinax, e^{ax}cosax.
6. Write a python program to evaluate special functions.
7. Write a python program to solve PDE.
8. Write a python program to compute first three harmonics in fourier series.
9. Write a python progam to solve one-dimensional wave equation.
10. Write a python progam to solve one-dimensional heat flow problems.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
3. RamanaB.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics",Vol II and III,6th Ed, S. Chand & Co., New Delhi, 2006.

20MA1014	Linear Algebra, Transforms and Numerical Methods for Robot Control	L	T	P	C
		2	0	2	3

Course Objectives:

1. To demonstrate knowledge in matrices and recognize the fundamental concepts of transforms.
2. Classify numerical solutions of algebraic and transcendental equations
3. To develop skills of students in MATLAB programing to solve mathematical problems

Course Outcomes:

The student will be able to

1. Recall the fundamentals of linear algebra
2. Reduce quadratic form to canonical form using orthogonal transformation
3. Apply numerical methods to solve engineering problems
4. Solve differential equations using Laplace Transforms, understand Fourier transform
5. Analyze discrete time systems using Z transforms.
6. Relate concepts of graph theory to robot navigation

Module 1: Linear Algebra: Matrices, Determinants, Linear Systems 6 Lectures

Matrices: Linear Systems of Equations, Rank of a Matrix, Determinants, Cramer's Rule, Inverse of a Matrix, Gauss-Jordan Elimination method.Application: Robot Kinematic Analysis using Matrices (for classroom discussions, assignments and term paper work).**Module 2: Linear Algebra: Matrix Eigen value Problems 6 Lectures**Eigen values, Eigen vectors, Cayley Hamilton Theorem, Diagonalization of a matrix, orthogonal transformation to reduce quadratic form to canonical form.Application: Coordinate Transformation using Homogeneous Transformation Matrices. (For classroom discussions, assignments and term paper work).

Module 3: Numerical Methods 8 Lectures

Ordinary differential equations of first order: Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order. Partial differential equations Solution of Laplace equation by Liebmann method, Solution of Poisson equation by Liebmann method, differential Equation by Bender Schmidt method, Crank Nicholson method. Application: System Identification and trajectory tracking applications of numerical methods. (For classroom discussions, assignments and term paper work).

Module 4: Laplace Transform, Fourier Transform 10 Lectures

Laplace transform- Definitions and Properties, Laplace transform of periodic functions. Inverse Laplace transform, convolution theorem, Solving Ordinary differential equations. Fourier transforms (infinite and finite) – definition- examples. Application: Mathematical Modeling of continuous systems using Laplace Transforms.(for classroom discussions, assignments and term paper work).

Module 5: Z Transform, Wavelet Transform 10 Lectures

Standard Z transforms–Standard results – Shifting $U_n$to the right-Multiplication by n -Inverse Z-transforms of standard functions**-**Method of Partial fractions – properties - Application to solve Difference equations.Wavelet transform-definition.Application: Analysis of discrete systems using Z transforms. (For classroom discussions, assignments and term paper work).

Module 6: Graph Theory **5 Lectures**

Definitions and operations of Graphs, Euler graph, Hamiltonian graph, Transportation network, coloring of graphs.Applications of Graph theory for Robot Navigation and path planning based on sensor networks. (For classroom discussions, assignments and term paper work).

List of experiments using MATLAB

1. To compute basic matrix operations.
2. To find Eigen values and Eigen vectors of a given matrix.
3. To diagonalise the given square matrix.
4. To find Taylor's series.
5. To solve ODE using Euler's method.
6. To solve ODE using Rungekutta method.
7. To find Laplace Transform of standard functions.
8. To find Inverse Laplace Transform.
9. To find Fourier Transform of standard functions.
10. To find Z transform, wavelet Transform.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
2. Bernard Kolman, Robert C.Busby, Sharo Cutler Ross, "Discrete Mathematical Structures", Prentice Hall of India, 5thEdition, 2004.

Reference Books:

1. D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.
2. N.P.Bali and M.Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.
3. V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press,2005.
4. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", S. Chand & Company, 2nd Edition, Reprint2012.
5. DingyuXue, Yanguan Chen, "Solving Applied Mathematical Problems with MATLAB", Taylor and Francis, 2009.
6. Steven C. Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists (Third Edition) ", McGraw Hill (2012).
7. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2ndEdn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
8. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

20MA1015	Basic Mathematics for Biotechnology	L	T	P	C
		2	0	2	3

Course Objective:

1. Demonstrate knowledge in matrices.
2. Solve using differentiation and integration techniques.
3. Apply Python programs to solve bio engineering problems.

Course Outcomes:

The student will be able to

1. Analyze the quadratic form using orthogonal transformation of the matrix.
2. Solve ordinary differential equation.
3. Understand different types of functions.
4. Apply differentiation techniques to find extreme values of functions.
5. Knowledge in special functions.
6. Evaluate surface area and volume using definite integral.

Module 1: Matrices **8 Lectures**

Eigen values and Eigen vectors of areal matrix – Characteristic equation - Properties of Eigen values and Eigen vectors – Cayley Hamilton theorem – Diagonalization of matrices – nature of quadratic forms - Application - Page Rank Algorithm in Google Search- Image processing.

Module 2: Ordinary differential Equations **8 Lectures**

Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x. Ordinary Differential Equations: Second order linear differential equations withconstantcoefficients, Method of variation of parameters - Modelling of growth and decay problems.

Module 3: Functions of several variables **8 Lectures**

Functions of two variables –partial derivatives– Jacobians- Taylor's theorem (statement only) and expansion – Maxima and Minima – Constrained extremum by Lagrange's multiplier method.

Module 4: Integral Calculus **7 Lectures**

Definite and indefinite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric substitutions - Beta and Gamma functions.

Module 5: Multiple Integrals – I **7 Lectures**

Double integrals – Change of order of integration (Cartesian co- ordinates) – Double integrals in Polar coordinates - Area enclosed by plane curves.

Module 6: Multiple Integrals – II **7 Lectures**

Triple integrals – Volume as triple integral – Change of variable: Transformation to polar, Cylindrical and Spherical polar coordinates.

List of Experiments using Python:

1. Introduction to Python and general Syntaxes.
2. Write a Python program to find Eigen values and Eigen vectors of a given matrix.
3. Write a Python program to find the diagonal form of the given matrix.
4. Write a python program to solve second order ordinary differential equation.
5. Write a python program to plot the solution of ODE.
6. Write a python program for computing the derivatives of functions.
7. Write a python program for computing the Jacobian of several variables.
8. Write a python program for computing Beta and gamma function for numeric input.
9. Write a python program for evaluating of (i) integrals (ii) Area of Curves.
10. Write a python program to find triple integral with Cylindrical and Spherical coordinators.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
2. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9thEdition, Pearson, Reprint, 2002.

Reference Books

1. Veerarajan T, "Engineering Mathematics", Tata McGraw Hill, New Delhi, 2015.
2. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics", S. Chand & Co., New Delhi, 2013.
3. S. Narayanan and Manicavachagam Pillai T.K., "Calculus Vol I, II and III" S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai 2009.
4. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.

		L	T	P	C
20MA1016	**Numerical Computing Using MATLAB**	**2**	**0**	**2**	**3**

Course Objective:

1. Develop skills in numerical methods for solving the engineering problems.
2. Understand the method of numerical integration and differentiation.
3. Apply MATLAB tool to solve engineering problems.

Course Outcome:

The student will be able to

1. Infer the knowledge with different kind of numerical methods for solving the problems in Biotechnology.
2. Develop knowledge in curve fitting.
3. Solve the system of linear algebraic equations using iterative process.
4. Build the knowledge in interpolation.
5. Evaluating integration using numerical techniques.
6. Solve ordinary differential equations using numerical techniques.

Module 1: Solution of Algebraic Equations **6 Lectures**

Types of Errors, Significant figures, Accuracy of Numbers, Precision, Error Propagation, Basic Properties of Equations, Relations between Roots and Co-efficient, Descartes Rule of Sign.

Module 2: Bracketing Methods **7 Lectures**

Bisection, Secant, Method of False position or Regula-Falsi Method - Convergence of Iterative Methods, Newton- Raphson Method for Non Linear Equations in Two Variables.

Module 3: Solution of Linear Equations and curve fitting **8 Lectures**

Mathematical Background, Matrix Inversion, Gauss Elimination, Gauss- Jordan Methods, Gauss- Seidal Iteration Methods, Jacobi's Method, Gauss Seidal Methods.Methods of Least squares, fitting a Straight Line and a Polynomial, Fitting a Non- Linear Function.

Module 4: Finite Differences & Interpolation **8 Lectures**

Finite Differences: Forward and Backward Differences Table, Central Differences, Newton's Forward and Backward Differences, Interpolation Formula, Interpolation Polynomials, Lagrange Interpolation Formula, Inverse Interpolation.

Module 5: **Numerical Differentiation and Integration** **8 Lecture**

Differentiation Formula based on Tabulator at Equal and Unequal Intervals, Newton-cotes Integration Formulas, Trapezoidal Rule and Simpson's 1/3rd rule and Simpson's 3/8rd rule.

Module 6: **Ordinary Differential Equations** **8 Lectures**

Taylor's Series and Euler's Methods, Modified and Improvements in Euler's Methods, Runge-Kutta 2^{nd}order &4^{th} order Methods.

List of Experiments using MATLAB:

1. Find the zeros of a polynomial using the bisection method.
2. Find the roots of an equation using Secant method.
3. Find the roots of an equation using Newton-Raphson and False Position methods.
4. Solving system of equations using Gauss- Seidal Iteration Methods.
5. Solving system of equations using Gauss- Jacobian Iteration Methods.
6. Fit the data in a straight line and parabola.
7. Find the integration of a function using Simpson's Rules.
8. Solve the differential equation using Modified and Improvements in Euler's Methods.
9. Solve the differential equation using Runge-Kutta Method.
10. Solve the differential equation using the Taylor's series method.

Text Books:

1. Kandasamy P., "Numerical Methods", S.Chand and Co, Reprint 2010.

Reference Books:

1. VenkataramanM.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.
2. M.K.Jain., Iyengar. S.R.K., Jain R.K., "Numerical Methods for Scientific and Engineering Computation", 6^{th}Edition, New Age International, 2012.
3. S.S.Sastry, "Introductory methods of NumericalAnylasis",PHI,4^{th}Edition 2005.
4. B.V.Ramana, "Higher Engineering Mathematics", 29^{th}Reprint, Tata McGraw Hill Education Private limited 2017.

5. S.R. Otto and J.P. Denier, “An Introduction to Programming and Numerical Methods in MATLAB”, Springer- Verlag London Limited, 2005.
6. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2nd Edn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
7. Kanti B. Dutta, Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

20MA1017	Basics of Calculus and Linear Algebra	L	T	P	C
		3	0	2	4

Course Objective:
1. Demonstrate knowledge in the matrix.
2. Solve using differentiation and integration techniques.
3. Apply Python programs to solve food processing problems

Course Outcomes

The student will be able to
1. Solve the systems of equations using matrices.
2. Find the Eigen values and Eigen vectors of matrices and diagonalizable the matrices.
3. Apply differentiation techniques to find extreme values of functions.
4. Demonstrate knowledge in integration.
5. Compute area and volume using integration techniques
6. Relate periodic and non-periodic functions as a series of sine and cosine functions.

Module 1: Linear Algebra: Matrices, Determinants, Linear Systems 7 Lectures

Introduction-Matrix operations - The trace and determinant of a matrix- Properties of determinants (excluding the proof) - Rank of a matrix - Inverse of a matrix - Solving simultaneous equations: Cramer’s rule and Inverse method -Gauss Elimination and Gauss-Jordan Elimination method.

Module 2: Linear Algebra: Matrix Eigen value Problems 8 Lectures

Introduction to Eigen values and Eigen vector - Properties of Eigen values – CayleyHamilton Theorem - Reduction to Diagonal Form - Canonical form - Reduction of quadratic form to canonical form - Application - Page Rank Algorithm in Google Search- Image processing.

Module 3: Differential Calculus 7 Lectures

Limits – continuity -Differentiation from the first principle -Rules of differentiation- Product rule - Quotient rule - Chain rule - Logarithmic differentiation - partial derivatives – Jacobians - Maxima and Minima of single variable.

Module 4: Integral Calculus 7 Lectures

Integration - definite and indefinite integral- Integration by parts - Integration by substitution -Bernoulli’s formula - Integration under differentiation.

Module 5: Multiple Integration 8 Lectures

Double integrals (Cartesian) – changeof order of integration in double integrals - Area enclosed by plane curves. Triple Integrals - volume of solids - Beta and Gamma functions and their properties.

Module 6: Fourier series 8 Lectures

Full range - Euler’s formula - Conditions for a Fourier expansion- Change of interval - Even and Odd functions - Half range Fourier sine and cosine series - Harmonic analysis - Finding Displacement of a crank through angular movement.

List of Experiments using Python
1. Introduction to Python and general Syntaxes.
2. Write a Python programfor matrix operations.
3. Write a Python program to find Eigen values and Eigen vectors of a given matrix.
4. Write a Python program for application of diagonalization of matrices in engineering.
5. Write a Python program to solve a system of linear equations using Cramer’s rule.

6. Write a Python program for computing the (i) derivatives of functions (ii) Jacobian of several variables.
7. Write a Python program to evaluate Extremum of a single variable function.
8. Write a Python program to evaluate definite integrals and their visualizations.
9. Write a Python program to find the area and volume of regions.
10. Write a Python program to find Euler's constants using numerical inputs and their visualizations.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
4. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010.
7. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint2005.
8. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2ndEdn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
9. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

20MA1018	**Transforms and Differential Equations**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

Course Objectives:

1. Understand transform techniques for continuous functions.
2. Demonstrate knowledge in differential equations and solve boundary value problems.
3. Apply MATLAB tools to solve mathematical problems.

Course Outcome:

The student will be able to

1. Understand solution of Ordinary Differential Equations.
2. Find the solution of PDE.
3. Apply solution of PDE in one dimensional wave and heat equations.
4. Evaluate definite integral using Laplace transform.
5. Solve the differential equation using Laplace transform.
6. Calculate the output of a linear system using Fourier transform.

Module 1: Ordinary Differential Equations **6 Lectures**

Second order linear differential equations with constant coefficients - method of variation of parameters - Cauchy Euler equation - Modelling of growth and decay problems.

Module 2: Partial Differential Equations **7 Lectures**

First order partial differential equations - solutions of first order standard type - Lagrange's equations. Solution to higher order homogeneous linear partial differential equations - Modelling of radio equation.

Module 3: Boundary value Problems **8 Lectures**

Solutions of one-dimensional wave equation - One-dimensional heat equation - Steady state solution (Cartesian co-ordinates only) - Vibration models of String and plate.

Module 4: Continuum Models - I **7 Lectures**

Transforms of elementary functions - Properties of Laplace transforms - Transforms of derivatives - Transforms of integrals - Multiplication by t - Division by t - Evaluation of Integrals by Laplace transforms-Application of Laplace transform in food problem.

Module 5: Continuum Models– II **7 Lectures**

Inverse Laplace transforms of standard functions - Method of Partial fractions - properties - Solving Differential Equations-Application of Inverse Laplace Transform in Growth and decay problem (plant growth, cell growth).

Module 6: Fourier Transforms **7 Lectures**

Fourier transform pair - Fourier sine and cosine transforms - Properties - Transforms of simple functions-Finding temperature distribution in a half space.

List of experiments using MATLAB:

1. To solve second order ODE with constant coefficients.
2. To solve homogeneous PDE.
3. To plot the solution of ODE and PDE.
4. Solving one-dimensional wave equation.
5. Computing one-dimensional heat flow problems.
6. To find Laplace Transform of standard functions.
7. To find Inverse Laplace Transform.
8. Solve differential equation using Laplace transform.
9. To find Fourier sine Transform of the given functions.
10. To find Fourier cosine Transform of the given functions.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9thEdition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9thEdition, John Wiley & Sons, 2006.
3. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
4. Veerarajan T., "Engineering Mathematics", second edition, Tata McGraw-Hill, New Delhi, 2009.
5. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (sixth revised Edition), S. Chand & Co., New Delhi, 2006.
6. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2ndEdn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
7. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

		L	T	P	C
20MA1019	**Mathematics for Data Science and Machine Learning in Civil Engineering**	**3**	**0**	**2**	**4**

Course Objective:

1. Develop the skills of the students in the area of data analytics.
2. Outline the basic principles of relationship and predictive analysis in machine learning problems.
3. Provide basic concept of probability distribution, statistical inference and also apply R software to visualize the data.

Course Outcomes:

The student will be able to

1. Determine the statistical measures of data.
2. Analyze the linear relationship of variables using correlation and regression models.
3. Apply the concept of probability in machine learning problems.

4. Understand the randomness in date in real time application.
5. Model the data using probability distributions.
6. Develop the knowledge in decision making.

Module 1: Preliminaries of Data Analytics **6 Lectures**

Frequency distribution and measures of central tendency- mean, median and mode–measures of dispersion–standard deviation-mean deviation-quartile deviation and its coefficients- coefficient of variation – Application - Survey data analysis–Consistency of the product - Visually inspecting data to improve product quality.

Module 2: Linear Relationship and Predictive Models **5 Lectures**

Karl Pearson's correlation coefficients – Spearman's Rank Correlation – Repeated Rank Correlation-Lines of regression and Regression equations - Application - Strength of relation between two variables – Measuring similarity between the data –Estimation of association among the variables- Streamflow estimation

Module 3: Probability – A tool in Machine Learning **8 Lectures**

Axioms of probability-Mathematical definition of probability - Conditional probability –Independent events –Addition law and multiplication law- Theorem of Total Probability-Baye's Theorem (statement only) and its problems - Application –Decision making –Prediction Problems in a real life – Construction of machine learning model – Return Period- Bridge collapse Preliminary assessment

Module 4: Randomness of Data **8 Lectures**

One Dimensional Random Variables: Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function. Two Dimensional Random Variables: Discrete random variables, Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables -Application in data analytics problems- Data Homogeneity

Module 5: Modelling of Data **8 Lectures**

Discrete Distribution: Binomial and Poisson distribution – Poisson distribution is a limiting case of binomial distribution - Fitting binomial and Poisson distribution - Continuous Distribution: Normal and Exponential distribution–Properties -Application –Analyzing the performance practical problems

Module 6: Decision Making Techniques **10 Lectures**

Tests of Significance- Large sample tests- Single mean-difference of two means – Single Proportion -difference of two proportion– Small sample test– Student's t test–Single mean-difference of two means-F test-Chi square test-Goodness of fit – Test of independence attributes–Application-Performance analysis-Comparative analysis – Quality testing- Material Procurement.

Lab Experiments: Programming in R

1. Introduction to Programming in R and syntax.
2. Preparation of graphs and plots using R.
3. Compute measures of central tendency and dispersion.
4. Applying linear regression and correlation model to real dataset.
5. Solving problems based on probability.
6. Probability function of discrete and continuous distribution.
7. Find expected value and variance for random variables.
8. Hypothesis test for large samples using mean values.
9. Test of hypothesis for small sample- t,F test.
10. Applying Chi-Square test for goodness of fit and contingency test to real dataset.

Text Books:

1. T.Veerarajan, "Probability, Statistics and Random Processes", 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

References:

1. S.C.Gupta , V.K. Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand &Sons, 11th Revised Edition 2007.
2. E. Kreyszig, “Advanced Engineering Mathematics”, 10thEdition, John Wiley & Sons, 2015.
3. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall, 2003.
4. S. Ross, “A First Course in Probability”, 9thEdition, Pearson Education India, 2019.
5. A.Papoulis and S. Unnikrishnan Pillai, “Probability, Random Variables and Stochastic Processes," Fourth Edition, McGrawHill, 2002.
6. G.JayKarns, “Introduction to Probability and Statistics using R”, Third Edition, 2018.

20MA1020	Mathematical Modelling for Civil Engineering Problems	L	T	P	C
		3	0	2	4

Course Objective:

1. To develop knowledge of the mathematical tools used in engineering problems.
2. To apply variational techniques in dynamical problems.
3. To interpret engineering problems using numerical techniques.

Course Outcomes:

The student will be able to

1. Apply Matrix concepts to model and solve problems in the fields of engineering appropriately.
2. Design and solve the engineering problems using variational techniques.
3. Construct the differentiation model to develop solutions in the fields of physical phenomena.
4. Recognize and find solution for real time technical problems using ordinary differential equations.
5. Apply numerical techniques in solving engineering problems.
6. Solve dynamical problems using numerical techniques.

Module 1: Mathematical Modeling Tool – Matrices **7 Lectures**

Matrices – Matrices Operations – Related Matrices – Rank of a Matrix – Linear Transformation – Eigen values – Eigen vector – Properties of Eigen Values – Cayley-Hamilton Theorem – Reduction to Diagonal Form –Application - Stiffness matrix- Natural frequency and mode shape of multi-storeyed buildings

Module 2: Variational Calculus **8 Lectures**

Tangents and Normals (Cartesian Curves)–Partial Derivatives –Homogenous Functions – Total Derivative – Change of Variables – Jacobians- Basics of trigonometry – Solving Equilibrium equations for static body-Water surface profiles

Definite Integrals – Applications – Areas of Cartesian Curves – Area of Polar Curves – Volumes of Revolution – Surface Areas of Revolution

Module 3: VectorCalculus **8 Lectures**

Scalar and Vector point functions – Gradient of Scalar and Vector Point Functions – Interpretation of Divergence – Integration of Vectors - Line Integrals – Surface Integrals – Volume Integrals – Green’s Theorem - Stoke’s Theorem – Gauss Divergence Theorem (No proof included).

Module 4: Higher Order Differential Equations in Dynamic Problems **8 Lectures**

Linear Differential Equations –Rules for Finding the Complementary Function – Rules for Finding Particular Integral – Simple Harmonic Motion – Oscillations of a Spring – Deflection of Beams – Whirling of shaft (Only Problems)- Vortex motion.

Module 5: Computational Techniques – I **7 Lectures**

Curve Fitting – Principles of Least Squares – Straight Line – Parabola – Fitting of the curve $y = ax^b$, $y = ae^{bx}$ and $xy^n = b$ – Solution of Algebraic and Transcendental Equation –Newton-Raphson Method – Solution of Linear Simultaneous Equation – Gauss Elimination Method – Gauss-Seidal Method – Determination of Eigen Values by Power Method. Application – Problems relating to the concerned engineering field.

Module 6: Computational Techniques – II **7 Lectures**

Numerical Differentiation – Newton's Forward and Backward Difference Formulae – Numerical Integration – Trapezoidal Rule – Simpson's One-Third Rule – Simpson's Three-Eighth Rule –Application– Problems relating to the concerned engineering field - Computer Graphics – Graphical User Interface.

Lab Experiments: Programming in Python

1. Write a python program for (i) matrix operations (ii) Eigen values and Eigen vectors of a given matrix (iii) to diagonalise the given square matrix.
2. Write a python program for application of diagonalization of matrices in engineering.
3. Write a python program for computing the (i) derivatives of functions (ii) Jacobian of several variables.
4. Write a python program for evaluating of (i) integrals (ii) Area of Curves (iii) Volume of rotation and the 3D View of the Surfaces.
5. Write a python program to find the motion of a boat across a stream.
6. Write a python program to find the velocity of escape from the earth.
7. Write a python program to find the deflection of beams under given stress.
8. Write a python program to find the acceleration of a moving particle using numerical methods. (Contaminant Transport)
9. Write a python program to solve an ODE in deflection of a beam using Runge- kutta method of fourth order.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44thEdition, 2017.

Reference Books:

1. Erwin kreyszig, "Advanced Engineering Mathematics", 10thEdition, John Wiley & Sons, 2015.
2. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", S. Chand & Company, 2ndrevised Edition, Reprint2007.
3. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, NewDelhi.
4. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", LaxmiPublications, Reprint, 2010.
5. David Beazley and Brian K Jones, "Python Cooking: Recipes For Mastering Python 3", O'Reilly Media, Inc, CA 95472, Third Edition, 2013.

20MA1021	Multivariable Calculus and Differential Equations	L	T	P	C
		3	1	0	4

Course Objectives

1. Demonstrate knowledge in special functions and series.
2. Solve using differentiation and integration techniques.
3. Formulate physical phenomena using vector spaces.

Course Outcomes

The student will be to

1. Evaluate surface area and volume using definite integral.
2. Express functions as infinite series.
3. Apply differentiation techniques to find extreme values of functions.
4. Calculate gravity and mass using integration techniques.
5. Relate vector calculus with magnetic field and moving fluid
6. Solve linear partial differential equations of first order.

Module 1: Sequences and Series **7 Lectures**

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions-Application of power series in polarization study (for classroom discussion, assignments and term paper work).

Module 2: Calculus **7 Lectures**

Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volume. Application in drug delivery system (for classroom discussion, assignments and term paper work).

Module 3: Fourier series **7 Lectures**

Full range – change of interval- Half range sine and cosine series, Parseval's theorem, Harmonic analysis. Application of Fourier series in bio signal processing (for classroom discussion, assignments and term paper work).

Module 4: Multivariable Calculus: Differentiation **8 Lectures**

Limit, continuity and partial derivatives, total derivative; Jacobians. Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, directional derivatives, curl and divergence.

Module 5: Multivariable Calculus: Integration **8 Lectures**

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Applications: area and volume. Application of calculus in modeling of physiological systems (for classroom discussion, assignments and term paper work).

Module 6: Ordinary and Partial Differential Equations **8 Lectures**

Ordinary Differential Equations: Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation; First order partial differential equations: solutions of first order standard types and Lagrange's equations. Application of differential equations in modeling of physiological systems (for classroom discussion, assignments and term paper work).

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44^{th}Edition, 2017.

Reference Books:

1. T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.
2. B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill, New Delhi, 2010.
3. N.P.Bali and M.Goyal,"A text book of Engineering Mathematics", Laxmi Publications, 2010.
4. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
5. W.E.Boyce and R.C.Di Prima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.
6. G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007.

		L	T	P	C
20MA1022	**Matrices, Transforms and Numerical Methods**	**3**	**1**	**0**	**4**

Course Objectives:

1. Demonstrate knowledge in matrices
2. Classify numerical solutions of algebraic and transcendental equations
3. Recognize the fundamental concepts of Transforms.

Course Outcomes:

The student will be able to

1. Analyze quadratic form using orthogonal transformation of matrix.
2. Compare integration solution and numerical solution.
3. Solve differential equations using Laplace Transforms.
4. Categorize Z-Transform of sequence and series.
5. Solve difference equations problems in their engineering fields.
6. Describe the different transform techniques.

Module 1: Matrices **7 Lectures**

Eigen values and eigenvectors; Cayley-Hamilton Theorem, Diagonalization of matrices; Orthogonal transformation to reduce quadratic forms to canonical forms

Applications in Biomaterial Science and related case study (for classroom discussion, assignments and term paper work).

Module 2: Numerical Method I **7 Lectures**

Solution of algebraic and transcendental equations – Bisection method, Newton-Raphson method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

Applications in Biomechanics and related case study (for classroom discussion, assignments and term paper work).

Module 3: Numerical Methods-II **7 Lectures**

Ordinary differential equations of first order: Taylor's series, Euler and modified Euler's methods. RungeKutta method of fourth order. Partial differential equations Solution of Laplace equation by Liebmann method, Applications in Bioinformatics and related case study (for classroom discussion, assignments and term paper work).

Module 4: Laplace Transform **8 Lectures**

Laplace transform- Definitions and Properties, Laplace transform of periodic functions. Inverse Laplace transform. Solving Ordinary differential equations.

Applications in Biomedical Signal Processing, Biomedical optics and biocontrol systems and related case study(for classroom discussion, assignments and term paper work).

Module 5: Fourier Transform **8 Lectures**

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions– Finite Fourier transform-definition-simple problems .Applications in biosignal processing and Medical Imaging and related case study (for classroom discussions, assignments and term paper work).

Module 6: Z Transform, Wavelet Transform **8 Lectures**

Standard Z transforms–Standard results -Inverse Z-transforms of standard functions-Method of Partial fractions – properties - Application to solve Difference equations. Wavelet transform-definition.

Applications in bio-signal processing and Medical Imaging and related case study (for classroom discussions, assignments and term paper work).

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017. Reference Books: 1. D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.

Reference Books:

1. N.P.Bali and M.Goyal, "A text book of Engineering Mathematics",Laxmi Publications, 2008.
2. V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press, 2005.
3. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", S. Chand & Company, 2nd Edition, Reprint2012.
4. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

		L	T	P	C
20MA1023	**Statistical Methods**	**1**	**0**	**2**	**2**

Course objectives:

1. Acquire the knowledge of statistical methods.
2. Understand the process of using statistics in Agricultural problems.
3. Develop the skills of problem solving in Agriculture.

Course outcomes:

1. Identify the applications of statistics to Agriculture.
2. Measure the central tendency and dispersion of Data.
3. Recognize the different probability distributions.
4. Utilize testing tools to verify hypothesis.
5. Design the experiments and make appropriate decisions.
6. Apply the skills of sampling in problem solving.

Course Descriptions:

Theory : Introduction to Statistics and its Applications in Agriculture, Graphical Representation of Data, Measures of Central Tendency & Dispersion, Definition of Probability, Addition and Multiplication Theorem (without proof). Simple Problems Based on Probability. Binomial & Poisson Distributions, Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation. Linear Regression Equations. Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table. Introduction to Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.

Practical: Graphical Representation of Data. Measures of Central Tendency (Ungrouped data) with Calculation of Quartiles, Deciles& Percentiles. Measures of Central Tendency (Grouped data) with Calculation of Quartiles, Deciles& Percentiles. Measures of Dispersion (Ungrouped Data).Measures of Dispersion (Grouped Data). Moments, Measures of Skewness& Kurtosis (Ungrouped Data). Moments, Measures of Skewness& Kurtosis (Grouped Data). Correlation & Regression Analysis. Application of One Sample t-test. Application of Two Sample Fisher's t-test. Chi-Square test of Goodness of Fit. Chi-Square test of Independence of Attributes for 2 ×2 contingency table. Analysis of Variance One Way Classification. Analysis of Variance Two Way Classification. Selection of random sample using Simple Random Sampling.

Reference Books:

1. Veerarajan T, "Probability, Statistics and Random Processes", Second Edition, Tata McGraw Hill publishing company, 2003.
2. Gupta S.P., "Statistical Methods", New Delhi, S.Chand& Co., 37thEdition, 2009.
3. Gupta S.C. and Kapoor V.K., "Fundamentals of Applied Statistics", Sultan Chand & Co., 1990.
4. Gomez, K.A. and Gomez, A.A., "Statistical Procedures for Agricultural Research", John Wiley and Sons. New York. 1984.
5. Panse, V. G. and P.V. Sukhatme, "Statistical Methods for Agricultural Workers", Indian Council of Agricultural Research, New Delhi, India, 1967.

		L	T	P	C
20MA2001	**Numerical Mathematics and Statistics**	**3**	**0**	**2**	**4**

Course Objectives:

1. Solving algebraic equations, interpolation and numerical integration.
2. Recognize splines.
3. Solve using differential equations.

Course Outcomes:

The Student will be able to

1. Knowledge about different methods of solving algebraic equations.
2. Interpolate data.
3. Compute using numerical integration.
4. Compute using spline functions.
5. Solving ordinary differential equations using numerical techniques.
6. Solving partial differential equations using numerical techniques.

Module 1: Solving algebraic equations and Interpolation **9 Lectures**
Nested Multiplication - Simple Numerical problems using Taylor's series- Representation of numbers in different bases. Bisection Method- Convergence of Bisection Method-Newton's method-Geometry of Newton's method-Polynomial interpolation - Newton interpolating polynomial - Calculating Newton interpolating formula using divided difference-Lagrange interpolating polynomial – Applications to shape function in FEM, Solving Kepler's equation in orbital mechanics.

Module 2: Numerical Integration and Splines **8 Lectures**
Trapezoidal rule - Romberg Algorithm-Simpson's rule-Gaussian Quadrature Formulas. First degree spline–examples-Second degree splines–Natural cubic splines– Applications to aircraft wing structural design.

Module 3: Ordinary differential equations **6 Lectures**
Taylor series methods-Euler's Method -Runge-Kutta method of order 4-Adams-Bashforth method-A predictor-corrector scheme – Application to buckling of structures, solving perturbed equations of motion in orbital mechanics.

Module 4: Partial Differential Equations **7 Lectures**
Parabolic Problems-Finite difference method- explicit method-Crank- Nicolson method- Hyperbolic problems-Wave equation model problems-Numerical solution-Elliptic Problems-Helmholtz equation model problems-Gauss-seidal Iterative method- Application in heat transfer methods.

Module5: Probability **7 Lectures**
Conditional probability, Baye's theorem-Moments generating functions. Discrete random variables; Probability mass and distribution functions – Discrete distributions; binomial, Poisson distribution. Continuous random variables and their properties. Distributions; normal, exponential and Gamma. Bivariate random variables – Applications of inventory management in aircraft industries. (M/c learning)

Module 6: Statistics and Sampling **8 Lectures**
Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis; Correlation andregression – Rank correlation. Curve fitting by the method of least squares- Test of significance: Large samples, Tests for single mean, difference of means, and difference of standard deviations. Small samples: t-test, F-test and Chi-square test for goodness of fit and independence of attributes. Applications in health monitoring and failure analysis of aircraft components.

List of experiments using MATLAB

1. Solving algebraic equation using bisection method.
2. Computing Newton Interpolating polynomial.
3. Creating Lagrange Interpolating polynomial.
4. Numerical Integration using Gaussian quadrature method.
5. Numerical Integration using Simpson's 1/3 rd rule, Simpson's 3/8 thrule..
7. Finding the solution of ODE using R-K method.
8. Solving ODE using Taylor's method.
9. Computing Binomial and Poisson distributions.
10. Finding exponential and Gamma distributions.
11. Computing correlation and regression.

Text Books:

1. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Cengage Learning Brooks/Cole Publishing Company, California, 2012.
2. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
3. T.Veerarajan,"Probability,Statistics and Random Processes", 2ndEdition,TataMcGraw-Hill,New Delhi, 2010.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010.

3. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall, 2003.
4. Kandasamy. P., Thilagavathy K., “Numerical Methods”, S. Chand & Co. Ltd., 2010.
5. Kandasamy P., Thilagavathi K and Gunavathi K., “Engineering Mathematics” Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.

20MA2002	Applied Computational Mathematics	L	T	P	C
		2	0	2	3

Course objective:

1. Develop the students with knowledge in continuous and periodic series and transforms.
2. Familiarize the students in the field of heat, wave and fluid models.
3. Test the solution of problems through MATLAB tools.

Course outcome:

The student will be able to

1. Build the solution of engineering problems through continuum model.
2. Relate Fourier series to solve dynamic problems.
3. Interpret the skills in Fourier transform to engineering models.
4. Apply differential techniques to solve multivariate models.
5. Make use of mathematical principles in solving heat and wave models.
6. Infer the knowledge of modeling to fluid problems.

Module 1: Preliminary Techniques for Continuum Models 8Lectures

Laplace Transform, Properties of Laplace Transform.-Inverse Laplace transform by different methods-Convolution theorem- Evaluation of integrals and solving Ordinary differential equations using Laplace transform. Calculating the maximum deflection of an encastre beam.

Module 2: Spectrum Analysis of Periodic Functions 8 Lectures

Euler’s formula–Conditions for a Fourier expansion–Functions having points of discontinuity–Change of Interval–Even and odd functions. Half range Fourier series**:** Typical wave forms – Complex form of Fourier series–Harmonic analysis. Finding Displacement of a crank through angular movement.

Module 3: Continuum Model in Infinite Domain 7 Lectures

Infinite Fourier transform pair – Fourier sine and cosine transforms – Properties of Fourier transform – Transforms of simple functions – Convolution theorem of Fourier transform – RMS value and Parseval’s identity. Finding temperature distribution in a half space.

Module 4: Multivariate Modeling 7 Lectures

Formations-solution of partial differential equations-Lagrange’s linear equation-Non-linear equations of first order (excluding Charpit’s method)-Homogenous linear equations with constant coefficients. Modeling of radio equation.

Module 5: Heat and Wave equation 7 Lectures

Solutions of one-dimensional wave equation – One-dimensional heat equation – Steady state solution (Cartesian co-ordinates only)- Two-dimensional heat equation: Temperature distribution in rectangular plate and infinite strip. Vibration models of String and plate.

Module 6: Appliedmodeling of physical processes. 8 Lectures

Two-Dimensional Horizontal Model and Stationary Flows: Equation of Ingredient Transport in Dissolved Phase, Equation of Suspended Particles Transport. Equation of ingredient Transport on Suspended Particles. Equations of Water Dynamics. Equation of Ground Deposit Contamination. Analysis of Stationary Flow Problem. About Simulation Techniques.

List of experiments using MATLAB

1. Starting with MATLAB creating arrays-Mathematical functions.
2. To find Laplace and Inverse Laplace transform of standard functions.
3. To solve Fourier transform of standard functions.

4. Creating complex array and plotting complex function.
5. Solving vibrational problems – membrane.
6. Solving one-dimensional wave equation.
7. Computing one-dimensional heat flow problems.
8. Programming Euler's, method and Collocation method.
9. Solving PDE using Finite difference method.
10. Computing fluid problems and plotting the output.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
2. Hritonenko, Yatsenko, "Applied Mathematical Modelling of Engineering Problems", Kluwer Academic Publishers, ISBN 978-1-4613-4815-3 I (ebook), 2003.

Reference Books:

1. Veerarajan T., "Engineering Mathematics", second edition, Tata McGraw-Hill, New Delhi, 2009.
2. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (sixth revised Edition), S. Chand & Co., New Delhi, 2006.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 9thEdition, John Wiley & Sons, 2006.
4. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9thEdition, Wiley India, 2009.
5. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7thEd.,Mc-GrawHill,2004.
6. Venkataraman M.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.
7. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

20MA2003	Simulation of Numerical Mathematics	L	T	P	C
		2	0	2	3

Course Objective:

1. To develop skills in numerical methods for solving the engineering problems.
2. To understand the method of numerical integration.
3. To highlight the importance of splines.

Course Outcome:

The students will be able to

1. Solve algebraic equations numerically in engineering fields.
2. Extend the uses of representation of numbers in different bases in engineering fields.
3. Produce numerical solution for transcendental equations in engineering fields.
4. Illustrate the interpolation techniques in other branches.
5. Evaluate integration using numerical methods.
6. Develop the application of splines in engineering fields.

Module 1: Solving Algebraic Equations **8 Lectures**

Representation of numbers in different bases-Bisection Method-Bisection method problems and pseudocode--Convergence of Bisection Method. Secant Method problems and Pseudo code. Regula-Falsi method problems and pseudo code.

Module 2: Interpolation **6 Lectures**

Polynomial interpolation-Existence-Newton interpolating polynomial- Nested form and pseudo code-Divided difference table and Pseudo code-Lagrange interpolating polynomial-Errors in polynomial interpolations.

Module 3: Numerical Integration **6 Lectures**

Romberg Algorithm related problems and pseudo code - Gaussian Quadrature method - Problems. Pseudo code for Trapezoidal rule, Simpson's ⅓ rd and 3/8th rules.

Module 4: Ordinary Differential Equations **7 Lectures**

Numerical Solutions of Ordinary Differential Equations –Taylor's Series Method – Euler's Method – Modified Euler's Method – Runge-Kutta Method of fourth order -Pseudocode-Adams-Moulton method-Pseudo code.

Module 5: Partial Differential Equations **8 Lectures**

Parabolic Problems-Finite difference method-Pseudo code for explicit method-Crank-Nicolson method-Pseudo code of Crank-Nicolson method-Hyperbolic problems-Wave equation model problems-Numerical solution-Pseudo code-Elliptic Problems-Laplace Equations - Liebmann's process.

Module 6: Integral Models of Physical Systems **10 Lectures**

Converting Differential Models to Integral Models: Initial Value Problems. Boundary Value Problems for Ordinary Differential Equations: Green's Function. Boundary Value Problems for Partial Differential Equations: Boundary Integral Equation Method. Integral Models Occurring in Physical Problems: Integral Model of Membrane Vibrations. Integral Models of Nuclear Reactors Dynamies

List of experiments using MATLAB:

1. Solving algebraic equation using bisection method.
2. Solving algebraic equation using regulafalsi method
3. Computing Newton Interpolating polynomial.
4. Creating Lagrange Interpolating polynomial.
5. Numerical Integration using Gaussian quadrature method.
6. Numerical Integration using Trapezoidal method.
7. Numerical Integration using Simpson's 1/3 rd rule, Simpson's 3/8 th rule.
8. Finding the solution of ODE using R-K method.
9. Solving ODE using Euler's method and Modified Euler's method.
10. Solving PDE using Crank Nicolson method.

Text Books:

1. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Cengage Learning Brooks / Cole Publishing Company, California, 2012.
2. Hritonenko, Yatsenko, "Applied Mathematical Modelling of Engineering Problems", Kluwer Academic Publishers, ISBN 978-1-4613-4815-3 I, 2003.

Reference Books:

1. M.K.Jain., Iyengar. S.R.K., Jain R.K., "Numerical Methods for Scientific and Engineering Computation", 6th Edition, New Age International, 2012.
2. Rajasekaran. S., "Numerical Methods in Science and Engineering: A Practical Approach", S. Chand publishers, 2003.
3. Kandasamy. P., Thilagavathy K., "Numerical Methods", S. Chand & Co. Ltd., 2010.

20MA2004	Partial Differential Equations, Probability and Statistics	L	T	P	C
		3	1	0	4

Course Objectives:

1. Demonstrate knowledge in solution of first and second order partial differential equations
2. Formulate problems using random variables.
3. Examine observed data using statistical methods

Course Outcomes:

The student will be able to

1. Understand solution of partial differential equations.

2. Apply solution of partial differential equations in heat and wave equations
3. Understand conditional probability and moment generation
4. Measure the relationship between variables
5. Execute the test of hypothesis for large and small samples
6. Examine the independence of attributes

Module 1: Partial Differential Equations **8 Lectures**

Mobile robot path planning using PDE. First order partial differential equations, solutions of first order standard type and Lagrange's equations. Solution to higher order homogenous linear partial differential equations.

Module 2: Boundary value Problems: **7 Lectures**

Image denoising using heat equation - Solutions of one-dimensional wave equation – One-dimensional heat equation – Steady state solution -two-dimensional heat equation (Finite plate-Cartesian co-ordinates).

Module 3: **Probability I** **8 Lectures**

Risk management in information security based on Probability - Definitions and axioms, conditional probability, Baye's theorem- One dimensional Discrete random variables; Probability mass function and distribution functions – Discrete distributions; binomial, Poisson distribution.

Module 4: Probability II **8 Lectures**

Insurance/Financial applications of probability distributions. Continuous random variables and their properties. Distributions; normal, exponential and Gamma. Bivariate random variables (both Discrete and continuous) and their properties.

Module 5: Statistics **7 Lectures**

Basic Statistics in business intelligence and planning, Measures of Central tendency: Moments, skewness and Kurtosis; Correlation and regression – Rank correlation. Curve fitting by the method of least squares-fitting of straight lines, second-degree parabolas

Module 6: Sampling **7 Lectures**

Performance analysis of algorithms using Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means- Small samples: t-test, F-test and Chi-square test for goodness of fit and independence of attributes.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
2. T.Veerarajan, "Probability,Statistics and Random Processes", 2nd Edition, Tata McGraw-Hill, New Delhi, 2010.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003(Reprint).
4. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
5. S. Ross, "A First Course in Probability", 6th Edition, Pearson Education India, 2002.

20MA2005	Discrete Structures	L	T	P	C
		3	1	0	4

Course Objectives:

1. To provide basic concepts in sets, numbers theory and logic
2. To relate error detection system and Boolean algebra.

3. To solve optimization problems using graph theory.

Course Outcomes:

The Student will be able to

1. Solve the problems using the concepts of sets, functions and relations.
2. Apply number theory in data encryption.
3. Demonstrate knowledge in counting techniques.
4. Establish truth values using mathematical logic
5. Understand algebraic structures and morphisms.
6. Model network problems using graph and trees

Module 1: Sets, Relation and Function **8 Lectures**

Vehicle Model Catalogue using Set, Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Functions, Sum and Product of Functions, Bijective functions, Inverse and Composite Function.

Module 2: Number theory **6 Lectures**

Securing Online Transaction using Number Theory-The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

Module 3: Basic counting techniques **6 Lectures**

CAPTCHA Creation using Counting Techniques, Mathematical Induction, Inclusion and exclusion, pigeon-hole principle, permutation and combination.

Module 4: Propositional Logic **7 Lectures**

Knowledge representation in artificial intelligence-Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers.

Module5: Algebraic Structures and Morphism **10 Lectures**

Automatic Error Diagnosing System using Boolean Algebra-Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Boolean algebra and Boolean Ring Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

Module 6: Graphs and Trees **8 Lectures**

Map for Online Food Delivery System Based on Graphs and Their Properties- Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, definition properties and example, rooted trees, trees and sorting, Shortest distances

Text Books:

1. J.P. Tremblay and R. Manohar, "Discrete Mathematical Structure and Its Application to Computer Science", TMG Edition, Tata Mcgraw-Hill, 2015.
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw –Hill, 2015

Reference books:

1. BernaldKolman, Robert C. Busby and Sharon Culter Ross, "Discrete Mathematical structures", 6thEdition, Pearson Education, 2009.
2. Susanna S. Epp, "Discrete Mathematics with Applications", 4thEdition, Wadsworth Publishing Co.Inc, 2010.
3. C L Liu and D P Mohapatra, "Elements of Discrete Mathematics A Computer Oriented Approach", 3rdEdition by, Tata McGraw –Hill, 2012.
4. Norman L. Biggs, "Discrete Mathematics", 2ndEdition, Oxford University Press, 2010.
5. Schaum's Outlines Series, Seymour Lipschutz, MarcLipson, "Discrete Mathematics", Tata McGraw –Hill, 2013.

6. Alexander Stanoyevitch, "Discrete Structures with Contemporary Applications", 1st Edition, CRC Press, Inc., 2011.
7. Duane Hanselman and Bruce Littlefield, "Mastering Matlab 7", Pearson, 2013.
8. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2ndEdn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).

20MA2006	**Probability and Stochastic Processes**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

1. Understand the basic concepts of Probability.
2. Measure uncertainty using various probability distributions.
3. Analyze linear system using random process.

Course Outcomes:

The student will be able to

1. Recognize probability models
2. Solve using discrete and continuous random variables.
3. Classify the problems using probability distributions
4. Analysesfunctions of random variables
5. Determine the characteristics of random processes
6. Understand propagation of random signals in linear systems.

Module 1: Probability **7 Lectures**

Definitions and axioms - conditional probability; Independent events-Theorem of Total Probability-Baye's Theorem; -Bernoulli's trials.Application: Bayes' classifier - pattern recognition- Communication -Entropy concept (for classroom discussions, assignments and term paper work).

Module 2: Random Variables **7 Lectures**

Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function.Two Dimensional Random Variables: Discrete and Continuous random variables, Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables. Applications: Linear IC, ADC concept - Digital Communications- Delta modulation, quantization error. (For classroom discussions, assignments and term paper work).

Module 3: Probability Distributions **7 Lectures**

Discrete: Binomial and Poisson. Continuous: Normal, Exponential and Gamma Distributions- Tchebycheff Inequality, central limit theorem(without proof) - problems.Applications: Communication - noise calculations/derivations in AM, FM, PM, PCM. (For classroom discussions, assignments and term paper work).

Module 4: Functions of Random Variables **8 Lectures**

Moment Generating Function(MGF)-Properties of MGF, Characteristic Function (CF)-Properties of CF.Function of One Random Variable, transformations of two Random Variables.Applications: MIMO, Wireless communication. (For classroom discussions, assignments and term paper work).

Module 5: Random Processes **8 Lectures**

Definition-Basic concepts and examples, Strict and wide sense stationaries, ergodicity - Second Order processes. Autocorrelation function and its properties-Power Spectral Density function-Linear system with random input. (Theorems statement only).Applications: Signals and systems-CTFT,DTFT concepts. (For classroom discussions, assignments and term paper work).

Module 6: Special Random Processes **8 Lectures**

Gaussian Process-Poisson process-Markov Process (theorems statement only)-Properties. Applications: MIMO, Wireless communication, Digital Communication. (For classroom discussions, assignments and term paper work).

Text Books:

1. Veerarajan T., "Engineering Mathematics (for semester III)", Tata McGraw-Hill, Newdelhi,2010.

Reference Books:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, 9thEdition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal BookStall, 2003(Reprint).
3. S. Ross, “A First Course in Probability”, 6thEd., Pearson Education India, 2002.
4. H. Stark and J. Woods, “Probability and Random Processes with Applications to Signal Processing," 3rdEdition, Pearson Education, 2002.
5. A.Papoulis and S. Unnikrishnan Pillai, “Probability, Random Variables and Stochastic Processes," Fourth Edition, Mc-GrawHill, 2002.
6. S.C.Gupta, V.Kapoor, “Fundamentals of Mathematical Statistics”, Tenth revised edition, Sultan Chand & Sons, 2000.

20MA2007	Probability and Statistics	L	T	P	C
		3	0	2	4

Course Objective:

1. Develop the skills of the students in the area of data analytics.
2. Outline the basic principles of relationship and predictive analysis in machine learning problems
3. Provide the basic concept of probability distribution, statistical inference and also apply R software to visualize the data

Course Outcomes:

The student will be able to

1. Determine the statistical measures of data
2. Analyze the linear relationship of variables using linear in correlation and regression models
3. Apply the concept of probability in machine learning problems
4. Adapt the knowledge of randomness of data
5. Model the data using probability distributions.
6. Develop the knowledge in decision making

Module 1: Preliminaries of Data Analytics **6 Lectures**

Frequency distribution and measures of central tendency- mean, median and mode–measures of dispersion–standard deviation-mean deviation-quartile deviation and its coefficients- coefficient of variation. Application - Survey data analysis–Consistency of the product - Visually inspecting data to improve product quality.(For classroom discussions, assignments and term paper work).

Module 2: Linear Relationship and Predictive Models **5 Lectures**

Karl Pearson’s correlation coefficients – Spearman’s Rank Correlation – Repeated Rank Correlation-Lines of regression and Regression equations. Application - Strength of relation between two variables – Measuring similarity between the data –Estimation of association among the variables.(for classroom discussions, assignments and term paper work).

Module 3: Probability – A tool in Machine Learning **8 Lectures**

Axioms of probability - Mathematical definition of probability - Conditional probability –Independent events –Addition law and multiplication law- Theorem of Total Probability-Baye’s Theorem (statement only) and its problems. Application –Decision making –Prediction Problems in a real life – Construction of machine learning model.(for classroom discussions, assignments and term paper work).

Module 4: Randomness of Data **8 Lectures**

One Dimensional Random Variables: Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function. Two Dimensional Random Variables: Discrete random variables, Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables. Application in data analytics problems (for classroom discussions, assignments and term paper work).

Module 5: Modeling of Data **8 Lectures**

Discrete Distribution: Binomial and Poisson distribution – Poisson distribution is a limiting case of binomial distribution - Fitting binomial and Poisson distribution - Continuous Distribution: Normal and Exponential distribution–Properties. Application –Analyzing the performance practical problems – Cloud computing (for classroom discussions, assignments and term paper work).

Module 6: Decision Making Techniques **10 Lectures**

Tests of Significance-large sample tests- Single mean- difference of two means – Single Proportion - difference of two proportion– Small sample test– Student's t test–Single mean-difference of two means- F test - Chi square test - Goodness of fit – Test of independence attributes. Application-Performance analysis- Comparative analysis – Quality testing. (for classroom discussions, assignments and term paper work).

Lab Experiments: Programming in R

1. Introduction to Programming in R and syntax.
2. Preparation of graphs and plots using R.
3. Compute measures of central tendency and dispersion.
4. Applying linear regression and correlation model to real dataset.
5. Solving problems based on probability.
6. Probability functions of discrete and continuous distribution.
7. Find expected value and variance for random variables.
8. Hypothesis test for large samples using mean values.
9. Test of hypothesis for small sample- t, F test.
10. Applying Chi-Square test for goodness of fit and contingency test to real dataset.

Text Books:

1. T. Veerarajan, "Probability, Statistics and Random Processes", 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

References:

1. S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand &Sons, 11th Revised Edition 2007.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10thEdition, John Wiley & Sons, 2015.
3. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
4. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
5. S. Ross, "A First Course in Probability", 9thEdition, Pearson Education India, 2019.
6. A.Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGrawHill, 2002.
7. G.JayKarns, "Introduction to Probability and Statistics using R", Third Edition, 2018.

20MA2008	Probability, Statistics and Random Processfor RoboticEngineering	L	T	P	C
		3	0	2	4

Course Objectives:

1. Understand random variables.
2. Measure uncertainty using various probability distributions.
3. Analyze data with statistical techniques using R.

Course Outcomes:

The student will be able to

1. Recognize probability models and solve using discrete and continuous random variables.
2. Classify the problems using probability distributions.
3. Apply statistical testing techniques for mobile robot applications.
4. Perform small sample tests using statistical techniques.
5. Design experiments for Data Analysis.

6. Apply random process for stochastic modeling.

Module 1: Random Variables **5 Lectures**

One dimensional Random variables – Two dimensional random variables - Discrete and continuous random variables.Application: Mathematical fundamentals of probabilistic robots.(for classroom discussions, assignments and term paper work).

Module 2: Probability Distributions **5 Lectures**

Binomial, Poisson, Exponential, Normal, Gamma, (Problems only) - Correlation – Regression (Problems only).Application of probability distributions for uncertainty analysis and error propagation in robot perception and motion.(for classroom discussions, assignments and term paper work).

Module 3: Large Sample Tests **6 Lectures**

Tests of means, variances and proportions – Large sample test based on Normal distribution for single mean and difference means. Test for single proportion, difference of proportion.Application of statistical testing in mobile robotics. (For classroom discussions, assignments and term paper work).

Module 4: **Small Sample Tests** **6 Lectures**

Tests of means, variances and attributes using t, F, Chi square distribution – Interval estimation for mean and proportion – Contingency table – Goodness of fit. Application: Mathematical Foundation of Machine Learning (for classroom discussions, assignments and term paper work).

Module 5: Design of Experiments **5 Lectures**

One way and two way classifications – Completely randomized block design – Latin square design. Application in the positioning and optimization of robots (for classroom discussions, assignments and term paper work).

Module 6: Random Process **8 Lectures**

Classification of random process – Stationary process – Auto correlation and cross correlation – properties – Mean ergodic and correlation ergodic process - properties –Markov process – Markov chain- Classification of states of a Markov chain – Steady state distribution of a Markov chain. Application: Basics of stochastic modeling and control of systems. (For classroom discussions, assignments and term paper work).

List of Experiments using R:

1. Evaluating mean, variance and CDF of one dimensional DRV.
2. Evaluating mean, variance and CDF of one dimensional CRV.
3. Fitting the following probability distributions: Binomial distribution, Normal distribution and Poisson distribution.
4. Hypothesis test for large samples using mean values.
5. Hypothesis test for small samples using mean values.
6. Applying Chi-square test for goodness of fit test and Contingency test to real data set.
7. Design of experiment using ANOVA (CRD).
8. Design of experiment using ANOVA (RBD).

Text Books:

1. Veerarajan T., "Probability and Random Process (with Queuing Theory and Queuing Networks)", Mc Graw-Hill Education (India) Pvt Ltd., New Delhi, 4thEdition, 2016.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9thEdition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal BookStall, 2003(Reprint).
3. S. Ross, "A First Course in Probability", 6thEd., Pearson Education India,2002.
4. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010.
5. The Math Works Inc, "Statistics Toolbox User's Guide", 2004.

6. G.JayKarns, “Introduction to Probability and Statistics using R”, Third Edition, 2018

20MA2009	Probability and Statistics Using R Programming	L	T	P	C
		2	0	2	3

Course Objectives:

1. Understand random variables and analyze linear system using random process.
2. Measure uncertainty using various probability distributions.
3. Analyze data with statistical techniques using R.

Course Outcomes:

The student will be able to

1. Identify probability models and solve using discrete and continuous random variables.
2. Classify the problems using probability distributions.
3. Test the hypothesis for large samples.
4. Analyze the parameters and attributes of small samples.
5. Construct the experimental designs using Analysis of Variance.
6. Examine ergodicity of random process.

Module 1: Random Variables **8 Lectures**

One Dimensional Random Variables: Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function. Two Dimensional Random Variables: Discrete random variables, Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables – Application in Biochemical engineering problems.

Module 2: Probability Distributions **8 Lectures**

Discrete Distribution: Binomial and Poisson distribution – Poisson distribution is a limiting case of binomial distribution - Fitting binomial and Poisson distribution - Continuous Distribution: Normal and Exponential distribution–Properties - Correlation – Regression -Measuring the influences between factors.

Module 3: Large Sample Tests **7 Lectures**

Tests of means, variances and proportions – Large sample test based on Normal distribution for single mean and difference means. Test for single proportion, difference of proportion - performance analysis.

Module 4: Small Sample Tests **8 Lectures**

Small sample test - Student’s t test - Single mean-difference of two means-F test-Chi square test-Goodness of fit - Test of independence attributes – Application- Comparative analysis - Quality testing.

Module 5: Design of Experiments **7 Lectures**

Analysis of variance: one-way and two-way classification. Completely randomized design - Randomized block design - Simple Latin Square Design-Problems in Manure distribution.

Module 6: Random Process **7 Lectures**

Classification of random process – Stationary process – Auto correlation and cross correlation – properties – Mean ergodic and cross ergodic process - properties –Markov process – Markov chain- Classification of states of a Markov chain – Steady state distribution of a Markov chain – Application in data analytics.

List of Experiments using R:

1. Introduction to Programming in R and syntax.
2. Preparation of graphs and plots using R.
3. Evaluating mean, variance and cdf of one dimensionalDRV.
4. Evaluating mean, variance and cdf of one dimensional CRV.
5. Fitting the Binomial distribution and Poisson distribution distributions.
6. Hypothesis test for large samples using mean values.
7. Hypothesis test for small samples using mean values.
8. Applying Chi-square test for goodness of fit test and Contingency test to real data set.
9. Design of experiment using ANOVA (CRD).
10. Design of experiment using ANOVA (RBD).

Text Books:

1. Veerarajan T., "Probability and Random Process (with Queuing Theory and Queuing Networks)", Mc Graw-Hill Education (India) Pvt Ltd., New Delhi, 4thEdition2016.
2. Veerarajan T., "Probability, Statistics and Random Processes", Second Edition, TataMcGraw Hill publishing company, 2007.

Reference Books

1. Gupta S.P., "Statistical Methods", Sultan Chand and sons, New Delhi, 2009.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal BookStall, 2003(Reprint).
4. S. Ross, "AFirstCoursein Probability", 6thEd., Pearson Education India, 2002.
5. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010.
6. The MathWorksInc, "Statistics Toolbox User's Guide", 2004.
7. G.JayKarns, "Introduction to Probability and Statistics using R", Third Edition, 2018.

20MA2010	Business Mathematics	L	T	P	C
		3	0	2	4

Course Objectives:

1. Understand the concepts of progressions, financial methods, Permutations and Combinations in decision making.
2. Acquire the knowledge to represent the business models using set theory and matrix methods.
3. Develop the Linear Programming Problem to find solutions to business problems.

Course Outcomes:

The student will be able to

1. Recognize the progression techniques in solving finance problems.
2. Determine the solutions to financial transactions.
3. Apply the concept of permutations and combinations in business organizations.
4. Represent the business problems using set theory.
5. Construct and solve business problems using matrix methods.
6. Formulate the business problems in terms of LPP.

Module 1: Progressions **8 Lectures**

Numerical sequence and series - Arithmetic progression – Sum of n terms of an A.P- Geometric progression - Sum of n terms of G.P - Summations and applications of progressions in solving finance problems.

Module 2: Finance **8 Lectures**

Simple and Compound Interests - Effective rate of Interest - Sinking Fund – Annuity - Present Value of an immediate annuity and annuity due – Amount of an immediate annuity and annuity due - Discounting of Bills - True Discount – Bankers discount - Banker's Gain.

Module 3: Permutations and Combinations **7 Lectures**

Principle of counting – Factorial notation – Permutations – Different types of permutation – Applications of permutation in business organizations – Combinations – Types of combinations – Applications of combinations in managerial decision making.

Module 4: Set Theory **7 Lectures**

Introduction - Types of sets - Venn diagram - Operations on sets – Union – Intersection – Difference of sets - Relations – Functions - Constants and Variables - Applications of set theory concepts in business environment.

Module 5: Matrices **8 Lectures**

Introduction - Types of matrices - Operations of matrices – Determinants - Inverse of a matrix - Rank of a matrix - Solving simultaneous linear equations using Cramer's rule and Matrix Inversion method – Input-output Analysis.

Module 6: Linear Programming problem **7 Lectures**

Introduction – Structure of LPP - Mathematical formulation of LPP - Graphical method: Types of solutions – No solution – Unique solution – Infinite number of solution - Unbounded solution - Solving an LPP by Graphical Method.

List of Experiments using Excel:

9. Solving A.P and G.P of a sequence and series.
10. Find the simple and Compound interest.
11. Finding the Annuities.
12. Calculate the discounting of bills.
13. Calculation of Permutation and Combination.
14. Operations of sets using Venn diagram.
15. Performing Matrix operations and evaluation of Determinants.
16. Solving linear simultaneous equations using Cramer's Rule.
17. Finding solution of linear simultaneous equations using matrix inversion method.
18. Performing LPP graphically in excel.

Text Books:

1. Navanitham P.A, "Business Mathematics & Statistics", Jai Publishers, Trichy, 2017.

Reference Books:

1. J.K. Singh, "Business Mathematics", Himalaya Publishing House, 2015.
2. N Sundaresan and Jayaseelan, "Introduction to Business Mathematics", Sultan Chand & Co Ltd, New Delhi, 2010.
3. Sanchetti D.C and Kapoor V.K, "Business Mathematics", Sultan Chand & Co Ltd, New Delhi, 2014.
4. Ranganath G.K, Sampangiram C.S and Rajaram Y, "A Text book of Business Mathematics", Himalaya Publishing House, 2014.
5. Jayaprakash Reddy R, "Business Mathematics", APH Publishing Corporation, 2012.

20MA2011	Mathematics for Finance	L	T	P	C
		3	0	2	4

Course Objectives:

1. Understand the concepts of progressions, financial methods, Permutations and Combinations in decision making.
2. Acquire the knowledge to represent the business models using set theory and matrix methods.
3. Develop the Linear Programming Problem to find solutions to business problems.

Course Outcomes:

The student will be able to

1. Determine the solutions to financial transactions.
2. Recognize the progression techniques in solving finance problems.
3. Apply the concepts of set theory, permutations and combinations in business organizations.
4. Construct and solve business problems using matrix methods.
5. Formulate the business problems in terms of LPP.
6. Solve the Linear programming problems using Simplex method.

Module 1: Finance **8 Lectures**

Ratios and Proportions - Certain types of interest rates - Types of Annuities - Present value and amount of an annuity - Cases of continuous compounding - Valuations of simple loans and debentures - Problems relating to sinking funds - Bill Discounting and Average Due Date.

Module 2: Progressions **8 Lectures**

Arithmetic Progression (A.P.) – Sum of n terms of an A.P - Geometric progression (G.P.) - Sum of n terms of G.P - Harmonic Progression (H.P.) - Applications of progressions in solving finance problems.

Module 3: Set Theory and Counting principle **7 Lectures**

Methods of description of sets - Types of sets - Operations on sets - Set theory and its practical applications – Principle of counting - Permutations and Combinations -Mathematical induction- Binomial Theorem.

Module 4: Matrices and Determinants **7 Lectures**

Matrix Operations - Determinants with simple applications for solution of linear simultaneous equations using Cramer's Rule - Matrices with simple application for solution of linear simultaneous equations using matrix inversion method.

Module 5: Linear Programming problem **8 Lectures**

Formulation of Linear Programming problem - Graphical method of solution: No solution – Unique solution – Infinite number of solution - Unbounded solution - Problem relating two variables including the case of mixed constraints.

Module 6: Simplex method and Transportation problem **7 Lectures**

Simplex method: Solution of problems up to three variables - Solution for cases of mixed constraints - Duality - Transportation Problem - Initial basic feasible solution: North West Corner Rule, Least Cost Method and Vogel's Approximation Method.

List of Experiments using Excel:

1. Finding the Annuities.
2. Calculate the discounting of bills.
3. Solving A.P, G.P and H.P of a sequence and series.
4. Calculation of permutation and combination.
5. Computing Binomial expansion with excel.
6. Performing Matrix operations and evaluation of Determinants.
7. Solving linear simultaneous equations using Cramer's Rule.
8. Finding solution of linear simultaneous equations using matrix inversion method.
9. Performing LPP graphically in excel.
10. Solution to Simplex method.

Text Books:

1. Navanitham P.A, "Business Mathematics & Statistics", Jai Publishers, Trichy, 2017.

Reference Books:

1. J.K. Singh, "Business Mathematics", Himalaya Publishing House, 2015.
2. N Sundaresan and Jayaseelan, "Introduction to Business Mathematics", Sultan Chand & Co Ltd, New Delhi, 2010.
3. Sanchetti D.C and Kapoor V.K, "Business Mathematics", Sultan Chand & Co Ltd, New Delhi, 2014.
4. Ranganath G.K, Sampangiram C.S and Rajaram Y, "A Text book of Business Mathematics", Himalaya Publishing House, 2014.
5. Jayaprakash Reddy R, "Business Mathematics", APH Publishing Corporation, 2012.

20MA2012	Business Statistics with R	L	T	P	C
		3	0	2	4

Course Objectives:

1. Acquiring the knowledge of different business statistical methods.
2. Understand the process of different statistical methods.

3. Apply the statistical methods in different business environment.

Course Outcomes:

The student will be able to

1. Present the data in tabular and graphical representation.
2. Determine the central tendency of the data.
3. Evaluate the dispersion of the data and associate with real time.
4. Analyze the relationship between the business parameters.
5. Model the regression lines to predict and analyze the future.
6. Analyze the trend and forecast the business development.

Module 1: Introduction to Statistics **7 Lectures**

Definition of Statistics – Scope of Statistics in Commerce and Business - Characteristics and limitations – Collection, classification and tabulation of data - Scales of measurement – Presentation of data by Diagrammatic and Graphical methods- Survey and presentation from local firms.

Module 2: Measures of Central Tendency **8 Lectures**

Mathematical averages – Mean Median and Mode – Combined Arithmetic Mean - Positional Measures - Quartiles, Deciles and Percentiles – Measuring the positional averages for the business problems.

Module 3: Measures of Dispersion **8 Lectures**

Importance of measures of dispersion – Absolute and Relative Measures – Range – Coefficient of range – Inter-quartile range - Quartile deviation - Average deviation- Standard deviation – Variance - Coefficient ofvariation – Decision making on performance of parameters.

Module 4: Measurement of relationship **7 lectures**

Simple Correlation – Meaning and Definition – Types of correlation – Properties of correlation - Scatter diagram - Karl Pearson's co-efficient of Correlation - Spearman's Rank Correlation – Ranks not given – Tied ranks – Measuring the influences between factors.

Module 5: Prediction Analysis **7 Lectures**

Simple linear regression - Lines of regression - Method of studying regression – Properties of regression lines and coefficients – Problems in regression of two variables – Difference between correlation and regression

Module 6: Analysis of Time Series and Business forecasting **8 Lectures**

Meaning and applications of Time series – Methods of measuring trend and Seasonal variations - Index number- Meaning and types of Index numbers- Unweighted: Simple aggregate and average of price relative Index numbers.

List of Experiments in R programming:

1. Basic R operations and concepts.
2. Constructing frequency table and diagrammatic presentation.
3. Draw the graphical representation of data- Histogram and Ogives.
4. Calculate measures of Central Tendency – Mean, median and mode.
5. Calculate the positional measures – quartiles, deciles and percentiles.
6. Compute the measures of Dispersion.
7. Solving coefficient of correlation.
8. Fitting simple linear regression.
9. To analyze the Time series.
10. Calculate the Index numbers.

Text Books:

1. Navanitham P.A, "Business Mathematics & Statistics", Jai Publishers, Trichy, 2017.

Reference Books:

1. R.S.N.Pillai, Bhagavathi, Statistics-Theory & practice, Sultan Chand & Sons, 2010.
2. S.P.Gupta, Statistical methods, Sultan Chand & Sons, 2012.

3. J.Joseph Francis, Business Statistics, Cengage learning publishers Ltd, 2014.
4. S.C.Gupta, V.K. Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand &Sons, 10th Revised Edition 2000.
5. N. Bajpai, “Business Statistics”, Pearson Education, New Delhi, 2013.

20MA2013	Statistical Methods for Finance	L	T	P	C
		3	0	2	4

Course Objectives:

1. Analyze data using statistical methods.
2. Acquire the knowledge of frequency distribution and measures of variations.
3. Develop the skills of measuring relationship, prediction and forecasting.

Course Outcomes:

The student will be able to

1. Identify the different forms of representation of data.
2. Determine the measure of central tendency of the data.
3. Evaluate the dispersion of the data and associate with real situations.
4. Estimate the various types of index numbers.
5. Recognize the different methods of Time series analysis and forecasting.
6. Discuss the relationship between variables using correlation and regression analysis.

Module 1: Introduction to Statistics **7 Lectures**

Meaning and Scope of Statistics - Data collection - Data classification and tabulation – Scales of measurement – Diagrams: Bar diagrams and Pie diagram - Graphical presentation: Histogram, frequency polygon, frequency curve and ogive curves.

Module 2: Measures of Central Tendency **8 Lectures**

Averages - Mathematical averages: Arithmetic Mean (A.M), Geometric mean (G.M) and Harmonic Mean (H.M) – Relationships between A.M, G.M, and H.M - Positional averages: Median and Mode - Measuring the averages for the business problems.

Module 3: Measures of Dispersion **8 Lectures**

Concept of variation - Purpose of measuring variation – Range - Inter-quartile range - Quartile deviation – Coefficient of quartile deviation - Average deviation and its coefficient - Standard Deviation – Variance - Coefficient of variation.

Module 4: Index numbers **7 Lectures**

Meaning and types of Index numbers – Construction of Index numbers – Price Index – Quantity Index – Unweighted: Simple aggregate method and Simple average of relatives method - Weighted: Laspeyre’s, Paasche’s and Fisher’s Index numbers.

Module 5: Analysis of Time Series **7 Lectures**

Meaning and Components of Time series – Business forecasting - Measurement of Secular trend: Graphic method, Semi-average method, Moving average method, Method of least squares - Measurement of Seasonal variations.

Module 6: Measurement of Relationship and Prediction **8 Lectures**

Simple Correlation – Definition and properties of correlation coefficient – Scatter diagram - Karl Pearson’s co-efficient of correlation - Spearman’s rank correlation - Regression Analysis – Lines of regression – The two regression equations.

List of Experiments in R programming:

1. Basic R operations and concepts.
2. Data visualization and basic graphs.
3. To draw the bar and Pie Diagrams.
4. To draw the graphical representation of data- Histogram and Ogives.
5. Calculate measures of Central Tendency.

6. Calculate measures of Dispersion.
7. Compute the Index numbers.
8. To analyze the Time series.
9. Solving Karl Pearson coefficient of correlation.
10. Fitting simple linear regression.

Text Books:

1. Navanitham P.A, “Business Mathematics & Statistics”, Jai Publishers, Trichy, 2017.

Reference Books:

1. R.S.N.Pillai, Bhagavathi, Statistics-Theory & practice, Sultan Chand & Sons, 2010.
2. S.P.Gupta, Statistical methods, Sultan Chand & Sons, 2012.
3. J.Joseph Francis, Business Statistics, Cengage learning publishers Ltd, 2014.
4. S.C.Gupta, V.K. Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand &Sons, 10^{th} Revised Edition 2000.
5. N. Bajpai, “Business Statistics”, Pearson Education, New Delhi, 2013.

20MA2014	Mathematics for Digital Science	L	T	P	C
		3	1	0	4

Course Objectives:

1. Acquire the knowledge of calculus and combinatorics.
2. Understand the logic and computing procedures.
3. Apply the process of combinatorics in computing.

Course Outcomes:

The student will be able to

1. Apply matrix techniques in solving simultaneous equations.
2. Recognize different calculus methods.
3. Use sets in computer representation.
4. Make decision using permutation and combination.
5. Construct and solve problems using Logic.
6. Model network problems.

Module 1: Matrices **8 Lectures**

Introduction- Matrix operations - The trace and determinant of a matrix- Properties of determinants (excluding the proof) - Rank of a matrix – Inverse of a matrix – Solving simultaneous equations: Cramer’s rule and Inverse method - Eigen values and Eigen vectors: properties, problems.

Module 2: Calculus **7 Lectures**

Differentiation from the first principle -Rules of differentiation- Methods of Differentiation: Implicit differentiation, Logarithmic differentiation – Integral calculus - Integration of standard functions - Integration by parts.

Module 3: Algebra **7 Lectures**

Sets and subsets – Operations on sets – Set identities – Cartesian product of sets – Venn Diagrams – Computer representation of sets - Multisets – Functions - Sequences – recurrence relation – Summations.

Module 4: Combinatorics **7 Lectures**

Counting principle – Sum and product rule, subtraction and division rule – Tree diagram - The Pigeonhole principle – Applications of Pigeonhole principle- Permutations and Combinations with and without repetition.

Module 5: Logic **8 Lectures**

Proposition – Conditional statements - Truth tables of compound proposition – Precedence of Logical operators – Logic and Bit operations – Propositional Equivalences – Tautology, Logical equivalences – Applications of Propositional logic: Translating English sentences.

Module 6: Networks **8 Lectures**

Graphs – Terminology of graphs – Representing graphs – Isomorphic graphs –Paths - Euler paths and circuits – Hamiltonian paths and circuits – Labeled trees– undirected trees – minimal spanning trees (Definition, examples and Theorems statement only).

Text Books:

1. Grewal B.S, "Higher Engineering Mathematics", 42^{nd} Edition, Khanna Publications, Delhi, 2012.
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill, 8^{th} Edition, 2019.

Reference Books:

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 6^{th} Edition, Pearson Education, 2009.
2. J.P. Tremblay and R. Manohar, "Discrete Mathematical Structure and Its Application to Computer Science", TMG Edition, Tata McGraw-Hill, 2015.
3. Susanna S. Epp, "Discrete Mathematics with Applications", 4^{th} Edition, Wadsworth Publishing Co.Inc, 2010.
4. Veerarajan T., "Engineering Mathematics", second edition, Tata McGraw-Hill, New Delhi, 2009.
5. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (sixth revised Edition), S. Chand & Co., New Delhi, 2006.

20MA2015	Fundamentals of Statistics and Probability	L	T	P	C
		3	1	0	4

Course Objectives:

1. Understand the basic principles of Statistics
2. Develop the skills of prediction and forecasting analysis.
3. Acquire the knowledge of probability models.

Course Outcomes:

The student will be able to

1. Recognize the different types of presentation of data.
2. Measure the central tendency and dispersion of data.
3. Analyze the linear relationship.
4. Identify the different methods of Time series analysis and forecasting.
5. Utilize the concepts of probability.
6. Apply the probability models to fit the data.

Module 1: Representation of Data **7 Lectures**

Statistics: Definition, Scope and Significance – Collection, classification and tabulation of data – Frequency distribution: Discrete and Continuous - Scales of measurement: Nominal, Ordinal and Interval - Diagrammatic and Graphical representation.

Module 2: Measurement of location **7 Lectures**

Measurement of central tendency: Mean, median and mode – Measurement of dispersion: Range, Quartile deviation, Mean deviation, standard deviation and its coefficients – Testing of consistency.

Module 3: Measurement of linear relationship and prediction **7 Lectures**

Correlation – Definition and types of correlation – Scatter diagram - Karl Pearson's co-efficient of correlation - Spearman's rank correlation – Repeated ranks - Regression Analysis: Lines of regression and regression equations - Regression in two variables.

Module 4: Forecasting **8 Lectures**

Meaning and Components of Time series – Measurement of Secular trend: Graphic method, Semi-average method, Moving average method and Method of least squares - Measurement of Seasonal variations: Simple Average method.

Module 5: Probability **8 Lectures**

Axioms of probability - Mathematical definition of probability - Conditional probability –Independent events –Addition law and multiplication law - Theorem of Total Probability - Baye's Theorem (statement only) and its problems.

Module 6: Models in Probability **8 Lectures**

Discrete Distribution: Binomial and Poisson distribution – Poisson distribution is a limiting case of binomial distribution - Fitting binomial and Poisson distribution - Continuous Distribution: Normal distribution.

Text Books:

1. R.S.N.Pillai, Bhagavathi, Statistics-Theory & practice, Sultan Chand & Sons, 8th edition 2016.
2. T.Veerarajan, "Probability, Statistics and Random Processes", 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.

Reference Books:

1. S.C.Gupta , V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 11th Revised Edition 2007.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2015.
3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
4. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
5. S. Ross, "A First Course in Probability", 9th Edition, Pearson Education India, 2019.

20MA2016	Statistics and Probability for Data Science	L	T	P	C
		3	1	0	4

Course Objectives:

1. Understand the basic tools of statistics.
2. Develop the skills of prediction and relationship analysis.
3. Acquire the knowledge of probability models.

Course Outcomes:

The student will be able to

1. Recognize the different types of presentation of data.
2. Measure the central tendency and dispersion of data.
3. Analyze the linear relationship.
4. Utilize the concepts of probability.
5. Determine the randomness of data.
6. Apply the probability models to fit the data.

Module 1: Representation of Data **7 Lectures**

Statistics: Definition, Scope and Significance – Collection, classification and tabulation of data – Frequency distribution: Discrete and Continuous - Scales of measurement: Nominal, Ordinal and Interval - Diagrammatic and Graphical representation.

Module 2: Measurement of location **7 Lectures**

Measurement of central tendency: Mean, median and mode – Measurement of dispersion: Range, Quartile deviation, Mean deviation, standard deviation and its coefficients – Testing of consistency.

Module 3: Measurement of linear relationship and prediction **7 Lectures**

Correlation – Definition and types of correlation – Scatter diagram - Karl Pearson's co-efficient of correlation - Spearman's rank correlation – Repeated ranks - Regression Analysis: Lines of regression and regression equations - Regression in two variables.

Module 4: Probability **8 Lectures**

Axioms of probability - Mathematical definition of probability - Conditional probability –Independent events –Addition law and multiplication law - Theorem of Total Probability - Baye's Theorem (statement only) and its problems.

Module 5: Randomness of Data **8 Lectures**

Random Variables: Discrete and Continuous random Variables - Probability mass function – Probability density function – Properties – Joint Distribution – marginal and conditional distributions - Independent random variables.

Module 6: Models in Probability **8 Lectures**

Discrete Distribution: Binomial and Poisson distribution – Poisson distribution is a limiting case of binomial distribution - Fitting binomial and Poisson distribution - Continuous Distribution: Normal distribution.

Text Books:

1. R.S.N.Pillai, Bhagavathi, "Statistics-Theory & practice", Sultan Chand & Sons, 8th edition, 2016.
2. T.Veerarajan, "Probability, "Statistics and Random Processes", 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.

Reference Books:

1. S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 11th Revised Edition 2007.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2015.
3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
4. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
5. S. Ross, "A First Course in Probability", 9th Edition, Pearson Education India, 2019.

20MA2017	Discrete Mathematics	L	T	P	C
		3	1	0	4

Course Objective:

1. Acquire the knowledge of basic algebra and mathematical logic.
2. Understand the process of combinatorics, relations and digraphs.
3. Apply the ideas of lattices and graphs in computing.

Course Outcome:

The students will be able to

1. Identify the various set operations and arithmetic algorithms.
2. Describe the logical equivalence relations.
3. Make decisions using permutation and combination.
4. Recognize the different types of relations.
5. Build their knowledge in lattices.
6. Analyze the properties of graphs.

Module 1: Basic Algebra **8 Lectures**

Sets and subsets - Operation on sets – Sequences – Matrices - Mathematical induction - Recurrence relation - Division in the integers – The division algorithm: Prime Numbers - Greatest common divisor - Euclidean algorithm - Fundamental Theorem of Arithmetic.

Module 2: Mathematical Logic **8 Lectures**

Syntax – Semantics - Validity and Satisfiability - Basic Connectives and Truth Tables - Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers.

Module 3: Combinatorics **8Lectures**

Counting principle – Sum and product rule, subtraction and division rule – Tree diagram - The Pigeonhole principle – Applications of Pigeonhole principle- Permutations and Combinations with and without repetition

Module 4: Relations and digraph **8 Lectures**

Products sets and partitions - Definition and properties of binary relations - Representing Relations - Paths in relations and digraphs - Properties of relations - Equivalence relations - Operations on relations - Transitive closure and Warshall's algorithm.

Module 5: Lattices **5 Lectures**

Lattices as partially ordered set - Properties of Lattices - Lattices as algebraic system - Sub lattices - Direct product and Homomorphism - Some special lattices.

Module 6: Graphs and Trees **8 Lectures**

Graphs and their properties: Degree, Connectivity, Path, Cycle, Sub Graph - Eulerian and Hamiltonian Walks - Graph Coloring - Coloring maps and Planar Graphs - Properties of trees - Rooted trees - Undirected trees - Minimal spanning trees.

Text Books:

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill, 8th Edition, 2019.
2. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 6th Edition, Pearson Education, 2009.

Reference books:

1. J.P. Tremblay and R. Manohar, "Discrete Mathematical Structure and its Application to Computer Science", TMG Edition, Tata McGraw - Hill, 2015.
2. Susanna S. Epp, "Discrete Mathematics with Applications", 4th Edition, Wadsworth Publishing Co.Inc, 2010.
3. C L Liu and D P Mohapatra, "Elements of Discrete Mathematics A Computer Oriented Approach", 3rd Edition by, Tata McGraw –Hill, 2012.
4. Norman L. Biggs, "Discrete Mathematics", 2nd Edition, Oxford University Press, 2010.
5. Seymour Lipschutz, MarcLipson, Schaum's Outlines Series, "Discrete Mathematics", Tata McGraw – Hill, 2013.
6. Alexander Stanoyevitch, "Discrete Structures with Contemporary Applications", 1st Edition, CRC Press, Inc., 2011.

20MA2018	Fuzzy Sets and Logic	L	T	P	C
		3	1	0	4

Course Objective:

1. Acquire the knowledge of fuzzy sets and fuzzy logic.
2. Understand the fuzzy operations, fuzzy numbers and fuzzy equations.
3. Apply fuzzy systems and fuzzy controller in Digital sciences.

Course Outcome:

Students will be able to

1. Recognize the different types of fuzzy sets.
2. Identify the operations of fuzzy sets.
3. Solve the problems using fuzzy arithmetic operations.
4. Differentiate classical logic and fuzzy logic.
5. Develop fuzzy expert systems.
6. Create rule base fuzzy systems.

Module 1: Classical to Fuzzy sets **6 Lectures**

Introduction- Crisp sets- an overview- fuzzy sets and types- fuzzy sets and basic concepts- Alpha cuts- Representation of fuzzy sets. Operations on fuzzy sets- Types of operations- fuzzy complements.

Module 2: Operations **8 Lectures**

Fuzzy intersections and t-Norms – Axioms – Examples of t-Norms: standard intersection, Algebraic product, Bounded difference, Drastic difference, fuzzy union and t-Co-norms – Axioms – Examples of t-co-norms – Standard union, Algebraic sum, Bounded sum and Drastic sum.

Module 3: Fuzzy Arithmetic **8 Lectures**

Fuzzy Numbers- Linguistic variables- Arithmetic operations on intervals-arithmetic operations on fuzzy numbers: Addition, subtraction, multiplication and division- lattice of fuzzy numbers- Fuzzy Equations.

Module 4: Fuzzy Logic **8 Lectures**

Classical Logic - an overview-Multi valued logics-fuzzy propositions - fuzzy quantifiers - Linguistic Hedges-Inference from conditional fuzzy propositions – Inference from Conditional and Qualified Propositions – Inference from Quantified Propositions.

Module 5: Approximate reasoning **6 Lectures**

Approximate Reasoning - Fuzzy Expert systems – An overview – Fuzzy implications – Axioms – Selection of Fuzzy implications – Multi conditional Approximate Reasoning – Interval valued approximate reasoning.

Module 6: Fuzzy Systems **8 Lectures**

Fuzzy controllers - An Overview- Fuzzification - Defuzzification - fuzzy rule base- fuzzy inference-defuzzification methods: Center of Area method, Center of Maxima method and Mean of Maximum method - fuzzy neural networks- fuzzy automata.

Text Book:

1. George J. Klir and Bo Yuan "Fuzzy Sets and Fuzzy Logic, Theory and Applications", Prentice – Hall of India, Pvt. Ltd., New Delhi, 2005.

Reference Books:

1. James J. Buckley, EsfaniarEslami., "An Introduction to Fuzzy Logic and Fuzzy Sets", (3rd Edition), Springer-Verlag, 2011.
2. Ganesh M., "Introduction to Fuzzy sets and Fuzzy Logic", (1st Edition), Prentice Hall of India Pvt., Ltd., 2006.
3. H J Zimmermann, Hans Jurgen Zimmerman, "Fuzzy Set Theory- And Its Applications", Springer-Verlag, 2001.
4. Timothy J. Ross., "Fuzzy Logic with engineering applications", 3rd Edition, John Wiley, 2010.
5. Barnabas Bede, Mathematics of Fuzzy Sets and Fuzzy Logic, Springer-Verlag Berlin Heidelberg, 2013.

20MA2019	Optimization Techniques	L	T	P	C
		3	1	0	4

Course Objectives:

1. Acquire the knowledge of Linear Programming problem and the methods of solution.
2. Understand the algorithms of transportation, assignment and sequencing models.
3. Develop the competitive games and analyze the network models.

Course Outcomes:

The student will be able to

1. Recognize the graphical solutions of LPP.
2. Identify the simplex and duality methods of solving LPP.
3. Classify the solutions of Transportation model.
4. Analyze the assignment and sequencing algorithms
5. Construct games and define the winning strategies.
6. Solve the network problems and simulate the data.

Module 1: Linear Programming Problem **6 Lectures**

Formulation of Linear Programming problem – Convex set – Convex functions - Graphical solutions to L.P.P: No solution, unique solution, infinitely many solutions and unbounded solution

Module 2: Simplex and Duality algorithm **10 Lectures**

Simplex method - Artificial variable technique: Big M - method and Two-phase simplex method - Degeneracy - Duality: Definition of dual problem – Dual and Simplex method – Dual simplex method

Module 3: Transportation model **7 Lectures**

Initial basic feasible solution: North West Corner Rule, Least Cost Method and Vogel's Approximation Method – Optimal solution: MODI method - Moving towards optimality without degeneracy -Degeneracy problems.

Module 4: Assignment and Sequencing problem **7 Lectures**

Introduction - Hungarian Method and problems - Unbalanced assignment problems - Travel sales person problems - Sequencing problem - processing of n jobs through 2 machines - n jobs through m machines

Module 5: Game Theory **7 Lectures**

Competitive games – Rectangular game – Saddle point - Two person zero-sum games – Maximum-minimum principle - Solution of games with saddle point - Games without saddle points -Mixed strategies for 2 x 2 games - Graphic method

Module 6: Network analysis and Simulation models **8 Lectures**

Formulation of Network problems - Network models for project analysis CPM - network construction and time analysis, cost time trade off - PERT problems - Elements of simulation model - Monte Carlo technique and its applications

Text Books:

1. Hamdy A Taha, "Operations Research", Pearson, 8th Edition, 2019.

Reference Books:

1. KantiSwarup, Gupta and Manmohan, "Operations Research", Sultan Chand and Sons, 15th Edition, 2010.
2. J K Sharma, "Operations Research Theory and Applications", Trinity Press, 6th Edition, 2017.
3. PaneerSelvam, "Operations Research", PHI learning Indian (P) Ltd, 2nd Edition, 2011.
4. Kapoor V.K, "Operations Research", Sultan Chand & sons, New Delhi, 2013.
5. Vittal P.R, "Operations Research", Margham Publications, 2012.

20MA2020	Calculus for Data Science	L	T	P	C
		3	1	0	4

Course Objectives:

1. Acquire the knowledge of differentiation and integration techniques.
2. Understand the process of solving differential equations.
3. Apply the concepts of differentiation and integration in finding area and volume.

Course Outcomes:

The student will be able to

1. Apply differentiation techniques to find extreme values of functions.
2. Relate functions with infinite series.
3. Solve using multivariable differentiation techniques.
4. Compute area and volume using integration techniques.
5. Solve differential equations.
6. Relate vector calculus with magnetic field and moving fluid.

Module 1: Single Variable Calculus **8 Lectures**

Limits and Continuity- L Hospital's rule - Differentiation - Rules of differentiation: Product rule, Quotient rule - Chain rule – Maxima and Minima - Integration of standard functions –Integration by parts – Definite Integrals.

Module 2: Sequences and series **7 Lectures**

Convergence of sequences and series - tests for convergence - Integral test, comparison test, ratio test, Power series, Series of exponential and logarithm functions.

Module 3: Multivariable calculus **8 Lectures**

Limits and Continuity – Partial derivatives – Jacobians– Taylor's theorem (statement only) and expansion – Maxima and Minima – Constrained extremum by Lagrange's multiplier method.

Module 4: Multiple integral **7 Lectures**

Double integrals – Changing the order of integration – Double integrals in Cartesian and polar forms- Evaluation of triple integrals- Application of multiple integrals in finding area and volume.

Module 5: Ordinary and Partial Differential Equations **8 Lectures**

Linear Differential Equations of first order – Second and higher order linear differential equations with constant coefficients - First order partial differential equations: Solutions of first order standard types and Lagrange's equations.

Module 6: Vector Calculus **7 Lectures**

Differentiation of vectors – Velocity and Acceleration – Scalar and Vector point functions - Gradient and directional derivative - Divergence and Curl- Irrotational and Solenoidal fields - Physical interpretation

Text Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. Erwin kreyszig, "Advanced Engineering Mathematics", 9thEdition, John Wiley & Sons, 2006.
2. W.E.Boyce and R.C.Di Prima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.
3. G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007.
4. S. Narayanan and Manicavachagam Pillai T.K., "Calculus vol I, II and III" S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai 2009.
5. T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.
6. B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill, New Delhi, 2010.

20MA2021	Linear Algebra for Data Science	L	T	P	C
		3	1	0	4

Course Objective:

1. Acquire the knowledge of solving system of linear equations.
2. Understand the concept of vector spaces.
3. Apply the sparse matrix methods in data science.

Course Outcomes:

The student will be able to

1. Solve system of linear equations.
2. Determine the Eigen values and Eigen vectors.
3. Differentiate the independence and dependence of vectors.
4. Describe the concepts of Inner product spaces.
5. Recognize the properties of linear transformation.
6. Solve data science problems using sparse matrices.

Module 1: System of linear equations: **8 Lectures**

Solving system of linear equations – Cramer's rule - Matrix inversion method – Consistency of linear system of equations - Gauss elimination method - Gauss Jordan method - Gauss-Jacobi method – Gauss - Seidal method.

Module 2: Eigen values and Eigen vectors **8 Lectures**

Introduction toEigen values and Eigen vector – Properties of Eigen values – Cayley-Hamilton Theorem– Reduction to Diagonal Form – Canonical form - Reduction of quadratic form to canonical form.

Module 3: Vector spaces **7 Lectures**

Vector spaces and subspaces – Linear combination, Span, Linear independence and dependence - Null space, Column space and Row space – Basis and dimension of a vector space – Rank and nullity.

Module 4: Inner product spaces **8 Lectures**

Norm definition - Inner product, length, angle and orthogonality - Properties - Inner product spaces - Orthogonal vectors – Orthonormal vectors- Orthonormal basis - Gram-Schmidt orthogonalization process (problems only).

Module 5: Linear Transformation **7 Lectures**

Introduction to linear transformations – General linear transformations – Kernel and range – Matrices of general linear transformation - Geometry linear operators - Change of basis – Invertible transformations.

Module 6: Sparse Matrices **7 Lectures**

Introduction to sparse matrix – Graph representation – Storage Schemes – Basic sparse matrix operations – Sparse direct solution methods: Minimum degree ordering and Nested dissection ordering – random walk problems.

Text Books:

1. David C. Lay, Steven R. Lay and Judi J. McDonald "Linear Algebra and its Applications', Pearson Education, 5th Edition, 2016.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2015.
2. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", S. Chand & Company, 2nd revised Edition, Reprint 2007.
3. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2007.
4. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", LaxmiPublications, Reprint, 2010.
5. Gilbert Strang, "Linear Algebra and its Applications", Cengage Learning, 5th Edition, 2016.

20MA2022	Statistical Modelling	L 3	T 1	P 0	C 4

Course Objectives:

1. Acquire the knowledge of different statistical models.
2. Understand the process of testing of hypothesis.
3. Develop the skills of design the experiments and find solutions.

Course Outcomes:

The student will be able to

1. Recognize the methods of trend analysis.
2. Relate the position of data with moments, skewness and kurtosis.
3. Identify the appropriate sampling techniques.
4. Test the hypothesis for large samples.
5. Analyze the parameters and attributes of small samples.
6. Construct the experimental designs using Analysis of Variance.

Module 1: Trend Analysis **7 Lectures**

Meaning and Components of Time series – Measurement of trend: Graphic method, Semi-average method, Moving average method and Method of least squares: straight line, parabola and exponential fit.

Module 2: Moments **7 Lectures**

Moments – Normal probability curve - Skewness – Positive skewness – Negative skewness – Pearson's coefficient of skewness- Quartile coefficient of skewness - Kurtosis: Leptokurtic, Platykurtic and Mesokurtic.

Module 3: Sampling **7 Lectures**

Introduction: Population and sample – Types of sampling – purposive sampling – random sampling – simple sampling – stratified sampling – cluster sampling – quota sampling – judgment sampling – convenient sampling – sampling distribution – standard error.

Module 4: Testing of Hypothesis of Large samples **7 Lectures**

Hypothesis: Definition and types – critical region –Level of Significance - Types of error – one tailed and two tailed test - Large samples: Test for single proportion- difference of proportion–single mean – difference of means.

Module 5: Testing of Hypothesis of Small samples **7 Lectures**

Tests of Significance of small samples - Student's t- test: Test for single mean and difference of means – F test - Chi square test: Test for goodness of fit and independence of attributes – Yates correction.

Module 6: Design of Experiments **8 Lectures**

Basic principles of experimental design - Analysis of variance – one factor classification- two factors classification - Completely Randomized Design(CRD) – Randomized Block Design (RBD)– Latin Square Design(LSD).

Text Books:

1. S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 11^{th} Revised Edition 2007.

Reference Books:

1. T.Veerarajan, "Probability, Statistics and Random Processes", 3^{rd} Edition, Tata McGraw-Hill, New Delhi, 2017.
2. R.S.N.Pillai, Bhagavathi, Statistics-Theory & practice, Sultan Chand & Sons, 8^{th} edition 2016.
3. E. Kreyszig, "Advanced Engineering Mathematics", 10^{th} Edition, John Wiley & Sons, 2015.
4. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44^{th} Edition, 2017.
5. Jay L. Devore, "Probability and Statistics for Engineering and Sciences", Cengage Learning, 2015.

20MA2023	Probability, Random Variables and Statistics	L	T	P	C
		3	1	0	4

Course Objective:

1. To understand the basic concepts of Probability.
2. To measure uncertainty using various probability distribution.
3. To analyze data with statistical methods.

Course Outcomes:

The student will be able to

1. Understand basic concepts of probability.
2. Solve problems on discrete and continuous random variables.
4. Understand the concepts of two dimensional random variables and solve problems.
5. Classify the problems using probability distributions and apply appropriate distributions.
6. Measure central tendency of the data
7. Compare variables using correlation and regression.

Module 1: Probability **7 Lectures**

Definitions and axioms, conditional probability - Independent events - Theorem of Total Probability - Baye's Theorem, applications in system identification and Machine Learning and related case study(for classroom discussions, assignments and term paper work).

Module 2: One Dimensional Random Variables **7 Lectures**

Discrete Random Variable: Probability mass Function and distribution functions. Continuous Random Variable: Probability Density Function - Cumulative Distribution Function and Properties-Applications in Bio-signal processing and related case study(for classroom discussions, assignments and term paper work).

Module 3: Two Dimensional Random Variables **7 Lectures**

Two Dimensional Random Variables: Discrete and Continuous random variables, Cumulative Distribution Function- Marginal Probability Distribution - Conditional Probability Distribution - Independent Random

Variables- Medical Imaging applications and related case study(for classroom discussions, assignments and term paper work)..

Module 4: Probability Distributions **8 Lectures**

Binomial distribution, Poisson distribution and Normal distribution. Exponential - Moments generating functions and its properties, Applications of probability distribution in Bioinformatics and related case study(for classroom discussions, assignments and term paper work).

Module 5: Statistics I **8 Lectures**

Measures of Central tendency: Mean, Median, Mode, Geometric mean, Harmonic mean. Measures of Dispersion: Range, Quartile deviation, Mean Deviation, Standard Deviation, Coefficient of variation, Biostatistics for Biomedical Practitioners and related case study(for classroom discussions, assignments and term paper work)..

Module 6: Statistics II **8 Lectures**

Moments - Skewness and Kurtosis - Rank correlation, co-efficient of correlation and regression lines, Machine learning applications and Hypothesis testing to biological and medical systems(for classroom discussions, assignments and term paper work)..

Text Books:

1. T.Veerarajan, "Probability, Statistics and Random Processes", 2nd Edition, Tata McGraw-Hill, New Delhi, 2010.

Reference Books:

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
3. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
4. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 1968.
5. S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics, Sultan Chand &Sons, 10th Revised Edition, 2000.

20MA2024	Basics of Probability and Statistics	L T P C 2 0 2 3

Course Objective:

1. Understand the basic concepts of Probability.
2. Measure uncertainty using various probability distributions.
3. Analyze data with statistical techniques using R.

Course Outcomes:

The student will be able to

1. Apply basic concepts of probability.
2. Solve problems on discrete and continuous random variables.
3. Utilize the concepts of two dimensional random variables to solve problems.
4. Classify the problems using probability distributions and apply appropriate distributions.
5. Measure central tendency of the data.
6. Compare the relationship between variables using correlation and regression analysis.

Module 1: Probability **7 Lectures**

Definitions and axioms - conditional probability - Independent events - Theorem of Total Probability - Baye's Theorem - Application - Decision making - Prediction Problems in a real life.

Module 2: One Dimensional Random Variables **7 Lectures**

Discrete Random Variable: Probability mass Function and distribution functions. Continuous Random Variable: Probability Density Function - Cumulative Distribution Function and Properties- Application in food engineering problems.

Module 3: Two Dimensional Random Variables **7 Lectures**

Two Dimensional Random Variables: Discrete and Continuous random variables, Cumulative Distribution Function- Marginal Probability Distribution - Conditional Probability Distribution -Independent Random Variables- Application in food engineering problems.

Module 4: Probability Distributions **7 Lectures**

Binomial distribution -Fitting binomial distribution-Poisson distribution -Fitting Poisson distribution Normal distribution - Application - Analyzing the performance using practical problems.

Module 5: Statistics - I **7 Lectures**

Measures of Central tendency: Mean, Median, Mode. Measures of Dispersion: Range, Quartile deviation, Mean Deviation, Standard Deviation, Coefficient of variation- Measuring the positional averages for the real life problems- Decision making on performance of parameters.

Module 6: Statistics - II **7 Lectures**

Simple Correlation – Meaning and Definition - Types of correlation - Properties of correlation - Karl Pearson's co-efficient of Correlation - Spearman's Rank Correlation - coefficient of correlation and regression lines- Measuring the influences between factors.

List of experiments using R:

1. Introduction to Programming in R and syntax.
2. Preparation of graphs and plots using R.
3. Solving problems based on probability.
4. Probability functions of discrete and continuous distribution.
5. Fitting binomial distribution.
6. Fitting Poisson distribution.
7. Find expected value and variance for random variables.
8. Calculate measures of Central Tendency, mean, median and mode.
9. Calculate measures of Dispersion.
10. Applying linear regression and correlation model to real dataset.

Text Books:

1. T.Veerarajan, "Probability, Statistics and Random Processes", 2nd Edition, Tata McGraw-Hill, New Delhi, 2010.

Reference Books:

1. Veerarajan T., "Probability and Random Process (with Queuing Theory and Queuing Networks)", Mc Graw-Hill Education (India) Pvt Ltd., New Delhi, 4th Edition2016.
2. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
3. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
4. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
5. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 1968.
6. S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics, Sultan Chand &Sons, 10th Revised Edition, 2000.
7. G. Jay Karns, "Introduction to Probability and Statistics using R", Third Edition, 2018.

20MA2025	Statistical Data Analysis and Reliability Engineering	L	T	P	C
		2	0	2	3

Course Objective:

1. Demonstrate knowledge in curve fitting.
2. Categorize using the concepts of reliability engineering.
3. Analyze data with statistical techniques using R.

Course Outcome:

The student will be able to

1. Apply the concept of curve fitting to analyze the given data.
2. Test hypothesis for large samples.
3. Test hypothesis for small samples.
4. Construct design of experiments.
5. Analyze data using statistical quality control.
6. Understand the reliability engineering problems.

Module 1: Curve fitting **7 Lectures**

Curve fitting: Method of least squares - fitting of straight lines - second degree parabolas and curves reducible to linear forms ($y = ae^{bx}, y = ax^{b}, y = ab^{x}$).

Module 2: Large Sample tests **7 Lectures**

Large Sample tests**:** Test for single proportion, difference of proportions, Tests for single mean, difference of means –Application-Performance analysis.

Module 3: Small Sample tests **7 Lectures**

Small sample test - Student's t test - Single mean - difference of two means - F test-Chi square test - Goodness of fit - Test of independence attributes – Application- Comparative analysis - Quality testing.

Module 4: Design of experiments 7 **Lectures**

Analysis of variance: one-way and two-way classification. Completely randomized design - Randomized block design - Simple Latin Square Design-Problems in Manure distribution.

Module 5: Statistical quality control **7 Lectures**

Types of variation - types of control charts - control chart of mean and range, Sigma Chart, control chart of proportion of defectives and number of defectives, C- Chart, Advantages and Limitations of SQC-Application of quality control in food industry.

Module 6: **Reliability engineering** **7 Lectures**

Concepts of reliability, hazard function, mean time to failure, series and parallel systems, System Reliability Model in food engineering.

List of experiments using R:

1. Fitting a linear model using least square method.
2. Hypothesis test for large samples using mean values.
3. Hypothesis test for small samples using mean values.
4. Applying Chi-square test for goodness of fit test and Contingency test to real data set.
5. Performing ANOVA for real data set (CRD).
6. Performing ANOVA for real data set (RBD).
7. Performing ANOVA for real data set (LSD).
8. Control charts of mean and range.
9. Construction of P Charts.
10. Construction of C Charts.

Text Books:

1. Veerarajan, T., "Probability, Statistics and Random Processes", Tata McGraw Hill, NewDelhi, 2006.

Reference Books:

1. Veerarajan T., "Probability and Random Process (with Queuing Theory and Queuing Networks)", Mc Graw-Hill Education (India) Pvt Ltd., New Delhi, 4th Edition2016.
2. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2008.
3. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.
4. Balagurusamy, E., "Reliability Engineering", Tata McGraw-Hill Publishing Co., New Delhi, Fourth Reprint, 2003.

5. G.JayKarns, “Introduction to Probability and Statistics using R”, Third Edition, 2018.

20MA2026	Numerical Mathematics and Computing	L	T	P	C
		3	1	0	4

Course Objective:

1. To develop skills in numerical methods for solving engineering problems.
2. To understand the method of numerical integration.
3. To highlight the importance of splines.

Course Outcome:

The students will be able to

1. Solve algebraic and transcendental equations occur in engineering fields, numerically.
2. Apply interpolation in forming polynomials to predict data.
3. Find solutions to complicated integrals arising in the field of engineering using numerical Integration techniques.
4. Approximate polynomials to find desired solution using spline functions.
5. Apply different numerical techniques to solve ordinary differential equations.
6. Find approximate solutions to partial differential equations using numerical methods.

Module 1: Solving Algebraic Equations **8 Lectures**

Representation of numbers in different bases-Bisection Method-Bisection method problems and pseudo code--Convergence of Bisection Method. Secant Method problems and Pseudo code.Regula- Falsi method problems and pseudo code.

Module 2: Interpolation **6 Lectures**

Polynomial interpolation-Existence-Newton interpolating polynomial- Nested form and pseudo code-Divided difference table and Pseudo code-Lagrange interpolating polynomial-Errors in polynomial interpolations.

Module 3: Numerical Integration **6 Lectures**

Romberg Algorithm related problems and pseudo code - Gaussian Quadrature method - Problems. Pseudo code for Trapezoidal rule, Simpson’s ⅓ rd and 3/8th rules.

Module 4: Approximations by Spline Functions **5 Lectures**

First degree spline–examples-Second degree splines–Natural cubic splines–B splines. Construction of spline functions of degree one, two and three.

Module 5: Ordinary Differential Equations **10 Lectures**

Numerical Solutions of Ordinary Differential Equations –Taylor’s Series Method – Euler’s Method – Modified Euler’s Method – Runge-Kutta Method of fourth order -Pseudocode-Adams-Moulton method-Pseudo code.

Module 6: Partial Differential Equations **10 Lectures**

Parabolic Problems-Finite difference method-Pseudo code for explicit method-Crank-Nicolson method-Pseudo code of Crank-Nicolson method-Hyperbolic problems-Wave equation model problems-Numerical solution-Pseudo code-Elliptic Problems-Laplace Equations - Liebmann’s process- Local time derivatives - Stream lines - Path lines - Vorticity and Circulation – Stream function, Velocity potential function – Examples.

Text Books:

1. Ward Cheney and David Kincaid, “Numerical Mathematics and Computing”, Cengage Learning Brooks/Cole Publishing Company, California, 2012.

Reference Books:

1. M.K.Jain., Iyengar. S.R.K., Jain R.K., “Numerical Methods for Scientific and Engineering Computation”, 6^{th} Edition, New Age International, 2012.

2. Rajasekaran. S., “Numerical Methods in Science and Engineering: A Practical Approach”, S. Chand publishers, 2003.
3. Kandasamy. P., Thilagavathy K., “Numerical Methods”, S. Chand & Co. Ltd., 2010.

20MA3001	Probability and Biostatistics	L	T	P	C
		3	1	0	4

Course Objective:

1. Understand the basic concepts of Correlation and Regression.
2. Analyze data with statistical methods.
3. Measure uncertainty using various probability distributions.

Course outcome:

1. Solve problems on discrete and continuous random variable.
2. Classify the problems using probability distributions and apply appropriate distributions.
3. Compare variables using partial and multiple correlations.
4. Test hypothesis for large and small samples.
5. Test hypothesis using non parametric tests.
6. Construct Design of experiments.

Course Description:

Module 1: Probability and Random Variables 7 Lectures

Axioms of probability – conditional probability- Independent events – Total probability – Baye’s Theorem – Random variables – Discrete and continuous random variables- Moments – Moment generating functions and their properties.

Module 2: Probability Distributions 7 Lectures

Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Gamma, Weibull (Mean, Variance and Simple Problems) Chebychev’s inequality (Simple problems).

Module 3: Correlation and Regression 7 Lectures

Correlations and regression, Partial correlation: Partial correlation coefficient- zero order, first order, second order coefficients – partial correlation coefficient in case of four variables- second order partial correlation coefficients. Coefficient of multiple correlations.

Module 4: Testing of hypothesis 8 Lectures

Population – sample – one tailed and two tailed tests - Tests based on large samples –proportion and mean – Small samples – t, F, chi square tests.

Module 5: Non parametric tests 8 Lectures

Introduction – Advantages of non parametric tests – The Sign Test: The paired sample sign test - A Rank sum test : The Mann whitney U test – The One Sample Runs Test – The kruskal Wallis or H test.

Module 6: Design of experiments 8 Lectures

Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification-comparison of RBD and LSD.

Text Books

1. Gupta S.P., “Statistical Methods”, Sultan Chand and sons, New Delhi, 2009.
2. Veerarajan T., “Probability, Statistics and Random Processes”, Second Edition, Tata McGraw Hill publishing company, 2007.

Reference Book

1. Gupta S.C. and Kapoor V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Co., 2007.
2. Erwin Kreyszig, “Advanced Engineering Mathematics”, 9th Edition, John Wiley & Sons, 2006.
3. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Bookstalls, 2003(Reprint).

4. S. Ross, “A First Course in Probability”, 6th Ed., Pearson Education India, 2002.

20MA3002	Operations Research Techniques	L	T	P	C
		3	0	0	3

Course Objective:

1. Understand the basic concepts of linear programming problem.
2. Analyze data by using transport and assignment algorithms.
3. Illustrate queuing theory models.

Course Outcome:

The student will be able to

1. Apply the dynamic programming to solve problems of discreet and continuous variables.
2. Solve linear programming problems.
3. Classify the problems using feasible solutions.
4. Model the real world problem and simulate it.
5. Develop knowledge in job sequences problems.
6. Find the shortest path by using network models.

Module 1: Linear Programming Problem **9 Lectures**

The Linear Programming Problem - Introduction, formulation of Linear Programming problem, Graphical solution to L.P.P, Simplex Method, Artificial variable techniques, Two phase Method, Variants of the Simplex Method.

Module 2: Duality in Linear Programming **8 Lectures**

Duality In Linear Programming - Concept of duality, Fundamental properties of Duality, Duality & Simplex method, Dual simplex method.

Module 3: Transportation and Assignment Problems **6 Lectures**

The Transportation Problem: Introduction, Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy. Assignment Problem - Introduction, Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

Module 4: Network Model & Simulation **6 Lectures**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

Module 5: Queuing Models **8 Lectures**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module 6: Game Theory **8 Lectures**

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic programming, Flow in Networks, Game Theory Simulation.

Text Book

1. KantiSwarup, Manmohan, Gupta P.K., “Operational Research” Sultan Chand &Sons., 14th Edn.2008.

Reference Books

1. H.A. Taha, “Operations Research, An Introduction”, PHI, 2008.
2. J.C. Pant, “Introduction to Optimization: Operations Research”, Jain Brothers, Delhi, 2008.
3. Hitler Libermann, “Operations Research”, McGraw Hill Pub. 2009.
4. Pannerselvam, “Operations Research”, Prentice Hall of India 2010.
5. Winston, “Operations Research, Applications and Algorithms” , Cengage Learning, 4th Edition, 2004.
6. Harvey M Wagner, “Principles of Operations Research”, Prentice Hall of India 2010.

7. HamdyTaha. A., “Operations Research”, Sixth Edition, Prentice – Hall of India Private Limited, New Delhi, 1997.
8. Natarajan A.M., Balasubramani P., Tamilarasi A., “Operations Research”, 1stEdn,Pearson Education, 2003.
9. Srinivasan G., “Operations Research”, 1st Edition,Eastern Economy Edition, 2007.

20MA3003	Statistical Methods for Food Science	L T P C 3 0 0 3

Course Objectives:

1. Develop the knowledge of different statistical models.
2. Understand the basic concepts of Correlation and Regression.
3. Develop the skills of design of experiment and find solutions.

Course Outcomes:

The student will be able to

1. Determine the measures of central tendency of statistical data.
2. Relate the position of data with moments, skewness and kurtosis.
3. Test the hypothesis for large samples.
4. Analyze the parameters and attributes of small samples.
5. Identify the appropriate sampling techniques.
6. Construct the experimental designs using Analysis of Variance.

Module 1: Measurement of location **8 Lectures**

Measures of Central tendency: Mean, Median, Mode, Geometric mean, Harmonic mean. Measures of Dispersion: Range, Quartile deviation, Mean Deviation, Standard Deviation, Coefficient of variation-Measuring the positional averages for the real life problems- Decision making on performance of parameters.

Module 2: Measurement of linear relationship and prediction **8 Lectures**

Moments - Skewness and Kurtosis -Simple Correlation – Meaning and Definition - Types of correlation -Properties of correlation - Karl Pearson’s co-efficient of Correlation - Spearman’s Rank Correlation - coefficient of correlation and regression lines- Measuring the influences between factors.

Module 3: Testing of Hypothesis of Large samples **7 Lectures**

Hypothesis: Definition and types – critical region –Level of Significance - Types of error – one tailed and two tailed test - Large samples: Test for single proportion- difference of proportion–single mean – difference of means.

Module 4: Testing of Hypothesis of Small samples **7 Lectures**

Tests of Significance of small samples - Student’s‘t test: Test for single mean and difference of means – F test - Chi square test: Test for goodness of fit and independence of attributes – Yates correction

Module 5: Acceptance sampling **8 Lectures**

Acceptance sampling - Single sampling plan - flowchart and algorithm- six sigma concepts-Application of sampling in food problem.

Module 6: Design of experiments **8 Lectures**

Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification, comparison of RBD and LSD.

Text Books:

1. S.C.Gupta, V.K. Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, 11th Revised Edition 2007.
2. T.Veerarajan, “Probability, Statistics and Random Processes”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.

Reference Books:

1. R.S.N.Pillai, Bhagavathi, Statistics-Theory & practice, Sultan Chand & Sons, 8th edition 2016.

2. E. Kreyszig, “Advanced Engineering Mathematics”, 10th Edition, John Wiley & Sons, 2015.
3. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, 2017.
4. Jay L. Devore, “Probability and Statistics for Engineering and Sciences”, Cengage Learning, 2015.

20MA3004	Computational Design Lab for Food Science	L T P C 0 0 3 1.5

Course Objectives:

1. Understand the basic concepts of R Programming.
2. Develop applications in Statistics.
3. Analyze various probability distributions.

Course Outcomes:

The student will be able to

1. Analyze the data using measures of central tendency and dispersion.
2. Analyze the data using correlation and Regression.
3. Apply R program for testing of hypothesis.
4. Analyze the parameters and attributes of small samples.
5. Construct the experimental designs using Analysis of Variance.
6. Describe probability distributions.

List of Experiments:

Programming in R:

1. Introduction to Programming in R and syntax.
2. Preparation of graphs and plots using R.
3. Computing measures of Central tendency.
4. Computing measures of dispersion.
5. Compute Correlation coefficient.
6. Compute Regression.
7. Problems in testing of hypothesis-large sample tests.
8. Problems in testing of hypothesis-small sample tests.
9. Design of experiments- CRD.
10. Design of experiments- RBD.
11. Design of experiments- LSD.
12. Problems using Binomial distribution.
13. Problems using Poisson distribution.
14. Problems using Normal Distribution.

20MA3005	Mathematics for Machine Learning	L T P C 4 0 0 4

Course Objectives

1. Demonstrate knowledge in Linear Algebra and Analytical Geometry
2. Solve using Matrix Decomposition, vector calculus and Data Modeling
3. Prediction using Linear Regression and PCA

Course Outcomes:

Students will be able to

1. Relate matrices to solve dynamic problems.
2. Understand the geometry of 2D and 3D structures.
3. Analyze the matrix decomposition
4. Model Data
5. Predict the values using Linear Regression
6. Make use of dimensionality reduction with PCA

Module 1: Linear Algebra **7 Lectures**

Systems of linear equations – Matrices – Solving Systems of Linear Equations – Vector Spaces – Linear Independences – Basis and Rank – Linear Mapping.

Module 2: Analytical Geometry **8 Lectures**

Norms – Inner Products – Lengths and Distances – Angles and Orthogonality – Orthonormal Basis – Orthogonal Complement – Inner Product of Functions – Orthogonal Projections – Rotations

Module 3: Matrix Decompositions, Vector Calculus **8 Lectures**

Eigen Values and Eigen Vectors – Cholesky Decomposition – Eigen Decomposition and Diagonalization – Singular Value Decomposition – Matrix Approximation – Differentiation of Univariate Functions – Partial Differentiation and Gradients – Gradients of Vector-Valued Functions – Gradients of Matrices – Higher Order Derivatives

Module 4: Data Modeling **7 Lectures**

Data, Models and Learning – Empirical Risk Minimization – Parameter Estimation – Probabilistic Modeling and Inference – Directed Graphical Methods

Module 5: Linear Regression **7 Lectures**

Problem Formulation – Parameter Estimation – Bayesian Linear Regression – maximum Likelihood as Orthogonal Projection

Module 6: Dimensionality Reduction with Principal Component Analysis **8 Lectures**

Problem Setting – Maximum variance Perspective – Projection Perspective – Eigen Vector Computation and Low-Rank Approximations – PCA in High Dimensions – Key Steps of PCA.

Reference Books

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, “Mathematics for Machine Learning”, Cambridge University Press, 2020.
2. Jason Brownlee , “Basics of Linear Algebra for Machine Learning – Discover the Mathematical Language of Data in Python” , , 2018
3. Chris Albon, “Machine Learning with Python Cookbook – Practical Solutions from Preprocessing to Deep Learning”, O’ Reilly Media Inc., CA, 2018.

DEPT. OF MATHEMATICS

LIST OF NEW COURSES

S.No.	Course Code	Name of the Course	Credits [L:T:P:C]
1.	18MA3009	Numerical Analysis	3:1:0:4
2.	19MA1001	Calculus and Linear Algebra	3:0:2:4
3.	19MA1002	Calculus and Laplace Transform	3:0:2:4
4.	19MA1003	Calculus and Differential Equations	3:0:2:4
5.	19MA1004	Calculus, Matrices and Vector Spaces	3:0:2:4
6.	19MA1005	Basics of Calculus and Linear Algebra	3:0:2:4
7.	19MA1006	Statistics and Probability Distributions	3:0:2:4
8.	19MA1007	Linear Algebra, Transforms and Numerical Methods	3:0:2:4
9.	19MA1008	Ordinary Differential Equations and Complex variables	3:0:2:4
10.	19MA1009	Transforms and Differential Equations	3:0:2:4
11.	19MA1010	Matrices and Calculus	3:0:2:4
12.	19MA1011	Ordinary Differential Equations, Vector Calculus and Complex Integration	3:0:2:4
13.	19MA1012	Differential Calculus	3:0:2:4
14.	19MA1013	Multivariable Calculus and Differential Equations	3:1:0:4
15.	19MA1014	Matrices, Transforms and Numerical Methods	3:1:0:4
16.	19MA2001	Partial Differential Equations, Probability and Statistics	3:0:2:4
17.	19MA2002	Numerical Methods	3:0:2:4
18.	19MA2003	Probability and Statistics	3:0:2:4
19.	19MA2004	Probability and Stochastic processes	3:0:2:4
20.	19MA2005	Basics of Probability and Statistics	3:0:2:4
21.	19MA2006	Statistical Data Analysis and Reliability Engineering	3:0:2:4
22.	19MA2007	Mathematical and Numerical Methods	3:0:2:4
23.	19MA2008	Probability, Statistics and Random Process	3:0:2:4
24.	19MA2009	Discrete Mathematics	3:0:2:4
25.	19MA2010	Numerical Mathematics and Computing	3:0:2:4
26.	19MA2011	Probability, Random Variables and Statistics	3:1:0:4
27.	19MA3001	Modern Algebra	3:1:0:4
28.	19MA3002	Ordinary Differential Equations	3:1:0:4
29.	19MA3003	Classical Mechanics	3:1:0:4
30.	19MA3004	Real Analysis	3:1:0:4
31.	19MA3005	Complex Analysis	3:1:0:4
32.	19MA3006	Linear Algebra	3:1:0:4
33.	19MA3007	Topology	3:1:0:4
34.	19MA3008	Partial Differential Equations	3:1:0:4
35.	19MA3009	Field Theory	3:1:0:4
36.	19MA3010	Advanced Calculus	3:1:0:4
37.	19MA3011	Advanced Numerical Analysis	3:1:0:4
38.	19MA3012	Functional Analysis	3:1:0:4
39.	19MA3013	Calculus of Variations and Integral Equations	3:1:0:4
40.	19MA3014	Matrix Computations	3:0:0:3
41.	19MA3015	Finite Element Methods	3:0:0:3
42.	19MA3016	Computational Mathematics	3:0:0:3
43.	19MA3017	Graph Theory and Algorithms	3:0:0:3

44.	19MA3018	Tensor Algebra and Tensor Calculus	3:1:0:4
45.	19MA3019	Control Theory	3:1:0:4
46.	19MA3020	Differential Geometry	3:1:0:4
47.	19MA3021	Mathematics For Competitive Examinations	3:0:0:3
48.	19MA3022	Applied Statistics	3:0:0:3
49.	19MA3023	Optimization Techniques	3:0:0:3
50.	19MA3024	Probability and Distributions	3:1:0:4
51.	19MA3025	Stochastic Processes	3:1:0:4
52.	19MA3026	Formal Languages and Automata Theory	3:1:0:4
53.	19MA3027	Fuzzy Set Theory and its Applications	3:1:0:4
54.	19MA3028	Statistical Tools for Engineering Applications	3:0:0:3
55.	19MA3029	Computational Tools	3:0:0:3
56.	19MA3030	Mathematical Modeling	3:0:0:3
57.	19MA3031	Operations Research	3:0:0:3

18MA3009	Numerical Analysis	L	T	P	C
		3	1	0	4

Course Objective:

1. To impart basic understanding about the theory and application of numerical methods or techniques to approximate mathematical procedures
2. To impart knowledge about numerical solutions of problems that arise in science and engineering
3. To impart knowledge about why and how these approximation techniques work are provided with emphasis on accuracy and efficiency of the developed methods

Course Outcome:

The students will be able to

1. Identify the uses of numerical method in engineering fields
2. Remember various numerical methods of solving problems
3. Compute a differentiation equation using numerical method
4. Compute a integral evaluation using numerical method
5. Solve ordinary differential equations using numerical methods
6. Solve partial differential equations using numerical methods

MODULE 1: Interpolation And Polynomial Approximation (8 Lectures)

Introduction of Mathematical Preliminaries Interpolation and Polynomial Approximation: forward, backward, divided differences, shift operator; Newton-Gregory forward and backward interpolation polynomials; Lagrange interpolation polynomial. Divided difference interpolation polynomials; Existence and Uniqueness error in interpolation; explicit formula for error bounds in the case of equally spaced points; illustrations and practice problems.

MODULE 2: Numerical Differentiation (5 Lectures)

Derivation of differentiation formulas with order of accuracy: Using polynomial interpolation; using forward, backward, shift operators; using the method of undetermined coefficients.

MODULE 3: Solution of Nonlinear Equations (7 Lectures)

Solution of Nonlinear equations(one variable: f(x) = 0) Mathematical preliminaries Bisection Method; examples; error analysis; convergence; Stopping criteria, Newton-Raphson Method; examples, error analysis; order of the method; Secant Method, examples; Regula- Falsi Method.

MODULE 4: Quadrature Method (9 Lectures)

Numerical Integration Newton- Cotes quadrature methods: Trapezoidal rule; error in trapezoidal rule; Simpson, TMs rule; error in Simpson TMs rule; Composite Trapezoidal rule and Composite Simpson, TMs rule, error in these rules; related problems. Quadrature methods using the method of undetermined coefficients; precision of the derived method, examples; Gaussian quadrature two, three, and five point methods; Adaptive quadrature methods.

MODULE 5: Numerical Solution of Ordinary Differential Equations (8 Lectures)

Numerical Solution of Ordinary Differential Equations(ODE) Initial Value Problems: Mathematical Theory of ODE; existence and uniqueness; Single-step, explicit methods: Taylor Series Methods; Euler, TMs method, error analysis, Runge-Kutta Methods of order 2 (derivation); Runge-Kutta Method of order 4. Predictor-Corrector Methods(PC methods) Modified Euler, TMs Method, examples; Adam- Bashforth, Adam-Moulton PC Methods; Milne, TMs PC methods.

MODULE 6: Numerical Methods For Partial Differential Equations (8 Lectures)

Some partial differential equations from physics: the heat equation, the diffusion equation, the Navier–Stokes equations, classification of second order partial differential equations. Finite difference methods for elliptic equations: Finite difference approximation of the Laplacian in two dimensions, the discrete maximum principle for a finite difference, stability and convergence of the finite difference approximation of the Poisson problem with Dirichlet boundary conditions, an efficient solver for the Dirichlet problem in the rectangle, a higher order discretization .

References

1. David Kincaid and Ward Cheney, "Numerical analysis" Brooks/ Cole, California, 1999.
2. James F. Epperson, "An Introduction to Numerical Methods and Analysis", John Wiley & Sons.NewYork, US, 2002.
3. Richard L. Burden, J. Douglas Faires, "Numerical Analysis" Brook/Cole, NewYork, US, 2001.
4. M.K. Jain, S.R.K. Iyengar and R.K.Jain, "Numerical Methods for Scientific and Engineering Computation", New Age international Publishers, New Delhi, India, 2003.
5. Granville Sewell, "The Numerical solution of Ordinary and Partial differential equations", John Willey & Sons, Inc, Publication, 2005.
6. K. W. Morton, D. F. Mayers, "Numerical Solution of Partial Differential Equations An Introduction" Second Edition, Cambridge University Press 2005.
7. NPTEL: Numerical Analysis: https://nptel.ac.in/courses/111106101/.
8. MIT OPEN COURSEWARE: Numerical Methods for Partial Differential Equations (SMA 5212).

		L	T	P	C
19MA1001	**Calculus and Linear Algebra**	**3**	**0**	**2**	**4**

Course objectives

1. Demonstrate knowledge in matrices and functions.
2. Solve using differentiation and integration techniques.
3. Formulate physical phenomena using vector spaces.

Course Outcomes

The student will be able to

1. Understand solving system of equations using matrices.
2. Express functions as infinite series.
3. Apply differentiation techniques to find extreme values of functions.
4. Calculate area and volume using integration techniques.
5. Relate vector spaces with magnetic field and moving fluid
6. Apply MATLAB tools to solve mathematical problems.

Module 1: **Matrices 6 Lectures**

Introduction, types of matrix Symmetric, skew-symmetric and orthogonal matrices; Determinants; Inverse and rank of a matrix, System of linear equations; Eigen values and eigenvectors; Cayley-Hamilton Theorem, Diagonalization of matrices.

Module 2: Sequences and Series: **6 Lectures**

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.

Module 3: Fourier Series **6 Lectures**

Full range series - Half range sine and cosine series, Parseval's theorem, Harmonic analysis.

Module 4: Fourier Transforms **6 Lectures**

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

Module 5: Multivariable Calculus –Integration **6 Lectures**

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: area, Center of mass and Gravity (constant and variable densities).Triple integrals (Cartesian).

Module 6: Vector Differentiation **6 Lectures**

Differentiation of vectors–Curves in space-Velocity and acceleration-Scalar and Vector point functions–Gradient–Divergence-Curl–Physical interpretations- Solenoidal and irrotational fields.

Vector Integration: Integration of vectors –problems on Greens theorem, Stoke's theorem and Gauss divergence theorem.

List of experiments using MATLAB:

1. Introduction to MATLAB and general Syntaxes.
2. Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB.
3. To find the Eigen values and Eigen vectors of a given matrix, finding inverse using Cayley-Hamilton theorem.
4. Plotting the Fibonacci sequence and its ratios of successive terms.
5. Graphical representations of Fourier series and Fourier transform.
6. Evaluation of multiple integral in the given region.
7. Calculating curl and divergence for the given vectors.
8. Identifying the nature of vector fields - Solenoidal or irrotational.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint,2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9thEdition, John Wiley & Sons, 2006.
3. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint,2010.
5. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
6. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
7. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2nd Edn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
8. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

		L	T	P	C
19MA1002	**Calculus and Laplace Transform**	**3**	**0**	**2**	**4**

Course Objectives:

1. To impart the knowledge on differentiation and integration techniques.
2. To provide essential concepts in Laplace Transforms.

3. To understand the basic concepts of vector calculus.

Course Outcomes:

Students will be able to

1. Apply differentiation techniques to find extreme values of functions.
2. Relate the properties of Laplace transform.
3. Solve using multivariable differentiation techniques.
4. Solve problems using integration techniques.
5. Apply basic tools in vector differentiation.
6. Apply MATLAB tools to solve mathematical problems

Module 1: S**ingle variable calculus** 7 **Lectures**

Differentiation- Extrema on an Interval-Rolle's Theorem and the Mean Value Theorem-Increasing and Decreasing functions and First derivative test-Second derivative test- Maxima and Minima – Concavity - Integration-Average function value - Area between curves - Volumes of solids of revolution - Gamma and Beta functions – Relationship between Gamma and Beta functions using simple problems.

Module 2: Laplace Transforms **7 Lectures**

Definition of Laplace transform-Properties-Laplace transform of periodic functions-Laplace transform of unit step function, Impulse function-Inverse Laplace transform – Convolution.

Module 3: Multivariable Calculus **7 Lectures**

Functions of two variables-limits and continuity- partial derivatives –total differential- Jacobian and it Properties - Applications of Multivariable Calculus, Taylor's expansion for two variables–maxima and minima–constrained maxima and minima Lagrange's multiplier method.

Module 4: Integral Calculus **8 Lectures**

Double integrals–changing the order of integration– Double integrals in Cartesian and polar forms- - Evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical co-ordinates.

Module 5: Vector Calculus – I **5 Lectures**

Scalar and vector fields – Gradient, Directional derivatives – Curl and divergence –scalar and vector potentials–Statement of vector identities-Simple problems.

Module 6: Vector Calculus - II **5 Lectures**

Line, surface and volume integrals – Theorems of Green's, Stoke's and Gauss **-** applications to workdone by a force and flux.

List of Experiments using MATLAB:

1. Introduction to MATLAB and general Syntaxes.
2. Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB.
3. Evaluating Extremum of a single variable function.
4. To determine Extremum of multivariable functions.
5. Evaluating surface and volume of Revolution.
6. Finding the value gradient, curl and divergence of the given vectors.
7. Evaluating line integrals and multiple integral in vectors.
8. Identifying the nature of vector fields **-** Solenoidal or irrotational.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44^{th} Edition, 2017.

References:

1. Erwin kreyszig, "Advanced Engineering Mathematics", 9^{th} Edition, John Wiley & Sons, 2006.
2. T. Veerarajan., "Engineering Mathematics", (Updated Second Edition), Tata McGraw Hill, New Delhi, 2009.
3. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

4. Kandasamy P., Thilagavathi K and Gunavathi K., “Engineering Mathematics” volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
5. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2n dEdn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
6. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

19MA1003	**Calculus and Differential Equations**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

Course Objectives

1. Demonstrate knowledge in special functions and series.
2. Solve using differentiation and integration techniques.
3. Formulate physical phenomena using vector spaces.

Course Outcomes

The student will be to

1. Evaluate surface area and volume using definite integral.
2. Express functions as infinite series.
3. Apply differentiation techniques to find extreme values of functions.
4. Relate vector spaces with magnetic field and moving fluid.
5. Solve linear partial differential equations of first order and second order ODE.
6. Apply MATLAB tools to solve mathematical problems.

Module 1: Sequences and Series **5 Lectures**

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions;

Module 2: Calculus **5 Lectures**

Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volume.

Module 3: Fourier series: 6 **Lectures**

Full range – change of interval- Half range sine and cosine series, Parseval’s theorem, Harmonic analysis.

Module 4: Multivariable Calculus: Differentiation **5 Lectures**

Limit, continuity and partial derivatives, total derivative; Jacobians. Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, directional derivatives, curl and divergence.

Module 5: Multivariable Calculus: Integration **8 Lectures**

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, , Applications: area and volume. Theorems of Green, Gauss and Stokes(statement only), Simple applications involving cubes, sphere and rectangular parallelepipeds.

Module 6: Ordinary and Partial Differential Equations **8 Lectures**

Ordinary Differential Equations: Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation; First order partial differential equations: solutions of first order standard types and Lagrange’s equations.

List of experiments using MATLAB:

1. Introduction to MATLAB and general Syntaxes.
2. Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB.
3. To find Taylor’s Series and computing Beta function for numeric inputs.
4. Evaluating Extremum of a single variable function and Extremum of multivariable functions.
5. Evaluating surface and volume of regions.
6. Finding Euler’s constants using numerical inputs.
7. Identifying the nature of vector fields - Solenoidal or irrotational.
8. To plot the solution of second order ODE with constant coefficients.

Text Books:

1. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. T. Veerarajan, “Engineering Mathematics”, McGraw-Hill, New Delhi, 2008.
2. B. V. Ramana, “Higher Engineering Mathematics”, McGraw Hill, New Delhi, 2010.
3. N.P.Bali and M.Goyal,“A text book of Engineering Mathematics”, Laxmi Publications, 2010.
4. E. Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2006.
5. W.E.Boyce and R.C.Di Prima, “Elementary Differential Equations and Boundary Value Problems”, Wiley India, 2009.
6. G.F. Simmons and S.G. Krantz, “Differential Equations”, McGraw Hill, 2007.
7. Dingyu Xue, Yanguan Chen, “ Solving Applied Mathematical Problems with MATLAB”,Taylor and Francis, 2009.
8. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2nd Edn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
9. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

19MA1004	Calculus, Matrices and Vector Spaces	L	T	P	C
		3	0	2	4

Course Objectives:

1. Demonstrate knowledge in matrices and special functions.
2. Solve using definite integral techniques.
3. Formulate physical phenomena using vector spaces.

Course Outcomes

The student will be able to

1. Demonstrate knowledge in special functions.
2. Evaluate surface area and volume using definite integral.
3. Express functions as infinite series.
4. Understands solving system of equations using matrices.
5. Relate vector spaces with magnetic field and moving fluid.
6. Solve mathematical problems using MATLAB.

Module 1: Calculus **6 Lectures**

Evolutes and involutes; Evaluation of definite and improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Sequences and series **6 Lectures**

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.

Module 3: Matrices **6 Lectures**

Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation to reduce quadratic form to canonical forms.

Module 4: Vector spaces **8 Lectures**

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, Inverse of a linear transformation, rank- nullity theorem, composition of linear maps, Matrix associated with a linear map.

Module 5:Vector Differentiation **5 Lectures**

Differentiation of vectors–Curves in space-Velocity and acceleration-Scalar and Vector point functions–Gradient–Divergence-Curl–Physical interpretations- Solenoidal and irrotational fields-Laplacian operator.

Module 6: Inner product spaces **5 Lectures**

Norm definition- properties -Inner product spaces, orthogonal vectors – orthonormal vectors- orthonormal basis- Gram-Schmidt orthogonalization process.

List of Experiments using MATLAB:

1. Introduction to MATLAB and general Syntaxes.
2. Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB.
3. Evaluating surface and volume of Revolution.
4. To find Taylor's Series of a given function.
5. To find the Eigen values and Eigen vectors of a given matrix, finding inverse using Cayley-Hamilton theorem.
6. Examine the dependence and independence of a set of vectors.
7. Finding the gradient, divergence and curl of a surface.
8. Evaluating orthonormal basis for a set of vectors using Gram-Schmidt method.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint,2002.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. D. Poole, "Linear Algebra: A Modern Introduction", 2ndEdition, Brooks/Cole,2005.
4. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint,2010.
6. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint,2010.
7. V. Krishnamurthy, V.P. Mainra and J.L. Arora, "An introduction to Linear Algebra", Affiliated East–West press, Reprint2005.
8. Duane Hanselman and Bruce Littlefield, "Mastering Matlab 7", Pearson, 2013.
9. Martin Golubitsky and Michael Dellnitz, "Linear Algebra and Differential Equations Using MATLAB", 1st Edition, Cengage Learning, 1999.
10. Dingyu Xue, Yanguan Chen, " Solving Applied Mathematical Problems with MATLAB",Taylor and Francis, 2009.
11. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2nd Edn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
12. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

19MA1005	Basics of Calculus and Linear Algebra	L	T	P	C
		3	0	2	4

Course Objective:

1. To demonstrate knowledge in matrix.
2. To solve using differentiation and integration techniques.
3. To formulate physical phenomena using vector spaces.

Course Outcomes

The student will be able to

1. Understand different solutions of systems of equations using matrices.
2. Find the Eigen values and Eigen vectors of matrices and diagonalize the matrices.
3. Apply differentiation techniques to find extreme values of functions.
4. Demonstrate knowledge in integration.
5. Apply the knowledge of multiple integrals and express periodic and non-periodic functions as a series of sine and cosine functions.

6. Apply MATLAB tools to solve mathematical problems.

Module 1: Linear Algebra: Matrices, Determinants, Linear Systems 6 Lectures

Matrices: Linear Systems of Equations, Rank of a Matrix, Determinants, Cramer's Rule, Inverse of a Matrix, Gauss-Jordan Elimination method.

Module 2: Linear Algebra: Matrix Eigen value Problems 6 Lectures

Eigen values, Eigen vectors, Cayley Hamilton Theorem, Diagonalization of a matrix, orthogonal transformation to reduce quadratic form to canonical form.

Module 3: Differential Calculus 6 Lectures

Limit continuity, differentiation (definition and simple problems), partial derivatives, Jacobians, Maxima Minima of single variable.

Module 4: Integral Calculus 6 Lectures

Integration, definite integral, Integration by parts, Integration by substitution, Integration using differentiation.

Module 5: Multiple Integration 6 Lectures

Double integrals (Cartesian), change of order of integration in double integrals, area. Triple Integrals, volume. Beta and Gamma functions and their properties.

Module 6: Fourier series 6 Lectures

Full range – Half range Fourier sine and cosine series and Harmonic analysis.

List of Experiments using MATLAB:

1. Introduction to MATLAB and general Syntaxes.
2. Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB.
3. To solve system of linear equations using Cramer's rule.
4. To find the Eigen values and Eigen vectors of a given matrix, finding inverse using Cayley-Hamilton theorem.
5. Evaluating Extremum of a single variable function.
6. Evaluating definite integrals and their visualizations.
7. Finding surface and volume of regions.
8. Finding Euler's constants using numerical inputs and their visualizations.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole, 2005.
4. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint,2010.
6. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010.
7. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint2005.
8. AMOS Gilat, MATLAB: An introduction with applications, John Wiley Publications – 2011.
9. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2nd Edn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
10. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

19MA1006	Statistics and Probability Distributions	L T P C 3 0 2 4

Course Objectives:

1. To analyze data using statistical methods.
2. To get adequate knowledge of random variables.
3. To measure uncertainty using various probability distributions.

Course Outcomes:

Students will be able to

1. Calculate the measures of central tendency of statistical data.
2. Gain knowledge in functions of random variables.
3. Compare variables using correlation and regression.
4. Classify the problems using probability distributions.
5. Test the hypotheses for small samples.
6. Apply R tools to solve mathematical problems

Module 1: Introduction to statistics **6 Lectures**

Introduction to statistics and data analysis-Measures of central tendency –Measures of variability-Moments, kurtosis and skewness based on moments only.

Module 2: Random variables **8 Lectures**

Introduction -random variables-Probability mass Function, distribution and density functions - joint Probability distribution and joint density functions- Marginal, conditional distribution and density functions- Mathematical expectation, and its properties Covariance , moment generating function – characteristic function.

Module 3: Correlation and regression **4 Lectures**

Correlation and Regression – Partial and Multiple correlation- Multiple regression – rank correlation.

Module 4: Probability distributions **7 Lectures**

Binomial and Poisson distributions – Normal distribution – Gamma distribution – Exponential distribution – Weibull distribution.

Module 5: hypothesis testing I **4 Lectures**

Testing of hypothesis – Introduction-Types of errors, critical region, procedure of testing hypothesis- Large sample tests- Z test for Single Proportion, Difference of Proportion, mean and difference of means.

Module 6: hypothesis testing II **9 Lectures**

Small sample tests- Student's t-test, F-test- chi-square test- goodness of fit - independence of attributes- Design of Experiments - Analysis of variance – one and two way classifications - CRDRBD- LSD.

List of Experiments using R:

1. Introduction to Programming in R and syntax.
2. Preparation of Boxplots using R.
3. Applying multiple linear regression model to real dataset; computing and interpreting the multiple coefficient of determination.
4. Fitting the following probability distributions: Binomial distribution, Normal distribution and Poisson distribution.
5. Hypothesis test for large and small samples using mean values.
6. Comparison of Two population variances.
7. Applying Chi-square test for goodness of fit test and Contingency test to real dataset.
8. Performing ANOVA for real dataset for completely randomized design, Randomized Block design, Latin square Design.

Text Books:

1. S.C.Gupta , V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand &Sons, 10^{th} Revised Edition 2000.

References:
1. E. Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall, 2003.
3. S. Ross, “A First Course in Probability”, Pearson Education India, 2002.
4. A.Papoulis and S. Unnikrishnan Pillai, “Probability, Random Variables and Stochastic Processes," Fourth Edition, McGrawHill, 2002.
5. T.Veerarajan, “Probability, Statistics and Random Processes”, 2nd Edition, Tata McGraw-Hill, New Delhi,2010.
6. G.Jay Karns, “Introduction to Probability and Statistics using R”, Third Edition, 2018.

19MA1007	Linear Algebra, Transforms and Numerical Methods	L	T	P	C
		3	0	2	4

Course Objectives:
1. Demonstrate knowledge in matrices
2. Classify numerical solutions of algebraic and transcendental equations
3. Recognize the fundamental concepts of Transforms.

Course Outcomes:
The student will be able to
1. Analyze quadratic form using orthogonal transformation of matrix.
2. Compare integration solution and numerical solution.
3. Solve differential equations using Laplace Transforms.
4. Describe the different transform techniques.
5. Demonstrate knowledge in different types of graph and to construct networks with maximum capacity.
6. Apply MATLAB tools to solve engineering problems

Module 1: Matrices **6 Lectures**
Eigenvalues and eigenvectors; Cayley-Hamilton Theorem, Diagonalization of matrices; Orthogonal transformation to reduce quadratic forms to canonical forms.

Module 2: Numerical Methods-I **7 Lectures**
Solution of algebraic and transcendental equations – Bisection method, Newton-Raphson method. Finite differences, Interpolation using Newton’s forward and backward difference formulae. Numerical integration: Trapezoidal rule and Simpson’s 1/3rd and 3/8 rules.

Module 3: Numerical Methods-II **8 Lectures**
Ordinary differential equations of first order: Taylor’s series, Euler and modified Euler’s methods. Runge-Kutta method of fourth order. Partial differential equations Solution of Laplace equation by Liebmann method, Solution of Poisson equation by Liebmann method, differential Equation by Bender Schmidt method, Crank Nicholson method.

Module 4: Transform I **7 Lectures**
Laplace transform- Definitions and Properties, Laplace transform of periodic functions. Inverse Laplace transform, convolution theorem, solving Ordinary differential equations

Module 5: Transforms II **3 Lectures**
Definitions and properties of the three transformations: Z- Transform, Fourier transforms (infinite and finite) and Wavelet Transform.

Module 6: Graph Theory **5 Lectures**
Definitions and operations of Graphs, Euler graph, Hamiltonian graph, Transportation network, coloring of graphs.

List of experiments using MATLAB:

1. To find the Eigen values and Eigen vectors of a given matrix, finding inverse using Cayley-Hamilton theorem.
2. Solution of algebraic equation using Bisection method and Newton- Raphson method.
3. Numerical integration : Trapezoidal and Simpson's rule.
4. Solving first order ODE using Euler's method.
5. Solving first order ODE using 4^{th} order Runge-Kutta method.
6. To find Laplace and Inverse Laplace transform of standard function.
7. To find Fourier transform and Z transform of standard functions.
8. Finding Chromatic number of graphs.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44^{th} Edition, 2017.
2. Bernard Kolman, Robert C.busby, Sharo Cutler Ross, "Discrete Mathematical Structures", Prentice Hall of India, 5^{th}Edition,2004.

Reference Books:

1. D. Poole, "Linear Algebra: A Modern Introduction",Brooks/Cole, 2005.
2. N.P.Bali and M.Goyal, "A text book of Engineering Mathematics",Laxmi Publications, 2008.
3. V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press,2005.
4. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", S. Chand & Company, 2^{nd} Edition, Reprint2012.
5. Dingyu Xue, Yanguan Chen, " Solving Applied Mathematical Problems with MATLAB",Taylor and Francis, 2009.
6. Steven C. Chapra , "Applied Numerical Methods with MATLAB for Engineers and Scientists (Third Edition) ", McGraw Hill(2012).
7. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2^{nd} Edn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
8. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

		L	T	P	C
19MA1008	**Ordinary Differential Equations and Complex variables**	**3**	**0**	**2**	**4**

Course Objective:

1. Solving ordinary and partial differential equations.
2. Express the knowledge in special functions.
3. Demonstrate calculus in complex domain.

Course Outcome:

The student will be able to

1. Evaluate surface area and volume using definite integral.
2. Understands solution of first and second order ODE.
3. Classify different types of higher order ODE and their solution.
4. Construct harmonic and bilinear transformations.
5. Evaluate definite integral using complex integration and find Laplace transform of standard functions.
6. Apply MATLAB tools to solve mathematical problems.

Module 1: **Calculus** 6 **Lectures**

Evolutes and involutes of given curves, Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: First order ordinary differential equations **6 Lectures**

First order liner equations. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x.

Module 3: Ordinary differential equations and special functions **7 Lectures**

Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 4: Complex Variable I **6 Lectures**

Differentiation: Cauchy-Riemann equations, analytic functions and properties, harmonic functions, finding harmonic conjugate; bilinear transformations, Conformal mappings (w=z+c, w=zc, w=1/z).

Module 5: Complex Variable II **7 Lectures**

Integration: Cauchy Integral formula (without proof), zeros and poles of analytic functions, Residues, Cauchy Residue theorem (without proof), Contour integration- Circular and semi circular contours with no pole on real axis.

Module 6: Laplace Transforms **7 Lectures**

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transforms.

List of experiments using MATLAB:

1. Computing Beta function for numeric input.
2. Evaluation of ordinary derivatives of a function at a given point.
3. Solving vibration problems-string and membrane.
4. To plot the solution of second order ODE with constant coefficients.
5. To analyze free damped and damped force oscillations.
6. Plotting Legendre polynomials and Bessel functions of the first kind.
7. Creating complex array and plotting complex function.
8. Laplace transform of standard functions.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9thEdition, Pearson, Reprint,2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9thEdition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9thEdition, Wiley India,2009.
4. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2ndEdn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
5. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

19MA1009	Transforms and Differential Equations	L	T	P	C
		3	0	2	4

Course Objective:

1. To understand transform techniques for different functions.
2. To solve ordinary and partial differential equations.
3. To demonstrate knowledge in boundary value problems.

Course Outcome:

The student will be able to

1. Understand solution of Ordinary Differential Equations.
2. Find the solution of PDE.

3. Apply solution of PDE in one dimensional wave and heat equations.
4. Apply solution of PDE in two dimensional heat transfer.
5. Evaluate definite integral using Laplace transform and convert non-periodic functions using Fourier transform.
6. Apply MATLAB tools to solve mathematical problems.

Module 1: Order ordinary Differential Equations **6 Lectures**
Ordinary Differential Equations: Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation.
Module 2: Partial Differential Equations **6 Lectures**
First order partial differential equations, solutions of first order standard type and Lagrange's equations. Solution to higher order homogenous differential equations.
Module 3: Boundary value Problems - 1 **6 Lectures**
Solutions of one-dimensional wave equation – One-dimensional heat equation – Steady state solution (Cartesian co-ordinates only).
Module 4: Boundary value Problems - 2 **6 Lectures**
Two-dimensional heat equation: Temperature distribution in rectangular plate and infinite strip. Circular and semi-circular plate.
Module 5: Laplace Transform **6 Lectures**
Laplace Transform, Properties of Laplace Transform. Inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transforms.
Module 6: Fourier Transforms **6 Lectures**
Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

List of experiments using MATLAB:
1. To plot the solution of ODE and PDE.
2. Solving vibrational problems – membrane
3. Solving one-dimensional wave equation.
4. One-dimensional Heat flow problems.
5. Finding Fourier Transform
6. Inverse of Fourier Transform
7. Convolution of two functions
8. Finding Laplace Transform and Inverse Laplace Transform.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9thEdition, Pearson, Reprint, 2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9thEdition, John Wiley & Sons, 2006.
3. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
4. Veerarajan T., "Engineering Mathematics", second edition, Tata McGraw-Hill, New Delhi, 2009.
5. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (sixth revised Edition), S. Chand & Co., New Delhi, 2006.
6. AMOS Gilat MATLAB: An introduction with applications, John Wiley Publications – 2011.
7. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2ndEdn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
8. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

19MA1010	Matrices and Calculus	L 3	T 0	P 2	C 4

Course Objective:

1. Demonstrate knowledge in matrices
2. Knowledge in special functions.
3. Solve using differentiation and integration techniques.

Course Outcomes:

The student will be able to

1. Analyze quadratic form using orthogonal transformation of matrix.
2. Understand different types of functions.
3. Apply differentiation techniques to find extreme values of functions.
4. Knowledge in special functions.
5. Solve problems using integration techniques.
6. Apply MATLAB tools to solve mathematical problems.

Module 1: Matrices **8 Lectures**

Eigen values and Eigen vectors of areal matrix – Characteristic equation - Properties of Eigen values and Eigen vectors – Cayley Hamilton theorem – Diagonalization of matrices – nature of quadratic forms.

Module 2: Hyperbolic function and differential calculus **5 Lectures**

Hyperbolic and inverse functions – Identities – Real and imaginary parts – Solving problems using hyperbolic functions.

Module 3: Functions of several variables **5 Lectures**

Functions of two variables - Taylor's theorem (statement only) and expansion – Maxima and Minima – Constrained extremum by Lagrange's multiplier method – Jacobians.

Module 4: Integral Calculus **5 Lectures**

Definite and indefinite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric substitutions - Beta and Gamma functions.

Module 5: Multiple Integrals – I **5 Lectures**

Double integrals – Change of order of integration (Cartesian co- ordinates) – Area enclosed by plane curves.

Module 6: Multiple Integrals – II **7 Lectures**

Triple integrals – Volume as triple integral – Transformation to polar, Cylindrical and Spherical polar coordinates.

List of Experiments using MATLAB:

1. Introduction to MATLAB and general Syntaxes.
2. Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB.
3. To find the Eigen values and Eigen vectors of a given matrix, finding inverse using Cayley-Hamilton theorem.
4. Finding real and imaginary parts of complex numbers.
5. Evaluating Extremum of a multi-variable functions.
6. Computing Beta function for numeric input.
7. Evaluation of multiple integral in the given region.
8. Find triple integral with Cylindrical and Spherical co – coordinates.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books

1. Veerarajan T, "Engineering Mathematics", Tata McGraw Hill, New Delhi, 2015.
2. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" S. Chand & Co., New Delhi, 2013.
3. S. Narayanan and Manicavachagam Pillai T.K., "Calculus vol I, II and III" S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai 2009.

4. E. Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2006.
5. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2ndEdn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
6. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.
7. AMOS Gilat MATLAB: An introduction with applications, John Wiley Publications – 2011.

19MA1011	Ordinary Differential Equations, Vector Calculus and Complex Integration	L	T	P	C
		3	0	2	4

Course Objective:
1. Knowledge in ordinary differential equations.
2. Apply methods of statistics and probability in analysing data.
3. Formulate physical phenomena using vector spaces.

Course Outcome:
The Student will be able to
1. Solve second order linear differential equations.
2. Recognize vector differentiation.
3. Analyze and represent data using Methods of statistics and probability
4. Solve differential equations problems by using Laplace transform.
5. Evaluate complex and vector integrals.
6. Apply MATLAB tools to solve mathematical problems.

Module 1: Ordinary differential Equations **6 Lectures**
Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x. Ordinary Differential Equations: Second order linear differential equations with constant coefficients.

Module 2: Vector Differentiation **5 Lectures**
Differentiation of vectos – Velocity and Acceleration – Scalar and Vector point functions - Gradient and directional derivative, Divergence and curl - irrotational and Solenoidal fields

Module 3: Vector Integration **7 Lectures**
Integration of Vectors: Line, Surface and Volume Integral- Green’s Theorem in a Plane, Gauss Divergence and Stoke’s Theorems (Statements only) - Verification.

Module 4: Complex Integration **7 Lectures**
Cauchy’s integral theorem, Cauchy’s integral formula- Taylor’s and Laurents theorems(Statement only) and expansions- Poles and Residues- Cauchy’s residue theorem- Contour integration- Circular contours.

Module 5: Statistics **5 Lectures**
Frequency distribution – Graphical Representation of Data – Measures of Central Tendency: Mean Median and Mode, Measures of Dispersion: Range, Standard Deviation, and Quartile deviation.

Module 6: Probability **5 Lectures**
Axioms of Probability, Joint and Conditional Probability, Theorem of Total Probability and Baye’s theorem – related problems

List of Experiments using MATLAB:
1. To plot the solution of ODE.
2. Finding the gradient, divergence and curl of a surface.
3. Identifying the nature of vector fields - Solenoidal or irrotational
4. Evaluating integration using Cauchy’s Residues theorem.
5. Graphical Representation of Data
6. Measure the central tendency and dispersion
7. Finding Conditional Probability
8. Calculating Total Probability

Text Books:

1. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 44^{th} Edition, 2017.

Reference Books:

1. Veerarajan T, “Engineering Mathematics for Semester I and II”, Tata McGraw Hill Publishing Co., New Delhi, 2015.
2. E. Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2006.
3. Kandasamy P, Thilagavathy K and Gunavathy K, “Engineering Mathematics for I year B.E/B.Tech”, S. Chand &Co, Ramnagar, New Delhi, Reprint 2013.
4. S. Narayanan and Manicavachagom Pillai T.K., “Calculus-Vol. III.”, S. Viswanathan, Printers and Publishers Pvt, Ltd, Chennai, 2009.
5. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2ndEdn.Chapman & Hall / CRC Press.New York, 2003 (Taylor and Francis, e-library, 2009).
6. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.
7. AMOS GilatMATLAB: An introduction with applications, John Wiley Publications – 2011.

19MA1012	Differential Calculus	L T P C 3 0 2 4

Course Objectives:

1. Solving ordinary and partial differential equations.
2. Knowledge in special functions.
3. Recognize the fundamental concepts of Boundary value problems.

Course Outcomes

The student will be able to

1. Understand several differentiation techniques.
2. Classify different types of higher order ODE.
3. Understands solution of second order ODE.
4. Demonstrate knowledge in solution of PDE.
5. Express functions as infinite series and apply solution of PDE in heat and wave equations.
6. Apply MATLAB tools to solve mathematical problems.

Module -1: Multivariable calculus **6 Lectures**

Limits and Continuity – Partial derivatives – Homogeneous functions and Euler’s theorem– Total derivative – Jacobians– Lagrange’s method of undetermined multipliers.

Module 2: Ordinary differential equations **8 Lectures**

Ordinary Differential Equations: Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation.

Module 3: Special functions **6 Lectures**

Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 4: Partial Differential Equations **5 Lectures**

First order partial differential equations, solutions of first order standard type and Lagrange’s equations. Solutions to higher order homogenous and non-homogenous linear partial differential equations.

Module 5: Fourier series **6 Lectures**

Euler’s formula–Conditions for a Fourier expansion–Functions having points of discontinuity–Change of Interval–Even and odd functions. Half range Fourier series – Harmonic analysis.

Module 6: Boundary Value problems **5 Lectures**

Solutions of one-dimensional wave equation – One-dimensional equation of heat conduction. (Cartesian coordinates only).

List of Experiments using Matlab:

1. Evaluate Jacobian of a function.
2. Evaluating Extremum of a multi-variable functions using Lagrange’s method.

3. Solving second order Ordinary Differential equations.
4. To plot the solution of ODE.
5. Plot the Bessel and Legendre function.
6. Evaluating the coefficients of Fourier series.
7. Solving one-dimensional wave equation.
8. One-dimensional Heat flow problems.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
3. RamanaB.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
5. Dean G.Duffy, ' Advanced Engineering Mathematics with Matlab', Taylor and Francis, fourth Edition, CRC Press, 2017.
6. Cezer Perez lopez, 'Matlab Differential and Integral Calculus", Springer, ISBN-13: 978-1484203057.
7. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.
8. AMOS Gilat MATLAB: An introduction with applications, John Wiley Publications – 2011.

19MA1013	Multivariable Calculus and Differential Equations	L T P C 3 1 0 4

Course Objectives

1. Demonstrate knowledge in special functions and series.
2. Solve using differentiation and integration techniques.
3. Formulate physical phenomena using vector spaces.

Course Outcomes

The student will be to

1. Evaluate surface area and volume using definite integral.
2. Express functions as infinite series.
3. Apply differentiation techniques to find extreme values of functions.
4. Calculate gravity and mass using integration techniques.
5. Relate vector spaces with magnetic field and moving fluid
6. Solve linear partial differential equations of first order.

Module 1: Sequences and Series **6 Lectures**

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions;

Module 2: Calculus **8 Lectures**

Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volume.

Module 3: Fourier series: **8 Lectures**

Full range – change of interval- Half range sine and cosine series, Parseval's theorem, Harmonic analysis.

Module 4: Multivariable Calculus: Differentiation **6 Lectures**

Limit, continuity and partial derivatives, total derivative; Jacobians. Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, directional derivatives, curl and divergence.

Module 5: Multivariable Calculus: Integration **8 Lectures**
Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Applications: area and volume.
Module 6: Ordinary and Partial Differential Equations **8 Lectures**
Ordinary Differential Equations: Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation; First order partial differential equations: solutions of first order standard types and Lagrange's equations.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.

Reference Books:

1. T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.
2. B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill, New Delhi, 2010.
3. N.P.Bali and M.Goyal,"A text book of Engineering Mathematics", Laxmi Publications, 2010.
4. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
5. W.E.Boyce and R.C.Di Prima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.
6. G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007.

19MA1014	Matrices, Transforms and Numerical Methods	L	T	P	C
		3	1	0	4

Course Objectives:

1. Demonstrate knowledge in matrices
2. Classify numerical solutions of algebraic and transcendental equations
3. Recognize the fundamental concepts of Transforms.

Course Outcomes:
The student will be able to

1. Analyze quadratic form using orthogonal transformation of matrix.
2. Compare integration solution and numerical solution.
3. Solve differential equations using Laplace Transforms.
4. Categorize Z-Transform of sequence and series.
5. Solve difference equations problems in their engineering fields.
6. Describe the different transform techniques.

Module 1: Matrices **8 Lectures**
Eigen values and eigenvectors; Cayley-Hamilton Theorem, Diagonalization of matrices; Orthogonal transformation to reduce quadratic forms to canonical forms.
Module 2: Numerical Methods-I **7 Lectures**
Solution of algebraic and transcendental equations – Bisection method, Newton-Raphson method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.
Module 3: Numerical Methods-II **8 Lectures**
Ordinary differential equations of first order: Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order. Partial differential equations Solution of Laplace equation by Liebmann method,
Module 4: Laplace Transforms **7 Lectures**
Transforms of elementary functions–Properties of Laplace transforms–Transforms of periodic functions–Transforms of special functions–Transforms of derivatives–Transforms of integrals-Multiplication by t^n-Division by t–Evaluation of Integrals by Laplace transforms.

Module 5: Inverse Laplace Transforms **6 Lectures**

Inverse Laplace transforms of standard functions-Method of Partial fractions – properties -Convolution theorem – Solving Differential Equations.

Module 6: Transforms **6 Lectures**

Definitions and properties of the three transformations: Z- Transform, Fourier transforms (infinite and finite) and Wavelet Transform.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44^{th} Edition, 2017.

Reference Books:

1. D. Poole, "Linear Algebra: A Modern Introduction",Brooks/Cole, 2005.
2. N.P.Bali and M.Goyal, "A text book of Engineering Mathematics",Laxmi Publications, 2008.
3. V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press,2005.
4. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", S. Chand & Company, 2^{nd} Edition, Reprint2012.
5. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

19MA2001	**Partial Differential Equations, Probability and Statistics**	**L** 3	**T** 0	**P** 2	**C** 4

Course Objective:

1. Demonstrate knowledge in solution of first and second order PDE
2. Formulate problems using random variables.
3. Examine observed data using statistical methods.

Course Outcome:

The student will be able to

1. Knowledge in solution of PDE.
2. Apply solution of PDE in heat and wave equations.
3. Calculate the central tendency of statistical data.
4. Measure the probability of the given event.
5. Test of hypothesis for samples.
6. Apply MATLAB and R tools to solve mathematical problems.

Module 1: Partial Differential Equations **6 Lectures**

First order partial differential equations, solutions of first order standard type and Lagrange's equations. Solution to higher order homogenous and non-homogenous linear partial differential equations.

Module 2: Boundary value Problems: **6 Lectures**

Solutions of one-dimensional wave equation – One-dimensional heat equation – Steady state solution -two-dimensional heat equation (Cartesian co-ordinates only).

Module 3: **Probability I** **6 Lectures**

Definitions and axioms, conditional probability, Baye's theorem. Discrete random variables; Probability mass function and distribution functions . Continuous random variables and their properties.

Module 4: Probability II **6 Lectures**

Discrete Distributions; binomial, Poisson. Continues Distributions: Normal, Exponential - Moments generating functions and its properties.

Module 5: Statistics **7 Lectures**

Basic Statistics, Measures of Central tendency: Mean, Median and Mode. Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second-degree parabolas and the curves reducible to linear forms.

Module 6: Sampling **7 Lectures**

Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean and difference of means. Small samples: t-test, F-test and Chi-square test for goodness of fit and independence of attributes.

List of Experiments using Matlab and R:

1. To Plot the solution of partial differential equation.
2. Solving one-dimensional wave equation.
3. One-dimensional Heat flow problems.
4. Introduction to R software and general syntaxes.
5. Finding mathematical probability and Baye’s rule.
6. Evaluating mean, variance and cdf of one dimensional DRV.
7. Plotting binomial and normal distribution.
8. Testing of hypothesis of large and small samples.

Text Books:

1. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 44th Edition, 2017.
2. T.Veerarajan,“ Probability,Statistics and Random Processes”, 2nd Edition, TataMcGraw-Hill, New Delhi,2010.

Reference Books:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, Reprint,2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall, 2003(Reprint).
4. Kandasamy P., Thilagavathi K and Gunavathi K., “Engineering Mathematics” Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
5. S. Ross, “A First Course in Probability”, 6thEd., Pearson Education India,2002.
6. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2ndEdn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
7. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.
8. G.Jay Karns, “Introduction to Probability and Statistics using R”, Third Edition, 2018.

19MA2002	Numerical Methods	L	T	P	C
		3	0	2	4

Course Objective:

1. To introduce various numerical methods to get approximation solutions.
2. To acquaint the student with understanding of numerical techniques of differentiation and integration.
3. To apply the numerical techniques of interpolation in various intervals.

Course Outcome:

The students will be able to

1. Discriminate and learn techniques of curve fitting.
2. Understand the basic concepts and techniques of solving algebraic and transcendental equations.
3. Appreciate the numerical techniques of interpolation in various intervals in real life situations.
4. Gain the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
5. Solve the ordinary differential equations with boundary conditions by using certain techniques with engineering applications.
6. Apply MATLAB tools to solve mathematical problems.

Module I - Empirical formulae and curve fitting **5 Lectures**
Principle of least squares - fitting a straight line, a parabola and exponential curve.
Module II - Solutions of algebraic and transcendental equations **7 Lectures**
Newton- Raphson method, Gauss elimination method, Gauss-Jordan method, Gauss-Jacobi, Gauss-Seidel method.
Module III – Interpolation **6 Lectures**
Finite differences - Newton forward Interpolation, Newton backward Interpolation, Gauss forward interpolation formula, Gauss backward interpolation formula, Lagrange's Interpolation formula.
Module IV - Numerical integration **5 Lectures**
Trapezoidal rule-Geometrical interpretation and error of Trapezoidal rule - Simpsons one third rule and three eighth rule formulae -Truncation errors in Simpsons rule.
Module V- Numerical solution for ordinary differential equation **6 Lectures**
Solution of first order ODE by Taylor series method - Solution of first order ODE by Euler method-Improved Euler method -Modified Euler method **-** Runge Kutta method of second, third and fourth order.
Module VI- Boundary Value Problem **8 Lectures**
Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

List of Experiments using MATLAB:
1. To solve Newton-Raphson method.
2. Evaluating Guass elimination method.
3. Solving Newton's interpolation polynomial.
4. To solve Lagrange interpolation polynomial.
5. Evaluation of integrals using Trapezoidal and Simpson's Rules.
6. Finding the solution of first order ODE using Euler's and Runge-Kutta methods.
7. Solving BVP using Finite difference method.
8. Solving One dimensional wave equation by explicit method.

Text Book:
1. Kandasamy P., "Numerical Methods", S. Chand and Co, Reprint 2010.

Reference Books

1. S.R.K. Iyengar, R.K.Jain, "Numerical Methods", New Age International (P) Ltd., (1st Edition), 2015.
2. Rajasekaran. S., "Numerical Methods in Science and Engineering: A Practical Approach", S. Chand publishers, 2003.
3. Venkataraman M.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.
4. P. Kandasamy, K. Thilagavathy & K.Gunavathy, "Numerical Methods", S. Chand Limited, 2008.
5. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
6. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
7. Steven C. Chapra., "Applied Numerical Methods with MATLAB for Engineers and Scientists", 3rd Edition, Mc Graw Hill, 2012.
8. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2nd Edn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
9. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

19MA2003	Probability and Statistics	L 3	T 0	P 2	C 4

Course Objective:

1. Understand the basic concepts of Probability.
2. Measure uncertainty using various probability distribution.
3. Analyze data with statistical methods.

Course Outcomes:

The student will be able to

1. Recognize probability models.
2. Solve using discrete and continuous random variables.
3. Classify the problems using probability distributions.
4. Compare variables using correlation and regression.
5. Test hypothesis for large and small samples.
6. Analyze data with statistical techniques using R.

Module 1: Probability **8 Lectures**

Definitions and axioms, - conditional probability-Independent events-Theorem of Total Probability-Baye's Theorem.

Module 2: Random Variables **10 Lectures**

Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function. Two Dimensional Random Variables: Discrete and Continuous random variables, Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables.

Module 3: Probability Distributions **7 Lectures**

Discrete: Binomial and Poisson. Continuous: Normal, Exponential - Moments generating functions and its properties.

Module 4: Statistics **7 Lectures**

Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines- second degree parabolas and cures reducible to linear forms.

Module 5: Large sampling **6 Lectures**

Test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations.

Module 6: **Small samples** **6 Lectures**

Student t-test, F-test and Chi-square test for goodness of fit and independence of attributes.

List of experiments using R:

1. Introduction to R software and general syntaxes.
2. Finding mathematical probability and Baye's rule.
3. Evaluating mean, variance and cdf of one dimensional DRV.
4. Fitting the following probability distributions: Binomial distribution, Normal distribution and Poisson distribution.
5. Lattice Graphics using R.
6. Finding Correlation and regression.
7. Hypothesis test for large and small samples using mean values.
8. Applying Chi-square test for goodness of fit test and Contingency test to real data set.

Text Books:

1. S.C.Gupta ,V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand &Sons, 10^{th} Revised Edition 2000.
2. T.Veerarajan,"Probability, Statistics and Random Processes", 2^{nd} Edition, TataMcGraw-Hill,New Delhi, 2010.

Reference Books:

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.

2. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall,2003.
3. S. Ross, “A First Course in Probability”, Pearson Education India, 2002.
4. G.Jay Karns, “Introduction to Probability and Statistics using R”, Third Edition, 2018.

19MA2004	Probability and Stochastic Processes	L	T	P	C
		3	0	2	4

Course Objective:
1. Understand the basic concepts of Probability.
2. Measure uncertainty using various probability distribution.
3. Analyze linear system using random process.

Course Outcomes:
The student will be able to
1. Recognize probability models.
2. Solve using discrete and continuous random variables.
3. Classify the problems using probability distributions.
4. Knowledge in functions of random variables.
5. Determine the characteristics of random processes.
6. Apply MATLAB tools in probability and Random process.

Module 1: Probability **7 Lectures**
Definitions and axioms, - conditional probability-Independent events-Theorem of Total Probability-Baye’s Theorem.

Module 2: Random Variables **10 Lectures**
Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function.Two Dimensional Random Variables: Discrete and Continuous random variables, Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables.

Module 3: Probability Distributions **8 Lectures**
Discrete: Binomial and Poisson. Continuous: Normal, Exponential Tchebycheff Inequality, central limit theorem(without proof) - problems.

Module 4: Functions of Random Variables **7 Lectures**
Moment Generating Function(MGF)-Properties of MGF, Characteristic Function (CF)-Properties of CF .Function of One Random Variable, transformations of two Random Variables.

Module 5: Random Processes **7 Lectures**
Definition-Basic concepts and examples, Strict and wide sense stationary process , ergodicity - Second Order processes. Autocorrelation function and its properties-Power Spectral Density function (Theorems statement only).

Module 6:Special Random Processes **6 Lectures**
Gaussian Process-Poisson process-Markov Process (theorems statement only)-Properties.

List of experiments using MATLAB:
1. Finding mathematical probability and Baye’s rule.
2. Evaluating mean, variance and cdf of one dimensional DRV.
3. Fitting the following probability distributions: Binomial distribution, Normal distribution and Poisson distribution.
4. Finding moment generating function of Binomial and exponential distributions.
5. Recognizing white noise.
6. Analyzing signal using spectral density function.
7. Finding Poisson and Markov processes.
8. Evaluating Auto Correlation.

Text Books:

1. Veerarajan T., "Probability, Statistics and Random processes (second edition)", Tata McGraw-Hill, New Delhi,2007.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal BookStall, 2003(Reprint).
3. S. Ross, "A First Course in Probability", 6thEd., Pearson Education India,2002.
4. H. Stark and J. Woods, "Probability and Random Processes with Applications to Signal Processing," 3rdEdition, Pearson Education, 2002.
5. A.Papoulis and S. Unnikrishnan Pillai, "Probability, Random Variables and Stochastic Processes," Fourth Edition, McGrawHill, 2002.
6. S.C.Gupta, V.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, Tenth revised edition, 2000.
7. G.Jay Karns, "Introduction to Probability and Statistics using R", Third Edition, 2018.
8. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2nd Edn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
9. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

19MA2005	Basics of Probability and Statistics	L	T	P	C
		3	0	2	4

Course Objective:

1. To understand the basic concepts of Probability.
2. To measure uncertainty using various probability distribution.
3. To analyze data with statistical methods.

Course Outcomes:

The student will be able to

1. Understand basic concepts of probability.
2. Solve problems on discrete and continuous random variables.
3. Understand the concepts of two dimensional random variables and solve problems.
4. Classify the problems using probability distributions and apply appropriate distributions.
5. Measure central tendency of the data and strength of the relationship between variables using correlation and regression analysis.
6. Analyze data with statistical techniques using R.

Module 1: Probability **6 Lectures**

Definitions and axioms, conditional probability - Independent events - Theorem of Total Probability - Baye's Theorem.

Module 2: One Dimensional Random Variables **6 Lectures**

Discrete Random Variable: Probability mass Function and distribution functions. Continuous Random Variable: Probability Density Function - Cumulative Distribution Function and Properties.

Module 3: Two Dimensional Random Variables **6 Lectures**

Two Dimensional Random Variables: Discrete and Continuous random variables, Cumulative Distribution Function- Marginal Probability Distribution - Conditional Probability Distribution - Independent Random Variables.

Module 4: Probability Distributions **6 Lectures**

Binomial distribution, Poisson distribution and Normal distribution. Exponential - Moments generating functions and its properties.

Module 5: Statistics - I **6 Lectures**

Measures of Central tendency :Mean, Median, Mode, Geometric mean, Harmonic mean. Measures of Dispersion: Range, Quartile deviation, Mean Deviation, Standard Deviation, Coefficient of variation.

Module 6: Statistics II **6 Lectures**

Moments - Skewness and Kurtosis - Rank correlation, co-efficient of correlation and regression lines.

List of experiments using R:

1. Introduction to R software and general syntaxes.
2. Finding mathematical probability and Baye's rule.
3. Evaluating mean, variance and cdf of one dimensional DRV.
4. Fitting the following probability distributions: Binomial distribution, Normal distribution and Poisson distribution .
5. Calculate measures of Central Tendency, mean, median and mode.
6. Calculate measures of Dispersion.
7. Lattice Graphics using R.
8. Finding Correlation and regression.

Text Books:

1. T.Veerarajan, "Probability, Statistics and Random Processes", 2ndEdition,TataMcGraw-Hill,New Delhi, 2010.

Reference Books:

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
3. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
4. W. Feller, "An Introduction to Probability Theory and its Applications" , Vol. 1, Wiley, 1968.
5. S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics, Sultan Chand &Sons, 10th Revised Edition, 2000.
6. G.Jay Karns, "Introduction to Probability and Statistics using R", Third Edition, 2018.

19MA2006	Statistical Data Analysis and Reliability Engineering	L	T	P	C
		3	0	2	4

Course Objective:

1. To develop knowledge in curve fitting and sampling techniques.
2. To categorize using the concepts of reliability engineering.
3. To analyze data with statistical methods.

Course Outcome:

The student will be able to

1. Apply the concept of curve fitting and test hypothesis for large samples.
2. Test hypothesis for small samples.
3. Construct design of experiments and analyze data using statistical quality control.
4. Decide using acceptance sampling.
5. Understand the reliability engineering problems.
6. Analyze data with statistical techniques using R.

Module 1: Curve fitting **6 Lectures**

Curve fitting: Method of least squares- fitting of straight lines- second degree parabolas and curves reducible to linear forms. Large Sample tests**:** Test for single proportion, difference of proportions, Tests for single mean, difference of means.

Module 2: Small Sample tests **6 Lectures**

Student t-test, F-test and Chi-square test for goodness of fit and independence of attributes.

Module 3: Design of experiments **6 Lectures**

Analysis of variance: one-way and two-way classification. Completely randomized design – Randomized block design – Simple Latin Square Design.

Module 4: Statistical quality control **6 Lectures**

Types of variation – types of control charts – control chart of mean and range, Sigma Chart, control chart of proportion of defectives and number of defectives, C- Chart, Advantages and Limitations of SQC.

Module 5: Acceptance sampling **6 Lectures**

Acceptance sampling – Single sampling plan–flowchart and algorithm- six sigma concepts.

Module 6: **Reliability engineering** **6 Lectures**

Concepts of reliability, hazard function, mean time to failure, series and parallel systems, System Reliability.

List of experiments using R:

1. Introduction to R software and general syntaxes.
2. Fitting a linear model using least square method.
3. Hypothesis test for large and small samples using mean values.
4. Applying Chi-square test for goodness of fit test and Contingency test to real data set.
5. Design of experiment using Anova (CRD, RBD).
6. Control charts of mean and range.
7. Construction of P and C-charts.
8. Finding operating characteristic curve.

Text Books:

1. Veerarajan, T., "Probability, Statistics and Random Processes", Tata McGraw Hill, NewDelhi, 2006.

Reference Books:

1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2008.
2. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.
3. Balagurusamy, E., "Reliability Engineering", Tata McGraw-Hill Publishing Co., New Delhi, Fourth Reprint, 2003.
4. G.Jay Karns, "Introduction to Probability and Statistics using R", Third Edition, 2018.

19MA2007	Mathematical and Numerical Methods	L	T	P	C
		3	0	2	4

Course Objective:

1. This course introduces a range of numerical methods for the approximate solution of mathematical equations encountered in biochemical engineering.
2. The methods are introduced in a problem specific context, such as Bioprocess engineering, Heat and Mass transfer and chemical reaction engineering.
3. Numerical Integration & Differentiation method helps the students to solve the area related problems &Ordinary differential equations helps in solving problems in Biochemical Engineering.

Course Outcome:

The student will be able to

1. Update the knowledge with different kind of numerical methods for solving the problems in Biotechnology.
2. Develop the skills in applying the boundary value problems in Biochemical Engineering.
3. Acquire the knowledge in interpolation.
4. Solve the system of linear algebraic equations using iterative process.
5. Discriminate and learn techniques of curve fitting, finite differences and interpolations.

6. Apply MATLAB tools in probability and Random process.

Module 1: Solution of Algebraic Equations **5 Lectures**

Types of Errors, Significant figures, Accuracy of Numbers, Precision, Error Propagation, Applications in Biochemical Engineering. Basic Properties of Equations, Relations between Roots and Co efficient,Descartes Rule of Sign.

Module 2: Bracketing Methods **5 Lectures**

Bisection, Secant, Method of False position or Regula Falsi Method - Convergence of Iterative Methods, Newton- Raphson Method for Non Linear Equations in Two Variables.

Module 3: Solution of Linear Equations **5 Lectures**

Mathematical Background, Matrix Inversion, Gauss Elimination, Gauss- Jourdan Methods, Gauss- Seidal Iteration Methods, Jacobi's Method, Gauss Seidal Methods.

Module 4: Curve Fitting, Finite Differences & Interpolation **8 Lectures**

Methods of Least squares, Fitting a Straight Line and a Polynomial, Fitting a Non- Linear Function. Finite Differences: Forward and Backward Differences Table, Central Differences, Newton's Forward and Backward Differences, Interpolation Formula, Interpolation Polynomials, Lagrange Interpolation Formula, Inverse Interpolation.

Module 5: **Numerical Differentiation and Integration** **5 Lecture**

Differentiation Formula based on Tabulator at Equal and Unequal Intervals, Newton-cotes Integration Formulas, Trapezoidal Rule and Simpson's 1/3rd rule.

Module 6: **Ordinary Differential Equations** **7 Lectures**

Taylor's Series and Euler's Methods, Modified and Improvements in Euler's Methods, Runge-Kutta 2^{nd}order &4^{th} order Methods, Applications in Biochemical Engineering.

List of Experiments using MATLAB:

1. Find the zeros of a polynomial using Bisection method.
2. Find the roots of an equation using Secant method.
3. Find the roots of an equation using Newton-Raphson and False Position methods.
4. Fit the data in a straight line and parabola.
5. Find the integration of a function using Simpson's Rules.
6. Solving system of equations using Gauss- Seidal Iteration Methods.
7. Solve the differential equation using Runge-Kutta Method.
8. Program in MATLAB to solve equations in "Heat and Mass Transfer in Bio-Processes" using Numerical Integration and Differentiation Methods.

Text Books:

1. Kandasamy P., "Numerical Methods", S.Chand and Co, Reprint 2010

Reference Books:

1. VenkataramanM.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.
2. M.K.Jain., Iyengar. S.R.K., Jain R.K., "Numerical Methods for Scientific and Engineering Computation", 6^{th}Edition, New Age International, 2012.
3. S.S.Sastry, "Introductory methods of NumericalAnylasis" ,PHI,4^{th}Edition 2005.
4. B.V.Ramana, "Higher Engineering Mathematics", 29^{th}Reprint, Tata McGraw Hill Education Private limited 2017.
5. S.R. Otto and J.P. Denier , "An Introduction to Programming and Numerical Methods in MATLAB", Springer- Verlag London Limited , 2005.
6. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2^{nd} Edn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
7. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

19MA2008	Probability, Statistics and Random Process	L	T	P	C
		3	0	2	4

Course Objectives:

1. Understand random variables.
2. Measure uncertainty using various probability distributions.
3. Analyze linear system using random process.

Course Outcomes:

The student will be able to

1. Recognize probability models and solve using discrete and continuous random variables.
2. Classify the problems using probability distributions.
3. Knowledge in functions of random variables.
4. Determine the characteristics of random processes.
5. Examine ergodicity of random process.
6. Analyze data with statistical techniques using R.

Module 1: Random Variables **5 Lectures**

One dimensional Random variables – Two dimensional random variables - Discrete and continuous random variables

Module 2: Probability Distributions **5 Lectures**

Binomial, Poisson, Exponential, Normal, Gamma, (Problems only) - Correlation – Regression (Problems only)

Module 3: Large Sample Tests **6 Lectures**

Tests of means, variances and proportions – Large sample test based on Normal distribution for single mean and difference means. Test for single proportion, difference of proportion.

Module 4: Small Sample Tests **6 Lectures**

Tests of means, variances and attributes using t, F, Chi square distribution – Interval estimation for mean and proportion – Contingency table – Goodness of fit.

Module 5: Design of Experiments **5 Lectures**

One way and two way classifications – Completely randomized block design – Latin square design

Module 6: Random Process **8 Lectures**

Classification of random process – Stationary process – Auto correlation and cross correlation – properties – Mean ergodic and cross ergodic process - properties –Markov process – Markov chain- Classification of states of a Markov chain – Steady state distribution of a Markov chain.

List of Experiments using R:

1. Evaluating mean, variance and cdf of one dimensional DRV.
2. Evaluating mean, variance and cdf of one dimensional CRV.
3. Fitting the following probability distributions: Binomial distribution, Normal distribution and Poisson distribution.
4. Hypothesis test for large samples using mean values.
5. Hypothesis test for small samples using mean values.
6. Applying Chi-square test for goodness of fit test and Contingency test to real data set.
7. Design of experiment using Anova (CRD).
8. Design of experiment using Anova (RBD).

Text Books:

1. Veerarajan T., "Probability and Random Process (with Queuing Theory and Queuing Networks)", Mc Graw-Hill Education (India) Pvt Ltd., New Delhi, 4thEdition2016.

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal BookStall, 2003(Reprint).

3. S. Ross, “A First Course in Probability”, 6th Ed., Pearson Education India,2002.
4. N.P. Bali and Manish Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, Reprint,2010.
5. The Math Works Inc, “Statistics Toolbox User’s Guide”, 2004.
6. G.JayKarns, “Introduction to Probability and Statistics using R”, Third Edition, 2018.

19MA2009	Discrete Mathematics	L	T	P	C
		3	0	2	4

Course Objectives:
1. Apply logical reasoning to solve problems.
2. Construct direct and indirect proofs.
3. Study abstract models of computation.

Course Outcomes:
The Student will be able to
1. Solve the practical examples of sets, functions and relations.
2. Describe the logical and mathematical foundations.
3. Illustrate the limitations of predicate logic.
4. Understand algebraic structures and morphisms.
5. Recognize the patterns that arise in graph problems and use this knowledge for constructing the trees and spanning trees.
6. Model the mathematical concepts with MATLAB programming.

Module 1: Sets, Relation and Function **5 Lectures**
Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function.

Module 2: Number theory **5 Lectures**
The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

Module 3: Basic counting techniques **4 Lectures**
Mathematical Induction, Inclusion and exclusion, pigeon-hole principle, permutation and combination.

Module 4: Propositional Logic **6 Lectures**
Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers.

Module 5: Algebraic Structures and Morphism **8 Lectures**
Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Boolean algebra and Boolean Ring Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

Module 6: Graphs and Trees **8 Lectures**
Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Coloring, Coloring maps and Planar Graphs, Coloring Vertices, Coloring Edges, List Coloring, Perfect Graph, definition properties and example, rooted trees, trees and sorting, weighted trees and prefix codes, Shortest distances.

List of Experiments using Matlab
1. Applying and finding different operations on sets.
2. Finding GCD using Euclidean algorithm using numerical inputs.
3. Evaluating permutation and combination.
4. Identifying the nature of logical statements.
5. Simplification of Boolean expression using logic gates and visualizing the same.

6. Finding spanning and minimal spanning tree.
7. Finding Chromatic numbers.
8. Finding the maximum flow of the networks.

Text Books:

1. J.P. Tremblay and R. Manohar, "Discrete Mathematical Structure and Its Application to Computer Science", TMG Edition, Tata Mcgraw-Hill, 2015.

Reference books:

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw –Hill, 2015.
2. Susanna S. Epp, "Discrete Mathematics with Applications", 4th Edition, Wadsworth Publishing Co.Inc, 2010.
3. C L Liu and D P Mohapatra, "Elements of Discrete Mathematics A Computer Oriented Approach", 3rdEdition by, Tata McGraw –Hill, 2012.
4. Norman L. Biggs, "Discrete Mathematics", 2ndEdition, Oxford University Press, 2010.
5. Schaum's Outlines Series, Seymour Lipschutz, MarcLipson, "Discrete Mathematics", Tata McGraw –Hill, 2013.
6. Alexander Stanoyevitch, "Discrete Structures with Contemporary Applications", 1st Edition, CRC Press, Inc., 2011.
7. Duane Hanselman and Bruce Littlefield, "Mastering Matlab 7", Pearson, 2013.
8. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2nd Edn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
9. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

19MA2010	**Numerical Mathematics and Computing**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

Course Objectives:

1. Solving algebraic equations, interpolation and numerical integration.
2. Recognize splines.
3. Solve using differential equations.

Course Outcomes:

The Student will be able to

1. Knowledge about different methods of solving algebraic equations.
2. Evaluating integration using numerical techniques.
3. Compute using spline functions.
4. Solving ordinary differential equations using numerical techniques.
5. Solving partial differential equations using numerical techniques.
6. Apply MATLAB tools in probability and Random process.

Module 1: Solving algebraic equations **7 Lectures**

Nested Multiplication-pseudocode- Simple Numerical problems using Taylor's series- Representation of numbers in different bases. Bisection Method-Bisection Algorithm and pseudocode--Convergence of Bisection Method-Newton's method-Geometry of Newton's method-Pseudocode-Convergence Analysis.

Module 2: Interpolation **6 Lectures**

Polynomial interpolation-Existence-Newton interpolating polynomial- Nested form- Calculating Newton interpolating formula using divided difference-Lagrange interpolating polynomial-Errors in polynomial interpolation.

Module 3: Numerical Integration **6 Lectures**

Trapezoidal rule- Error analysis-Recursive Trapezoidal formula – Pseudo code - Romberg Algorithm-Simpson's rule-Gaussian Quadrature Formulas.

Module 4: Approximations by spline functions **5 Lectures**

First degree spline–examples-Second degree splines–Natural cubic splines–B splines.

Module 5: Ordinary differential equations **8 Lectures**

Taylor series methods-Euler's Method Pseudocode-Taylor series of higher order method-Runge-Kutta Method-Runge-Kutta method of order 2-Pseudocode-Adams-Moulton method-A predictor-corrector scheme-Pseudocode.

Module 6: Partial Differential Equations **8 Lectures**

Parabolic Problems-Finite difference method-Pseudocode for explicit method-Crank- Nicolson method-Pseudocode of Crank-Nicolson method-Hyperbolic problems-Wave equation model problems-Numerical solution-Pseudocode-Elliptic Problems-Helmholtz equation model problems-Gauss-seidal Iterative method.

List of experiment using MATLAB:

1. Solution of algebraic equation by Bisection and Newton-Raphson methods,
2. Newton's and Lagrange interpolation polynomial process.
3. Solving definite integral using Romberg integration.
4. Computing solution by Guassian quadrature.
5. Expressing Linear spline function.
6. Programming Euler's method and Runge-Kutta method.
7. Evaluating string problem using R-K method.
8. Solving PDE using Finite difference method.

Text Books:

1. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Cengage Learning Brooks/Cole Publishing Company, California, 2012.

Reference Books:

1. M.K.Jain., Iyengar. S.R.K., Jain R.K., "Numerical Methods for Scientific and Engineering Computation", (6^{th} Edition), New Age International, 2012.
2. Rajasekaran. S., "Numerical Methods in Science and Engineering: A Practical Approach", S. Chand publishers, 2003.
3. Kandasamy. P., Thilagavathy K., "Numerical Methods", S. Chand & Co. Ltd., 2010.
4. Steven C. Chapra., "Applied Numerical Methods with MATLAB for Engineers and Scientists", 3^{rd} Edition, Mc Graw Hill., 2012.
5. Dean G. Duffy. Advanced Engineering Mathematics with MATLAB, 2^{nd} Edn. Chapman & Hall / CRC Press. New York, 2003 (Taylor and Francis, e-library, 2009).
6. Kanti B. Dutta., Mathematical Methods of Science and Engineering – Aided with MATLAB, Cengage Learning, New Delhi, 2013.

		L	T	P	C
19MA2011	**Probability, Random Variables and Statistics**	**3**	**1**	**0**	**4**

Course Objective:

1. To understand the basic concepts of Probability.
2. To measure uncertainty using various probability distribution.
3. To analyze data with statistical methods.

Course Outcomes:

The student will be able to

1. Understand basic concepts of probability.
2. Solve problems on discrete and continuous random variables.
3. Understand the concepts of two dimensional random variables and solve problems.
4. Classify the problems using probability distributions and apply appropriate distributions.
5. Measure central tendency of the data
6. Compare variables using correlation and regression.

Module 1: Probability **7 Lectures**

Definitions and axioms, conditional probability - Independent events - Theorem of Total Probability - Baye's Theorem.

Module 2: One Dimensional Random Variables **7 Lectures**

Discrete Random Variable: Probability mass Function and distribution functions. Continuous Random Variable: Probability Density Function - Cumulative Distribution Function and Properties.

Module 3: Two Dimensional Random Variables **7 Lectures**

Two Dimensional Random Variables: Discrete and Continuous random variables, Cumulative Distribution Function- Marginal Probability Distribution - Conditional Probability Distribution - Independent Random Variables.

Module 4: Probability Distributions **7 Lectures**

Binomial distribution, Poisson distribution and Normal distribution. Exponential - Moments generating functions and its properties.

Module 5: Statistics - I **8 Lectures**

Measures of Central tendency :Mean, Median, Mode, Geometric mean, Harmonic mean. Measures of Dispersion: Range, Quartile deviation, Mean Deviation, Standard Deviation, Coefficient of variation.

Module 6: Statistics II **8 Lectures**

Moments - Skewness and Kurtosis - Rank correlation, co-efficient of correlation and regression lines.

Text Books:

1. T.Veerarajan, "Probability, Statistics and Random Processes", 2nd Edition,Tata McGraw-Hill, New Delhi, 2010.

Reference Books:

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
3. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
4. W. Feller, "An Introduction to Probability Theory and its Applications" , Vol. 1, Wiley, 1968.
5. S.C.Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics, Sultan Chand &Sons, 10th Revised Edition, 2000.

19MA3001	Modern Algebra	L T P C 3 1 0 4

Course Objectives:

1. To extend the knowledge in basic concept of number theory and congruence.
2. To classify the fundamental concepts of Algebra,
3. To create the students with the knowledge of ring theory

Course Outcomes:

The student will be able to

1. Apply the knowledge of real numbers, their operations and basic properties to find the greatest common divisor
2. Develop the skills in solving systems of linear equations in real time situations
3. Apply Sylow's theorems to solve different problems
4. Describe the fundamental theorem of finite abelian groups
5. Identify the concepts of ideals and homomorphism and isomorphism of rings
6. Extend the knowledge of Euclidean rings and unique factorization theorem

Module I: Divisibility theory of integers **(6 Lectures)**

Divisibility in Integers, Division Algorithm, Euclidean Algorithm, Primes, Fundamental Theorem of Arithmetic.

Module II: The Theory of Congruence's (12 Lectures)
Basic Properties of Congruence's, Linear Congruence's, Chinese Remainder Theorem, Fermat's Theorem, Wilson's Theorem, Euler's Phi Function, Primitive Roots.
Module III: Sylow's theorem (12 Lectures)
Counting Principle, Sylow's Theorem for Abelian Groups, Cayley's Theorem, Permutation Groups, Class Equations, Sylow's Theorem.
Module IV: Finite abelian groups (5 Lectures)
Internal Direct Products, External Direct Products, Finite Abelian Groups, Fundamental Theorem on Finite Abelian Groups.
Module V: Ring Theory (5 Lectures)
Ring Theory - an Introduction- Some special classes of rings-Homeomorphisms-Ideals and Quotient Rings - More Ideals and Quotient Rings.
Module VI: Euclidean Rings (10 Lectures)
Euclidean Ring, Principal Ideal Ring, Unique Factorization Theorem, Ring of Gaussian Integers. Polynomial Rings, polynomial over the Rational Field.

Reference Books:

1. HersteinI.N, "Topics in Algebra", Second Edition, Wiley India (P) Ltd., 2009.
2. John B.Fraleigh, "A First Course in Abstract Algebra", 7th Edition, Pearl Books, 2008.
3. David M.Burton, "Elementary Number theory", 7th Edition, McGraw-Hill Education(India) PVT.LTD., 2013
4. Alan Baker, "A Comprehensive course in Number theory", Cambridge University Press, 2013.
5. M K Sen, Shamik Ghosh, ParthasarathiMukhopadhyay, "Topics in Abstract Algebra", University Press, 2006.
6. Ivan Niven , Herbert S. Zuckerman , Hugh L Montgomery , "An Introduction To The Theory Of Numbers", 5th Edition, Wiley India Pvt Ltd, 2008.

19MA3002	Ordinary Differential Equations	L T P C 3 1 0 4

Course Objectives:
1. To understand the concept of Linear Differential Equations and Nonlinear Differential Equations
2. To analyze the method of Fixed Point Technique and Monotone Iterative Technique
3. To determine the existence of nonlinear differential equations and develop the applications of Boundary Value Problems.

Course Outcomes:
Students will be able to
1. demonstrate the method of successive approximations and fixed point technique
2. utilize the various methods to solve linear differential equations
3. solve differential equation using variation of parameters method
4. analyze the methods of iterative and quasi linearization
5. relate Gronwall's inequality and Bihari's Inequality in nonlinear differential equation
6. examine the various types of boundary value problems

Module I: Systems of Linear Differential Equations (8 Lectures)
Introduction, systems of first order equations, examples, Existence and Uniqueness Theorem, Fundamental Matrix and non-homogeneous Linear Systems.
Module II: Existence and Uniqueness of solutions (8 Lectures)
Introduction, preliminaries, Successive Approximations, Picard's Theorem, Examples, Fixed Point Method, examples and theorems.

Module III: Methods of Nonlinear Differential Equations **(8 Lectures)**
Introduction, Existence Theorem, Extremal Solutions, Upper and Lower Solutions, Monotone Iterative Method and Method of Quasi linearization, examples and theorems.

Module IV: Analysis of Nonlinear Differential Equations **(8 Lectures)**
Gronwall's Inequality, Bihari's Inequality, Application of Bihari's integral inequality, Variation of Parameters for Nonlinear Versions, examples and theorems.

Module V: Boundary Value Problems - I **(8 Lectures)**
Introduction, various types of boundary value problems, Sturm-Liouville Problem, theorems, Green's Functions and examples.

Module VI: Boundary Value Problems – II **(8 Lectures)**
Picard's Theorem, examples, oscillations of second order equations, fundamental results and Stum's Comparison Theorem.

Reference Books:

1. Deo S.G, Lakshimikantham V and Raghavendra V, "Textbook of Ordinary Differential Equations", 2nd Edition, Tata McGraw-Hill Ltd., 2009.
2. Coddington E.A, "An introduction to Ordinary Differential Equations", Prentice Hall of India Ltd., New Delhi, 2009.
3. Jordan D.W and Smith P, "Nonlinear Ordinary Differential Equations: An introduction for Scientists and Engineers", 4th Edition, Oxford University press, 2009.
4. Ravi P, Agarwal and Donal O'regan, "An Introduction to Ordinary Differential Equations", Springer, 2012.
5. Henry Ricardo, " A Modern Introduction to Differential Equations", Houghton Miffince, 2012.
6. George F. Simmons, "Differential Equations with Applications and Historical notes", TMH, 1991.

19MA3003	Classical Mechanics	L	T	P	C
		3	1	0	4

Course Objectives:
1. To provide the students with the understanding of particle dynamics, Lagrangian and Hamiltonian formulations
2. To learn about the method of small oscillations
3. To develop the skills with various methods of dynamics of rigid body and various applications of rigid body motions

Course Outcomes:
The students will be able to
1. Apply particle dynamics in practical problems
2. Update the knowledge with Lagrangian and Hamiltonian models
3. Developing the skills in solving small oscillational problems
4. Understand the variation techniques involved in real life problems
5. Identify the concept of rigid body motions in modeling and analysis
6. Demonstrate the mathematical model with experimental data

Module 1: Particle Dynamics **(8 Lectures)**
Basic Concepts, Degrees of freedom, Holonomic, Non-holonomic, Scleronomic constraints, Generalized Coordinates, Virtual Displacement, Virtual Work, D'Alembert's Principle, simple problems.

Module 2: Lagrangian Formulations **(7 Lectures)**
Lagrange's Equations, Rayleigh Function, Galilean Transformation, Legendre Transformation, Applications of Lagrange's equation, linear harmonic oscillator problem, simple pendulum problem

Module 3: Hamiltonian Formulation **(7 Lectures)**
Hamilton's Equations, Ignorable Coordinates, Routhian function, Conservation Laws. Applications of Hamilton's equation of motion-simple and compound pendulum, particle moving near the surface of the earth

Module 4: Small Oscillations **(8 Lectures)**
Stable and Unstable Equilibrium, Formulation of the Problem, The Orthogonality of Eigen Vectors, Normal Coordinates.

Module 5: Variation Techniques **(7 Lectures)**
Hamilton's Principle, Principle of Least Action, Kepler's problem, the case of projectile problems, Damped harmonic oscillator problem.

Module 6: Dynamics of a Rigid Body **(8 Lectures)**
The Inertia Tensor, Angular Momentum, The Eulerian Angles, Euler's Dynamical Equations for the Motion of a Rigid Body, Motion of a Symmetrical Top.

Reference Books:

1. Herbert Goldstein, Charles P.Poole, John Safko, "Classical Mechanics",Pearson Education, 2012.
2. Vimal Kumar Jain, "Classical Mechanics", Ane Books Pvt. Ltd., 2009.
3. Gupta S.L, Kumar V, SharmaH.V, " Classical Mechanics", Pragati Prakashan, 2008.
4. Sankara Rao K, "Classical Mechanics", PHI Learning, 2011.
5. Greenwood D.T, "Classical Dynamics", PHI Learning, New Delhi, 1997.

19MA3004	Real Analysis	L	T	P	C
		3	1	0	4

Course Objectives:

1. Students have the knowledge of basic properties of real numbers
2. To create the knowledge in Archimedean property and Cauchy – Schwarz inequality and Bolzano - Weierstrass theorem.
3. To equip the students with the knowledge of continuity, differentiability of real functions and Sequence and Series of functions

Course Outcomes:

Student will be able to

1. understand the axiomatic foundation of real number system, Archimedean property and Cauchy – Schwarz inequality
2. describe the fundamental types of point sets, such as open sets, closed sets, compact sets and more generally, sets in higher dimensional spaces
3. apply the Bolzano – Weierstrass theorem
4. summarize the completeness, continuity and other notions are generalized from the real line to metric spaces
5. appraise the sequences of convergence and uniform convergence
6. explain the notion of uniform convergence of Infinite series

Module I: Real Number system **(8 Lectures)**
Axioms – Geometric representation of real numbers - Unique factorization theorem - Least Upper Bound and Greatest Lower Bound – Some properties of the Supremum - Archimedean property – Absolute values and the triangle inequality - Cauchy-Schwarz inequality.

Module II: Operations on Sets **(7 Lectures)**
Cartesian product of two sets - Relations and functions – Composite functions – Finite and infinite sets - Countable and uncountable sets – Uncountability of the real number system – Set Algebra – Countable collection of countable sets.

Module III: Euclidean Space **(8 Lectures)**
Open balls and open sets in Euclidean space– Closed sets – Adherent and accumulation points – Bolzona-Weierstrass Theorem - Cantor Intersection Theorem – Lindelof covering theorem - Heine-Borel covering Theorem.

Module IV: Metric spaces **(8 Lectures)**
Convergent sequences in a metric space – Limit of a function - Continuous functions - Continuity of composite functions - Uniform Continuity – Fixed point theorem for contractions – Derivatives and continuity - Rolle's theorem - Mean value theorem for derivatives.

Module V: Convergence of Sequence of functions **(7 Lectures)**
Pointwise convergence of sequence of functions – Sequences of Real-valued functions- Uniformly bounded sequence - Uniform convergence and continuity – Cauchy condition for uniform convergence.

Module VI: Convergence of Infinite Series **(7 Lectures)**
Uniform convergence of infinite series of functions – Weierstrass M-test - Uniform convergence and Riemann- Stieltjes integration - Uniform convergence and differentiation – Sufficient condition for uniform convergence of a series.

Reference Books:

1. Apostol T. M, "Mathematical Analysis", Second Edition, Narosa Publishing House, 2009.
2. Malik S.C, Savita Arora, "Mathematical Analysis", Third Edition, New Age International Ltd., 2008.
3. Royden H and Patrick Fitzpatrick, "Real Analysis", 4th Edition, Macmillan, New York, 2010.
4. Walter Rudin," Principles of Mathematical Analysis", Tata McGraw Hill, 2013.
5. Bali N.P, "Real Analysis", Lakshmi Publications, 2009.

		L	T	P	C
19MA3005	**Complex Analysis**	**3**	**1**	**0**	**4**

Course Objectives:

1. To develop the concept of analytic functions and Elementary functions
2. To create the knowledge in complex Integration
3. To determine the applications of conformal Mappings

Course Outcomes:

Student will be able to

1. Understand the concept of Analytic functions, C R equations and Harmonic function
2. Create the knowledge about the Exponential functions and their properties, logarithmic function, Trignometric function and Hyperbolic function
3. Understand the concept of Cauchy Goursat Theorem, Cauchy's Integral formula, Morera's Theorem, Liouville's Theorem
4. Evaluate Improper Integrals
5. Analyzing different types of mappings of the elementary functions
6. Create the knowledge in conformal mapping and its application in engineering fields

Module I: Analytic functions **(7 Lectures)**
Functions of Complex variable – Limit Theorem on Limits – Continuity – Derivatives - C - R Equations- Sufficient Condition for Differentiability - Polar Coordinates – Analytic functions - Harmonic functions

Module II: Elementary Functions **(7 Lectures)**
The Exponential Function – Other properties of exponential z - The logarithmic function and its Branches - Trigonometric Function - Hyperbolic Functions- Inverse Trignometric and Hyperbolic functions.

Module III: Complex Integration (8 **Lectures**)
Contour Integration – – Cauchy Goursat Theorem - Cauchy's Integral formula – An extension of Cauchy's Integral formula – Derivatives of analytic functions – Morera's Theorem – Maximum Moduli of functions - Liouville's Theorem and the fundamental Theorem of Algebra.

Module IV: Residues and Poles **(7 Lectures)**

Convergence of Sequences and series – Uniform Convergence - Integration and Differentiation of power series – Uniqueness of series representation – Residues – Quotients of Analytic function – Evaluation of Improper Real Integrals – Improper Integrals involving sines and cosines.-Integration through a Branh cut.

Module V: Mapping by elementary functions (8 **Lectures**)

The transformation w=1/z – Linear fractional transformation – special linear fractional transformation - The transformation w = sin z- Mappings by $w = z^2$ and $z^{1/2}$- Schwarz–Christoffel Transformation - Special Transformations, - Bilinear Transformations.

Module VI : **Conformal Mapping and its applications** (8 **Lectures**)

Basic properties – Harmonic conjugates – Steady temperatures- Steady temperature in a half plane – Temperatures in a Quadrant – Electro static potential – Potential in a cylindrical space – Two dimensional fluid flow – The stream function – Flows round a corner and around a cylinder.

Reference Books:

1. James Ward Brown, Ruel V. Churchill, "Complex Variables and Applications", McGraw Hill pvt.Ltd., 2009.
2. Anuradha Gupta, "Complex Analysis", Ane Books Pvt. Ltd, New Delhi, 2011.
3. James Ward Brown, Ruel V. Churchill, "Complex Variables and Applications", McGraw Hill pvt.Ltd., 2009.
4. Lars Ahlfors V, "Introduction to the Theory of functions of a Complex Variable", (3rd edition) 2nd Reprint, McGraw Hill Co., New York, 2013.
5. Tang K.T, "Mathematical Methods for Engineers and Scientists: Complex Analysis, Determinants and Matrices", Springer, 2007.
6. Dube K.K, "Fundamentals of Complex Analysis, Theory and Applications", International publishing house pvt.ltd, 2009.

19MA3006	Linear Algebra	L	T	P	C
		3	1	0	4

Pre-Requisite: 19MA3001 Modern Algebra

Course Objectives:

1. Understand the relationship between systems of linear equations and their matrix form
2. To create the knowledge in Vector Spaces and transforms
3. To determine the applications of diagonalization and canonical forms of matrices

Course Outcomes:

Students will be able to

1. Understand Bases and Dimension
2. Construct Linear Transformations and its matrix forms.
3. Design minimal polynomials
4. Recognize canonical forms of matrix
5. Construct quadratic forms
6. Determine rank and signature

Module I: Vector Spaces **(8 Lectures)**

Definitions and examples of vector spaces and subspaces, Linear Independence and dependence, Bases and Dimension, Quotient spaces and coordinates.

Module II: Linear Transformations **(8 Lectures)**

Algebra of Linear Transformations, Matrix Representation of Linear Transformations, singular and non-singular transformations, linear functional and dual spaces. annihilators.

Module III: Diagonalization **(8 Lectures)**

Characteristic Roots, Characteristic Vectors, Eigen values and Eigen vectors. Minimal Polynomials and related theorems.

Module IV: Canonical forms **(8 Lectures)**
Triangular Forms, Nilpotent Transformations, Jordan Forms, Rational Canonical Forms and related properties and theorems.
Module V: Algebra of Matrices **(8 Lectures)**
Trace and Determinants, Real Quadratic Forms, Classification of Quadratic Forms, Reduction, Sylvester's Law, Rank and Signature**.**
Module VI Bilinear forms **(8 Lectures)**
Bilinear forms as vectors. Matrix of bilinear forms, symmetric bilinear forms, Skew-symmetric bilinear forms and group preserving bilinear forms.

Reference Books:

1. Herstein I.N, "Topics in Algebra", Second Edition, Wiley India (P) LTD., 2009.
2. Kenneth Hoffman and Ray Kunze, "Linear Algebra", Second Edition, Prentice Hall of India Private Limited, 2005.
3. Jimmie Gilbert, "Linear Algebra and Matrix Theory", First Edition, Academic Press, 2005.
4. Jin Ho Kwak and Sungpyo Hong, "Linear Algebra", Second Edition, Birkhauser Publication, 2005.
5. Klaus Janich, "Linear Algebra", First Indian Reprint, Springer Publication, 2004.
6. Seymour Lipschutz and Marc Lars Lipson, "Theory and Problems of Linear Algebra", Third Edition, Tata McGraw – Hill Publishing Company Ltd, 2006.
7. A.R. Vasishtha, " Matrices", Twentieth Edition, Krishna Prakashan Mandir, 1993.

19MA3007	Topology	L T P C 3 1 0 4

Course Objectives:
1. To acquire knowledge about topological space
2. To analyze the problems of continuity, connectedness, compactness, separation axioms
3. To understand the basic concepts of algebraic topology

Course Outcomes: Student will be able to
1. recognize the concepts of topological space, Basis, subspaces and continuity
2. differentiate connected and disconnected spaces
3. characterize new ideas in compactness using the basic concepts of topology
4. demonstrate the relationship among all the separation axioms
5. construct the ideas of separation axioms
6. Recognize the basic concepts of algebraic topology

Module I: Topological Spaces **(8 Lectures)**
The Nature and Origin of Topology**,** Basic concepts: Interior, closure and boundary – Examples and properties - Basis and Sub basis - Subspaces: The Zariski topology – Properties of subspace topology - Continuity and topological Equivalence
Module II: Connected Spaces **(8 Lectures)**
Connected and disconnected spaces, Theorems on connectedness, Connected subsets of the real line – Applications of connectedness – Path connectedness – Locally connected and Locally path connected spaces.
Module III: Compact Spaces **(7 Lectures)**
Compactness - Compact spaces and subspaces, compactness and continuity, Properties related to compactness - One point Compactification – The Cantor set.
Module IV: Separation Axioms **(8 Lectures)**
Comparison of Topologies - Quotient Spaces - Separation axioms: T_0, T_1, T_2- Spaces, Regular Spaces, Normal spaces: Properties and theorems - Separation by Continuous Functions.

Module V: Algebraic Topology **(7 Lectures)**
The nature of algebraic topology - Homotopy of Paths – The Fundamental Group – Covering Spaces – The Fundamental Group of the Circle – Retraction and Fixed Points

Module VI: Fundamental Groups **(7 Lectures)**
The Fundamental Theorem of Algebra -The Borsuk –Ulam Theorem - Deformation Retracts- The Brouwer Fixed Point Theorem -the fundamental group of S^n - Categories and Factors.

Reference Books

1. James R.Munkres, "Topology", Second edition, Pearson Prentice Hall, 2015.
2. Fred H.Croom, "Principles of Topology", Cengage Learning, 2009.
3. Paul L.Shick, "Topology: Point set and Geometric", Wiley Inter Science, 2013.
4. Murdeshwar M.G,"General Topology", New Age International Publisher, 2008.
5. Malik A.K, and Singh S.R, "Topology", International Publishing House Pvt.Ltd. 2012.
6. Stephen Willard, "General Topology", Dover Publications Inc., 2004.

19MA3008	Partial Differential Equations	L T P C 3 1 0 4

Pre-Requisite: 19MA3002 Ordinary Differential Equations

Course Objectives:

1. To discuss about first order linear and nonlinear partial differential equations
2. To classify the second order partial differential equations and analyze about boundary value problems
3. To explain about one-dimensional and two-dimensional wave equations and their uses. .

Course Outcomes:

1. Students get the knowledge of Lagrange's method
2. Students will recognize Cauchy method of characteristics
3. Student will be able to examine about Charpit's method
4. To analyze about Laplace equation and Dirichlet problem
5. Students will get knowledge about separation of variables method in diffusion equation and wave equation
6. Understand the uses of method of Eigen functions

Module I: First Order PDEs **(8 Lectures)**
Introduction, Formation of Partial Differential equation, Solution of PDE of first order, Lagrange's Method, Cauchy Problem for First Order Partial Differential Equations and examples.

Module II: First Order Non linear PDEs **(8 Lectures)**
First Order Nonlinear Equations, Cauchy Method of Characteristics, Compatible Systems of first order equations, Charpit's Method and examples.

Module III: Second Order PDEs **(8 Lectures)**
Introduction, Classification of second order PDE, Canonical Forms, Derivation of Laplace, BVP, Separation of Variables, Dirichlet Problem and examples.

Module IV: Laplace equation **(8 Lectures)**
Occurrence of the Laplace equations, Derivation of Laplace equation, separation of variables, Solution of Laplace Equation in Cylindrical and Spherical Coordinates.

Module V: Diffusion Equation **(8 Lectures)**
Diffusion Equation, Dirac-Delta Function, Separation of Variables Method, Solution of Diffusion Equation in Cylindrical and Spherical Coordinates.

Module VI: Wave equation **(8 Lectures)**
One-Dimensional Wave Equation, Vibrating String, Variable Separable Solution, D Alembert's Two Dimensional Wave Equation, Method of Eigen Functions.

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Reference Books:

1. Sankara Rao K, “Introduction to Partial Differential Equations”, 3rd Edition, PHI Learning .Ltd., 2011.
2. Hillen T, Leonard I.E and Van Roessel H, “Partial Differential Equations”, Wiley, 2012.
3. Jianhong WU, “Theory and Applications of Partial Differential Equations”, Springer, 2005.
4. Victor Henner, Tatyana Bolozerova and Mikhail Khenner, “Ordinary and Partial Differential Equations”, A K Peters/CRC Press, 2013.
5. Robert C.Mcowen, “Partial Differential Equations: Methods and Applications”, Pearson Education Asia, 2004.
6. Ian Naismith Sneddon, “Elements of Partial Differential Equations”, Dover Publications, 2006.

19MA3009	Field Theory	L	T	P	C
		3	1	0	4

Pre-Requisite: 19MA3001 Modern Algebra.

Course Objectives:

1. To provide the student with the understanding of basic concepts of different kind of fields and various properties of division rings
2. To create knowledge in various properties of primitive polynomials, extension of field theory and splitting field
3. To understand principles of Galois Theory and normal extension

Course Outcomes:

Students will be able to

1. understand the proof techniques in Wedderburn Theorem on Finite Division Ring
2. Characterizing the properties of finite and infinite fields
3. remember various properties of polynomials and fields
4. identify the classifications of polynomials
5. analyze various properties of fields
6. describe the structure of certain types of *field* extensions by using Galois Theory

Module I: Finite and infinite Field (8 Lectures)

Axioms of the fields, Infinite Fields and Finite Fields, Wedderburn’s Theorem on Finite Division rings and related theorems.

Module II: Polynomial Rings (6 Lectures)

Rings, Polynomial Rings, The Division Algorithm, Polynomial Rings over the Rational Field, Primitive Polynomials, Gauss Lemma, Eisenstein Irreducible Criterion and related theorems.

Module III: Field Extension (8 Lectures)

Extension of Fields, Algebraic Extension, Finite Extension, Roots of polynomials and related theorems.

Module IV: Splitting field (6 Lectures)

Roots of Polynomials, Splitting Field, Construction with Straight Edge and Compass, Simple Extension

Module V: Elements of Galois Theory (12 Lectures)

Galois Group, Fixed Field, Normal Extension, fundamental theorem of Galois Theory and related problems.

Module VI Galois Theory (8 Lectures)

Galois Group over Rationals, Solvability by Radicals and related theorems and problems.

Reference Books:

1. Herstein I.N, “Topics in Algebra”, Second Edition, Wiley India (P) LTD., 2009.
2. Joseph A.Galilean, “Contemporary Abstract Algebra”, Cengage learning, 2014.
3. Joseph Rotman, “Galois Theory”, Second Edition, Springer, 2005.
4. Bhattacharya P.B, Jain S.K, Nagpaul S.R, “Basic Abstract Algebra”, Second Edition, Cambridge University Press, 2012.
5. John M.Howie, “Fields and Galois Theory”, Springer, 2008.

19MA3010	Advanced Calculus	L T P C 3 1 0 4

Pre-Requisite: 19MA3004 Real Analysis.

Course Objectives:

1. To provide the student with the understanding of basic concepts of Functions of Bounded Variation, and different types of integrals
2. To learn various properties of Measurable set and Measurable Functions
3. To equip the students with the knowledge of Directional Derivative, Continuity and the Total Derivative

Course Outcomes:

Students will be able to

1. understand Functions of Bounded Variation
2. construct measurable sets and functions
3. describe Riemann-Stieltjes Integral
4. evaluate Lebesgue Integral
5. analyse Fourier Integrals
6. apply mean value theorem for differentiation

Module I: Measure on the Real Line (8 Lectures)

Lebesgue outer measure –measurable sets – Regularity – Measurable functions –Borel and Lebesgue Measurability.

Module II: Function of Bounded Variation (8 Lectures)

Functions of Bounded Variation – Total variation – Additive property of total variation - Function of bounded variation expressed as the difference of increasing functions - Rectifiable Curves.

Module III: Riemann-Stieltjes Integral (8 Lectures)

Reduction to a Riemann Integral – Riemann's condition - Differentiation under the Integral Sign, Conditions for Existence of Riemann Integrals.

Module IV : The Lebesgue Integral (8 Lectures)

Uniform Convergence with example - Lebesgue Integral – Basic properties of Lebesgue integral Levi Convergence Theorems – Lebesgue dominated convergence theorem – Improper Riemann Integrals.

Module V: Fourier Integrals (8 Lectures)

Fourier Integral Theorem – The exponential form – Convolution theorem for Fourier Transforms – The Poisson Summation Formula.

Module VI Multivariable Differential Calculus (8 Lectures)

The Directional Derivative and Continuity – The Total Derivative - The Total Derivatives Expressed in Terms of Partial Derivatives – The chain rule - Mean value theorem for differentiable functions.

Reference Books:

1. Apostol T.M, "Mathematical Analysis", Second Edition, Narosa Publishing House, 2009.
2. G.de.Barra, "Measure Theory and Integration", Second Edition, New Age International Publishers, 2015.
3. Jain P.K., Gupta V.P., Pankaj Jain, "Lebesgue Measure and Integration", New Age International Publishers, 2015.
4. Malik S.C, Savita Arora, " Mathematical Analysis", Third Edition, New Age international Ltd., 2008.
5. Royden H and Patrick Fitzpatrick, "Real Analysis", 4th Edition, Macmillan, New York, 2010.
6. Bali N.P, "Real Analysis", Lakshmi Publications, 2009.

19MA3011	Advanced Numerical Analysis	L T P C 3 1 0 4

Pre-Requisite: 19MA3002 Linear and Non Linear Ordinary Differential Equations,
19MA3008 Partial Differential Equations,
19MA3006 Linear Algebra.

Course Objectives:

1. To apply the numerical methods for solving algebraic and transcendental equations
2. To develop skills to various methods in Interpolation techniques
3. To analyze various numerical methods to solve ODE and PDE

Course Outcomes:

Students will be able to

1. evaluate the solutions of algebraic and transcendental equations using numerical methods
2. apply different methods to find the solution of system of linear Algebraic Equation
3. analyze different Interpolation techniques
4. evaluate a definite integral using an appropriate numerical method
5. evaluate the numerical solution of ODE
6. find the numerical solutions of PDE

Module I: Numerical Solutions of Algebraic and Transcendental Equations (7 Lectures)

Bisection method - Method of Iteration – Method of false position - Newton-Raphson Method - Mullers method - Graffe's root square method - Horner's method,- Rate of Convergence.

Module II: Solutions of Systems of Linear Algebraic Equations (7 Lectures)

Gauss Elimination - Gauss Jordan method - LU Decomposition Method-- Gauss Jacobi method – GaussSeidel Methods - Modification of the Gauss method to compute the Inverse of the matrices.

Module III: Polynomial Interpolation (8 Lectures)

Finite Differences - Lagrange Interpolation Formulae – Newton's formula for Interpolation – Gauss formula for Interpolation - Hermite Interpolation Formulae - Spline functions - Linear Splines, Quadratic Splines and Cubic Splines.

Module IV: Numerical Calculus (7 Lectures)

Numerical Differentiation - Errors in Numerical Differentiation - Trapezoidal Rule - Simpson's one-third Rule - Simpson's Three-Eighth Rule- Boole's and Weddle's Rule, Use of Cubic Splines.

Module V: Numerical Solutions of ODE (8 Lectures)

Numerical Solutions of ODE using Taylor's method- Picard method - Euler method - Modified Euler method – Improved Euler's method – Runge Kutta Methods - Predictor– Corrector Method.

Module VI: Numerical Solutions of PDE (8 Lectures)

Solution of Laplace Equation – Gauss Jacobi's Method – Gauss Seidel Method – Heat Equation in One Dimension – Solution of one dimensional wave equation.

Reference Books:

1. Sastry S.S, "Introductory Methods of Numerical Analysis", 5th Edition,PHI , 2013.
2. Richard L.Burden, Douglas Faires J, "Numerical Analysis", 9th Edition, Cengage Learning India Private Limited, 2012.
3. Samuel D.Conte, Carl De Boor, "Elementary Numerical Analysis: An Algorithmic Approach", 3rd Edition, TMG, 2009.
4. Madhumangal Pal, "Numerical Analysis for Scientists and Engineers: Theory and C Programs", Narosa Publishing House, 2011.
5. Grewal B S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2017.

19MA3012	Functional Analysis	L T P C 3 1 0 4

Pre-Requisite: 19MA3004 Real Analysis, 19MA3007 Topology, 19MA3006 Linear Algebra.

Objectives

1. Knowledge in various operators and Spaces
2. Recognize the methods in Operators & Functional
3. Remember the application of Hilbert spaces

Outcomes

Students will be able to have Knowledge in applications of

1. Understanding the concept of Normed linear spaces
2. Recognize the concept of linear functionals
3. Relating the Banach Fixed Point Theorem with other mathematical concepts
4. Skill to differentiate the Banach and Hilbert space
5. Relating Orthogonality in inner product
6. Characterize the Operators of Hilbert spaces

Module I: Normed linear spaces **(8 Lectures)**

Basic Concepts, Properties, Examples of a normed linear spaces, Banach Spaces, Subspace, Linear Operators, Bounded and Continuous Linear Operators.

Module II: Linear Functional **(8 Lectures)**

Linear functions, linear operators and functionals on finite Dimensional spaces, Normed spaces of operators: Dual space, Examples of Dual spaces, Hahn-Banach Theorem.

Module III: Banach Spaces **(8 Lectures)**

Uniform boundedness Principle, Open Mapping Theorem, Closed Graph Theorem, Banach Fixed Point Theorem, Applications of Banach fixed point theorem.

Module IV: Hilbert Spaces **(8 Lectures)**

Inner Product Spaces: Real inner product, complex inner product, Hilbert Space, Examples of Hilbert spaces, Cauchy Schwarz's inequality, Properties of Hilbert spaces.

Module V: Orthogonality **(8 Lectures)**

Orthogonal Complements and Direct Sums, Orthonormal Sets, Gram-Schmidt orthogonalization, Bessel inequality, Representation of a Functional on a Hilbert Space.

Module VI: Operators on Hilbert Spaces **(8 Lectures)**

Hilbert-Adjoint operators and properties of adjoint operators, Self-adjoint operators, Normal, Unitary Operators and its characterizations.

Reference Books:

1. Simmons.G.F., "Introduction to Topology and Modern Analysis", Tata McGraw Hill Publishing Company, 2009.
2. Thambar Nair M., "Functional Analysis: First Course", PHI, 2002.
3. Peter D. Lax, "Functional Analysis", Wiley Publishing Inc. 2014.
4. Francis Hirsch, Gilles Lacombe "Elements of Functional Analysis", Springer, 2010.
5. Kreyszig E., "Introductory Functional Analysis with Applications", John Wiley & Sons, New York, 2001.

19MA3013	Calculus of Variations and Integral Equations	L T P C 3 1 0 4

Pre-Requisite: 19MA3002 Ordinary Differential Equations,
19MA3003 Classical Mechanics,
19MA3008 Partial Differential Equations,
19MA3006 Linear Algebra.

Course Objectives:

1. To know the ideas and techniques of calculus of variations and integral equations
2. To understand variational methods for boundary value problems in ordinary and partial differential equations
3. To have complete familiarity with Fredholm and Volterra Type Integral equations

Course Outcomes:

Students will be able to

1. explore the methods for finding maximum or minimum of a functionals
2. apply the calculus of variations to engineering and science problems
3. solve the Initial and boundary value problems
4. use the solving techniques of integral equations
5. distinguish Fredholm and Volterra integral equations
6. recognize the characteristic numbers and Eigen functions

Module I: Variational problems with fixed boundaries (8 Lectures)

The Concepts of Variation and its properties, Geodesies, Euler–Lagrange's equation - Necessary and sufficient conditions for extrema – Functionals involving higher order derivatives – several independent variables- variational problems in parametric form.

Module II: Direct methods in Variational problems-I (8 Lectures)

Variational methods for Boundary Value Problems in Ordinary Differential equations, Simple problems and simple applications.

Module III: Direct methods in Variational problems-II (8 Lectures)

Variational methods for Boundary Value Problems in Partial Differential equations, Rayleigh – Ritz method. Simple problems and simple applications.

Module IV: Integral Equations (8 Lectures)

Introduction - Linear and Non-linear Integral equations – Fredholm integral equation, Volterra Integral equation of the first and second kind.

Module V: Conversion of Differential equations into integral equations (8 Lectures)

Method of converting an initial value problem into a Volterra integral equation – Alternative method of converting an initial value problem into a Volterra integral equation- Method of converting a boundary value problem into a Fredholm integral equation.

Module VI: Integral equations with Special kinds of kernels (8 Lectures)

Solutions with Separable Kernels, Symmetric kernels and Resolvent Kernel - Characteristic numbers and Eigen functions.

Reference Books:

1. Shanthi Swarup, "Integral equations", 19th Edition, Krishna Prakashan Media Pvt Ltd, 2010.
2. Goyal, Linear Integral Equations, 19th Edition, Jaipur Publishing house, 2010.
3. Gupta. A.S, "Calculus of Variations with Applications", PHI , 2014.
4. Van Brunt, Bruce, "The Calculus of Variations", Springer Publications, 2004.
5. Ajay Pratap, "Special Functions in Mathematics (Linear integral equations)", University Science Press, New Delhi, 2011.
6. Andrei D. Polyanin, Alexander V. Manzhirov, "Handbook of Integral equations", Chapman & Hall/CRC, 2008.

7. Kanwal R.P, "Linear Integral Equations: Theory & Technique", Springer, 2013.

19MA3014	Matrix Computations	L T P C 3 0 0 3

Course Objective:
1. To provide the students with the understanding of linear equations and their applications
2. To equip the students with the concept of Cholesky matrix, LU, QR and Matrix decomposition methods
3. To understand the various methods of Gram-Schmidt model

Course outcome:
Students will be able to
1. apply linear equations in their core subjects
2. analyse electric circuit problems using advanced matrix theory
3. solve linear systems
4. understand the mathematical principles involved in real life problems
5. apply the concept in modeling and analysis
6. demonstrate the mathematical model with experimental data

Module I: Cholesky Decomposition (8 Lectures)
Linear Equations-Simple Electrical circuit problem-partitioning matrices- Systems of linear equations-Triangular systems- Positive Definite Systems- Cholesky Decomposition- Cholesky Decomposition Theorem- Cholesky algorithm.

Module II: LU Decomposition (8 Lectures)
Gaussian Elimination Method- LU Decomposition Theorem- LDV Decomposition Theorem- Gaussian Elimination with pivoting.

Module III: Iterative Methods (8 Lectures)
Linear systems: Solutions by Iteration – Gauss Jacobi Method – Gauss Seidel Iteration method.

Module IV: QR Decomposition (8 Lectures)
The discrete least squares problem-orthogonal matrices-Rotators-Reflectors-QR decomposition-Solving least squares problems by using QR decomposition-Complex rotators-complex reflectors.

Module V: The Gram-Schmidt Method (8 Lectures)
Orthonormal vectors- Classical Gram Schmidt Algorithm- Modified Gram Schmidt Algorithm- The discrete least squares problems- The continuous least squares problems.

Module VI: Singular Value Decomposition (8 Lectures)
Singular Value Decomposition Theorems- Computing the Singular Value Decomposition - least squares problems-The pseudo inverse of the matrices.

Reference Books:
1. David S.Watkins, "Fundamentals of Matrix Computations", John Wiley & Sons, Singapore. 2004.
2. Richard Bronson, "Matrix Operations", (2nd Edition), Schaum's Outline Series, McGraw Hill, New Delhi 2011.
3. Steven J. Leon, " Linear Algebra with Applications," 9th Ed, Pearson Publication, 2014.
4. Jimmie Gilbert, Linda Gilbert, "Linear Algebra and Matrix Theory", (1st Edition), Academic Press, 2005.
5. Erwin Kreszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi.2011

19MA3015	Finite Element Methods	L T P C 3 0 0 3

Course Objective:
1. To understand the Finite Element Methods with example of heat transfer, solid mechanic problems, discrete systems, Eigen value problems

2. To analyze the real time situations and convert in to finite element methods to find solution
3. To formulate governing equations and solve using finite element methods using numerical integration

Course Outcome:

Students will be able to

1. recognize mathematical modeling and finite element methods
2. demonstrate the steps of finite element methods in finding solution of Dynamic, Heat transfer, solid mechanic, discrete systems, fluid mechanics and Eigen value problems.
3. construct mathematical models using Euler equation and Hamilton's principle
4. solve the boundary value problems by finite element method
5. apply the ideas of calculus of variation, boundary conditions in finite element problems
6. apply numerical integration in evaluating finite element problems

Module I: Introduction to Finite Elements Methods (8 Lectures)

Mathematical Models-Dynamic, heat transfer and solid mechanic problems, Introduction to Finite Element Method -The basic idea and features – Advantages and applications

Module II: Calculus of variation (7 Lectures)

Fundamentals of calculus of variation- variational operation and First iteration - Fundamental lemma of variational calculus -Euler Equation-Natural and Essential Boundary Conditions-Hamilton's Principle

Module III: Discrete Systems (7 Lectures)

Linear Elastic Spring-Torsion of Circular Shafts-Electrical Resistor Circuits – Fluid Flow throws pipes. Heat Transfer: Governing equations and Finite element Models.

Module IV: Discrete Systems in Mechanics (7 Lectures)

Governing Equations and Finite Element models-Analysis of Beams element – Solid and structural Mechanics: Finite element model of Bars and Cables

Module V: Eigen value problems (8 Lectures)

Formulation: Parabolic equation, hyperbolic equation - Finite Element Formulation - Heat transfer and Bar-like problem-Natural Vibration of Beams: Euler-Bernoulli beam theory-Stability of Beam.

Module VI: Numerical Integration (8 Lectures)

Introduction - Coordinate Transformations- Integration over a Master Rectangular Element: Gauss points for linear, quadratic and cubic quadrilateral elements – Integration over a Master triangular element: Quadrature points and weights for triangular elements.

Reference Books:

1. J.N. Reddy, "An introduction to the finite element method", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. O.C.Zienkiewicz. "The Finite Element method". Tata Mc GrawHill.1989.
3. C. S. Desai and John F.Abel., Introduction to Finite Elements Method, Litton Educational Publishing Inc. 2004
4. Erik G. Thompson. Introduction to Finite Element Method, John Wiley & Sons, 2000.
5. T. R. Chandrupatla and A. D. Belegundu, "Introduction to Finite Elements in Engineering", 4th Edition, Prentice Hall, New Jersey, 2011.

		L	T	P	C
19MA3016	**Computational Mathematics**	**3**	**0**	**0**	**3**

Course objective:

1. To equip the students with the concept of Variations and Partial Differential Equations
2. To learn about the Initial value and Eigen value problems
3. To understand the various methods in Boundary value problems and Numerical Methods for analysis and modeling

Course outcome:
Students are able to

1. understand the concept of calculus of variation
2. acquire the knowledge in Partial Differential Equations of second order
3. develop the skills in solving Initial value problems
4. analyze different types of Eigen value problems
5. solve the boundary value problems
6. analyzing numerical solutions by using Integration techniques

Module I: Calculus of variations (7 Lectures)
Functional – Necessary condition of extremum - Euler's equation, Functional containing first and second order derivatives – Euler -Poisson equation – Euler equation in parametric form.

Module II: Numerical solutions of elliptic and parabolic equations (7 Lectures)
Elliptic Equations: Solution of Laplace equation by Liebmann method - Solution of Poisson equation - .Parabolic equations:- Bender Schmidt method, -Crank Nicholson's method.

Module III: Initial value problems (8 Lectures)
Picard's method -Taylor series method – Euler, Improved Euler and modified Euler method- Runge – Kutta method – Predictor Corrector method.

Module IV: Solutions of system of Equations and Eigen value problems (8 Lectures)
Solution of a linear system by Gaussian, Gauss Jordan, Jacobian and Gauss Seidel methods. Inverse of a matrix by Gauss Jordan method – Eigen value of a matrix by Power & Inverse power methods – Jacobi methods.

Module V: Solutions of Algebraic equations and Boundary value problems (7 Lectures)
Raleigh-Ritz - collocation methods - Horner's method - Muller's method - Chebyshev's method - Graffe's root square method - Relaxation method.

ModuleVI:Numerical Integration (8 Lectures)
Newton-Cotes quadrature formula – Simpson's $1/3^{rd}$ and $3/8^{th}$ rules – Weddle's rule (Single & Double integral) –Romberge Method - Gaussian quadrature formula.

Reference Books:

1. Naveenkumar, "An Elementary course on Variational problems in calculus", Narosa Publishing House, 2005.
2. Veerarajan T., Ramachandran T., "Numerical Methods", Tata McGraw Hill, 2007.
3. Curtis F-Gerald, "Applied Numerical Analysis", 5th edition, Addison Wesley Publishing Company, 2001.
4. Venkataraman M.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.
5. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Third edition, Brooks/Cole Publishing Company, California, 1994.
6. Grewal B S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2017.
7. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical methods for scientific and Engineering Computation", 6th Edition, New Age International, 2005.

		L	T	P	C
19MA3017	**Graph Theory and Algorithms**	**3**	**0**	**0**	**3**

Course Objective:

1. To provide the student with the understanding of basic concepts in Graph theory and to learn some special types of graphs, their properties and application to real life situations
2. To learn structures of trees and their properties and the application of graph colorings
3. To learn linear programming problems and the concepts of modeling and optimization and solve linear programming problems

Course Outcome:

The students will be able to

1. apply the understanding of the basic structure of graphs to real world situations
2. solve the complex engineering problems into simple graphs and find solutions
3. apply graph theory concepts in modeling and solving problems in the field of engineering
4. understand Graph network problems and give solutions to simple and complex networks
5. apply the appropriate algorithms to the situations exactly to get solutions
6. formulate linear programming models and apply various method for solving linear programming problems

Module I: Basics of graph theory (7 Lectures)

Graphs – Data structures for graphs – Sub graphs – Graphs Connectivity – Basic theorems on connectivity - Operations on Graphs.

Module II: Special graphs (7 Lectures)

Eulerian graphs – Theorems on Eulerian graphs – Arbitrarily traceable graphs - Hamiltonian graphs – Hamiltonian paths and circuits – Traveling sales man problem.

Module III: Trees (7 Lectures)

Trees – Spanning trees – Rooted trees – Matrix representation of graphs - Standard theorems – Planar graphs – Euler's formula.

Module IV: Coloring of Graphs (7 Lectures)

Five color theorem – Coloring of graphs – Chromatic number (vertex and edge) properties and examples – Directed graphs - Computer representation of graphs

Module V Basic graph algorithms (7 Lectures)

Minimal spanning tree algorithm – Kruskal and Prim's algorithm - Shortest path algorithms – BFS and DFS – Dijsktra's algorithm - Networks - the maximum flow minimum cut theorem.

Module VI: Linear Programming (7 Lectures)

Formulation of LPP – Solution of LPP - Graphical method – Simplex method (Artificial variables not included).

Reference Books:

1. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India (p) Ltd. 2004.
2. Kenneth Rosen H., "Discrete mathematics and its Applications", Tata McGraw –Hill Edition, 2012.
3. Kanti Swarup, Man Mohan, Gupta P.K., "Operations Research", Sultan Chand &Sons, 2000.
4. Walpole Myers, Myers, Ye, "Probability & Statistics for Engineers and Scientists". Pearson Education, first Indian reprint, 2002.

19MA3018	Tensor Algebra and Tensor Calculus	L 3	T 1	P 0	C 4

Pre-requisite: 19MA3006 Linear Algebra,
19MA3020 Differential geometry

Course objective:

1. To learn about the fundamentals of tensor algebraic structures and the generalization of vectors to tensors
2. To develop the skills with the tensor calculus and the various idea of tensor with transformation coordinates
3. To understand the various applications of tensor calculus

Course outcome:

The students will be able to

1. apply vectors and tensors in practical problems
2. update the knowledge with tensor algebra models

3. develop the skills in solving tensor algebraic structures problems
4. understand the tensor calculus involved in real life problems
5. demonstrate the concept of tensor with transformation coordinates in analysis
6. identify the physical law in to tensor calculus

Module 1: Tensor Algebra **(8 Lectures)**

Systems of Different orders – Kronecker Symbols – Transformation of coordinates in Sn – Invariants – Covariant and Contra variant vectors.

Module 2 : **Classification of Tensor** **(8 Lectures)**

Tensors of Second Order – Mixed Tensors – Zero Tensor – Tensor Field – Algebra of Tensors – Equality of Tensors – Symmetric and Skew-symmetric tensors.

Module 3: Multiplication **(8 Lectures)**

Outer multiplication, Contraction and Inner Multiplication – Quotient Law of Tensors – Reciprocal Tensor of Tensor – Relative Tensor – Cross Product of Vectors.

Module 4: Tensor Calculus **7 Lectures**

Riemannian Space – Riemannian and Euclidean spaces, The E-system and the generalized Kronecker delta Christoffel Symbols and their properties

Module 5: Tensor Calculus (contd) **(7 Lectures)**

Covariant Differentiation of Tensors – Tensor character of covariant and contravariant laws Riemann-Christoffel Curvature Tensor

Module 6: Geodesics **(7 Lectures)**

Intrinsic Differentiation-Geodesics, Canonical geodesic equations, Normal property of Geodesic, Local non –Intrinsic properties of surface.

Reference Books:

1. U.C. De, Absos Ali Shaikh and Joydeep Sengupta, *Tensor Calculus*, Narosa Publishing House, New Delhi, 2012.
2. Landsberg J.M, “Tensor: Geometry and Applications”, American Mathematical Society, 2012.
3. Charle Harper, Introduction to Mathematical Physics”, PHI Learning private limited, New Delhi, 2012.
4. David C.Kay, “Schaum’s Outline of Tensor Calculus”, Schaum’s Outline, Revised Edition, 2011.
5. Springer C.E, “Tensor and Vector Analysis with Applications to Differential Geometry”, Dover Publications. Inc., New York, 2012.

19MA3019	Control Theory	L T P C 3 1 0 4

Pre-Requisite: 19MA3002 Ordinary Differential Equations,
19MA3003 Classical Mechanics,
19MA3008 Partial Differential Equations,
19MA3006 Linear Algebra.

Course Objectives:

1. To acquire basic knowledge about Control Theory, the Optimal Control in Matrix equations and stabilizability
2. To distinguish linear & nonlinear systems
3. To motivate the uses & concepts of Controllability

Course Outcomes:

Students are able to

1. comprehend the advanced concept in Control Theory
2. generalize the concept of observability
3. apply Controllability concept in their subjects
4. imbibe knowledge about stability in linear & nonlinear systems

5. estimate stabilizability for various systems
6. compute & conclude optimal control for linear & nonlinear systems

Module I: Observability **(8 Lectures)**

Linear Systems: Definitions, Grammian, Constant Coefficient Systems, Reconstruction Kernel, Examples and Propositions, Nonlinear Systems: Definitions, Examples and Propositions.

Module II: Controllability **(8 Lectures)**

Linear Systems: Definitions, Grammian, Adjoint Systems. Constant Coefficient Systems, Steering Function, Examples and Propositions, Nonlinear Systems: Definitions, Examples and Propositions.

Module III: Stability **(8 Lectures)**

Linear Systems: Definitions, Uniform Stability, Asymptotic Stability, Examples and Propositions. Linear Time Varying Systems: Gronwall Inequality, Perturbed Linear Systems and Nonlinear Systems: Examples and Propositions.

Module IV: Stabilizability **(8 Lectures)**

Linear system: Definitions, Stabilization via Linear Feedback Control – Bass Method, Examples and Propositions.

Module V: Controllable Subspace **(8 Lectures)**

Linear system: Definitions, Controllable Subspace, Stabilization with Restricted Feedback, Examples and Propositions.

Module VI: Optimal Control **(8 Lectures)**

Linear Time Varying Systems with Quadratic Performance Criteria, Matrix Riccati Equation, Linear Time Invariant Systems and Nonlinear Systems.

Reference Books:

1. K. Balachandran and Dauer J.P, "Elements of Control Theory", Oxford: Alpha Science International, 2012.
2. Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Prentice Hall, 2009.
3. Zdzislaw Bubnicki, "Modern Control Theory", Springer, First Indian Reprint, 2007.
4. Donald E. Kirk, "Optimal Control Theory: An introduction", Dover publication inc, Dover Edition first, 2004.
5. Thomas A. Hughes, "Measurement and Control Basics", 4th Edition, International Society of Automation, 2006.

19MA3020	Differential Geometry	L T P C 3 1 0 4

Pre-Requisite: 19MA3002 Ordinary Differential Equations

Course Objectives:

1. To understand classical concepts in the local theory of curves and surfaces and their properties and classifications
2. Students will be able to understand the property of Geodesics and Existence Theorems, Geodesic Parallels, and Gauss Bonnet Theorems
3. To provide the students with basic tools and competences regarding the analysis and applications of curves and surfaces in 3D

Course Outcomes:

Students will be able to

1. understand the concept of theory of space curves
2. evaluate the concepts of involutes and evolutes.
3. construct metrics and Geodesis
4. analyze the concepts of Geodesic on a Surface
5. generalize the concept of Geodesic Parallels and Gauss Bonnet theorems
6. develop curves and surfaces in 3D

Module 1: Theory of Space Curves **(8 Lectures)**
Introduction, Definitions, Arc-length, Tangent, Normal and Binormal, The Curvature and Torsion of a curve given as the intersection of two surfaces.

Module II: Involutes and Evolutes **(8 Lectures)**
Contact between curves and surfaces, Tangent surface, involutes and evolutes, Intrinsic equations.

Module III: Theory of Surfaces **(8 Lectures)**
Fundamental existence theorem for space curves, Helices. Definition of a surface, Curves on a surface, Surfaces of revolution,

Module IV: Metrics **(8 Lectures)**
Definitions and properties of Metrics, Helicoids, Direction coefficients, Families of curves, Isometric correspondence.

Module V: Geodesics **(8 Lectures)**
Intrinsic properties, Geodesics, Canonical geodesic equations, Normal property of geodesics, Existence theorems, Geodesic parallels.

Module VI: Local Intrinsic Properties of a Surface **(8 Lectures)**
Geodesic curvature, Gauss-Bonnet theorem, Gaussian curvature, Surfaces of constant curvature.

Reference books

1. Willmore T.J., "An Introduction to Differential Geometry", Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print).
2. Andrew Pressley, "Elementary Differential Geometry", Springer 2004.
3. Thomas F. Banchoff and Stephen T., "Differential Geometry of Curves and Surfaces", A K Peters/CRC Press, 2010.
4. Thorpe J.A., "Elementary topics in Differential Geometry", under - graduate Texts in Mathematics, Springer - Verlag ,2004
5. Kumaresan S, "A Course in Differential Geometry and Lie Groups", Hindustan Book Agency, 2002.

19MA3021	Mathematics for Competitive Examinations	L	T	P	C
		3	0	0	3

Course Objectives:
1. To train the students for solving problems on Arithmetic and Mensuration
2. To motivate the students to give importance for numerical problems in Competitive Examinations
3. To equip the students with Short Cut Methods to solve the problems on Arithmetical Reasoning

Course Outcomes:
Students are able to
1. solve problems in Elementary Algebra
2. estimate interests
3. know the short cut methods to solve the arithmetical reasoning problems
4. arrange objects in a particular order
5. understand concepts of trigonometry
6. analyze data

Module 1 – Elementary Algebra **(6 Lectures)**
Problems on HCF,LCM, Ratio &Proportion, Percentage, Average, Elementary Algebra and Elementary Mensuration

Module 2 – Numbers **(10 Lectures)**
Square & Square Root, Cube & Cube Root, Series and Sequences, Fractions, Simple & Compound Interests, Mathematical Operations, Divisibility, Number System.

Module 3 – Probability **(5 Lectures)**
Counting Principle, Permutations& Combinations, Circular Permutation, Probability and Partnership.

Module 4 – Reasoning **(12 Lectures)**
Age Problems, Profit & Loss, Time & Work, Work & Wages, Pipes & Cistern, Allegation, Problems on Train, Boats & Streams and Arithmetical Reasoning.
Module 5 – Trigonometry **(8 Lectures)**
Trigonometric Ratios, Trigonometric identities, Problems on Time and Distance, Problems on Height and Distance.
Module 6 – Data Interpretation **(4 Lectures)**
Data Analysis: Tabulation, Bar diagrams, Pie-charts

References:

1. Mittal P.K, "Numerical Ability and Quantitative Aptitude: For Competitive Examinations", Galgotia Publishers Pvt. Ltd, 2004.
2. Aggarwal R.S., "Quantitative Aptitude", Revised Edition, S. Chand & Company Ltd., (New), 2017.
3. Praveen R.V, "Quantity Aptitude and Reasoning", PHI, 2012.
4. Edgar Thorpe, "Course In Mental Ability And Quantitative Aptitude: For Competitive Examinations", 2nd Edition, Tata Mcgraw-Hill Publishing Company Limited, 2000.
5. Arun Sharma, "How To Prepare For Quantitative Aptitude For The CAT", 1st Edition, Tata Mcgraw-Hill Publishing Company Limited, 2003.

19MA3022	Applied Statistics	L T P C 3 0 0 3

Course Objective:
1. To develop skills of the students in the area of probability, statistics and reliability
2. To understand the various applications of Time Series, Design of experiments and the multiple linear regression models
3. To recognize the difference between a population and a sample

Course Outcome:
Students are able to
1. gain knowledge in Theory of Probability
2. understand the reliability engineering problems
3. know the basic concept of Time series
4. apply regression analysis to their engineering problems
5. explain the essential components of experimental design
6. analyze data by appropriately fitting, assessing, and interpreting a variety of statistical models

Module I: Probability and Distributions **(8 Lectures)**
Probability-Axioms of probability–Conditional probability –Baye's theorem and related problems, Binomial, Poisson and Normal Distributions,
Module II: Reliability **(8 Lectures)**
Concepts of reliability, Hazard function, series and parallel systems, reliability of Markovian systems, maintainability, preventive maintenance.
Module III: Curve Fitting **(8 Lectures)**
Method of least squares, fitting a straight line, parabola, the curves transforming into linear forms, exponential and power curve.
Module IV: Time Series **(8 Lectures)**
Components of Time Series, Measurement of Trend, Method of Semi averages, Method of Moving Average, Method of Simple Averages, Ratio to Moving Average Method.
Module V: Statistical Analysis **(8 Lectures)**
Multiple Regression of X_1 on X_2 and X_3, Tests based on large samples, Small samples. The Mann Whitney U test.

Module VI: Design of Experiments **(8 Lectures)**

Analysis of variance–one factor classification- two factors classification - completely randomized design–randomized block design– Latin square design, comparison of RBD and LSD.

Reference Books:

1. Gupta S.P., “Statistical Methods”, New Delhi, S. Chand & Co., 37th Edition 2009.
2. Veerarajan T, “Probability, Statistics and Random Processes”, Second Edition, Tata McGraw Hill publishing company, 2003.
3. Kandasamy P., Thilagavathi K and Gunavathy K., “Numerical Methods”, S. Chand & Co., 2009
4. Richard A. Johnson, “Probability and Statistics For Engineers”, Prentice Hall of India, 2005.
5. Gupta S.C. and Kapoor V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Co., 2007.
6. Kapoor J.N. & Saxena H.C. “Mathematical Statistics”, S. Chand& Company, 2006.
7. David P. Doane, Lori E. Seward, “Applied Statistics in Business and Economics”, Tata McGraw Hill Publishing Company, 2007.

19MA3023	**Optimization Techniques**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course objective:

To provide the student with the concept and an understanding of basic concepts in

1. Linear and Non-linear programming models and Job sequencing
2. Game Theory, Integer programming and Network techniques
3. Application of everything learnt in real life

Course outcome:

The students will be able to

1. Understand the importance of optimization and to formulate and solve linear programming problems
2. Assess and articulate the Non-linear Programming and application
3. Construct and Demonstrate the basic concepts of PERT- CPM and their application
4. Compose the findings of Integer Programming problem
5. Formulate, analyze the game theory problems
6. Acquire the knowledge of Job Sequencing

Module I: Linear Programming **(8 Lectures)**

Engineering applications of optimization – classification of optimization problems- **Linear programming**: Formulation of LPP, Solution to LPP by simplex method and Dualtiy and Dual and simplex method

Module II: Integer programming **(8 Lectures)**

Construction of Integer programming problem- Differentiating between the simplex and Integer programming problem solution -Cutting plane algorithm, Branch and bound technique,

Module III: Job Sequencing **(8 Lectures)**

Sequence of 2 machines, 3 machines and m machines and n jobs. Sequence of two jobs in m machines using Graphical method.

Module IV: Network Techniques **(8 Lectures)**

Network diagram-Critical Path Method- PERT- probability of achieving completion date- crash time- cost analysis.

Module V: Game theory **(8 Lectures)**

Game theory: Two person zero-sum games, Maximum- minimum principle, Games without saddle points, Mixed strategies, Graphical method.

Module VI: Non linear Programming **(8 Lectures)**

Lagrangian method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Geometric programming – Introduction of Genetic Algorithm

Reference Books:

1. S. S. Rao, "Engineering Optimization – Theory and Practice", NAI publishers, 2013.
2. R. Panneerselvam, "Operations Research", Prentice Hall of India Private Limited, NewDelhi, 2005
3. Kalymanoy Deb, "Optimization for Engineering Design", Prentice Hall of India Private Ltd., New Delhi, 2003
4. P.K.Gupta and D.S. Hira, "Practical Problems in Operations Research" – Sultan Chand & Sons, New Delhi, 2008.
5. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, New Delhi, 2000.

19MA3024	**Probability and Distributions**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Course Objectives:

1. To acquire knowledge about Multivariate, limiting and some probability distributions
2. To understand the concepts of multivariate, limiting and probability distributions
3. To apply the concepts of probability distributions in solving problems, and the functions of random variables

Course Outcomes:

Student will be able to

1. acquire knowledge multivariate, limiting and special probability distributions
2. outline of multivariate and special probability distributions
3. demonstrate the steps involved in applying probability distributions
4. distinguish between the statistics and probability distributions
5. apply the probability distributions in decision-making
6. construct real time problems using probability distribution and limiting distributions

Module I: Probability **(7 Lectures)**

Probability, Axioms of Probability, Conditional Probability, Independent events, Total Probability, Baye's Theorem.

Module II: Random Variable **(7 Lectures)**

Discrete and Continuous Random Variables, Expectation of a Random Variable, Cumulative distribution function and its properties

Module III: Multivariate Distributions **(7 Lectures)**

Distributions of Two Random Variables, Independent Random Variables, Conditional Distributions, Correlation and Regression

Module IV: Standard Distributions **(9 Lectures)**

Binomial, Mean and variance of Binomial, Poisson, Mean and Variance of Poisson, Normal, Gamma, and Exponential Distributions**.**

Module V: Functions of Random Variable **(8 Lectures)**

Sampling Theory, Transformations of Variables of the Discrete and Continuous type, Beta ,t and F Distributions, Moment-Generating-Function Technique, The Distributions of $\overline{X}$ and nS^2/σ^2

Module VI: Convergence of Distributions **(7 Lectures)**

Convergence in Probability, Limiting Moment Generating function, The Central Limit Theorem, Some Theorems on Limiting Distributions.

Reference Books:

1. Robert V.Hogg and Allen T.Craig, "Introduction to Mathematical Statistics", PearsonEducation, Asia, 5th Edition,2005.
2. John A.Rice, "Mathematical Statistics and Data Analysis", Thomson Brooks/Cole, Third Edition, 2007.
3. Veerarajan T, "Probability, Statistics and Random Processes", Second Edition, Tata McGraw Hill publishing company, 2003.
4. RamachandranK.M, Chris P.Tsokos, "Mathematical Statistics with Applications",Academic Press,2009.
5. Ajay Goal,Alka Goal, "Mathematics and Statistics",Taxmann Allied Services Pvt.Ltd,2006.
6. Richard. J. Larsen, Monis L. Marx, "Introduction to Mathematical Statistics & its Applications", 5th Edition, Pearson Education, 2011.

19MA3025	Stochastic Processes	L	T	P	C
		3	1	0	4

Pre-requisite: 19MA3024 Probability and Distributions

Course Objectives:

1. Learn stochastic process and its large variety from introduction to an intermediate level of application knowledge
2. Understand the concepts and applications of time series and power spectrum in the field of signal processing
3. Learn the stochastic processes in queues and understand different queue models, and its application in industry

Course Outcomes:

The students will be able to

1. understand stochastic processes in its meaning and develop stochastic models
2. apply the concepts of stationarity and statistical averages in real time
3. apply Markovian model stochastic processes and obtain solutions especially in the field of engineering
4. derive new queue models to provide better solutions
5. find solutions for the untoward happening using the knowledge on reliability theory
6. develop a sense of strong research to get solutions in all walks of life since everything is probabilistic

Module I: Introduction **(7 Lectures)**

Specification of Stochastic Processes, Stationery Processes – Second order processes and Gaussian processes – Martingales - properties.

Module II: Markov Chains **(8 Lectures)**

Definition and Examples – Transition probability Matrix – Markov chain as graphs - Bernoulli Trials, Classification of States and Chains - Non-homogeneous Chains – Matrix approach for finite Non-homogeneous Chains.

Module III: Discrete Markov Processes **(8 Lectures)**

Poison Process - Birth and Death process - Randomization – Markov processes with discrete state space and continuous time Markov chain - Erlang Process,

Module IV: Continuous Markov Processes

Brownian Motion - Wiener process. Renewal Process, Renewal Theorems, Markov Renewal Equation.

Unit V: Time Series **(7 Lectures)**

Introduction - Stationary processes - Models of Time Series - Power Spectrum - Statistical Analysis of Time Series.

Unit VI: Stochastic Processes in Queuing & Reliability **(7 Lectures)**
Queuing Models**,** Birth and Death processes in Queuing Theory, Markovian Queuing Models, Non-Markovian Queuing Models, Reliability.

Reference Books

1. Samuel Karlin, Howard M.Taylor, " A First Course in Stochastic Processes", Second Edition, Academic Press, 2011.
2. P.W.Jones, P.Smith, "Stochastic Processes An Introduction", Arnold and co published by Oxford University Press Inc. Newyork, 2009.
3. Erhan Cinlar, "Introduction to Stochastic Processes", Dover Publications, 2013.
4. Roy D.Yates, David J.Goodman, Probability and Stochastic Processes, Second Edition, Wiley India Pvt. Ltd., 2011.
5. J.Medhi, "Stochastic Processes", New Age Science, 3rdRevised edition, 2009**.**
6. Sheldon M. Ross, Introduction to Probability models, 10th Edition, Academic Press, 2009.

19MA3026	Formal Languages and Automata Theory	L T P C 3 1 0 4

Course Objectives:

1. Acquire knowledge in different types of grammars and languages
2. Skills to construct machines for different languages
3. Relate languages and their corresponding machines

Course Outcomes:
Students will be able to

1. understand basics of grammars and mathematical proof techniques
2. construct deterministic, non-deterministic finite automata and compare
3. demonstrate knowledge in regular, context free and context sensitive languages
4. develop push down automata for a given CFL and compare
5. design a Turing machine for a recursively enumerable language
6. compare recursively enumerable language and regular language

Module 1: Theory of Computation **(8 Lectures)**
Basic concepts – Sequences-Strings –Regular expression-- Grammars –languages- Formal proof- proving equivalence of sets- proof by contradiction - counter examples.

Unit II: Finite Automata **(8 Lectures)**
Deterministic Finite automaton - Transition Graph - Languages of DFA - Non-deterministic finite automata - Languages of NFA -Equivalence of Deterministic and Non deterministic finite automata.

Unit III: Regular Languages **(8 Lectures)**
Regular Expressions -Regular Grammars - Regular Grammars- Identifying non-regular languages- Pumping Lemma – Closure properties of regular languages under Boolean operations.

Unit IV: Context free Languages **(8 Lectures)**
Context-free Grammars - Context-free Languages - Pumping Lemma for context free language – Closure properties for Context Free Language.

Unit V: Push down Automata **(8 Lectures)**
Push down automata – Language of Push Down Automata- Acceptance by final state – empty stack- Equivalence of Push down automata and context free grammar.

Unit VI: Turing Machines **(8 Lectures)**
Turing Machine–Language of TM– recursively enumerable languages–Context sensitive grammars and languages – relation between recursive and CSL – Halting Problems.

Reference Books:

1. Peter Linz, "Introduction to Formal Languages and Automata", Fourth edition, Narosa Publishing House, 2010.
2. Kamala K, Rama R, "Introduction to Formal Languages, Automata Theory and Computation", Pearsorn Education India, 2009.
3. John E. Hopcraft and Jeffrey D.Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Publishing, 2009.
4. John.C.Martin, "Introduction to the Languages and the Theory of Computation", Third Edition, Tata McGrawHill, 2003.
5. Sipser M; "Introduction to the Theory of Computation", Thomson Course Technology, 2006.

19MA3027	Fuzzy Set Theory and its Applications	L T P C 3 1 0 4

Course Objectives:

1. To acquire the knowledge about fuzzy sets, fuzzy numbers and fuzzy systems
2. To synthesis, the ideas of fuzzy sets and fuzzy systems in reconstructing fuzzy decision-making
3. To evaluate the fuzzy decision making, fuzzy neural networks problems by fuzzy sets and fuzzy systems

Course Outcomes:

Student will be able to

1. Recognize the basic concepts of fuzzy sets, fuzzy numbers and fuzzy systems
2. Classify the various operations on fuzzy sets
3. Solve the arithmetic operations on fuzzy numbers
4. Design the fuzzy systems using the basic concepts
5. Apply the concepts of fuzzification in decision making
6. Recognize and justify the best fuzzy decision making techniques

MODULE I: Fuzzy Sets (8 Lectures)

Introduction, Crisp Sets, Fuzzy sets: Basic types, characteristics and significance of the paradigm shift - Alpha Cuts, Properties, Representation of Alpha.

MODULE II: Fuzzy Compliment & Fuzzy Intersection (9 Lectures)

Types of Operations - Fuzzy Complements: Arbitrary complement function – Axioms – Fundamental Theorems - Fuzzy Intersections: t-norms – Axioms.

MODULE III: Fuzzy Union & Combinations (9 Lectures)

Fuzzy Unions: operations: t-co-norms – Axioms - combinations of operations – Dual Triple – Basic Theorems – aggregation operations – Axioms – Examples.

MODULE IV: Fuzzy Arithmetic (8 Lectures)

Fuzzy Numbers - Arithmetic Operations - Interval Analysis - Arithmetic Operations on Fuzzy Numbers - Operations MIN and MAX

MODULE V: Fuzzy Systems (8 Lectures)

General Discussion - Fuzzy Controllers: overview and example - Fuzzy Systems and Neural Networks - Fuzzy Neural Networks - Fuzzy Automata

MODULE VI: Fuzzy Decision Making (8 Lectures)

General Discussion – Individual Decision Making, Multi person Decision Making, Multi criteria Decision Making, Multi stage Decision Making

Reference Books:

1. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic Theory and Applications", PHI, New Delhi, 2005.
2. Zimmermann H.J., "Fuzzy Set Theory and its Applications", Kluwer Academic Publishers,2006.

3. Witold Pedrycz and Fernando Gomide, "An Introduction to Fuzzy Sets-Analysis and Design", Prentice-Hall of India Pvt. Ltd, 2005.
4. Hung T.Nguyen, Elbert A.Walker, "A First Course in Fuzzy Logic", Third Edition, Chapman & Hall/CRC, 2009.
5. John Yen Reza Langari, "Fuzzy Logic, Intelligence, Controle and Information", Pearson Education, 2005.
6. M. Ganesh, "Introduction to Fuzzy Sets and Fuzzy Logic", PHI, 2006.

19MA3028	Statistical Tools for Engineering Applications	L	T	P	C
		3	0	0	3

Course Objective

1. To learn the programming language and environment, commonly used in statistical computing, data analytics and scientific research
2. To understand the main features of SPSS
3. To practice symbolic computing, numerical computing and data visualization using Mathematica

Course Outcome

The student will be able to

1. apply the concepts in data exploration
2. analyze the data visualization
3. create a new database, independently analyze, edit the data and report using SPSS
4. discuss the parametric and non-parametric tests on data.
5. use Mathematica to perform symbolic computations and integrations
6. analyze the engineering problems using various plots designed Mathematica programming

MODULE I : R Programming (7 Lectures)

R Programming – Introduction – Data types – Variables – Strings – Vectors – vector operations – Arrays & Matrices – Lists – Conditions and Loops.

MODULE II : Dataframes (8 Lectures)

Dataframes – Functions – Reading CSV and Excel files – reading text files – graphics

MODULE III: SPSS (8 Lectures)

SPSS – Data handling – open SPSS data file – save – import from other data source – data entry – diagrammatic representation – Bar diagram – Pie diagram – Histogram – Frequency Table – Scatter Diagram – Box plot. Descriptive Statistics – Mean – Median – Mode – Standard Deviation – Correlation.

MODULE IV: Testing of Hypothesis by using SPSS (8 Lectures)

Testing of Hypothesis – Parametric – One sample – Two sample Independent t – test – Paired t – test – Non-Parametric – One Sample KS test – Mann- Whitney U Test – Wilcoxon Signed Rank Test – Chi – Square test. Analysis of Variance: One way and Two-way ANOVA.

MODULE V: Mathematica (7 Lectures)

Running Mathematica – Numerical Calculations – Using the Mathematica System – Algebraic Calculations – Symbolic Mathematics – Numerical mathematics

MODULE VI: Calculus by Using Mathematica (7 Lectures)

Functions and Programs – Lists – Graphics – Calculus – Differentiation – Total Derivative – Indefinite Integrals – Definite Integral.

Exercise

R Programming

1. Write a program for matrix operations.
2. Write a program to find the sum of first 'n' natural numbers
3. Write a program to find the sum and product of two vectors
4. Write a program to plot a scatter diagram for the given data.

SPSS

5. Find the descriptive statistics of the given data using SPSS
6. Find the correlation between the two data using SPSS
7. Check the acceptance of hypothesis using paired sample t test in SPSS
8. Check the acceptance of hypothesis using ANOVA test in SPSS
   MATHEMATICA
9. Integrate and Differentiate a given function f(x) using Mathematica
10. Make a color plot of f(x,y) using Mathematica.

Reference Books

1. Norman Matloff (2011), The Art of R programming – A Tour of Statistical Software Design, No Starch Press, Inc. San Francisco.
2. Roger D Peng (2015), R Programming for Data Science, Learn Publishing
3. Darren George and Paul Mallery, (2009) SPSS for Windows Step by Step: A Simple Study Guide for Reference, Allyn &Bacon, USA.
4. Sabine Landau and Brian S Everitt (2003) A Handbook of Statistical Analysis using SPSS, Chapman and Hall, London.
5. Stephen Wolfram (2003) The Mathematica Book, Cambridge University Press, Fourth Edition, USA.
6. David McMahon and Daniel M Topa, (2006) A Beginner's Guide to Mathematica, Chapman & Hall/CRC, Taylor and Francis Group, London.

19MA3029	Computational Tools	L	T	P	C
		3	0	0	3

Course Objectives

1. To introduce the elements and application of computer programming through MATLAB
2. To master the basics of PYTHON programming
3. To practice the high quality type – setting systems using LaTeX

Course Outcomes

The student will be able to

1. develop MATLAB code for solving engineering problems
2. analyze the engineering problems using various plots and user defined functions using MATLAB commands
3. compute basic arithmetic and use variables in PYTHON
4. operate data structures such as Python list and Numpy arrays
5. use features designed for the production of the technical and scientific documentation
6. create great looking presentations of their technical projects

MODULE I: MATLAB Programming (7 Lectures)

Matlab Programming – Introduction – Variables – Arrays – Loops – Conditional statements – Functions – Matrix Computation.

MODULE II: Solving Equations by using MATLAB (8 Lectures)

Numerical Differentiation – Higher Order Differentiation – Numerical Integration – Partial Differential Equation.

MODULE III: Python Programming (8 Lectures)

Python Programming – Introduction – Values and Variables – Expressions and Arithmetic – String Manipulations – Arrays

MODULE IV: Lists (8 Lectures)

Loops: For – While – Nested Loops – Conditional statements: IF – IF-ELSE – Nested IF-ELSE – Functions – Matrix Computation – Lists

MODULE V: Report Writing (7 Lectures)

Latex – basic Syntax - Writing equations – Matrix – Tables - Page Layout – Sections – Packages

MODULE VI: Presentations **(7 Lectures)**
References – Equation references – citations – applications to writing resume, research article – Beamer.

Exercises

MATLAB

1. Write a program to solve a quadratic equation.
2. Write a program to find area and volume.
3. Write a program for matrix operations (Multiplication, addition, inversion).
4. Write a program for differentiation and integration.
5. Write a program to solve differential equation.

PYTHON

6. Write a program to check if a number is a prime or not.
7. Write a program to find the largest number in a list.
8. Write a program to generate the first 'n' numbers in the Fibonacci series.

LaTeX

9. Write a code to create a document with mathematical expressions, references and citations.
10. Write a code to create a presentation using beamer class.

Reference Books

1. Duane Hanselman & Bruce Littlefield, (2007), Mastering MATLAB 7, Pearson India Education Services Ltd.
2. Brian R Hunt, Ronals L Lipsman & Jonathan M Rosenberg, (2001) A Guide to MATLAB: For Beginners and Experiences Users, Cambridge University Press.
3. Richard L. Halterman - Fundamentals of Python Programming.
4. Kenneth A. Lambert, (2010), The Fundamentals of Python: First Programs, 2011, Cengage learning, ISBN: 978-1111822705.
5. Leslie Lamport (1994), LaTeX A Document Preparation System, User's Guide and Reference Manual, Addison-Wesley Publishing Company, USA.
6. Stefan Kottwitz, (2011) LaTex Beginner's Guide, Packt Publishing.

19MA3030	**Mathematical Modeling**	**L T P C** **3 0 0 3**

Course objectives

1. To enable the students to learn mathematical concepts
2. Gain a working knowledge of core techniques behind mathematical modelling
3. To build mathematical models of real-world systems, analyze them and make predictions about behavior of these systems

Course Outcomes

Upon the successful completion of the course, students will be able to

1. understand the importance of Mathematical modeling in the real world
2. assess and articulate what type of modeling techniques are appropriate for a given physical system
3. construct a mathematical model of a given physical system and analyze it, make predictions
4. compose the findings from the methods applied for the problem
5. formulate, analyze and simulate mathematical models

Module I: Mathematical Modeling through Systems of Ordinary Differential Equations of the First Order **(8 Lectures)**
Mathematical modeling in population dynamics, *Mathematical modeling in Arms Race, Battles and international Trade in terms of systems of ordinary differential equations*-Mathematical modeling in dynamics through systems of ordinary differential equations of first order.

Module II: Mathematical Modeling through linear difference equations (8 Lectures)
The need for Mathematical modeling through difference equations - Some simple models - Basic theory of linear difference equations with constant coefficients - Mathematical modeling through difference equations in economics and finance.

Module III: Mathematical Modeling through nonlinear difference equations (8 Lectures)
Mathematical modeling through difference equation in population dynamics and genetics - Mathematical modeling through difference equations in probability theory - Miscellaneous examples of mathematical modeling through difference equations.

Module IV: Mathematical modeling through Graphs (8 Lectures)
Situations that can be modeled through graphs –Mathematical models in terms of directed graphs - mathematical models in terms of signed graphs - Mathematical models in terms of weighted graphs.

Module V: Mathematical Modeling through calculus of Variations and Dynamic Programming (8 Lectures) Optimization principles and techniques - Mathematical modeling through calculus of variations – Mathematical Modeling through dynamic programming.

Reference Books:

1. J.N. Kapur, Mathematical Modelling, Willey Eastern Limited, Reprint 2000.
2. K. Kamalanand and P. Mannar Jawahar, Mathematical Modelling of Systems and Analysis, Phi Learning Pvt Limited, Delhi 2019.
3. D.J.G James and J.J Macdonald, Case Studies in Mathematical Modelling, Stanly Thames, Cheltenham publishers, 2003.
4. C. Dyson, Elvery, Principles of Mathematical Modelling, Academic Press, New York 2001.
5. Walter J. Meyer, Concept of Mathematical Modelling, McGraw Hill, Tokyo 1985.
6. J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East –West Press Pvt Limited, New Delhi 1981.
7. Frank R. Giordano, A First Course in Mathematical Modelling, William Price Fox, Maurice D. Weir, Brooks/Cole, Cengage Learning, 5th Edition 2014.

19MA3031	Operations Research	L	T	P	C
		3	0	0	3

Course Objective:
1. Understand the basic concepts of linear programming problem
2. Analyze data by using transport and assignment algorithms
3. To learn queuing theory models

Course Outcome:
The student will be able to
1. Apply the dynamic programming to solve problems of discreet and continuous variables.
2. Solve linear programming problems
3. Classify the problems using feasible solutions
4. Model the real world problem and simulate it.
5. Acquire knowledge in job sequences problems
6. Find the shortest path by using network models

Module 1: Linear Programming Problem (9 Lectures)
The Linear Programming Problem - Introduction, formulation of Linear Programming problem, Graphical solution to L.P.P, Simplex Method, Artificial variable techniques, Two phase Method, Variants of the Simplex Method.

Module 2: Duality in Linear Programming (8 Lectures)
Duality In Linear Programming - Concept of duality, Fundamental properties of Duality, Duality & Simplex method, Dual simplex method.

Module 3: Transportation and Assignment Problems **(6 Lectures)**

The Transportation Problem: Introduction, Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

Assignment Problem - Introduction, Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

Module 4: Network Model & Simulation **(6 Lectures)**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Module 5: Queuing Models **(8 Lectures)**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module 6: Game Theory **(8 Lectures)**

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Text Book

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008 **.**
2. KantiSwarup, Manmohan, Gupta P.K., “Operationals Research” Sultan Chand &Sons., 14th Edn.2008
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009.
5. Pannerselvam, Operations Research: Prentice Hall of India 2010.
6. Winston, “Operations Research, Applications and Algorithms” – Cengage Learning, 4th Edition, 2004.
7. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

MATHEMATICS

LIST OF COURSES

S.No.	Course Code	Name of the Course	Credits
1.	17MA3045	Mathematical Modelling	4:0:0
2.	18MA2001	Foundation of Mathematics and Statistics	3:0:0
3.	18MA2002	Design and Analysis of Experiments	1:1:0
			L:T:P:C
4.	18MA1001	Calculus and Linear Algebra	3:1:0:4
5.	18MA1002	Multivariable Calculus and Linear Algebra	3:1:0:4
6.	18MA1003	Calculus and Differential Equations	3:1:0:4
7.	18MA1004	Calculus, Matrices and Vector Spaces	3:1:0:4
8.	18MA1005	Basics of Calculus and Linear Algebra	3:1:0:4
9.	18MA1006	Differential Equations and complex variables	3:1:0:4
10.	18MA1007	Linear Algebra, Transforms and Numerical Methods	3:1:0:4
11.	18MA1008	Ordinary Differential Equations and Complex variables	3:1:0:4
12.	18MA1009	Transforms and Differential Equations	3:1:0:4
13.	18MA1010	Matrices and Calculus	3:1:0:4
14.	18MA1011	Differential Calculus, Complex Analysis and Laplace Transform	3:1:0:4
15.	18MA1012	Differential Calculus	3:1:0:4
16.	18MA2003	Partial Differential Equations, Probability and Statistics	3:1:0:4
17.	18MA2004	Transforms, Integrations and Graph Theory	3:1:0:4
18.	18MA2005	Probability and Statistics	3:1:0:4
19.	18MA2006	Probability and Stochastic Processes	3:1:0:4
20.	18MA2007	Basics of Probability and Statistics	3:1:0:4
21.	18MA2008	Statistical Data Analysis and Reliability Engineering	3:1:0:4
22.	18MA2009	Discrete Mathematics	3:1:0:4
23.	18MA2010	Mathematical and Numerical Methods	3:1:0:4
24.	18MA2011	Probability, Statistics and Random Process	3:1:0:4
25.	18MA2012	Numerical Mathematics and Computing	3:1:0:4
26.	18MA3001	Advanced Mathematical Methods in Engineering	3:0:0:3
27.	18MA3002	Mathematical Foundation for Computer Science	3:0:0:3
28.	18MA3003	Biostatistics and Quality Control	4:0:0:4
29.	18MA3004	Operations Research Techniques	4:0:0:4
30.	18MA3005	Foundations of Mathematics and Statistics	3:0:0:3
31.	18MA3006	Sparse Representations and Compressive Sensing	3:0:0:3
32.	18MA3007	Membrane Computing and Spiking Neural P Systems	3:0:0:3
33.	18MA3008	Nonlinear Differential Equations	3:0:0:3

17MA3045 MATHEMATICAL MODELLING

Credit: 4:0:0

Course objectives

- To enable the students to learn mathematical concepts
- To build mathematical models of real-world systems, analyze them and make predictions about behavior of these systems.

Course Outcomes

Upon the successful completion of the course, students will be able to

- Understand the importance of Mathematical modeling in the real world
- Assess and articulate what type of modeling techniques are appropriate for a given physical system
- Construct a mathematical model of a given physical system and analyze it, make predictions
- Compose the findings from the methods applied for the problem
- Formulate, analyze and simulate mathematical models

Unit I -Mathematical Modeling through Systems of Ordinary Differential Equations of the First Order: Mathematical modeling in population dynamics, Mathematical modeling in Arms Race, Battles and international Trade in terms of systems of ordinary differential equations-Mathematical modeling in dynamics through systems of ordinary differential equations of first order.

Unit II -Mathematical Modeling through lineardifference equations: The need for Mathematical modeling through difference equations - Some simple models - Basic theory of linear difference equations with constant coefficients - Mathematical modeling through difference equations in economics and finance.

Unit III - Mathematical Modeling throughnonlinear difference equations

Mathematical modeling through difference equation in population dynamics and genetics - Mathematical modeling through difference equations in probability theory - Miscellaneous examples of mathematical modeling through difference equations.

UnitIV - Mathematical modeling through Graphs: Situations that can be modeled through graphs – Mathematical models in terms of directed graphs - mathematical models in terms of signed graphs - Mathematical models in terms of weighted graphs.

Unit V -Mathematical Modeling through calculus of Variations and Dynamic Programming: Optimization principles and techniques - Mathematical modeling through calculus of variations – Mathematical Modeling through dynamic programming.

Reference Books:

1. J.N. Kapur, Mathematical Modelling, Willey Eastern Limited, Reprint 2000.
2. D.J.G James and J.J Macdonald, Case studies in mathematical Modelling, Stanly Thames, Cheltenham publishers, 2003.
3. C. Dyson, Elvery, Principles of Mathematical Modelling, Academic Press, New York 2001.
4. Walter J. Meyer, Concept of Mathematical Modelling, McGraw Hill, Tokyo 1985.
5. J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East –West Press Pvt Limited, New Delhi 1981.
6. Frank R. Giordano, A First Course in Mathematical Modelling, William Price Fox, Maurice D. Weir, Brooks/Cole, Cengage Learning, 5th Edition 2014.

18MA2001 FOUNDATION OF MATHEMATICS AND STATISTICS

Credits: 3:0:0

Course Objective:

- To Develop the skills of the students in the areas of basic calculus, Probability and Statistics
- To equip the students with the knowledge of basic algebra.
- To Understand the various application of probability distributions.

Course Outcome:

The students will be able to

- Understand basic mathematics and the technique, methodology.
- Understand classification and tabulation of data.
- Apply Probability theory to solve the problems
- Knowledge in technique and methodology of solving problems in calculus.
- Knowledge in technique and methodology of solving problems using probability distributions.

Course Description:

Calculus: Differentiation – Differentiation of standard functions – product rule – quotient rule- Integration - Integration of standard functions – Bernoulli's UV – Integration – Integration of the form $\int e^{ax} Sinbxdx \; and \int e^{ax} Cosbxdx$. **Algebra:** Partial Fractions – P(x)/Q(x) , a proper fraction- Q(x) is factorizable into nonrepeated linear factors- Q(x) contain a repeated linear factor- Q(x) contain a non repeated quadratic factor- Binomial Theorem (statement only)- general term – some particular expansions - properties of binomial coefficients - expansion of the form $(ax \pm by)^n$. **Basic Probability:** Axioms of probability – mutually exclusive events- independent events- Addition Theorem (statement only) – simple problems based on probability. **Probability Disttributions:** Binomial Distribution – Poisson Distribution – Simple Problems – Fitting Binomial and Poisson Distribution - problems in Normal Distribution. **Statistics:** Construction of frequency distribution- Digrammatic and graphic presentation of data- Bar di gram, piediagram, histogram, frequency polygon, frequency curve, Ogives.

Reference Books

1. Kandasamy P., Thilagavathi K and Gunavathy K., "Engineering Mathematics", Volume I, S.Chand& Co.,1999.
2. Kandasamy P., Thilagavathi K and Gunavathy K., "Engineering Mathematics", Volume II, S.Chand& Co., 2000.
3. Veerarajan T, "Probability, Statistics and Random Processes", Second Edition, Tata McGraw Hill publishing company, 2003.
4. Gupta S.P., "Statistical Methods", 37th Edition, S. Chand& Co., 2009.
5. Gupta S.C. and Kapoor V.K., 2007, "Fundamentals of Mathematical Statistics", Sultan Chand & Co. 2007.

18MA2002 DESIGN AND ANALYSIS OF EXPERIMENTS

Credits: 1:1:0

Course Objective:

- To develop the students skills in the areas of basic statistics and design of experiments
- To equip the students with the knowledge of descriptive and inferential statistics
- To understand the various application of Testing of hypothesis and design of experiments

Course Outcome:

The students will be able to

- Understand basic statistics and the technique, methodology
- Use the applications of statistics
- • Apply statistical methods to solve Agricultural problems
- Knowledge in technique and methodology of solving problems in testing of hypothesis
- Knowledge in technique and methodology of solving problems in design of experiments

Course Description:

Statistics: Measures of central tendency – Mean , Median ,Mode - Measures of Dispersion – Quartile Deviation – Standard Deviation – Coefficient of Variation. **Correlation and Regression:** Karl Pearson's

Coefficient of Correlation – Linear Regression Equations –Rank correlatioan. **Testing of Hypothesis:** Small Sample Tests- t test for single mean- t test for difference of means-F test, Chi square test for Goodness of fit , Independence of Attributes. **Design of Experiments- CRD,RBD,LSD:** Introduction to design of experiment- Basic principles of experimental design-replication, randomization and local control. Analysis of variance–- completely randomized design– randomized block design– Latin square design - Comparison of RBD and LSD. **Design of Experiments- Factorial and Split plot design:** .Analysis of data from 2^2 and 2^3 factorial experiments. Layout and analysisof split-plot design.

Reference Books

1. Veerarajan T, “Probability, Statistics and Random Processes”, Second Edition, Tata McGraw Hill publishing company,2003.
2. Gupta S.P., “Statistical Methods”, S. Chand & Co., 37th Edition,2009.
3. Gupta S.C. and Kapoor V.K., “Fundamentals of Applied Statistics”, Sultan Chand & Co., 1990.
4. Gomez, K.A. and Gomez, A.A. “Statistical Procedures for Agricultural Research”, John Wiley and Sons. New York. 680 p.,1984.
5. Panse, V. G. and P.V. Sukhatme, “Statistical Methods for Agricultural Workers”, Indian Council of Agricultural Research, New Delhi, India,1967.

18MA1001	Calculus and Linear Algebra	L T P C 3 1 0 4

Course objectives

1. Demonstrate knowledge in matrices and functions.
2. Solve using differentiation and integration techniques.
3. Formulate physical phenomena using vector spaces.

Course Outcomes

The student will be able to

1. understand solving system of equations using matrices.
2. express functions as infinite series.
3. apply differentiation techniques to find extreme values of functions.
4. calculate area and volume using integration techniques.
5. relate vector spaces with magnetic field and moving fluid
6. illustrate the relation between line and surface integral.

Module 1: **Matrices** **7 Lectures**

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Module 2: Sequences and Series: **7 Lectures**

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.

Module 3: Fourier Series **7 Lectures**

Full range series - Half range sine and cosine series, Parseval’s theorem, Harmonic analysis.

Module 4: Fourier Transforms **7 Lectures**

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval’s identity, Harmonic Analysis.

Module 5: Multivariable Calculus –Integration **10 Lectures**

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: area, Center of mass and Gravity (constant and variable densities).Triple integrals (Cartesian).

Module 6: Vector Differentiation **7 Lectures**

Differentiation of vectors–Curves in space-Velocity and acceleration-Scalar and Vector point functions–Gradient–Divergence-Curl–Physical interpretations- Solenoidal and irrotational fields-Laplacian operator. **Vector Integration:** Integration of vectors –problems on Greens theorem, Stoke's theorem and Gauss divergence theorem, orthogonal curvilinear coordinates.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9thEdition, Pearson, Reprint,2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9thEdition, John Wiley & Sons, 2006.
3. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint,2010.
5. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole,2005.
6. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint,2008.

18MA1002	Multivariable Calculus and Linear Algebra	L	T	P	C
		3	1	0	4

Course Objective:

1. Demonstrate knowledge in special functions.
2. Solve using differentiation and integration techniques.
3. Formulate physical phenomena using vector spaces.

Course Outcomes:

The student will be able to

1. Evaluate surface area and volume using definite integral.
2. Express functions as infinite series.
3. Apply differentiation techniques to find extreme values of functions.
4. Calculate area and volume using integration techniques.
5. Relate vector spaces with magnetic field and moving fluid
6. Demonstrate knowledge in matrices.

Module 1: Calculus - I **5 Lectures**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2:Sequences and series **8 Lectures**

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions;

Module 3: Fourier series **6 Lectures**

Full range, change of intervals, Half range sine and cosine series, Parseval's theorem. Harmonic analysis.

Module 4:**Multivariable Calculus –Differentiation** **6 Lectures**

Limit, continuity and partial derivatives, total derivative; Tangent plane and normal line; Jacobians, Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, directional derivatives, curl and divergence.

Module 5: **Multivariable Calculus – Integration** **10 Lectures**

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and

Stokes(Statement only), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

Module 6: Matrices **10Lectures**

Algebra of matrices, Inverse and rank of a matrix; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation to reduce quadratic form to canonical forms.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 47th Edition, Khanna Publishers, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9thEdition, Pearson, Reprint, 2002.
2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, NewDelhi, 2008.
3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11thReprint, 2010.
4. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2010.
5. D. Poole, "Linear Algebra: A Modern Introduction", 2ndEdition, Brooks/Cole, 2005.
6. V. Krishnamurthy, V.P. Mainra and J.L. Arora, "An introduction to Linear Algebra", Affiliated East–West press, Reprint2005.
7. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

		L	T	P	C
18MA1003	**Calculus and Differential Equations**	**3**	**1**	**0**	**4**

Course Objectives

1. Demonstrate knowledge in special functions and series.
2. Solve using differentiation and integration techniques.
3. Formulate physical phenomena using vector spaces.

Course Outcomes

The student will be to

1. Evaluate surface area and volume using definite integral.
2. Express functions as infinite series.
3. Apply differentiation techniques to find extreme values of functions.
4. Calculate gravity and mass using integration techniques.
5. Relate vector spaces with magnetic field and moving fluid
6. Solvelinear partial differential equations of first order.

Module 1: Sequences and Series **7 Lectures**

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions;

Module 2: Calculus **8 Lectures**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 3:Fourier series: 6 **Lectures**

Full range – change of interval- Half range sine and cosine series, Parseval's theorem, Harmonic analysis

Module 4: Multivariable Calculus: Differentiation **7 Lectures**

Limit, continuity and partial derivatives, total derivative; Tangent plane and normal line; Jacobians. Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, directional derivatives, curl and divergence.

Module 5: Multivariable Calculus: Integration **6 Lectures**

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and Stokes(statement only), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

Module 6: Ordinary and Partial Differential Equations **10 Lectures**

Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Ordinary Differential Equations: Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation; First order partial differential equations: solutions of first order standard types and Lagrange's equations.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.

Reference Books:

1. T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.
2. B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill, New Delhi, 2010.
3. N.P.Bali and M.Goyal,"A Textbook of Engineering Mathematics", Laxmi Publications, 2010.
4. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
5. W.E.Boyce and R.C.DiPrima,"Elementary Differential Equations and Boundary Value Problems", Wiley India,2009.
6. G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007.

18MA1004	Calculus, Matrices and Vector Spaces	L 3	T 1	P 0	C 4

Course Objectives:

1. Demonstrate knowledge in matrices and special functions.
2. Solve using definite integral techniques.
3. Formulate physical phenomena using ve spaces.

Course Outcomes

The student will be able to

1. Demonstrate knowledge in special functions.
2. Evaluate surface area and volume using definite integral.
3. Express functions as infinite series.
4. Understands solving system of equations using matrices.
5. Relate vector spaces with magnetic field and moving fluid
6. Construct linear transformation.

Module 1: Calculus **6Lectures**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Sequences and series **8 Lectures**

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions;

Module 3: Matrices **8 Lectures**

Algebra of matrices, Inverse and rank of a matrix; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation to reduce quadratic form to canonical forms. Gauss Elimination and gauss Jourdan Elimination.

Module 4: Vector spaces **9 Lectures**

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, Inverse of a linear transformation, rank- nullity theorem, composition of linear maps, Matrix associated with a linear map.

Module5:Vector Differentiation **9 Lectures**

Differentiation of vectors–Curves in space-Velocity and acceleration-Scalar and Vector point functions–Gradient–Divergence-Curl–Physical interpretations- Solenoidal and irrotational fields-Laplacian operator.

Module 6: Inner product spaces **5 Lectures**

Norm definition- properties -Inner product spaces, orthogonal vectors – orthonormal vectors- orthonormal basis- Gram-Schmidt orthogonalization process.

Text Books:

1. B.S. Grewal, “Higher Engineering Mathematics”, 44th Edition, Khanna Publishers, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, “Calculus and Analytic geometry”, 9th Edition, Pearson, Reprint,2002.
2. Erwin Kreyszig, “Advanced Engineering Mathematics”, 9th Edition, John Wiley & Sons, 2006.
3. D. Poole, “Linear Algebra: A Modern Introduction”, 2nd Edition, Brooks/Cole,2005.
4. Veerarajan T., “Engineering Mathematics for first year”, Tata McGraw-Hill, New Delhi, 2008.
5. Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. N.P. Bali and Manish Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, Reprint,2010.
7. V. Krishnamurthy, V.P. Mainra and J.L. Arora, “An introduction to Linear Algebra”, Affiliated East–West press, Reprint 2005.

18MA1005	Basics of Calculus and Linear Algebra	L	T	P	C
		3	1	0	4

Course Objective:

1. Demonstrate knowledge in matrix.
2. Solve using differentiation and integration techniques.
3. Formulate physical phenomena using vector spaces.

Course Outcomes

The student will be able to

1. Understands solution of system of equations using matrices.
2. Analyze quadratic form using matrix.
3. Apply differentiation techniques to find extreme values of functions.
4. Calculate curvature of curve using differentiation techniques.
5. Relate vector spaces with magnetic field and moving fluid
6. Demonstrate knowledge in integration.

Module 1: Linear Algebra: Matrices, Determinants, Linear Systems **8 Lectures**

Matrices : Addition and Scalar Multiplication, Matrix Multiplication, Symmetric, Skew-Symmetric, Linear Systems of Equations, Rank of a Matrix, Determinants, Cramer’s Rule, Inverse of a Matrix, Gauss Elimination and Gauss-Jordan Elimination method.

Module 2: Linear Algebra: Matrix Eigen value Problems **9 Lectures**

Eigen values, Eigen vectors, Applications of Eigen value Problems, Diagonalization of a matrix,Orthogonal transformation to reduce quadratic form to canonical form.

Module 3: Vector Differential Calculus. **4 Lectures**

Vectors: Addition and Scalar Multiplication, Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, *Curl* of a Vector Field.

Module 4: Vector Spaces **8 Lectures**
Linear Independence, Vector Space, Solutions of Linear Systems: Existence, Uniqueness. Vectors in 2-Space and 3-Space, Inner Product (Dot Product), Vector Product (Cross Product), Vector and Scalar Functions and Fields, Derivatives, Curves. Arc Length. Curvature.

Module 5: Differential Calculus **7 Lectures**
Limit, continuity, differentiation (definition and simple problems), partial derivatives, Jacobians, Maxima Minima of single variable.

Module 6: Integral Calculus **8 Lectures**
Integration, definite integral, Integration by parts, Integration by substitution, Integration using differentiation.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint, 2002.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. D. Poole, "Linear Algebra: A Modern Introduction", 2nd Edition, Brooks/Cole,2005.
4. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
5. RamanaB.V., "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th Reprint,2010.
6. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint,2010.
7. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

18MA1006	Differential Equations and Complex Variables	L	T	P	C
		3	1	0	4

Course Objective:

1. Solving ordinary and partial differential equations
2. Demonstrate knowledge in boundary value problems
3. Understands numerical solutions of differential equations

Course Outcome:

The student will be able to

1. Understands solution of first and second order ODE
2. Classify different types of higher order ODE and their solution
3. Demonstrate knowledge in solution of PDE
4. Apply solution of PDE in heat and wave equations
5. Compare numerical solutions with standard methods
6. Construct bilinear transformation functions

Module 1:First order ordinary differential equations **6 Lectures**
Linear and Bernoulli's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 2: Higher order Ordinary differential equations and special functions **8 Lectures**
Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 3:Partial Differential Equations **6 Lectures**
First order partial differential equations, solutions of first order standard type and Lagrange's equations. Solutions to higher order homogenous and non-homogenous linear partial differential equations.

Module 4: Boundary value Problems: **10 Lectures**

Solutions of one-dimensional wave equation – One-dimensional heat equation – Steady state solution - Two-dimensional heat equation (Cartesian co-ordinates only).

Module 5: Complex Variable – Differentiation **8 Lectures**

Differentiation, Cauchy-Riemann equations, analytic functions and their properties, harmonic functions, finding harmonic conjugate; conformal mappings and bilinear transformations.

Module 6: Numerical Solutions for first order ODE **7 Lectures**

Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order. Milne's and Adam's predicator-corrector methods.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", S. Chand & Company, 2nd Edition, Reprint 2012.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons,2006.
2. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9thEdition, Wiley India,2009.
3. G.F. Simmons and S.G. Krantz, "Differential Equations", Tata McGraw Hill,2007.
4. R. Haberman, "Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem", 4th Ed., Prentice Hall, 1998.
5. Manish Goyal and N.P. Bali, "Transforms and Partial Differential Equations", 2nd Edition, University Science Press, 2010.
6. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7thEd.,Mc-GrawHill,2004.
7. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
8. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint,2010.
9. S.S. Sastry, "Introductory methods of numerical analysis", 4th Edition, PHI, 2005.

18MA1007	Linear Algebra, Transforms and Numerical Methods	L	T	P	C
		3	1	0	4

Course Objectives:

1. Demonstrate knowledge in matrices
2. Classify numerical solutions of algebraic and transcendental equations
3. Recognize the fundamental concepts ofTransforms.

Course Outcomes:

The student will be able to

1. Analyze quadratic form using orthogonal transformation of matrix.
2. Compare integration solution and numerical solution.
3. Solve differential equations using Laplace Transforms.
4. Describe the different transform techniques.
5. Demonstrate knowledge in different types of graph
6. Construct networks with maximum capacity.

Module 1: Matrices **10 Lectures**

Algebra of matrices, Inverse and rank of a matrix; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Cayley-Hamilton Theorem, Diagonalization of matrices; Orthogonal transformation to reduce quadratic forms to canonical forms.

Module 2: Numerical Methods-I **10 Lectures**

Solution of algebraic and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

Module 3: Numerical Methods-II **10 Lectures**

Ordinary differential equations of first order: Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order.Milne's and Adam's predicator-corrector methods. Partial differential equations Solution of Laplace equation by Liebmann method, Solution of Poisson equation by Liebmann method, differential Equation by Bender Schmidt method, Crank Nicholson method.

Module 4: Transform I **7 Lectures**

Laplace transform- Definitions and Properties, Laplace transform of periodic functions. Inverse Laplace transform, convolution theorem. Evaluation of integrals, solving Ordinary differential equations and integral equations(initial value problems).

Module 5: Transforms II **3 Lectures**

Definitions and properties of the three transformations: Z- Transform, Fourier transforms (infinite and finite) and Wavelet Transform.

Module 6: Graph Theory **5 Lectures**

Definitions and operations of Graphs, Euler graph, Hamiltonian graph, Transportation network, coloring of graphs.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Bernard Kolman, Robert C.busby, Sharo Cutler Ross, "Discrete Mathematical Structures", 5th Edition, Prentice Hall of India, 2004.

Reference Books:

1. D. Poole, "Linear Algebra: A Modern Introduction",Brooks/Cole, 2005.
2. N.P.Bali and M.Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.
3. V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press,2005.
4. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", 2nd Edition, S. Chand & Company, Reprint2012.

		L	T	P	C
18MA1008	**Ordinary Differential Equations and Complex Variables**	**3**	**1**	**0**	**4**

Course Objective:

1. Demonstrate knowledge in special functions
2. Solving ordinary and partial differential equations
3. Evaluate definite integral using complexintegration

Course Outcome:

The student will be able to

1. Evaluate surface area and volume using definite integral.
2. Understands solution of first and second order ODE
3. Classify different types of higher order ODE and their solution
4. Construct harmonic and bilinear transformations
5. Evaluate definite integral using complex integration
6. Express complex functions as infinite series

Module 1: **Calculus** **7 Lectures**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: First order ordinary differential equations **6 Lectures**

Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 3: Ordinary differential equations and special functions **8 Lectures**

Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 4: Complex Variable – Differentiation **8 Lectures**

Differentiation, Cauchy-Riemann equations, analytic functions and properties, harmonic functions, finding harmonic conjugate; Conformal mappings, bilinear transformations.

Module 5: Complex Variable – Integration I **8 Lectures**

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Contour integration- Circular and semi circular contours with no pole on real axis.

Module 6 Laplace Transforms **8Lectures**

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transforms.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9thEdition, Pearson, Reprint,2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9thEdition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", 9thEdition, Wiley India,2009.
4. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7thEd.,Mc-GrawHill,2004.
5. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint,2008.

18MA1009	Transforms and Differential Equations	L	T	P	C
		3	1	0	4

Course Objective:

1. Understand transform techniques for different functions
2. Solving ordinary and partial differential equations
3. Demonstrate knowledge in boundary value problems

Course Outcome:

The student will be able to

1. Express periodic functions as infinite sine and cosine series.
2. Evaluate definite integral using laplace transform
3. Convert non-periodic functions using Fourier transform
4. Understand solution of first and second order ODE
5. Demonstrate knowledge in solution of PDE
6. Apply solution of PDE in heat and wave equations

Module 1: Fourier Series **8 Lectures**

Full range – Half range Fourier sine and cosine series – Parseval's Theorem and Harmonic analysis.

Module 2: Laplace Transform **7 Lectures**

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transforms.

Module 3: Fourier Transforms **8 Lectures**

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity, Harmonic Analysis.

Module 4: First-Order ordinary Differential Equations **8 Lectures**

Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Ordinary Differential Equations: Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation.

Module 5: Partial Differential Equations **6 Lectures**

First order partial differential equations, solutions of first order standard type and Lagrange's equations. Solution to higher order homogenous and non-homogenous linear partial differential equations.

Module 6: Boundary value Problems **8 Lectures**

Solutions of one-dimensional wave equation – One-dimensional heat equation – Steady state solution -two-dimensional heat equation (Cartesian co-ordinates only).

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.

Reference Books:

1. G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", 9th Edition, Pearson, Reprint,2002.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.
4. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (sixth revised Edition), S. Chand & Co., New Delhi, 2006.

18MA1010	Matrices and Calculus	L	T	P	C
		3	1	0	4

Course Objective:

1. Demonstrate knowledge in matrices
2. Knowledge in special functions.
3. Solve using differentiation and integration techniques.

Course Outcomes:

The student will be able to

1. Analyze quadratic form using orthogonal transformation of matrix.
2. Understand different types of functions
3. Apply differentiation techniques to find extreme values of functions.
4. Knowledge in special functions
5. Solve problems using integration techniques
6. Calculate area and volume using integration techniques.

Module 1: Matrices **8 Lectures**

Eigen values and Eigen vectors of areal matrix – Characteristic equation - Properties of Eigen values and Eigen vectors – Cayley Hamilton theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – nature of quadratic forms.

Module 2: Hyperbolic function and differential calculus **9 Lectures**

Hyperbolic and inverse functions – Identities – Real and imaginary parts – Solving problems using hyperbolic functions. Curvature and radius of curvature – Cartesian and polar coordinates – center of curvature and Evolutes – Envelopes and Evolutes as the envelope of normal.

Module 3:Functions of several variables **9 Lectures**

Functions of two variables - Taylor's theorem (statement only) and expansion – Maxima and Minima – Constrained extremum by Lagrange's multiplier method – Jacobians – Differentiation under integral sign.

Module 4: Integral Calculus **9 Lectures**

Definite and indefinite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric substitutions – integration of rational function by partial fractions – Integration of irrational functions – improper integrals - Beta and Gamma functions

Module 5: Multiple Integrals – I **5 Lectures**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves.

Module 6: Multiple Integrals – II **5 Lectures**

Triple integrals – Volume as triple integral – Transformation to polar, Cylindrical and Spherical polar coordinates.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.

Reference Books

1. Veerarajan T, "Engineering Mathematics", Tata McGraw Hill, New Delhi, 2015.
2. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" S. Chand & Co., New Delhi, 2013.
3. S. Narayanan and Manicavachagam Pillai T.K., "Calculus vol I, II and III" S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai 2009.
4. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.

18MA1011	Differential Calculus, Complex Analysis and Laplace Transform	L	T	P	C
		3	1	0	4

Course Objective:

1. Knowledge in ordinary differential equations
2. Apply complex variable to find dynamics, heat conduction and elasticity.
3. Formulate physical phenomena using vector spaces

Course Outcome:

The Student will be able to

1. Solve second and higher order differential equations
2. Understand the techniques involved in complex differentiation.
3. Solve usingcomplex integration.
4. Relate the properties of Laplace Transform
5. Solve differential equations problems by using Laplace transform
6. Evaluate complex integrals and numerical integrals

Module 1: Ordinary differential Equations **9 Lectures**

Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Ordinary Differential Equations: Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation.

Module 2: Vector Calculus **9 Lectures**

Gradient and directional derivative, Divergence and curl-irrotational and Solenoidal fields-Vector identities-Line, Surface and Volume Integral- Green's Theorem in a Plane, Gauss Divergence and Stoke's Theorems(Statements only)- Verification and Applications.

Module 3: Complex Differentiation **9 Lectures**

Functions of a Complex variable- Analytic functions- Cauchy Riemann equations and sufficient conditions(excluding proof)-Harmonic conjugates- Construction of analytic functions-Conformal mappings: $w = z + a, az, 1/z, z^2, e^z, \sin z, \cos z$ and Bilinear Transformation.

Module 4: Complex Integration **8 Lectures**

Cauchy's integral theorem, Cauchy's integral formula- Taylor's and Laurents theorems(Statement only) and expansions- Poles and Residues- Cauchy's residue theorem- Contour integration- Circular and semi-circular contours with no pole on real axis.

Module 5:Laplace Transforms **5 Lectures**

Properties and standard transform- Transforms of unit step, Unit Impulse and error functions- transforms of periodic functions. Initial and final value theorems.

Module 6: Inverse Laplace Transform **5 Lectures**

Inverse Laplace transforms of standard functions-Method of Partial fractions – properties – Convolution theorem(Statement only)- Solving Linear differential equations using inverse Laplace transform.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44^{th} Edition, Khanna Publishers, 2017.

Reference Books:

1. Veerarajan T, "Engineering Mathematics for Semester I and II.", Tata McGraw Hill Publishing Co., New Delhi, 2015.
2. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
3. Kandasamy P, Thilagavathy K and Gunavathy K, "Engineering Mathematics for I year B.E/B.Tech", S. Chand &Co, Ramnagar, New Delhi, Reprint 2013.
4. S. Narayanan and Manicavachagom Pillai T.K., "Calculus-Vol. III.", S. Viswanathan, Printers and Publishers Pvt, Ltd, Chennai, 2009.

18MA1012	Differential Calculus	L	T	P	C
		3	1	0	4

Course Objectives:

1. Solving ordinary and partial differential equations
2. Knowledge in special functions
3. Recognize the fundamental concepts of Transforms.

Course Outcomes

The student will be able to

1. Solve using differentiation techniques.
2. Classify different types of higher order ODE
3. Understands solution of first and second order ODE
4. Demonstrate knowledge in solution of PDE
5. Apply solution of PDE in heat and wave equations
6. Express functions as infinite series.

Module -1: Multivariable calculus **10 Lectures**

Limits and Continuity – Partial derivatives – Homogeneous functions and Euler's theorem– Total derivative – Differentiation of implicit functions – Change of variables – Jacobians– Lagrange's method of undetermined multipliers.

Module 2: Ordinary differential equations **8 Lectures**

Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut'stype. Ordinary Differential Equations: Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy-Euler equation.

Module 3: Special functions **6 Lectures**

Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 4: Partial Differential Equations **5 Lectures**

First order partial differential equations, solutions of first order standard type and Lagrange's equations. Solutions to higher order homogenous and non-homogenous linear partial differential equations.

Module 5:Fourier series **6 Lectures**

Euler's formula–Conditions for a Fourier expansion–Functions having points of discontinuity–Change of Interval–Even and odd functions. Half range Fourier series: – Typical waveforms – Complex form of Fourier series–Harmonic analysis.

Module 6: Boundary Value problems **10 Lectures**

Solutions of one-dimensional wave equation – One-dimensional equation of heat conduction – Steady state solution of two-dimensional heat equation (Cartesian coordinates only).

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.

Reference Books:

1. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
3. RamanaB.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.

		L	T	P	C
18MA2003	**Partial Differential Equations, Probability and Statistics**	**3**	**1**	**0**	**4**

Course Objective:

1. Demonstrate knowledge in solution of first and second order PDE
2. Formulate problems using random variables.
3. Examine observed data using statistical methods

Course Outcome:

The student will be able to

1. knowledge in solution of PDE
2. Apply solution of PDE in heat and wave equations
3. Calculate the central tendency of statistical data
4. Measure the relation between variables
5. Test of hypothesis for small samples
6. Examine the independence of attributes

Module 1: Partial Differential Equations **6 Lectures**

First order partial differential equations, solutions of first order standard type and Lagrange's equations. Solution to higher order homogenous and non-homogenous linear partial differential equations.

Module 2: Boundary value Problems: **9 Lectures**

Solutions of one-dimensional wave equation – One-dimensional heat equation – Steady state solution -two-dimensional heat equation (Cartesian co-ordinates only).

Module3: **Probability I** **8 Lectures**

Definitions and axioms, conditional probability, Baye's theorem-Moments generating functions. Discrete random variables; Probability mass function and distribution functions – Discrete distributions; binomial, Poisson distribution.

Module 4: Probability II **7 Lectures**

Continuous random variables and their properties. Distributions; normal, exponential and Gamma. Bivariate random variables (both Discrete and continuous) and their properties.

Module 5: Statistics **8 Lectures**

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis; Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second-degree parabolas and the curves reducible to linear forms.

Module6: Sampling **7 Lectures**

Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Small samples: t-test, F-test and Chi-square test for goodness of fit and independence of attributes.

Text Books:

1. B.S. Grewal, “Higher Engineering Mathematics”, 44^{th} Edition, Khanna Publishers, 2017.
2. T.Veerarajan,“Probability,Statistics and Random Processes”, 2^{nd}Edition,TataMcGraw-Hill,New Delhi,2010.

Reference Books:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, 9^{th} Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, Reprint, 2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall, 2003(Reprint).
4. Kandasamy P., Thilagavathi K and Gunavathi K., “Engineering Mathematics” Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
5. S. Ross, “A First Course in Probability”, 6^{th} Ed., Pearson Education India,2002.

18MA2004	Transforms, Integrations and Graph Theory	L	T	P	C
		3	1	0	4

Course Objective:

1. Knowledge about the application of different transforms
2. Solve using complex integration
3. Estimate using graph theory

Course Outcome:

The Student will be able to

1. Relate the properties of Laplace Transform
2. Apply FourierTransform technique.
3. Categorize Z-Transform of sequence and series
4. Solve difference and differential equations problems
5. Evaluate complex integrals and numerical integrals
6. Equip with the knowledge of solving network problems

Module 1: Laplace Transform **10 Lectures**

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transforms.

Module 2: Fourier Transforms **8 Lectures**

Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval’s identity.

Module 3: Z - Transforms and Difference Equations **7 Lectures**

Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem. Solving difference equations by using Z - transform.

Module 4: Complex Variable –Integration **12 Lectures**

Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville’s theorem and Maximum-Modulus theorem (without proof); Taylor’s series, zeros of analytic functions, singularities, Laurent’s series; Residues, Cauchy Residue theorem (without proof), Contour integration- Circular and semi-circular contours with no pole on real axis.

Module 5: Numerical integration **3 Lectures**

Trapezoidal rule and Simpson’s 1/3rd and 3/8rules.

Module 6: Graph Theory **5 Lectures**

Definitions and operations of Graphs, Euler graph, Hamiltonian graph, tree, labeled tree, minimal panning tree, Transportation network, coloring of graphs.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 6thEdition, Pearson Education, 2009.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons,2006.
2. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint,2010.
3. Veerarajan T., "Engineering Mathematics", Tata McGraw-Hill, New Delhi,2008.
4. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", 7thEd.,Mc-GrawHill,2004.
5. P. Kandasamy, K. Thilagavathy, K. Gunavathi, "Numerical Methods", S. Chand & Company, 2nd Edition, Reprint2012.
6. S.S. Sastry, "Introductory methods of numerical analysis", PHI, 4th Edition,2005.
7. K. H. Rosen, "Discrete Mathematics and its Applications", 6thEd., Tata McGraw-Hill, 2007.
8. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 6th Edition, Pearson Education, 2009.

18MA2005	Probability and Statistics	L	T	P	C
		3	1	0	4

Course Objective:

1. Understand the basic concepts of Probability
2. Measure uncertainty using various probability distribution
3. Analyze data with statistical methods.

Course Outcomes:

The student will be able to

1. Recognizeprobabilitymodels
2. Solve using discrete and continuous random variables.
3. Classify the problems usingprobability distributions
4. Measure central tendency, of the data
5. Compare variables using correlation and regression.
6. Testhypothesis for small samples.

Module 1: Probability **8 Lectures**

Definitions and axioms, - conditional probability-Independent events-Theorem of Total Probability-Baye's Theorem-Bernoulli's trials

Module 2: Random Variables **10 Lectures**

Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function.Two Dimensional Random Variables: Discrete and Continuous random variables, Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables.

Module 3: Probability Distributions **8 Lectures**

Discrete: Binomial and Poisson. Continuous:Normal, Exponential and Gamma Distributions- Tchebycheff Inequality.

Module 4: Statistics **7 Lectures**

Measures of Central tendency- Moments, skewness and Kurtosis - Correlation and regression – Rank correlation.Curve fitting by the method of least squares- fitting of straight lines- second degree parabolas and cures reducible to linear forms.

Module 5: Large sampling **6 Lectures**

Test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations.

Module 6: **Small samples** **6 Lectures**

Student t-test, F-test and Chi-square test for goodness of fit and independence of attributes.

Text Books:

1. S.C.Gupta ,V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand &Sons,10th Revised Edition 2000.
2. T.Veerarajan,"Probability, Statistics and Random Processes", 2nd Edition,TataMcGraw-Hill, New Delhi,2010.

Reference Books:

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall,2003.
3. S. Ross, "A First Course in Probability", Pearson Education India, 2002.

18MA2006	**Probability and Stochastic Processes**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Course Objective:

1. Understand the basic concepts of Probability
2. Measure uncertainty using various probability distribution
3. Analyze linear system using random process.

Course Outcomes:

The student will be able to

1. Recognize probability models
2. Solve using discrete and continuous random variables.
3. Classify the problems using probability distributions
4. Knowledge in functions of random variables
5. Determine the characteristics of random processes
6. Understand propagation of random signals in Linear systems.

Module 1: Probability **7 Lectures**

Definitions and axioms, - conditional probability-Independent events-Theorem of Total Probability-Baye's Theorem-Bernoulli's trials

Module 2: Random Variables **10 Lectures**

Discrete and Continuous Random Variables-Probability Density Function-Cumulative Distribution Function.Two Dimensional Random Variables: Discrete and Continuous random variables, Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables.

Module 3: Probability Distributions **8 Lectures**

Discrete: Binomial and Poisson. Continuous: Normal, Exponential and Gamma Distributions- Tchebycheff Inequality, central limit theorem(without proof) - problems.

Module 4: Functions of Random Variables **7 Lectures**

Moment Generating Function(MGF)-Properties of MGF, Characteristic Function (CF)-Properties of CF.Function of One Random Variable, transformations of two Random Variables.

Module 5: Random Processes **7 Lectures**

Definition-Basic concepts and examples, Strict and wide sense stationaries, ergodicity - Second Order processes. Autocorrelation function and its properties-Power Spectral Density function-Linear system with random input. (Theorems statement only)

Module 6: Special Random Processes **6 Lectures**

Gaussian Process-Poisson process-Markov Process (theorems statement only)-Properties.

Text Books:

1. Veerarajan T., “Engineering Mathematics (for semester III)”, Tata McGraw-Hill, New Delhi,2010.

Reference Books:

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal BookStall, 2003(Reprint).
3. S. Ross, “A First Course in Probability”, 6th Ed., Pearson Education India, 2002.
4. H. Stark and J. Woods, “Probability and Random Processes with Applications to Signal Processing," 3rd Edition, Pearson Education, 2002.
5. A.Papoulis and S. Unnikrishnan Pillai, “Probability, Random Variables and Stochastic Processes," Fourth Edition, McGrawHill, 2002.
6. S.C.Gupta, V.Kapoor, “Fundamentals of Mathematical Statistics”, Tenth revised edition, Sultan Chand & Sons, 2000.

18MA2007	Basics of Probability and Statistics	L	T	P	C
		3	1	0	4

Course Objective:

1. Understand the basic concepts of Probability
2. Measure uncertainty using various probability distribution
3. Analyze data with statistical methods.

Course Outcomes:

The student will be able to

1. Recognize probability models
2. Solve using discrete and continuous random variables.
3. Classify the problems using probability distributions
4. Measure central tendency of the data
5. Compare variables using correlation and regression.
6. Test hypothesis for small samples.

Module 1: Probability **8Lectures**

Definitions and axioms, conditional probability-Independent events-Theorem of Total Probability-Baye’s Theorem

Module 2: One Dimensional Random Variables **7 Lectures**

Discrete Random Variable;Probabilitymass Function and distribution functions. Continuous Random Variable:Probability Density Function-Cumulative Distribution Function and Properties.

Module 3: Two Dimensional Random Variables **8 Lectures**

Two Dimensional Random Variables: Discrete and Continuous random variables, Cumulative Distribution Function-Marginal Probability Distribution-Conditional Probability Distribution-Independent Random Variables.

Module 4: Probability Distributions **7 Lectures**

Binomial, Poisson and Normal distribution.

Module 5: Statistics I **8 Lectures**

Measures of Central tendency(Mean, Median,Mode,Geometric mean,Harmonic mean)- Measures of Dispersion(Range,Quartiledeviation,MeanDeviation,StandardDeviation,Coefficient of variation)

Module 6: Statistics II **7 Lectures**

Moments- Skewness and Kurtosis - Rank correlation, co-efficient of correlation and regression lines.

Text Books:

1. T.Veerarajan,"Probability,Statistics and Random Processes", 2nd Edition,TataMcGraw-Hill,New Delhi,2010.

Reference Books:

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall,2003.
3. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
4. W. Feller, " An Introduction to Probability Theory and its Applications" , Vol. 1, Wiley, 1968.
5. S.C.Gupta ,V.K. Kapoor, "Fundamentals of Mathematical Statistics, Sultan Chand &Sons,10th Revised Edition, 2000.

18MA2008	Statistical Data Analysis and Reliability Engineering	L	T	P	C
		3	1	0	4

Course Objective:

1. Knowledge in curve fitting and sampling techniques.
2. Categorize using the concepts of reliability engineering.
3. Analyze data with statistical methods.

Course Outcome:

The student will be able to

1. Test hypothesis for small samples
2. Test hypothesis for large samples
3. Construct design of experiments.
4. Decide using accetance sampling.
5. Analyze using statistical quality control
6. Understand the reliability engineering problems.

Module 1: Curve fitting **9 Lectures**

Curve fitting: Method of least squares- fitting of straight lines- second degree parabolas and curves reducible to linear forms. Large Sample tests**:**Test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations.

Module 2: Small Sample tests **7 Lectures**

Student t-test, F-test and Chi-square test for goodness of fit and independence of attributes.

Module 3: Design of experiments **8 Lectures**

Analysis of variance: one-way and two-way classification. Completely randomized design-– Randomized block design – Simple Latin Square Design.

Module 4: Statistical quality control **8 Lectures**

Types of variation – types of control charts – control chart of mean and range, Sigma Chart, control chart of proportion of defectives and number of defectives, C- Chart, Advantages and Limitations of SQC.

Module 5: Acceptance sampling **7 Lectures**

Acceptance sampling – Single sampling plan, Measures of single sampling plan, Construction of a OC curve, Double sampling plan –flowchart and algorithm, Six σ concepts.

Module 6: Reliability engineering **6 Lectures**

Concepts of reliability, hazard function, mean time to failure, series and parallel systems, System Reliability.

Text Books:

1. Veerarajan, T., "Probability, Statistics and Random Processes", Tata McGraw Hill,NewDelhi, 2006.

Reference Books:

1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2008.

2. Gupta, S.P, “Statistical Methods”, Sultan Chand and Sons, New Delhi, 2008.
3. Balagurusamy, E., “Reliability Engineering”, Tata McGraw-Hill Publishing Co., New Delhi, Fourth Reprint, 2003.

18MA2009	Discrete Mathematics	L T P C 3 1 0 4

Course Objectives:
1. To familiarize the students about the basic concepts in
2. Construct direct and indirectproofs.
3. Apply logical reasoning to solveproblems

Course Outcomes:
The Student will be able to
1. Knowledge in sets, relation and function.
2. Analyze using Mathematical induction
3. Understand basic counting techniques
4. about propositional logic
5. Understand algebraic structures and morphisms
6. Classify different types of graphs.

Module 1: Sets, Relation and Function **10 Lectures**
Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem.

Module 2: Number theory **4 Lectures**
The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem ofArithmetic.

Module 3: Basic counting techniques **3 Lectures**
Mathematical Induction, Inclusion and exclusion, pigeon-hole principle, permutation and combination.

Module 4: Propositional Logic **10 Lectures**
Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques**:** Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

Module 5: Algebraic Structures and Morphism **10 Lectures**
Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields.
Boolean algebra and Boolean Ring Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

Module 6: Graphs and Trees **8 Lectures**
Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Coloring, Coloring maps and Planar Graphs, Coloring Vertices, Coloring Edges, List Coloring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.

Text Books:
1. J.P. Tremblay and R. Manohar, “Discrete Mathematical Structure and Its Application to Computer Science”, TMG Edition,TataMcgraw-Hill, 2015

Reference books:
1. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, Tata McGraw –Hill, 2015

2. Susanna S. Epp, “Discrete Mathematics with Applications”,4th Edition, Wadsworth Publishing Co.Inc, 2010.
3. C L Liu and D P Mohapatra, “Elements of Discrete Mathematics A Computer Oriented Approach”, 3rdEdition by, Tata McGraw –Hill, 2012.
4. J.P. Tremblay and R. Manohar, “Discrete Mathematical Structure and Its Application to Computer Science”, TMG Edition,Tata Mcgraw-Hill, 2015
5. Norman L. Biggs, “Discrete Mathematics”, 2ndEdition, Oxford University Press, 2010.
6. Schaum’s Outlines Series, Seymour Lipschutz, MarcLipson, “Discrete Mathematics”, Tata McGraw –Hill, 2013.

18MA2010	Mathematical and Numerical Methods	L T P C 3 1 0 4

Course Objective:

1. This course introduces a range of numerical methods for the approximate solution of mathematical equations encountered in biochemical engineering.
2. The methods are introduced in a problem specific context, such as Bioprocess engineering, Heat and Mass transfer and chemical reaction engineering.
3. Numerical Integration & Differentiation method helps the students to solve the area related problems &Ordinary differential equations helps in solving problems in Biochemical Engineering.

Course Outcome:

The student will be able to

1. Familiarize the prospective engineers with techniques in Mathematical Biology
2. Update the knowledge with different kind of numerical methods for solving the problems in Biotechnology.
3. Develop the skills in applying the boundary value problems in Biochemical Engineering.
4. Acquire the knowledge in interpolation.
5. Solve the system of linear algebraic equations using iterative process.
6. Discriminate and learn techniques of curve fitting, finite differences and interpolations.

Module 1: Solution of Algebraic Equations **5 Lectures**

Types of Errors, Significant figures, Accuracy of Numbers, Precision, Error Propagation, Applications in Biochemical Engineering. Basic Properties of Equations, Relations between Roots and Co efficient, Descartes Rule of Sign, Synthetic Division of a Polynomial by a Linear Expression.

Module 2: Bracketing Methods **5 Lectures**

Bisection, Secant, Method of False position or Regula Falsi Method - Convergence of Iterative Methods, Newton- Raphson Method for Non Linear Equations in Two Variables.

Module 3: Solution of Linear Equations **8 Lectures**

Mathematical Background, Matrix Inversion, Gauss Elimination, Gauss- Jourdan Methods, Gauss- Seidal Iteration Methods, Jacobi’s Method, Gauss Seidal Methods.

Module 4:Curve Fitting, Finite Differences & Interpolation **10 Lectures**

Methods of Least squares, Fitting a Straight Line and a Polynomial, Fitting a Non- Linear Function. Finite Differences: Forward, Backward and Divided Differences Table, Central Differences, Newton’s Forward, Backward and Divided Differences, Interpolation Formula, Interpolation Polynomials, Lagrange Interpolation Formula, Inverse Interpolation.

Module 5: **Numerical Differentiation and Integration** **8 Lectures**

Differentiation Formula based on Tabulator at Equal and Unequal Intervals, Newton-cotes Integration Formulas, Trapezoidal Rule and Simpson’s 1/3rd rule.

Module 6:**Ordinary Differential Equations** **9 Lectures**

Taylor’s Series and Euler’s Methods, Modified and Improvements in Euler’s Methods, Runge-Kutta 2ndorder &4th order Methods,Milne’s Predictor- Corrector Methods, Boundary Value Problems, Parabolic, Applications in Biochemical Engineering.

Text Books:

1. Kandasamy P., “Numerical Methods”, S.Chand and Co, Reprint 2010

Reference Books:

1. VenkataramanM.K., “Numerical methods in Science and Engineering”, , Revised Edition, National Publishing Company2005.
2. M.K.Jain., Iyengar. S.R.K., Jain R.K., “Numerical Methods for Scientific and Engineering Computation”, 6th Edition, New Age International, 2012.
3. S.S.Sastry, “Introductory methods of Numerical Anylasis”, 4thEdition, PHI, 2005.
4. B.V.Ramana, “Higher Engineering Mathematics”, 29thReprint, Tata McGraw Hill Education Private limited 2017.

18MA2011	Probability, Statistics and Random Process	L	T	P	C
		3	1	0	4

Course Objectives:

1. To familiarize the students about the concepts in
2. Understand the basic concepts of Probability
3. Measure uncertainty using various probability distribution
4. Analyze linear system using random process.

Course Outcomes:

The student will be able to

1. Recognize probability models
2. Solve using discrete and continuous random variables.
3. Classify the problems using probability distributions
4. Knowledge in functions of random variables
5. Determine the characteristics of random processes
6. Examine ergodicity of random process.

Module 1: Probability and Random Variables 7 Lectures

Axioms of probability – conditional probability- Independent events – Total probability – Baye’s Theorem – Random variables – Discrete and continuous random variables- Moments – Moment generating functions and their properties.

Module 2: Probability Distributions 10 Lectures

Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Gamma, Weibull (Mean, Variance and Simple Problems) Chebychev’s inequality (Simple problems). Correlation – Regression – Multiple and Partial correlation – Partial correlation (Problems only).

Module 3: Large Sample Tests 6 Lectures

Tests of means, variances and proportions – Interval estimation of large samples for mean, standard deviation and proportion – Large sample test based on Normal distribution for single mean and difference means.

Module 4: Small Sample Tests 6 Lectures

Tests of means, variances and attributes using t, F, Chi square distribution – Interval estimation for mean, standard deviation and proportion – Contingency table – Goodness of fit.

Module 5: Design of Experiments 6 Lectures

One way and two way classifications – Completely randomized block design – Latin square design – 2x2 factorial design.

Module 6: Random Process 10 Lectures

Classification of random process – Stationary process – Auto correlation and cross correlation – properties – Mean ergodic and cross ergodic process – Power spectral density – Cross spectral density – properties –

Poisson process – Markov process – Markov chain- Classification of states of a Markov chain – Steady state distribution of a Markov chain.

Text Books:

1. Veerarajan T., "Probability and Random Process (with Queueing Theory and Queueing Networks)", 4th Edition, Mc Graw-Hill Education (India) Pvt Ltd., New Delhi, 2016.

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal BookStall, 2003(Reprint).
3. S. Ross, "A First Course in Probability", 6thEd., Pearson Education India,2002.
4. N.P. Bali and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, Reprint,2010.

18MA2012	Numerical Mathematics and Computing	L	T	P	C
		3	1	0	4

Course Objectives:

1. Solving algebraic equations, interpolation and numerical integration
2. Recognize splines
3. Solve using differential equations

Course Outcomes:

The Student will be able to

1. Knowledge about different methods of solving algebraic equations
2. Interpolate data
3. Compute using numerical integration
4. Compute using spline functions
5. Solving ordinary differential equations using numerical techniques
6. Solving partial differential equations using numerical techniques.

Module 1: Solving algebraic equations **8 Lectures**

Nested Multiplication-pseudocode- Simple Numerical problems using Taylor's series- Representation of numbers in different bases. Bisection Method-Bisection Algorithm and pseudocode--Convergence of Bisection Method-Newton's method-Geometry of Newton's method-Pseudocode-Convergence Analysis.

Module 2: Interpolation **6 Lectures**

Polynomial interpolation-Existence-Newton interpolating polynomial- Nested form- Calculating Newton interpolating formula using divided difference-Lagrange interpolating polynomial-Errors in polynomial interpolation.

Module 3: Numerical Integration **6 Lectures**

Trapezoidal rule- Error analysis-Recursive Trapezoidal formula – Pseudo code - Romberg Algorithm-Simpson's rule-Gaussian Quadrature Formulas.

Module 4: Approximations by spline functions **5 Lectures**

First degree spline–examples-Second degree splines–Natural cubic splines–B splines.

Module 5: Ordinary differential equations **10 Lectures**

Taylor series methods-Euler's Method Pseudocode-Taylor series of higher order method-Runge-Kutta Method-Runge-Kutta method of order 2-Pseudocode-Adams-Moulton method-A predictor-corrector scheme-Pseudocode.

Module 6: Partial Differential Equations **10 Lectures**

Parabolic Problems-Finite difference method-Pseudocode for explicit method-Crank- Nicolson method-Pseudocode of Crank-Nicolson method-Hyperbolic problems-Wave equation model problems-Numerical solution-Pseudocode-Elliptic Problems-Helmholtz equation model problems-Gauss-seidal Iterative method-Numerical example and computer program.

Text Books:

1. Ward Cheney and David Kincaid, “Numerical Mathematics and Computing”, Cengage Learning Brooks/Cole Publishing Company, California, 2012.

Reference Books:

1. M.K.Jain., Iyengar. S.R.K., Jain R.K., “Numerical Methods for Scientific and Engineering Computation”, 6th Edition, New Age International, 2012.
2. Rajasekaran. S., “Numerical Methods in Science and Engineering: A Practical Approach”, S. Chand publishers, 2003.
3. Kandasamy. P., Thilagavathy K., “Numerical Methods”, S. Chand & Co. Ltd., 2010.

18MA3001	Advanced Mathematical Methods in Engineering	L	T	P	C
		3	0	0	3

Course objective:

1. Develop the students with knowledge in variations, initial and boundary value problems
2. Familiarize the students in the field of eigen value problems and 1D,2D heat and wave equations
3. Expose the students about the integral equation and random process.

Course outcome:

The student will be able to

1. Students are able to understand the application of variations in engineering.
2. Updating the knowledge with initial and boundary value problems.
3. Developing the skills in solving eigen value problems.
4. Students will be able to understand the mathematical principles involved in 1D, 2D heat and wave equations.
5. Students will be able to apply the concept in integral equations.
6. Students will be able to demonstrate the idea of random process and design of experiment.

Module 1: Calculus of variations **7 Lectures**

Euler’s equation, Functional dependent on its first and second order derivatives.Isoperimetric problems.

Module 2: Initial, Boundary value problems **7 Lectures**

Picard’s method – Euler, Improved Euler and modified Euler methods. Raleigh-Ritz, collocation methods, Horner’s, Muller’s and Chebyshev’s method, Graffe’s root square method, Relaxation methods, Newton Raphson methods

Module 3: Eigen value problems **7 Lectures**

Power & Inverse power methods – Jacobi methods.

Module 4: Wave and heat equations **8 Lectures**

String, rods. Two-dimensional heat equation-finite, infinite, semi-circular and circular plates, simple problems in one dimensional wave equations.

Module 5: **Integral equations** **8 Lectures**

Conversion of BVP to integral equations using Green‟s Function -Fredholm equation with separable kernels –Solution of Fredholm and Volterra equations by the method of Successive approximations.

Module 6: Random process &Design of Experiments **8 Lectures**

Random process Classification of random processes, Special Classes, Average values of Random processes, Stationary, Autocorrelation Function, Cross-correlation Function & their properties, Ergodicity, Mean Ergodic Theorem – Gaussian Process & its properties. Randomized block design, Latin square design, comparison of RBD and LSD.

Reference Books:

1. Naveenkumar, "An Elementary course on Variational problems in calculus", Narosa Publishing House, 2003.
2. Curtis F-Gerald, "Applied Numerical Analysis", 5th edition, Addison Wesley Publishing Company, 2001.
3. VenkataramanM.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.
4. Grewal B S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, 2012.
5. Richard Williams H., "Probability, Statistics and Random Process for Engineers", CENGAGE Learning, 2009.
6. Veerarajan T., "Probability, Statistics and Random Processes", Second edition, Tata McGraw-Hill, Sixth reprint 2009.

18MA3002	Mathematical Foundation for Computer Science	L	T	P	C
		3	0	0	3

Course Objective:

1. To equip the students with the basic knowledge in number theory, graph theory and automata theory that have applications in software technology.
2. To provide the students with soft computing techniques from random processes.
3. To learn queuing theory models.

Course Outcome:

The student will be able to

1. Write efficient programs.
2. Develop algorithms.
3. Apply queuing models.
4. Knowledge in grammar and language
5. Examine the characteristics of random process
6. Knowledge in number theory concepts

Module 1: Graph theory **8 Lectures**

Basic Terminology, Some special simple graphs, Representations of graphs, Eulerian graphs and Hamiltonian graphs – Standard theorems – Planar graphs – Euler's formula -Five colour theorem – Coloring of graphs – Chromatic number (vertex and edge) properties and examples – Directed graphs.

Module 2: Graph algorithm **7 Lectures**

Computer Representation of graphs Connectivity, Shortest path algorithm and Trees – Related basic theorems and results with proof.

Module 3: Number theory **8 Lectures**

Divisibility, primes, fundamental theorem of arithmetic, Division Algorithm, G.C.D & LCM – Eulers and Fermat's Theorems - Related basic theorems with proof and related problems.

Module 4: Automata theory **7 Lectures**

Languages& Grammars, Chomskey's classification of grammars, Derivation trees, Backus-Naur Form, Finite-state machines with outputs- Melay and Moore Machines- Finite-state automata, Regular sets, Kleene's theorem, Regular grammars.

Module 5: Random process **8 Lectures**

Classification of random processes, Special Classes, Average values of Random processes, Stationary, Autocorrelation Function, Cross-correlation Function & their properties, Ergodicity, Mean Ergodic Theorem – Gaussian Process & its properties.

Module 6: Queuing theory **7 Lectures**

Characteristics of Queuing systems, Representation a queuing Model, Properties of the models (M/M/1): (∞/FIFO) and (M/M/k): (∞/FIFO) – simple problems

Reference Books:

1. Kenneth Rosen H., “Discrete mathematics and its Applications”, Tata McGraw –Hill Edition, 2012.
2. Veerarajan T., “Probability, Statistics and Random Processes”, Second edition, Tata McGraw-Hill, Sixth reprint 2009.
3. Bernard Kolman, Robert Busby C., Sharon Cutler Ross, “Discrete Mathematical Structures”, Fifth Edition, Pearson Education, 2004.
4. Richard Williams H., “Probability, Statistics and Random Process for Engineers”, CENGAGE Learning, 2009.
5. Narsingh Deo, “Graph Theory with Application to Engineering and Computer Science”, Prentice-Hall of India Private Ltd. 2004.
6. Handy Taha. A., “Operations Research” 6th Edition, Prentice – Hall of India Private Limited, New Delhi, 2010.
7. Kreyszig E., “Advanced Engineering Mathematics”, 8th Edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000

18MA3003	BIOSTATISTICS AND QUALITY CONTROL	L	T	P	C
		4	0	0	4

Course Objective:

1. Understand the basic concepts of Correlation and Regression
2. Analyze data with statistical methods
3. Understand the concept of Statistical Quality control

Course outcome:

1. Compare variables using linear correlation and regression.
2. Compare variables using partial and multiple correlation
3. Test hypothesis for large and small samples.
4. Test hypothesis using non parametric tests.
5. Apply Design of experiments.
6. Apply quality control tools.

Module 1: CORRELATION AND REGRESSION 7 Lectures

Correlations and regression, - Correlations coefficients – correlations coefficients in terms of regression coefficients, Rank correlation and repeated ranks. (Proofs and derivations not included)

Module 2: PARTIAL AND MULTIPLE CORRELATION 7 Lectures

Partial correlation: Partial correlation coefficient- zero order, first order, second order coefficients – partial correlation coefficient in case of four variables- second order partial correlation coefficients. Coefficient of multiple correlation.

Module 3: TESTING OF HYPOTHESIS 8 Lectures

Population – sample – one tailed and two tailed tests - Tests based on large samples –proportion and mean – Small samples – t, F, chi square

Module 4: NON PARAMETRIC TESTS 8 Lectures

Introduction – Advantages of non parametric tests – The Sign Test: The paired sample sign test - A Rank sum test : The Mann whitney U test – The One Sample Runs Test – The kruskal Wallis or H test.

Module 5: DESIGN OF EXPERIMENTS 8 Lectures

Aim of the design of experiments – completely randomized design- analysis of variance for one factor of classification – randomized block design- analysis of variance for two factors of classification- Latin square design – analysis of design for three factors of classification
comparison of RBD and LSD.

Module 6: SQC 8 Lectures

Introduction – Types of variation – types of control charts – X chart, R. Chart, Sigma Chart, C Chart,Advantages and Limitations of SQC – Acceptance sampling – Single acceptance sampling plan, double sampling plan, multiple sampling plan, construction of a OC curve – AQL and LTPD.

Text Books

1. Gupta S.P., “Statistical Methods”, Sultan Chand and sons., New Delhi, 2009.
2. Veerarajan T., “Probability, Statistics and Random Processes”, Second Edition, Tata McGraw Hill publishing company, 2007

Reference Book

1. Gupta S.C. and Kapoor V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Co., 2007.
2. Erwin Kreyszig, “Advanced Engineering Mathematics”, 9th Edition, John Wiley & Sons, 2006.
3. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal BookStall, 2003(Reprint).
4. S. Ross, “A First Course in Probability”, 6th Ed., Pearson Education India,2002.

18MA3004	OPERATIONS RESEARCH TECHNIQUES	L 4	T 0	P 0	C 4

Course Objective:

1. Understand the basic concepts of linear programming problem
2. Analyze data by using transport and assignment algorithms.
3. To learn queuing theory models.

Course Outcome:

The student will be able to

1. Apply artificial variable techniques.
2. Solve linear programming problems
3. Classify the problems using feasible solutions
4. Apply queuing models.
5. Knowledge in job sequences problems
6. Find the shortest path by using network models.

Module 1: LINEAR PROGRAMMING PROBLEM 9 Lectures

The Linear Programming Problem - Introduction, formulation of Linear Programming problem, Graphical solution to L.P.P, Simplex Method, Artificial variable techniques, Two phase Method, Variants of the Simplex Method.

Module 2: DUALITY & TRANSPORTATION 8 Lectures

Duality In Linear Programming - Concept of duality, Fundamental properties of Duality, Duality & Simplex method, Dual simplex method.

THE TRANSPORTATION PROBLEM: Introduction, Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

Module 3: ASSIGNMENT PRBLEMS 6 Lectures

Assignment Problem - Introduction, Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

Module 4: SEQUENCING 6 Lectures

Job sequencing, n jobs through two machines, two jobs through m machines, n jobs through m machines.

Module 5 : QUEUING MODELS 8 Lectures

Introduction, Definition of terms in Queuing model, problem involving M\M\1: ∞\FIFO queue, M\M\c: ∞\FIFO

Module 6: NETWORK MODEL & SIMULATION 8 Lectures

Network analysis– PERT & CPM- network diagram-probability of achieving completion date- crash time-cost analysis. Simulation models. Elements of simulation model-Monte Carlo technique – applications.

Text Book

1. Kanti Swarup, Manmohan, Gupta P.K., "Operationals Research" 14th Edn., Sultan Chand &Sons., 2008.

Reference Books

1. Winston, "Operations Research, Applications and Algorithms", 4th Edition, Cengage Learning, 2004.
2. Hamdy Taha. A., "Operations Research" Sixth Edition, Prentice – Hall of India Private Limited, New Delhi, 1997.
3. Natarajan A.M., Balasubramani P., Tamilarasi A., "Operations Research", I Edn, Pearson Education, 2003.
4. Srinivasan G., "Operations Research", I Edn., Eastern Economy Edition, 2007.

18MA3005	FOUNDATIONS OF MATHEMATICS AND STATISTICS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To equip the students with the concept of Differential calculus
2. To develop the students skills in the area of probability and statistics.
3. To provide the students with the understanding of Testing of Hypothesis

Course Outcome:

The students will be able to

1. Understand the basic concepts of binomial theorem.
2. Classify the linear and quadratic equations.
3. Apply the concept of integration in their engineering subjects.
4. Apply the concept of probability in real life.
5. Understand the properties of various distributions.
6. Test the hypothesis of large sample problems

Module 1: Algebra **7 Lectures**

Linear and quadratic equations- Binomial Theorem- Summation of series – coefficient of x^n - exponential function-logarithmic function.

Module 2: Differential Calculus **7 Lectures**

Limits and Continuity- Differentiation–Product and Quotient Rule –Maxima and Minima of f(x).

Module 3: Integral Calculus **7 Lectures**

Integration of standard functions – Methods of Integration – Integration by parts – Definite Integrals - Bernoulli's formula.

Module 4: Probability and distributions **8 Lectures**

Probability – Axiomatic definition of probability – Independent events –Binomial, Poisson Distributions – – Normal Distribution – Properties of Normal Distribution —Importance of Normal Distribution —Normal probability curve – fitting Binomial, Poisson Distributions – problems (proofs and derivations not included).

Module 5: Testing of hypothesis **8 Lectures**

One tailed and two tailed tests - Tests based on large samples –proportion and mean – Small samples – t, F, chi square distributions.

Module 6: Design of Experiments **8 Lectures**

Analysis of variance-one factor classification-two factor classification-completely randomized design-randomized block design-Latin square design.

Reference Books:

1. Gupta S.P., "Statistical Methods", 37th Edition, S.Chand & Co., 2009.
2. Veerarajan T, "Probability, Statistics and Random Processes", Second Edition, Tata McGraw Hill publishing company, 2003.

3. Kandasamy P., Thilagavathi K and Gunavathy K., “Numerical Methods”, S.Chand & Co., 2009.
4. Gupta S.C. and Kapoor V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Co., 2007.
5. Kapoor J.N. & Saxena H.C. “Mathematical Statistics”, S.Chand & Company, 2006.
6. Kandasamy P., Thilagavathi K and Gunavathy K., “Engineering Mathematics”, Volume I, S.Chand & Co., 2001.
7. Manickavasagam Pillai, “Algebra” , Volume I & II, S. Viswanathan publishers, 2002.

18MA3006	SPARSE REPRESENTATIONS AND COMPRESSIVE SENSING	L	T	P	C
		3	0	0	3

Course Objectives:
- Understand the concept of Sampling
- Understand the variants of Compressive Sensing
- Understand about the Sparse Representation

Course Outcomes:
The students will
- have the knowledge of Sparse Representations
- apply the concept of Compressive Sensing to study about images
- know the Compressive Sensing For Vision
- have the knowledge of sensing matrices
- have the knowledge of Dictionary Learning Algorithms
- know the Sparse representation and Applying on Objects

Module 1: COMPRESSIVE SENSING
Introduction-Sparsity- Incoherent Sampling – Recovery- Sensing Matrices- Phase Transition Diagrams-Numerical Examples

Module 2: COMPRESSIVE ACQUISITION
Single Pixel Camera- Compressive Magnetic Resonance Imaging- Compressive Synthetic Aperture Radar Imaging- Compressive Passive Millimeter Wave Imaging- Compressive Light Transport Sensing.

Module 3: COMPRESSIVE SENSING FOR VISION
Compressive Target Tracking - Compressive Video Processing- Shape from gradients.

Module 4: SPARSE REPRESENTATION-BASED OBJECT RECOGNITION
Sparse Representation- Sparse Representation-based Classification- Non-linear Kernel Sparse Representation-Non-linear Kernel Sparse Representation-Multimodal Multivariate Sparse Representation - Kernel Space Multimodal Recognition

Module 5: DICTIONARY LEARNING
Dictionary Learning Algorithms - Discriminative Dictionary Learning-Non-Linear Kernel Dictionary Learning.

Reference Books/Journals:
1. Patel, Vishal M., Chellappa, Rama “Sparse Representations and Compressive Sensing for Imaging and Vision”, Springer Publishing Company, 2013.
2. DeVore, Ronald A. "Deterministic constructions of compressed sensing matrices." *Journal of complexity* 23.4 (2007): 918-925.
3. Candès, Emmanuel J., and Michael B. Wakin. "An introduction to compressive sampling." *IEEE signal processing magazine* 25.2 (2008): 21-30.

18MA3007	MEMBRANE COMPUTING AND SPIKING NEURAL P YSTEMS	L T P C 3 0 0 3

Course Objectives:
- Understand the concept of Membrane Computing
- Understand the variants of P system
- Understand about the spiking neural P system

Course Outcomes:
The students will
- have the knowledge of Membrane Computing
- know the various parameters of computing
- know the concepts of variants of P system
- apply the concept of P system in image problems
- apply the concept of spiking Neural P system
- know the concept of computational power of SN P system

Module 1: Membrane Computing
An Introduction – Strings and Multisets – Membrane Structure – Rewriting rules – Maximal Parallelism – Basic P System and Examples.

Module 2: Variants of P system
Conditional communication P system – Splicing P system -Tissue P system - Examples.

Module 3: Applications of P System
Application of P system in Image Problems like Segmentation, Skeletonization, Algebraic and Topological Aspects of Images.

Module 4: Spiking Neural P system
Introduction – Basic of SN P system – SN P system with one spikes – Universality of SN P system - Performing arithmetic operations by SN P systems with communication on request.

Module 5: Computational Power of SN P system
Variants of SN P – Complexity – Various Parameter

Reference Books/Journals:

1. Gheorghe Paun, Grzegorz Rosenberg, and ArtoS alomaa, "The Oxford Handbook of Membrane Computing", 2002.
2. L. Lakshmanan. *On the Crossroads of P Systems and Contextual Grammars: Variants, Computability Complexity and Efficiency*. PhD thesis, Dept. of Mathematics, Indian Institute of Technology, Madras, India, 2004.
3. A.M. Ionescu, "Membrane Computing: Traces, Neural Inspired Models, Controls", VDM Verlag Dr. Muller, Saarbrucken, Germany, 2009.
4. Ionescu, Mihai, Gheorghe Păun, and Takashi Yokomori. "Spiking neural P systems." *Fundamenta informaticae* 71.2, 3 (2006): 279-308.
5. Oscar H. Ibarra , Alberto Leporati , Andrei P˘aun , Sara Woodworth, 13th chapter of Condon, Anne, et al., eds. Algorithmic bioprocesses. Springer Science & Business Media, 2009.
6. *Daniel Diaz Pernil, Miguel A G N, Hong Peng, Membrane Computing and Image Processing : A Short Survey.*

18MA3008	NONLINEAR DIFFERENTIAL EQUATIONS	L T P C 3 0 0 3

Course Objective:
- Learn about First order systems in two variable, linearization and stability.
- To teach the Averaging Methods in Amplitude and frequency.

- To provide the students about Structure of general linear systems.

Course Outcome:

Students will

- Be able to distinguish between the linearization andFirst order systems in two variable.
- Be capable of representing Averaging Methods in Amplitude, frequency and harmonic balance
- Have the knowledge of Perturbation Method.
- Have the knowledge of Structure of general linear systems.
- Have the knowledge of Constant Coefficients, Periodic Coefficients, Floquet theory and Wronskian
- Be knowledgeable of Stability.

Module 1: First order systems in two variables and linearization

The general phase plane - Some population models – Linear approximation at equilibrium points – Linear systems in matrix form.

Module 2: Averaging Methods

An energy balance method for limit cycles – Amplitude and frequency estimates – Slowly varying amplitudes ; Nearly periodic solutions - Periodic solutions: Harmonic balance – Equivalent linear equation by harmonic balance – Accuracy of a period estimate.

Module 3: Perturbation Methods

Outline of the direct method – Forced oscillations far from resonance Forced oscillations near resonance with weak excitation – Amplitude equation for undamped pendulum – Amplitude perturbation for the pendulum equation – Lindstedt's method – Forced oscillation of a self – excited equation – The Perturbation method and Fourier series.

Module 4: **Linear systems**

Structure of solutions of the general linear system – Constant coefficient system – Periodic coefficients – Floquet theory – Wronskian.

Module 5: Stability

Poincare stability – Solutions, paths and norms – Liapunov stability- Stability of linearsystems – Comparison theorem for the zero solutions of nearly-linear systems.

Text Book:

1. D.W.Jordan and P.Smith, Nonlinear Ordinary Differential Equations" Clarendon Press, Oxford, 1977.

Reference Books:

1. G.F. Simmons, "Differential Equations", Tata McGraw-Hill, New Delhi, 1979.
2. D.A. Sanchez, "Ordinary Differential Equations and Stability Theory", Dover, New York, 1968.
3. J.K. Aggarwal, "Notes on Nonlinear Systems", Van Nostrand, 1972.

LIST OF COURSES

Course Code	Name of the Course	Credits
17MA1001	Basic Mathematics for Engineering	3:1:0
17MA1002	Calculus and Statistics	3:1:0
17MA1003	Basic Mathematics for Sciences	3:1:0
17MA1004	Calculus and Transforms	3:1:0
17MA1005	Basic Mathematics for Computer Science	3:1:0
17MA1006	Foundations of Mathematics and Statistics	3:0:0
17MA2001	Vector Calculus and Complex Analysis	3:1:0
17MA2002	Fourier Series and Applications	3:1:0
17MA2003	Mathematical Transforms	3:1:0
17MA2004	Laplace Transforms, Fourier Series and Transforms	3:1:0
17MA2005	Mathematical Foundation#	3:0:0
17MA2006	Numerical Mathematics and Computing	3:1:0
17MA2007	Probability and Random Process	3:1:0
17MA2008	Probability and Statistics	3:1:0
17MA2009	Statistical Data Analysis and Reliability Engineering	3:1:0
17MA2010	Discrete Mathematics	3:1:0
17MA2011	Probability and Queuing Theory	3:1:0
17MA2012	Numerical Methods	3:1:0
17MA2013	Applied Linear Algebra	3:1:0
17MA2014	Fuzzy Sets and Logic	3:1:0
17MA2015	Probability, Random Process and Numerical Methods	3:1:0
17MA2016	Sampling Techniques	3:1:0
17MA2017	Operations Research-I	3:1:0
17MA2018	Operations Research-II	3:1:0
17MA2019	Analytical Geometry, Fourier Series and Transforms	3:1:0
17MA2020	Probability, Random Variables and Statistics	3:1:0
17MA2021	Applied Mathematics	3:1:0
17MA2022	Quantitative Techniques	3:1:0
17MA2023	Basics of Operations Research	3:1:0
17MA2024	Business Mathematics	3:1:0
17MA3001	Matrix Computations	3:0:0
17MA3002	Finite Element Methods	3:0:0
17MA3003	Foundations of Mathematics and Statistics	3:0:0
17MA3004	Advanced Calculus and Numerical Methods	3:0:0
17MA3005	Calculus of Variations and Vector Spaces	3:0:0
17MA3006	Graph Theory and Random Process	3:0:0
17MA3007	Applied Statistics	3:0:0
17MA3008	Computational Mathematics	3:0:0
17MA3009	Applied Graph Theory and Queuing Theory	3:0:0
17MA3010	Graph Theory and Algorithms	3:0:0
17MA3011	Biostatistics and Quality Control	3:0:0
17MA3012	Numerical Methods and Biostatistics	3:0:0
17MA3013	Graph Theory and Probability	3:0:0
17MA3014	Fundamentals of Statistics	3:0:0
17MA3015	Operations Research Techniques	3:0:0
17MA3016	Statistics and Numerical Mathematics	3:0:0
17MA3017	Discrete Mathematics	3:0:0
17MA3018	Optimization Techniques	3:0:0
17MA3019	Algebra	3:1:0
17MA3020	Ordinary Differential Equations	3:1:0

17MA3021	Classical Mechanics	3:1:0
17MA3022	Real Analysis	3:1:0
17MA3023	Complex Analysis	3:1:0
17MA3024	Linear Algebra	3:1:0
17MA3025	Topology	3:1:0
17MA3026	Partial Differential Equations	3:1:0
17MA3027	Field Theory	3:1:0
17MA3028	Advanced Calculus	3:1:0
17MA3029	Numerical Analysis	3:1:0
17MA3030	Functional Analysis	3:1:0
17MA3031	Calculus of Variations and Integral Equations	3:1:0
17MA3032	Tensor Algebra and Tensor Calculus	3:1:0
17MA3033	Control Theory	3:1:0
17MA3034	Differential Geometry	3:1:0
17MA3035	Mathematics for Competitive Examinations	3:0:0
17MA3036	Probability and Distributions	3:1:0
17MA3037	Stochastic Processes	3:1:0
17MA3038	Formal Languages and Automata Theory	3:1:0
17MA3039	Fuzzy Set Theory and its Applications	3:1:0
17MA3040	Research Methodology	3:1:0
17MA3041	Mathematical Theory of Elasticity	3:1:0
17MA3042	Semigroups of Linear Operators and Applications	3:1:0
17MA3043	Computational Methods and Applications	3:0:0
17MA3044	Applied Operations Research	3:1:0

17MA1001 BASIC MATHEMATICS FOR ENGINEERING

Credits: 3:1:0

Course Objective:

- To equip the students with the knowledge of calculus.
- To train the students thoroughly in Mathematical concepts of partial differential equations
- To understand expansions of standard functions through Taylor series of one and two variables.

Course Outcome:

The students will be able to

- Relate their subject knowledge with their engineering subjects during their course of study.
- Understand the techniques involved in differentiation.
- Develop the skills in solving problems in integral calculus.
- Expand the function using Taylor series.
- Compute dot, cross products, length of vectors and find the shortest distance between two lines.
- Know the applications of determinant and Eigen values and Eigen vectors.

UNIT I - Algebra: Simple functions and equations- Trigonometric identities- Coordinate geometry-Partial fractions-Binomial expansions-

UNIT II - Calculus: Differentiation from the first principle-Rules of differentiation-Implicit differentiation-Logarithmic differentiation-Methods of integration-Integration by parts.

UNIT III - Taylors Series and Partial Differentiation: Taylor's series for functions of one variable-Standard Maclaurin's series-Partial derivatives- Taylor's series for functions of two variables.

UNIT IV - Vectors: Scalars and vectors- Operations on vectors- Magnitude of a vector- Equations of lines and planes.

UNIT V - Matrix Algebra: Introduction -Matrix operations- The trace and the determinant of a matrix- Properties of determinants(excluding the proof)- The inverse and the rank of a matrix- Special types of square matrices-Eigen values and Eigen vectors(problems only).

Text Book:

1. Grewal B.S, "Higher Engineering Mathematics", 42^{nd} Edition, Khanna Publications, Delhi, 2012.

Reference Books

1. James Steward, "Calculus", 5^{th} Edition, Thomson Brooks/Cole, Micro Print Pvt. Ltd, Chennai, 2003.
2. Riley K.F, Hobson M.P, and Bence S.J, "Mathematical Methods for Physics and Engineering, 2^{nd} Edition, Cambridge Low – Price Editions, Cambridge University Press, 2004.
3. Hepzibah Christinal A, Selvamani R, and Porselvi K, "Basic Engineering Mathematics", HIS Publications, Coimbatore, 2011.
4. "Lecture Notes on Basic Mathematics for Engineering", Department of Mathematics, Karunya University, Karunya Nagar, Coimbatore, 2013.

17MA1002 CALCULUS AND STATISTICS

(Common to all branches in B.Tech)

Credits: 3:1:0

Course Objective:

- To provide the students with the concept and an understanding of Differential equations.
- To teach the students about the art of multiple integrations.
- To enlighten the students about the use of statistical parameters

Course Outcome:

The students will be able to

- Relate their subject knowledge with their engineering subjects during their course of study.
- Analyze real world scenarios to recognize when ordinary differential equations or systems of ODEs are appropriate, formulate problems and in order to solve the problems using multiple approaches.
- Develop their skills in evaluating multiple integrals.
- Solve linear partial differential equations of first order.
- Know the applications of statistics to modeling and analysis.
- Analyze data sets commonly found in the biological and life sciences and describe a data set graphically and numerically with a meaningful numeric summary.

UNIT I - Ordinary differential equations: Higher order linear differential equations with constant Coefficients Methods of variation of parameters-Simultaneous first order linear equations withconstant coefficient.
UNIT II - Multiple integrals: Double integrals – Area of bounded region - Triple integrals – Volume.
UNIT III - Beta and gamma integrals: Definitions-Properties-Relation between beta and gamma integrals Evaluation of definite integrals in terms of beta and gamma functions.
UNIT IV - Partial differential equations: Formations -Solution of partial differential equations-Lagrange's linear equation-Non-linear equations of first order (excluding Charpit's method)-Homogenous linear equations with constant coefficients.
UNIT V - Statistics: Introduction–Graphical representation of data-Measures of central tendency-Measures of dispersion- Correlation-Regression-Rank Correlation.

Text Book:

1. Grewal B.S, "Higher Engineering Mathematics", 42^{nd} Edition, Khanna Publications, New Delhi, 2012.

Reference Books

1. Veerarajan T, " Engineering Mathematics", Tata McGraw Hill, New Delhi, 2011.
2. Kandasamy P, Thilagavathi K and Gunavathi K, "Engineering Mathematics", 9^{th} Revised Edition, S Chand & Co, New Delhi, 2010.
3. DassH.K., "Advanced Engineering Mathematics", (18^{th} Revised Edition), S. Chand & Co., New Delhi, 2008.
4. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.

17MA1003 BASIC MATHEMATICS FOR SCIENCES

Credits: 3:1:0

Course Objectives:

- To impart basic understanding of complex numbers related problems.
- To develop skills in solving homogenous and nonhomogeous linear equations.
- To Acquire the techniques of collecting, representing and interpreting data

Course Outcomes

The students will be able to

- Solve algebraic and transcendental equations.
- Obtain eigen values and vectors by using algorithms.
- Apply correlation and regression analysis for decision-making.
- Obtain various properties of groups.
- Analyze the importance of probability distributions.
- Understand the application of Baye's theorem in engineering fields

UNIT I - Trigonometry: Trigonometric ratios, identities, Hyperbolic and circular functions and their relations**,** Properties of hyperbolic functions, Inverse functions

UNIT II - Complex Numbers: Rectangular, polar and exponential forms of complex numbers, De-Moivre's Theorem, Powers, roots and log of complex numbers.

UNIT III - Linear Algebra: Eigen values and Eigen vectors, Characteristic equation, Cayley-Hamilton Theorem, System of homogeneous and non-homogeneous linearequations,Condition for consistency

UNIT IV - Group Theory and Statistics: Binary Operations − Semi groups − Monoids, Groups (Simple examples, simple Problems and properties only).**Statistics:** Introduction–Graphical representation of data-Measures of central tendency-Measures of dispersion- Correlation-Regression-Rank Correlation.

UNIT V - PROBABILITY: Random experiment, Sample space, events, axiomatic approach for probability, Conditional probability, Baye's theorem.

Text Book:

1. Robert E, Moyer Frank Ayres JR, "Trigonometry, 3rd Edition", Schaum's Outlines, Tata McGraw-Hill Edition, 2005.

Reference Books

1. Frank Ayres Jr, Elliott Mendelson, "Calculus", 3rd Edition, Schaum's Outline series, McGraw-Hill, INC., 1990.
2. Shanti Narayan, "Differential Calculus" S. Chand and Company, 2005.
3. Shanti Narayan, "Integral Calculus" S. Chand and Company, 2005.
4. Shanti Narayan and P. K. Mittal, "Text Book of Matrices", S. Chand and Company, 2011
5. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, 2012.
6. Dass H.K, "Advanced Engineering Mathematics", 18th edition, S. Chand and Company, 2008.
7. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
8. Gupta S.P, "Statistical Methods", Sultan Chand and sons., New Delhi, 2009.

17MA1004CALCULUS AND TRANSFORMS

Credits: 3:1:0

Course Objectives:

- To impart the knowledge of the applications of integration.
- To provide the students with the concept and an understanding of Differential equations.
- To enable the students to apply Laplace and Fourier transforms in practical life.

Course Outcomes

The students will be able to

- Apply mean value theorem concept in practical life. .
- Update the knowledge with different kind of integrations.
- Develope the skills in solving differential equations.

- Understand the Newton's law of cooling and harmonic motions involved in real life problems.
- Demonstrate the Kirchoff's law of electrical circuits.
- Apply the concept of Laplace and Fourier Transformation in analysis.

UNIT I - Differential Calculus: Methods of differentiations, Mean Value theorems, Taylor's theorem, Taylor's series and Maclaurian's series, Series expansions of cosx, sinx, log(1+x), $(1+x)^n$.
UNIT II - Integral Calculus: Methods of integration, Gamma and beta functions, Double and triple integrals, Jacobian, Applications to areas and volumes.
UNIT III - Differential Equations: Linear differential equations of first order and Linear differential equations of second order(constant coefficients only), Applications to Newton's law of Cooling, Kirchoff's law of electrical circuits, Motion under gravity, Simple harmonic motion.
UNIT IV - Laplace Transforms and Fourier series: Basic definitions, elementary properties and simple problems only.
UNIT V - Fourier transforms: Basic definitions, elementary properties and simple problems only.Half Range Fourier Transforms - Basic definitions, elementary properties and simple problems only.

Text Book:

1. Frank Ayres Jr, Elliott Mendelson, " Calculus', 3rd Edition, Schaum's Outline series, McGraw-Hill, INC., 1990.

Reference Books:

1. Shanti Narayan, "Differential Calculus" S. Chand and Company, 2005.
2. Shanti Narayan, 'Integral Calculus" S. Chand and Company, 2005.
3. Shanti Narayan and P. K. Mittal, "Text Book of Matrices", S. Chand and Company, 2011
4. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, 2012.
5. Dass H.K, "Advanced Engineering Mathematics", 18th edition, S. Chand and Company, 2008.

17MA1005 BASIC MATHEMATICS FOR COMPUTER SCIENCE

(Common to B.Sc.(CS), BCA and B.Sc.(IT))

Credits: 3:1:0

Objective:

- To make the students understand the importance of differential calculus in various fields of engineering
- To equip the students with the knowledge of matrices and Integrations.
- To enlighten the students about the use of differentiation of vectors

Course Outcome:

The students will be able to

- Relate their subject knowledge with their engineering subjects during their course of study.
- Know the applications of matrices.
- Apply the eigen values and eigen vectors in engineering problems.
- Understand the techniques involved in calculus.
- Understand the applications of integrations.
- Get the applications of vectors differentiations.

UNIT I - Algebra: Set Theory – Relations and functions- Trigonometric identities- Partial fractions
UNIT II - Matrices: Introduction-Matrix operations- The trace and the determinant of a matrix- Properties of determinants(excluding the proof)- The inverse and the rank of a matrix- Special types of square matrices-Eigen values and Eigen vectors(problems only).
UNIT III - Calculus: Differentiation from the first principle-Rules of differentiation-Implicit differentiation-Logarithmic differentiation-Methods of integration-Integration by parts.
UNIT IV - Vectors: Scalars and vectors- Operations on vectors- Magnitude of a vector-Differentiation of vectors– Curves in space-Velocity and acceleration-Scalar and Vector point functions–
UNIT V - Gradient and Divergence: Gradient and Divergence - Curl–Physical interpretations- Solenoidal and irrotational fields-Laplacian operator.Integration of vectors.

Text Book:

1. Grewal B.S, “Higher Engineering Mathematics”, 42nd Edition, Khanna Publications, Delhi, 2012.

Reference Books

1. James Steward, “Calculus”, 5th Edition, Thomson Brooks/Cole, Micro Print Pvt. Ltd, Chennai, 2003.
2. Riley K.F, Hobson M.P, and Bence S.J, “Mathematical Methods for Physics and Engineering”, 2nd Edition, Cambridge Low – Price Editions, Cambridge University Press, 2004.
3. Kandasamy P., Thilagavathi K and Gunavathi K., “Engineering Mathematics” volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
4. T. Veerarajan., “Engineering Mathematics”, (Updated Second Edition), Tata McGraw Hill, New Delhi, 2009.

17MA1006 FOUNDATIONS OF MATHEMATICS AND STATISTICS

Credits: 3:0:0

Course Objective:

- To Develop the skills of the students in the areas of basic algebra, probability and statistics
- To equip the students with the knowledge of descriptive and inferential statistics
- To Understand the various application design of experiments

Course Outcome:

The students will be able to

- Understand basic mathematics and the technique, methodology
- Know the applications of Maxima and Minima concepts
- Use the applications of statistics in practical life
- Apply Probability Distributions logics to solve the problems
- Understand in collection, presentation and drawing conclusion about biological data
- Apply the subject knowledge in their engineering subjects

Unit I – Algebra: Linear and quadratic equations- Binomial Theorem- Summation of series – coefficient of n x - exponential function-logarithmic function.

Unit II - Differential Calculus: Limits and Continuity- Differentiation–Product and Quotient Rule –Maxima and Minima of f(x).

Unit III - Integral Calculus: Integration of standard functions – Methods of Integration – Integration by parts – Definite Integrals - Bernoulli’s formula.

Unit IV - Probability and distributions: Probability – Axiomatic definition of probability – Independent events – Binomial, Poisson Distributions –– Normal Distribution – Properties of Normal Distribution ––Importance of Normal Distribution ––Normal probability curve – fitting Binomial, Poisson Distributions – problems (proofs and derivations not included).

Unit V - Testing of hypothesis: One tailed and two tailed tests - Tests based on large samples –proportion and mean – Small samples – t, F, chi square distributions.

Text Book:

1. Gupta S.P.,2009, “Statistical Methods”, New Delhi, S.Chand & Co., 37th Edition.

References:

1. Veerarajan T,2003, “Probability, Statistics and Random Processes”, Second Edition, Tata McGraw Hill publishing company.
2. Kandasamy P., Thilagavathi K and Gunavathy K., 2009, “Numerical Methods”, S.Chand & Co.
3. Gupta S.C. and Kapoor V.K., 2007, “Fundamentals of Mathematical Statistics”, Sultan Chand & Co.
4. Kapoor J.N. & Saxena H.C.,2006, “Mathematical Statistics”, S.Chand & Company.
5. Kandasamy P., Thilagavathi K and Gunavathy K.,2001, “Engineering Mathematics”, Volume I, S.Chand & Co.
6. Manickavasagam Pillai, 2002, “Algebra” , Volume I & II, S. Viswanathan publishers,.

17MA2001 VECTOR CALCULUS AND COMPLEX ANALYSIS

Credits: 3:1:0

Course Objective:

- To teach the students about the basic concepts of vector calculus.
- To provide the students about the basic concepts of the complex variables.
- To provides the students about the concept of analytic functions and complex integration.

Course Outcome:

The students will be able to

- Understand the application of Stokes theorem.
- Relate their knowledge in complex variables with their engineering subjects during their course of study.
- Apply transformation techniques in engineering problems.
- Understand the main properties and examples of analytic functions and be able to compute and manipulate series expansions for analytic functions;
- Perform basic calculations relating to tangent planes, directional derivatives, curves and surfaces in three dimensional space
- Use the major integral theorems; and able to identify and classify zeroes and poles of functions and find their residues.

UNIT I - Vector Differentiation: Differentiation of vectors–Curves in space-Velocity and acceleration-Scalar and Vector point functions–Gradient–Divergence-Curl–Physical interpretations- Solenoidal and irrotational fields-Laplacian operator.

UNIT II - Vector Integration: Integration of vectors – Line Integral–Simple problems-Surface Integral–problems on Greens theorem, Stoke's theorem, Gauss divergence theorem.

UNIT III - Analytic functions: Limit of a complex function–Derivative of f (z)–Cauchy Riemann equations-Harmonic functions-Construction of an Analytic function; Milne Thompson Method-Orthogonal Trajectories

UNIT IV - Transformations: Standard transformations z+c, cz, 1/z,-Bilinear transformation-Conformal transformation-Special conformal transformations-Schwarz-Christoffel Transformation.

UNIT IV - Complex Integration: Line integral of f (z)-Cauchy's theorem–Cauchy'sIntegral formula– Morera's theorem-Taylor's series –Laurent's series–Zero's and Singularities of an analytic function–Residue theorem–Evaluation of real definite Integrals.

Text Book:

1. Grewal B.S., "Higher Engineering Mathematics" , (42^{nd} Edition) Khanna Publishers, New Delhi, 2012.

Reference Books:

1. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
2. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
3. T. Veerarajan., "Engineering Mathematics", (Updated Second Edition), Tata McGraw Hill, New Delhi, 2009.
4. H.K.Dass., "Advanced Engineering Mathematics", (18^{th} Revised Edition), S. Chand & Co., New Delhi, 2008.

17MA2002 FOURIER SERIES AND APPLICATIONS

Credits: 3:1:0

Course Objective:

- To orient the students to know about the application of Harmonic analysis.
- To teach the students about the solutions of wave and heat equations.
- To motivate the students to know about the applications of Fourier Series

Course Outcome:

The students will be able to

- Relate the properties of Fourier series with their engineering subjects during their course of study.

- Gain the knowledge in vibrations of stretched strings.
- Apply the knowledge in Fourier series in science and technology.
- Develop the fundamental ideas of D Alembert's solution of the wave equation
- Understand the concepts of Steady state conditions
- Have the knowledge in solving engineering problems using Laplace Transforms

UNIT I - Fourier series: Euler's formula – Conditions for a Fourier expansion – Functions having points of discontinuity- Change of Interval.
UNIT II - Half Range Fourier series: Typical wave forms - Complex form of Fourier series –Harmonic analysis.
UNIT III - One Dimensional Wave Equation: Vibrations of stretched string – D Alembert's solution of the wave equation.
UNIT IV - One-dimensional heat flow: Solution of the heat equation – Steady state conditions.
UNIT V - Two-dimensional heat flow: Solution of Laplace Equation (Cartesian form only) – Temperature distribution.

Text Book:

1. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition), Khanna Publisher, New Delhi, 2012.

Reference Books:

1. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
2. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th Revised Edition), S. Chand & Co., New Delhi, 2006.
3. H.K.Dass., "Advanced Engineering Mathematics", (18th Revised Edition), S.Chand & Co., New Delhi, 2008
4. K.F.Riley., M.P.Hobson., S.J.Bence., 'Mathematical Methods for Physics and Engineering", (2nd Edition), Cambridge University Press, 2004.

17MA2003 MATHEMATICAL TRANSFORMS

Credits: 3:1:0

Course Objective:
- To illustrate the solutions of differential equations using Laplace Transform
- To define and compare the formulas of Infinite, cosine, sine, finite Fourier Transform
- To motivate about the applications of Laplace, Fourier, Z-Transforms.

Course Outcome:
The students will be able to
- Discriminate &learn all the properties of Laplace Transform
- Apply Laplace Transforms in mechanical & signal system engineering problems.
- Evaluate certain definite integrals with infinite limits using Fourier Transform
- Categorize Z-Transform of sequence and series.
- List the formulas & properties of Z-Transform & Inverse Z-Transform
- Solve difference and differential equations problems in their engineering fields.

UNIT I - Laplace transforms: Transforms of elementary functions–Properties of Laplace transforms–Transforms of periodic functions–Transforms of special functions–Transforms of derivatives–Transforms of integrals-Multiplication by t^n- Division by t–Evaluation of Integrals by Laplace transforms.
UNIT II - Inverse Laplace transforms: Inverse Laplace transforms of standard functions-Method of Partial fractions – properties -Convolution theorem – Solving Differential Equations.
UNIT III - Fourier transforms: Fourier integral Theorem–Inverse transform-Properties– Convolution– Parseval's Identity– Relation between Fourier and Laplace transforms–Fourier transforms of the derivatives of a function.
UNIT IV - Z-transforms: Standard z transforms–Standard results – Shifting U_n to the Right–Multiplication by n - Initial value and Final value theorems–Convolution theorem-Convergence of z- transforms.
UNIT V - Inverse Z-transforms: Inverse Z-transforms of standard functions-Method of Partial fractions – properties -Convolution theorem – Solving Difference Equations.

Text Book:

1. Grewal B.S., "Higher Engineering Mathematics", (42^{nd} Edition), Khanna Publishers, New Delhi, 2012.

Reference Books:

1. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th Revised Edition), S. Chand & Co., New Delhi, 2006.
2. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
3. H.K.Dass., "Advanced Engineering Mathematics", (18^{th} Revised Edition), S. Chand & Co., New Delhi, 2008.
4. K.F.Riley., M.P.Hobson., S.J.Bence., 'Mathematical Methods for Physics and Engineering", (2^{nd} Edition), Cambridge University Press, 2004.

17MA2004 LAPLACE TRANSFORMS, FOURIER SERIES AND TRANSFORMS

Credits: 3:1:0

Course Objective:

- To develop the students in acquiring transform techniques.
- To introduce the students about the fourier series and its application to the solution of partial differential equations
- To explain the general linear system theory for continuous-time signals and systems using the Laplace transform

Course Outcome:

The students will be able to

- Have the knowledge of applying Laplace and Fourier Transforms in a growing number of fields.
- Calculate the output of a linear system using convolution and the Fourier transform
- Analyze the spectral characteristics of continuous-time periodic and periodic signals using Fourier series.
- Apply the knowledge gathered in the subject to Signal processing.
- Solve a Cauchy problem for the wave or diffusion equations using the Fourier Transform.
- Apply the transform techniques to their engineering subjects.

UNIT I - Laplace transforms: Transforms of elementary functions–Properties of Laplace transforms–Transforms of periodic functions–Transforms of special functions–

UNIT II - Transforms of derivatives: Transforms of integrals-Multiplication by t^n- Division by t –Evaluation of Integrals by Laplace transforms.

UNIT III - Inverse Laplace transforms: Inverse transforms of standard functions**-**Method of Partial fractions–properties–Convolution theorem–Application to Differential Equations.

UNIT IV - Fourier series: Euler's formula–Conditions for a Fourier expansion–Functions having points of discontinuity–Change of Interval–Even and odd functions. Half range Fourier series**:** – Typical wave forms – Complex form of Fourier series–Harmonic analysis.

UNIT V - Fourier transforms: Fourier integral Theorem– Inverse transform-Properties–Convolution–Parseval's Identity–Relation between Fourier and Laplace transforms–Fourier transforms of the derivatives of a function.

Text Book:

1. Grewal B.S., "Higher Engineering Mathematics", (42^{nd} Edition), Khanna Publishers New Delhi, 2012.

Reference Books:

1. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
2. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
3. H.K.Dass., "Advanced Engineering Mathematics", (18^{th} Revised Edition), S. Chand & Co., New Delhi, 2008.
4. K.F.Riley., M.P.Hobson., S.J.Bence., 'Mathematical Methods for Physics and Engineering", (2^{nd} Edition), Cambridge University Press, 2004.

17MA2005 MATHEMATICAL FOUNDATION

Credits: 3:1:0

Course Objective:

- To understand and know the basic operations in matrices
- To understand and remember the basic formulas in differentiation and integration.
- To highlight the importance of solving ordinary differential equations

Course Outcome:

The students will be able to

- Apply the knowledge of trigonometry in engineering
- Apply the knowledge of matrices in computing
- Solve engineering problems using differentiation
- Solve engineering problems using integration
- Solve engineering problems using ODE solutions
- Apply the knowledge of curvature

UNIT I - Trigonometry: Expansions of sinnθ, cosnθ and tannθ.Hyperbolic functions–Separating real and imaginary parts.
UNIT II - Matrices: Rank of a matrix–Eigen values and Eigen vectors – Cayley Hamilton theorem.
UNIT III - Calculus: Differentiation from the first principle–Rules of differentiation: Addition rule–Product Rule–Quotient rule–Chain rule–Implicit differentiation–Logarithmic differentiation–Curvature in Cartesian coordinates.
UNIT IV - Integration: Integration of standard functions- Bernoulli's Formula.
UNIT V - Differential equations: Second order linear differential equations with constant coefficients.

Text Book:

1. Veerarajan T., "Engineering Mathematics", (4th Edition) Tata McGraw Hill, New Delhi, 2009.

Reference Books:

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Vol.I" S.Chand & Co.New Delhi, 2009.
2. K.F.Riley., M.P.Hobson., S.J.Bence., 'Mathematical Methods for Physics and Engineering", (2nd Edition), Cambridge University Press, 2004.
3. A. Hepzibah, R. Selvamani, K. Porselvi, "Basic Engineering Mathematics", HSI Publications, Coimbatore, 2011.
4. A. Singaravelu, Engineering Mathematics, Meenakshi Publications, 2001.
5. Moorthy M B K, Subramaniyam N, Engineering Mathematics II, VRB Publishers, 2005.

17MA2006 NUMERICAL MATHEMATICS AND COMPUTING

Credits: 3:1:0

Course Objective:

- To impart basic understanding about representation of numbers in different bases in computer and compute numerical solution for algebraic equations
- To determine numerical integration
- To highlight the importance of splines

Course Outcome:

The students will be able to

- Identify the uses of Taylor's series in engineering fields.
- Extend the uses of representation of numbers in different bases in engineering fields.
- Produce numerical solution for transcendental equations in engineering fields.
- Illustrate the interpolation techniques in other branches
- Evaluate integration using numerical methods
- Develop the application of splines in engineering fields.

UNIT I - Application of Taylor's series: Nested multiplication-Rounding and Chopping-pseudocode- Simple Numerical problems using Taylor's series- Representation of numbers in different bases.
UNIT II - Locating Roots of Equations: Bisection Method-Bisection Algorithm and pseudocode--Convergence of Bisection Method-Newton's method-Geometry of Newton's method-Pseudocode-Convergence Analysis.
UNIT III - Interpolation: Polynomial interpolation-Existence-Newton interpolating polynomial- Nested form-Calculating Newton interpolating formula using divided difference-Lagrange interpolating polynomial-Errors in polynomial interpolation.
UNIT IV - Numerical Integration: Trapezoidal rule- Error analysis-Recursive Trapezoidal formula-Romberg Algorithm- Simpson's rule-Gaussian Quadrature Formulas.
UNIT V - Approximation by Spline Functions: First degree spline–examples-Second degree splines–Natural cubic splines–B splines.

Text Book:

1. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Cengage Learning Brooks/Cole Publishing Company, California, 2012.

Reference Books:

1. M.K.Jain., Iyengar. S.R.K., Jain R.K., "Numerical Methods for Scientific and Engineering Computation", (6^{th} Edition), New Age International.,2012.
2. Rajasekaran. S., "Numerical Methods in Science and Engineering: A Practical Approach", S. Chand publishers, 2003.
3. Ralph G. Stanton., "Numerical Methods for Science and Engineering", (1^{st} Edition), Prentice Hall of India Pvt. Ltd., 1988.
4. Kandasamy. P., Thilagavathy K., "Numerical Methods", S. Chand & Co. Ltd., 2010.

17MA2007 PROBABILITY AND RANDOM PROCESS

Credits: 3:1:0

Course Objective:

- To expose the students to the basics of probability distributions and application of family of random variables in real life situations..
- To provide the students with an understanding of basic concept in Random Process.
- To understand the classifications of random processes and concepts such as strict stationarity, wide-sense stationarity and ergodicity.

Outcome:

The students will be able to

- Apply the knowledge gained in Probability theory in engineering fields.
- Translate real world problems into Probability models.
- Explore the random experiments specified by two random variables and study the distribution of them.
- Make simple mathematical descriptions or modeling of random signals.
- Apply the Random process techniques to signal processing.
- Familiar with application of auto correlation and cross correlation functions.

UNIT I - Probability Theory: Axioms of probability, Joint and conditional probabilities, Theorem of Total Probability-Baye's Theorem.
UNIT II - Random Variables: One-Dimensional random variables, Two-Dimensional random variables.Functions of one random variable.
UNIT III - Statistical Averages: Characteristic Function, Moment generating Function, Tchebysheff Inequality, Central limit theorem.
UNIT IV - Random process: Wide-sense stationarity, Strict-sense stationarity, Mean Ergodic Process, Correlation Ergodic Process, Power Spectral Density Function.
UNIT V - Special Random Processes: Linear systems, Gaussian Process, Poisson process.

Text Book:

1. T.Veerarajan, "Probability, Statistics and Random Process" Tata Mc Graw Hill, Second edition, 2009.

Reference Books:
1. Kapur J.N. and Saxena H.C., "Mathematical Statistics", S. Chand & Co. Ltd., New Delhi. 2003.
2. S.C.Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Co., 2009.
3. Kandasamy P. , Thilagavathy, Gunavathy, "Probability, Random Process and Queuing Theory, S. Chand & Co. New Delhi, 2007.
4. H. Stark and J.W. Woods: "Probability, Random process and Estimation theory for Engineers", Pearson Education Asia, third edition, 2002.

17MA2008 PROBABILITY AND STATISTICS

Credits: 3:1:0

Course Objective:
- To develop the skills of the students in the area of Probability and Statistics.
- To equip the students with understanding of basic concepts in Testing of Hypothesis.
- To learn the design of experiments and Latin square design.

Course Outcome:
The students will be able to
- Have knowledge in the Technique, Methodology and Application in Statistics.
- Have knowledge in collection, presentation and tabulation of data.
- Apply their knowledge gathered in the subject to life sciences.
- Translate real world problems into Probability models.
- Design hypothesis tests for a given set of data and select the appropriate thresholds for the test.
- Use linear regression analysis to develop an empirical model of experimental data.

UNIT I - Statistics: Frequency distribution and measures of central tendency–measures of dispersion-Linear correlation–Regression lines.
UNIT II - Probability: Axioms of probability–Conditional probability –Baye's theorem and related problems.
UNIT III - Theoretical distributions: Binomial, Poisson, Normal Distributions- Properties– joint distribution–conditional probability distribution–Independent random variables.
UNIT IV - Testing of Hypothesis: Tests of Significance-large sample tests- difference of means- difference of proportion–small sample test– t test– Chi square test.
UNIT V - Design of Experiments: Analysis of variance–one factor classification- two factors classification - completely randomized design– randomized block design– Latin square design.

Text Book:
1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2008.

Reference Books:
1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2008.
2. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.
3. Veerarajan, T., Probability, Statistics and Random Processes, TataMcGrawHill, 2nd Edition, 2009.
4. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition) , Khanna Publishers New Delhi, 2012.

17MA2009 STATISTICAL DATA ANALYSIS AND RELIABILITY ENGINEERING

Credits: 3:1:0

Course Objective:
- To provide the students the concepts in Testing of Hypothesis and reliability engineering
- To learn sampling techniques and Design of Experiments
- To develop the students skill in quality control.

Course Outcome:
The students will be able to
- Get the Knowledge in Statistical Data Analysis
- Solve problems in the design of experiments.

- Analyses samples for testing of Hypothesis.
- Construct control charts for process control.
- Understand the reliability engineering problems.
- Apply their subject knowledge in their engineering subjects

UNIT I - Correlation Analysis: Correlation coefficient–Rank correlation-Method of least squares- Linear, Parabolic and Logarithmic curve– regression coefficients.
UNIT II - Testing of Hypothesis: One tailed and two tailed tests- Large sample tests for proportion and mean – Small Sample tests.
UNIT III - Design of experiments: Analysis of variance for one factor and two factors of classification - completely randomized design-– randomized block design – Simple Latin Square Design.
UNIT IV - Statistical quality control: Types of variation – types of control charts – X chart, R. Chart, Sigma Chart, Advantages and Limitations of SQC – Acceptance sampling – Single sampling plan, Double sampling plan, Construction of a OC curve – Six σ concepts.
UNIT V - Reliability engineering: Concepts of reliability, hazard function, series and parallel systems, reliability of Markovian systems, maintainability, preventive maintenance.

Text Book:

1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2008.

Reference Books:

1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2008.
2. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.
3. Balagurusamy, E., "Reliability Engineering", Tata McGraw-Hill Publishing Co., New Delhi, Fourth Reprint, 2003.
4. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition), Khanna Publishers New Delhi, 2012.

17MA2010 DISCRETE MATHEMATICS

Credits: 3:1:0

Course Objective:

- To provide the student with the concept and the understanding of basic concepts in logical relations and digraphs.
- To equip the students with the basic concepts of Lattice Theory and Graph theory.
- Demonstrate different traversal methods for trees and graphs.

Course Outcome:

The students will be able to

- Understand the fundamental mathematical concepts and terminology.
- Use and analyze recursive definitions.
- Use techniques for constructing mathematical proofs.
- Understand the concepts of coding and decoding.
- Develop modeling for computer science and engineering problems.
- Understand some basic properties of graphs and related discrete structures, and be able to relate these to practical examples.

UNIT I - Basic Algebra: Sets and subsets – operation on sets – sequences – division in the integers – matrices – logical operations–conditional statements –Mathematical induction – Recurrence relation.
UNIT II - Relations and digraph: Products sets and partitions – relations and digraphs – paths in Relations and digraphs– properties of relations – equivalence relations– operations on relations – transitive closure and Warshall's algorithm.
UNIT III - Order relations and structures: Partially ordered sets – external elements of partially ordered sets– lattices–finite Boolean algebras–functions on Boolean algebra.
UNIT IV - Trees: Labeled trees– undirected trees – minimal spanning trees. Graph theory: Graphs –Euler paths and circuits–Hamiltonian Paths and circuits–transport networks-Coloring Graphs.

UNIT V - Groups and coding: Semi-groups and groups: binary operations revisited – semi-groups–groups–Groups and coding: coding of binary information.

Text Book:

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 6th Edition, Pearson Education, 2009.

Reference Books:

1. Iyengar N.Ch.S.N., Chandrasekharan V., Venkatesh K.A. and Arunachalam P.S., "Discrete mathematics", Vikas Publishing, 2003.
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill, 5th Edition, 2003.
3. Swapan Kumar Sarkar, "A Text Book of Discrete Mathematics", S.Chand & Company, 2009.
4. Nanda S, "Discrete Mathematics", Allied Publishers, 2002.

17MA2011 PROBABILITY AND QUEUING THEORY

Credits: 3:1:0

Course Objective:

- To develop the skills of the students in the area of Probability and Conditional Probability
- To provide the students the concepts in one dimensional and two dimensional Random variables.
- To provide the students about the basic concepts in testing of hypothesis and Queuing theory

Course Outcome:

The students will be able to

- Gain knowledge in Probability.
- Get knowledge in Conditional Probability
- Get the knowledge in Random variables
- Analyses samples for Testing of Hypothesis
- Make simple mathematical descriptions or modeling.
- Solve the problems in Queuing theory

UNIT I - Probability: Axioms of probability – Joint and conditional probabilities –Independent events-Theorem of Total Probability-Baye's Theorem
UNIT II - Random Variables: One-Dimensional discrete random variables- One-Dimensional continuous random variables-Two-Dimensional discrete random variables-Two-Dimensional continuous random variables.
UNIT III - Testing of hypothesis: One tailed and two tailed tests – Tests based on large samples –proportion and mean
UNIT IV - Tests based on Small samples: Tests based on t, F, chi square test of Goodness of fit, chi square test of independence of attributes.
UNIT V - Queuing theory: Characteristics of Queueing systems, Representation a queuing Model, Problems on the models (M/M/1): (∞/FIFO) and (M/M/k): (∞/FIFO).

Text Book:

1. T.Veerarajan, "Probability statistics and Random Process" Tata Mc Graw Hill, Second edition, 2009.

Reference Books:

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics Sultan Chand & Co., 2009.
2. Kapur J.N. and Saxena H.C., "Mathematical Statistics", S. Chand & Co. Ltd., New Delhi. 2003.
3. Kanti Swarup, Manmohan, Gupta P.K., "Operations Research" Sultan Chand &Sons., 14th Edition. 2008.
4. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.

17MA2012 NUMERICAL METHODS

Credits: 3:1:0

Course Objective:

- To provide the knowledge in solving different types of equations.
- To apply appropriate numerical methods to solve a linear system of equations
- To equip the students with interpolation, numerical differentiation and numerical integration techniques.

Course Outcome:

The students will be able to

- Relate their subject knowledge with their experiments during their course of study.
- Understand the use of numerical methods in modern scientific computing with finite precision computation.
- Solve an algebraic or transcendental equation using an appropriate numerical method.
- Solve their engineering problems using interpolation techniques.
- Understand the calculation and interpretation of errors in numerical methods.
- Identify the numerical techniques for their engineering problem.

UNIT I - Empirical formulae and curve fitting: Principle of least squares - fitting a straight line, a parabola and exponential curve.

UNIT II - Solutions of algebraic and transcendental equations: Newton- Raphson method, Gauss elimination method, Gauss-Jordan method, Gauss-Jacobi, Gauss-Seidel method.

UNIT III - Interpolation: Finite differences - Newton forward Interpolation, Newton backward Interpolation, Gauss forward interpolation formula, Gauss backward interpolation formula, Lagrange's Interpolation formula.

UNIT IV - Numerical integration: Trapezoidal rule-Geometrical interpretation and error of Trapezoidel rule - Simpsons one third rule and three eighth rule formulae -Truncation errors in Simpsons rule.

Unit Numerical solution for ordinary differential equation: Solution of first order ODE by Taylor series method - Solution of first order ODE by Euler method- Improved Euler method -Modified Euler method **-** Runge Kutta method of second, third and fourth order

Text Book:

1. Venkataraman M.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.

Reference Books

1. Kandasamy P., "Numerical Methods", S.Chand and Co, Reprint 2010
2. M.K.Jain., Iyengar. S.R.K., Jain R.K., "Numerical Methods for Scientific and Engineering Computation", (6th Edition), New Age International, 2012.
3. Rajasekaran. S., "Numerical Methods in Science and Engineering: A Practical Approach", S. Chand publishers, 2003.
4. Ralph G. Stanton., "Numerical Methods for Science and Engineering", (1^{st} Edition), Prentice Hall of India Pvt. Ltd., 1988.

17MA2013 APPLIED LINEAR ALGEBRA

Credits: 3:1:0

Course Objective:

- Explaining the basic concepts in linear transformations and advanced matrix theory.
- Identifying the application of computer graphics in Linear Algebra.
- To justify the skills of students in applying linear differential equations in Linear Algebra.

Course Outcome:

The students will be able to

- Relate the concepts of vectors and matrices in their engineering subjects.
- Apply their knowledge in the subject to Computer graphics.
- Summarize Matrix decompositions.
- Interpret the applications of systems of Linear Differential Equations .
- Generalizing the concepts of Markov Chain.

- Understand the concept of Inner Product Space.

UNIT I - Vector Spaces: Vectors in R^n- Linear combinations and Linear independence- Vector spaces-subspaces-Basis and dimension- coordinates and change of basis. Application to Differential equations.
UNIT II - Linear transformations: The null space and Range- Isomorphisms-Algebra of linear transformation-Matrix representation of a Linear transformation- Similarity- Application to Computer graphics-simple problems.
UNIT III - Eigen Values and Eigen Vectors: Introduction– properties of Eigen values- Diagonalization-Reduction of a matrix to a canonical forms-Application to the system of linear differential equations- and Markov chains.
UNIT IV - Inner Product Spaces: The dot product in R^n-Located Vectors, Hyperplanes,Lines,curves R^n in Inner product spaces- Orthonormal spaces- Orthogonal complements- Application to least squares approximation- Simple problems.
UNIT V - Quadratic Forms: Diagonalization of symmetric matrices- Quadratics forms- Bilinear forms and matrices – Alternating Bilinear Forms-simple problems- Application to Singular Value Decomposition.

Text Book:

1. Jim Defranza and Daniel Gagliardi, “Introduction to Linear Algebra with applications”, Tata McGraw-Hill Edition, New Delhi, 2012.

Reference Books

1. Seymour Lipschutz, Marc Lipson, “Schaum's Outline of Theory and Problems of Linear Algebra”, Schaum's outline series, 2001.
2. Kumaresan.S., “Linear Algebra: A Geometric Approach”, PHI Pvt., Ltd., 2001.
3. Jimmie Gilbert, Linda Gilbert., “ Linear Algebra and Matrix Theory” (1st Edition), Academic Press, 2005.
4. Kenneth Hoffman, Ray Kunze, “Linear Algebra”, (2nd Edition), Prentice Hall of India Pvt., Ltd., 2002.

17MA2014 FUZZY SETS AND LOGIC

Credits: 3:1:0

Course Objective:

- To teach the fundamental concepts of fuzzy sets and fuzzy logic.
- Provide an emphasis on the differences and similarities between fuzzy sets and classical sets theories.
- Provide a brief introduction to fuzzy arithmetic concepts and applications of fuzzy sets.

Course Outcome:

The students will be able to

- Distinguish between the crisp set and fuzzy set concepts through the learned differences between the crisp set characteristic function and the fuzzy set membership function.
- Represent a simple classical proposition using crisp set characteristic function and likewise representing a fuzzy proposition using fuzzy set membership function.
- Have the knowledge of applying fuzzy sets and fuzzy logic in their fields.
- Have the knowledge of fuzzification of a crisp concept.
- Have the knowledge of defuzzification of a fuzzy concept.
- Understand the conditional fuzzy propositions and fuzzy inference systems.

UNIT I - Classical to Fuzzy: Introduction- Crisp sets- an overview- fuzzy sets and types- fuzzy sets and basic concepts- Alpha cuts- Representation of fuzzy sets. Operations on fuzzy sets- Types of operations- fuzzy complements
UNIT II - Operations: Fuzzy intersections and t-Norms - fuzzy union and t-Co-norms
UNIT III - Fuzzy Arithmetic: Fuzzy Numbers- Linguistic variables- Arithmetic operations on intervals-arithmetic operations on fuzzy numbers- lattice of fuzzy numbers- fuzzy equations.
UNIT IV - Fuzzy Logic: Classical Logic-an overview-Multivalued logics-fuzzy propositions- fuzzy quantifiers-Linguistic Hedges-conditional fuzzy propositions- inferences.
UNIT V - Fuzzy Systems: Fuzzy controllers- an overview- fuzzification-defuzzification-fuzzy rule base- fuzzy inference- defuzzification methods- fuzzy neural networks- fuzzy automata.

Text Book:

1. George J. Klir and Bo Yuan “Fuzzy Sets and Fuzzy Logic, Theory and Applications”, Prentice – Hall of India, Pvt. Ltd., New Delhi, 2005.

Reference Books:

1. James J. Buckley, Esfaniar Eslami., “An Introduction to Fuzzy Logic and Fuzzy Sets”, (3rd Edition), Springer-Verlog, 2011.
2. Ganesh M., “Introduction to Fuzzy sets and Fuzzy Logic”, (1st Edition), Prentice Hall of India Pvt., Ltd., 2006.
3. H J Zimmermann, Hans Jurgen Zimmerman, “Fuzzy Set Theory- And Its Applications”, Springer, 2001.
4. Timothy J. Ross., “Fuzzy Logic with engineering applications”, 3rd Edition, John Wiley, 2010.

17MA2015 PROBABILITY, RANDOM PROCESS AND NUMERICAL METHODS

Credits: 3:1:0

Course Objective:

- To develop the skills of the students in the area of Probability and Random Process.
- To equip the students with the basic concepts of various distributions and Random process
- To develop the skills of solving first and second order differential equations using numerical methods.

Course Outcome:

The students will be able to

- Have knowledge in Probability theory.
- Get knowledge on various distributions.
- Make simple mathematical descriptions or modeling of random signals.
- Solve problems based on central limit theorem
- Apply numerical methods for scientific computing.
- Solve differential equations using numerical methods

UNIT I - Probability: Axioms of probability – conditional probability –Independent events-Theorem of Total Probability-Baye’s Theorem.

UNIT II - Distributions: Random variables, Binomial, Poisson, Normal and exponential distributions.

UNITIII: **Moments:** MGF, Moments, Tchebysheff Inequality, Problems based on Central limit theorem.

UNIT IV - Random process: Basics of Random Processes, wide sense, strict Sense stationary processes, Ergodicity, Mean Ergodic Process-Correlation Ergodic Process.

UNIT V - Numerical Methods: Newton’s forward and backward difference formula, Trapezoidal rule and Simpson’s rule, Taylor series, Euler’s method, Fourth order Runge-Kutta method to solve first and second order differential equations.

Text Book:

1. Veerarajan, T., “Probability, Statistics and Random Process” Tata McGraw Hill, Second edition, 2009.

Reference Books:

1. Stark, H. and J.W. Woods: “Probability, Random process and estimation theory for Engineers”, Pearson Education Asia, Third edition, 2002.
2. Gupta, S.C., and V.K.Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 2008.
3. Venkataraman M.K., “Numerical methods in Science and Engineering”, National Publishing Company, Revised Edition, 2005.
4. Curtis F-Gerald, “Applied Numerical Analysis”, 5th Edition, Addison Wesley Publishing Company, 2001.

17MA2016 SAMPLING TECHNIQUES

Credits: 3:1:0

Course Objective:

- To develop skills of the students in the area of Random Sampling.
- To provide the students the concepts in Testing of Hypothesis and quality control
- To understand the applications of the design experiments and ANOVA, SPSS

Course Outcome:
The students will be able to

- Relate their subject knowledge in techniques, methodology and statistics with their engineering subjects during the course of study
- Analyses samples for Testing of Hypothesis
- Construct control charts for process control
- Apply sampling plans in quality control
- Use ANOVA to their engineering problem.
- Use SPSS packages to their engineering problems

UNIT I - Random Sampling: Stratified, Systematic and Cluster Samplings, Non-random sampling, Judgment, Quota, Convenience sampling.
UNIT II - Testing of Hypothesis: Large sample tests, Difference of Means, Difference of proportion, Small Samples, Student's t test, F Test, Chi square test.
UNIT III - Statistical quality control: Types of variation – Types of control charts – X, R, Sigma and C charts- Acceptance Sampling:, Single and Double sampling plans.
UNIT IV - Design of Experiments: Basic Principles of Experimental Design - Completely randomized design-– Randomized block design – Simple Latin Square Design.
UNIT V - Statistical Package for the Social Science: Basics of SPSS, data creation and saving, opening of the Data file, defining the attributes of variables, Univariate Analysis, Graphs (Bar, Line, Area and Pie), Comparing the Means of independent samples Paired t-test, One way ANOVA using SPSS.

Text Book:

1. Gupta S.C. and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand Sons, 2007.

Reference Books:

1. Gupta S.C. and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand & Sons, 2007.
2. Gupta S.P., "Statistical Methods", Sultan Chand and sons, New Delhi, 2009.
3. Vijay Gupta, SPSS for Beginners SPSS versions 7.x through 10.0., VJ Books Inc, 1999.
4. Dennis Howitt and Duncan Cramer "Introduction to SPSS in Psychology", 3rd Edition, PHI, 2005.

17MA2017 OPERATIONS RESEARCH –I

Credits: 3:1:0

Course objective:
To provide the student with the concept and an understanding of basic concepts in

- Linear Programming techniques,
- Duality Principles
- Transportation and Assignment problems

Course outcome:
The students will be able to

- Explain the basic concepts of optimization and to formulate and solve linear programming problems
- Apply the concepts of Transportation Problem and Assignment Problem
- Participate in the class room discussion on Transportation algorithm
- Explain and apply the concepts of sequencing problem
- Explain and demonstrate the basic concepts of sequencing problem and their application
- Apply duality principle in day to day life style

UNIT I - Linear Programming Problem: Formulation of LPP - Graphical Method - Simplex Method - Artificial variable technique and two-phase simplex method.
Unit II - Duality: Duality - Dual and simplex method - Dual Simplex Method
Unit III - Sequencing: Job sequencing - n jobs through two machines - n jobs through m machines and two jobs through m machines.
UNIT IV - Transportation problem: Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy.

UNIT V - Assignment Problem: Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

Text Book:

1. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.

Reference Books:

1. Kanti Swarup, Manmohan, Gupta P.K., "Operations Research" Sultan Chand &Sons., 14th Edn.2008.
2. Natarajan A.M., Balasubramani P., Thamilarasi A., "Operations Research", Pearson Education, I Edn, 2003.
3. Srinivasan G., "Operations Research", Eastern Economy Edition, I Edn. 2007.
4. Winston, "Operations Research, Applications and Algorithms" – Cengage Learning, 4th Edition, 2004.

17MA2018 OPERATIONS RESEARCH –II

Credits: 3:1:0

Course objective:

To provide the student with the concept and an understanding of basic concepts in

- Inventory models,
- PERT/CPM and Simulation,
- Queuing and Game theory,

Course outcome:

The students will be able to

- Explain the basic concepts of optimization and to formulate and solve inventory problems
- Apply the concepts of queueing theory
- Participate in the class room discussion on Simulation Models and application
- Explain and apply the concepts of Game theory
- Explain and Demonstrate the basic concepts of PERT- CPM and their application
- Reproduce the network model

Unit I - Inventory models: Economic order quantity models-techniques in inventory management-ABC analysis.
UNIT II - Network analysis: PERT & CPM- network diagram-probability of achieving completion date- crash time- cost analysis.
UNIT III - Simulation models: Elements of simulation model -Monte Carlo technique – applications.
UNIT IV - Queuing model and Game Theory: Problems involving (M\M\1): (∞\FIFO) , (M\M\c): (∞\FIFO) Models. Game theory –two person Zero sum game,-graphical solution-algebraic solution
UNIT V - Replacement models: Models based on models that gradually detoriate with time-whose maintenance cost increase with time-Replacement of items that fail suddenly and completely.

Text Book:

1. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.

Reference Books:

1. Kanti Swarup, Manmohan, Gupta P.K., "Operations Research" Sultan Chand &Sons., 14th Edn.2008.
2. Natarajan A.M., Balasubramani P., Thamilarasi A., "Operations Research", Pearson Education, I Edn, 2003.
3. Srinivasan G., "Operations Research", Eastern Economy Edition, I Edn. 2007.
4. Winston, "Operations Research, Applications and Algorithms" – Cengage Learning, 4th Edition, 2004.

17MA2019 ANALYTICAL GEOMETRY, FOURIER SERIES AND TRANSFORMS

Credits: 3:1:0

Course Objective:

- To teach the students about the fundamental concepts of Analytical Geometry.
- To orient the students to know about the application ofLaplace Transform, Fourier Series and Harmonic analysis.
- To enable the students to analyze the spectral characteristics of continuous-time periodic and periodic signals using Fourier series.

Course Outcome:

The students will be able to

- Have the knowledge of applying Laplace and Fourier Transforms in a growing number of fields.
- Calculate the output of a linear system using convolution and the Fourier transform
- Analyze the spectral characteristics of continuous-time periodic and a periodic signals using Fourier series.
- Have the capacity to apply the knowledge gathered in the subject to Signal processing.
- Evaluate certain definite integrals with infinite limits using Fourier Transform
- Apply the transform techniques to their engineering subjects.

UNIT I - Analytical Geometry: Direction cosines and ratios – Angle between two lines – Equation of a plane – Equation of a straight line – Co-planar lines – Shortest distance between skew lines.

UNIT II - Laplace Transforms: Transforms of elementary functions–Properties of Laplace transforms–Transforms of periodic functions–Transforms of special functions–Transforms of derivatives–Transforms of integrals-Multiplication by t^n- Division by t–Evaluation of Integrals by Laplace transforms –

UNIT III - Inverse Laplace transforms: Inverse Laplace transforms of standard functions-Method of Partial fractions.

UNIT IV - Fourier Series: Euler's formula – Conditions for a Fourier expansion – Functions having points of discontinuity- Change of Interval. **Half Range Fourier series:** Typical wave forms –Harmonic analysis.

UNIT V - Fourier transforms: Fourier integral Theorem–Inverse transform-Properties- simple problems.

Text Book:

1. Grewal B.S., "Higher Engineering Mathematics", (42^{nd} Edition), Khanna Publisher, New Delhi, 2012.

Reference Books:

1. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
2. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th Revised Edition), S. Chand & Co., New Delhi, 2006.
3. H.K.Dass., "Advanced Engineering Mathematics", (18^{th} Revised Edition), S.Chand& Co., New Delhi, 2008
4. K.F.Riley., M.P.Hobson., S.J.Bence., 'Mathematical Methods for Physics and Engineering", (2^{nd} Edition), Cambridge University Press, 2004.

17MA2020 PROBABILITY, RANDOM VARIABLES AND STATISTICS

Credits: 3:1:0

Course Objective:

- To equip the students with an understanding of basic concepts in Probability, Statistics Testing of Hypothesis.
- To learn the design of experiments and Latin square design.
- To become an informed consumer of statistical information.

Course Outcome:

The students will be able to

- Knowledge in the Technique, Methodology and Application in Statistics.
- Knowledge in collection, presentation and tabulation of data.
- Apply their knowledge gathered in the subject to life sciences.
- Translate real world problems into Probability models.
- Design hypothesis tests for a given set of data and select the appropriate thresholds for the test.

- Use linear regression analysis to develop an empirical model of experimental data.

UNIT I - Statistics and Probability: Moments, Skewnesss, Kurtosis - Axioms of probability–Conditional probability –Baye's theorem and related problems.
UNIT II - Random Variables: Probability mass function – probability density function – properties – Joint Distribution – marginal and conditional distributions - Independent random variables
UNIT III - Theoretical distributions: Binomial, Poisson, Normal Distributions-Exponential Distribution - properties – problems.
UNIT IV - Testing of Hypothesis: Tests of Significance-large sample tests- difference of means- difference of proportion–small sample test– t test– F test - Chi square test.
UNIT V - Design of Experiments: Analysis of variance–one factor classification- two factors classification - completely randomized design– randomized block design– Latin square design.

Text Book:
1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2008.

Reference Books:
1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2008.
2. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.
3. Veerarajan, T., Probability, Statistics and Random Processes, TataMcGrawHill, 2nd Edition, 2009.
4. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition) , Khanna Publishers New Delhi, 2012.

17MA2021 APPLIED MATHEMATICS

Credits: 3:1:0

Course Objectives:
- To provide the students about the knowledge of three dimensional geometry.
- To orient the students to know the techniques in differential calculus, partial derivatives and multiple integrals.
- To teach the students about the applications of matrices.

Course Outcomes:
The students will be able to
- Relate the properties of sphere, cone and cylinder with their subjects during the course of study.
- Apply the knowledge of orthogonal transformation in solving equations.
- Find curvature, evolutes and envelopes of different curves.
- Calculate the area and volume of the regions using double and triple integrals.
- Recognize the partial derivative techniques.
- Apply the ideas of partial derivatives and find maxima and minima of a function.

UNIT I - Analytical Geometr: Sphere, Plane section of a sphere, Tangent plane, Cone, Right circular cone, Cylinder, Right circular cylinder.
UNIT II - Matrices: Types and operations of matrices, Rank and inverse matrix, Eigen values and Eigen vectors, Properties, Cayley-Hamilton Theorem, Orthogonal transformation, Diagonal form, Quadratic form, Canonical form.
UNIT III - Differential Calculus: Curvature**,** Centre and radius ofcurvature, Circle of curvature, Evolutes, Envelopes, Evolutes as envelope of normal.
UNIT IV - Partial derivatives: Introduction, Euler's theorem, Total derivatives, Jacobians, Taylor's expansion, Maxima and minima.
UNIT V - Integral calculus: Double integrals: Change the order of integration, Area as double integral, Triple integrals Volume as triple integral.

Text Book:
1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing House, New Delhi, 2007.

Reference Books:

1. Glyn James, " Advanced Engineering Mathematics", 7th Edition, Pearson Education, 2007.
2. Jain R.K and Iyenger S.R.K, " Advanced Engineering Mathematics" 3rd Edition, Narosa Publishing House, 2007.
3. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition), Khanna Publisher, New Delhi, 2012.
4. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
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17MA2022 QUANTITATIVE TECHNIQUES

Credit 3:1:0

Course Objectives:

- To enable the students to acquire knowledge of matrice,s set theory, financial analysis and statistical parameters
- To know the different methods of time series analysis.
- To understand the concepts of time series analysis.

Course Outcomes:

The students will be able to

- Apply matrix techniques to the Business models.
- Recognize different types of sets and operations of sets.
- Calculate the simple and compound interests.
- Apply measures of central tendency and variations in data analysis.
- Apply different methods in time series analysis.
- Recognize the use of index numbers.

UNIT I - Matrices: Introduction, Types of matrices, Operations of matrices, Determinants, Rank of a square matrix, Solving Simultaneous linear equations using Inverse method.
UNIT II - Set theory: Introduction, types of sets, Operations of sets, Venn Diagrams, Relations and functions. Problems on Finance: Mathematics of Finance, Simple and Compound Interests.
UNIT III - Statistics: Meaning, Scope, Limitations of Statistics, Data Collection, Presentation of data by Diagrammatic and Graphical Methods, Formation of Frequency Distribution.
UNIT IV - Data Analysis: Measures of Central tendency: Mean Median and Mode, Measures of deviations: standard deviation, Measures of Variation, coefficient of variation.
UNIT V - Time Series: Methods of Measuring Trend: Graphical method, average method, least square principle and Index numbers.

Text Book:

1. J.K Thukral, "Business Mathematics for BBA", Scholar Tech Press, 2015.

Reference Books:

1. J.K.Singh, "Business Mathematics", Himalaya Publishing House Pvt Ltd, 2013.
2. Sundaresan and Jayaseelan, "An Introduction to Business Mathematics and Statistical Methods", Sultan Chand and Sons , 2010.
3. S.P.Gupta , "Statistical Methods", Sultan Chand and Sons, 2012.
4. Grewal B.S, "Higher Engineering Mathematics", (42nd Edition), Khanna Publisher, New Delhi, 2012.

17MA2023 BASICS OF OPERATIONS RESEARCH

Credit 3:1:0

Course Objective:

- To acquire knowledge of the linear programming problems.
- To formulate and solve transportation and Assignment problems.
- To acquire knowledge of Games and Queuing models.

Course Outcomes:

The students will be able to

- Formulate linear programming problems.

- Apply graphical and simplex method in solving LPP.
- Recognize different procedures for finding initial and optimal solutions of transportation problems.
- Apply Hungarian method to solve assignment problems.
- Solve game theory using graphic methods.
- Recognize the queuing models.

UNIT I - Linear programming: Mathematical formulation, Graphical solution, Simplex method, Duality in linear programming, Applications in management decision making.
UNIT II - Transportation problem: Introduction, Initial solution, North west corner method, Least cost method, Vogel's approximation method, Optimal solution, MODI method, Degeneracy in transportation problem.
UNIT III - Assignment problem: Introduction, Hungarian method, unbalanced assignment problems, travelling salesman problem.
UNIT IV - Game theory: Two person zero-sum games, Maximum- minimum principle, Games without saddle points, Mixed strategies, Graphic method.
UNIT V - Queuing theory: Introduction, characteristics of a queuing system, service system, behavior of queue members, Notation of Queuing model, (M/M/1):(∞/FIFO) model.

Text Book:

1. Bhaskar S, "Operations Research", Anurradha Publications, 2013.

Reference Books:

1. Kapoor V.K, "Operations Research", Sultan Chand & sons, New Delhi, 2013.
2. Vittal P.R, "Operations Research", Margham Publications, 2012.
3. Kanti Swarup, Gupta and Manmohan, "Operations Research", Sultan Chand, New Delhi , 2011.
4. Gupta P.K and. Hira D.S, "Operations Research", Sultan Chand, New Delhi, 2008.

17MA2024BUSINESS MATHEMATICS

Credits 3:1:0

Course Objectives:
- To know different types of progressions, financial methods and matrix methods
- To learn the concepts of differential and integral calculus.
- To acquire the knowledge of LPP and finding solutions.

Course Outcomes:
The students will be able to
- Apply progression techniques in business models.
- Recognize different methods of solving finance problems.
- Solve the modern business problems using set theory and matrices.
- Develop business problems using calculus and solving using differential and integral calculus.
- Formulate the business problems in terms of LPP.
- Solve LPP using graphical method.

UNIT I - Progressions: Numerical sequences, Arithmetic progression, Geometric progression, Summations and applications of progressions in solving finance problems.
UNIT II - Finance: Simple and Compound Interests, Effective rate of Interest, Sinking Fund, Annuity, Present Value, Discounting of Bills, True Discount, Banker's Gain**.**
UNIT III - Set Theory: Introduction, types of sets, Operations of sets, Relations, Functions, Constants and Variables. Matrices: Introduction, Types of matrices, Operations of matrices, Inverse of a Matrix, Rank of Matrix.
UNIT IV - Calculus: Differentiation and integration of Algebraic Functions, e^x and logx, second Order Derivatives, Maxima and Minima, Integration by Parts.
UNIT V - Linear Programming Problem: Introduction, Mathematical formulation of an LPP, Graphical method: Types of solutions, solving an LPP by Graphical Method.

Text Book:

1. Navanitham P.A, "Business Mathematics & Statistics", Jai Publishers, Trichy, 2013.

Reference Books:

1. Sundaresan and Jayaseelan, "Introduction to Business Mathematics", Sultan Chand & Co Ltd, New Delhi, 2010.
2. Sanchetti D.C and Kapoor V.K, "Business Mathematics", Sultan Chand & Co Ltd, New Delhi, 2014.
3. Ranganath G.K, Sampamgiram C.S and Rajan Y, "A Text book of Business Mathematics", Himalaya Publishing House,2014.
4. Jayaprakash Reddy R, "Business Mathematics", APH Publishing Corporation, 2012.

17MA3001 MATRIX COMPUTATIONS

Credits: 3:0:0

Course Objective:

- To equip the students with the concept of Cholesky matrix decomposition, linear equations and their applications
- To develop the skills with the the LU decomposition and QR decomposition methods.
- To understand the various methods of Gram-Schmidt model, matrix decomposition algorithms.

Course outcome:

The students will be able to

- Apply linear equations in their core subjects.
- Update the knowledge with the advanced matrix theory.
- Develop the skills in solving higher order matrices.
- Understand the mathematical principles involved in real life problems.
- Apply the concept in modeling and analysis.
- Demonstrate the mathematical model with experimental data.

UNIT I - Cholesky Decomposition: Linear Equations-Simple Electrical circuit problem-partitioning matrices-Systems of linear equations-Triangular systems- Positive Definite Systems- Cholesky Decomposition- Cholesky Decomposition Theorem- Cholesky algorithm.
UNIT II - LU Decomposition: Gaussian Elimination Method- LU Decomposition Theorem- LDV Decomposition Theorem- Gaussian Elimination with pivoting.
UNIT III - QR Decomposition: The discrete least squares problem-orthogonal matrices-Rotators-Reflectors-QR decomposition-Solving least squares problems by using QR decomposition-Complex rotators-complex reflectors.
UNIT IV - The Gram-Schmidt Method: Orthonormal vectors- Classical Gram Schmidt Algorithm- Modified Gram Schmidt Algorithm- The discrete least squares problems- The continuous least squares problems. Singular Value
UNIT V - Decomposition (SVD): SVD Theorems- Computing the SVD- SVD and the least squares problems-The pseudo inverse.

Reference Books:

1. David S.Watkins, "Fundamentals of Matrix Computations", John Wiley & Sons, Singapore. 2004.
2. Richard Bronson, "Matrix Operations", (2nd Edition), Schaum's Outline Series, McGraw Hill, New Delhi 2011.
3. David W. Lewis., "Matrix Theory", (1st Edition), Allied Publishers Pvt., Ltd., 1995.
4. Jimmie Gilbert, Linda Gilbert, "Linear Algebra and Matrix Theory", (1st Edition), Academic Press, 2005.
5. L. N. Trefethen and D. Bau, Numerical Linear Algebra, SIAM, 1997.
6. G. H. Golub and C. F. Van Loan, Matrix Computations, 3rd Ed., John Hopkins University Press, 1996.
7. J. W. Demmel, Applied Numerical Linear Algebra, SIAM, 1997.

17MA3002 FINITE ELEMENT METHODS

Credits: 3:0:0

Course Objective:

- To acquire knowledge about Mathematical Modeling and Finite Element Methods.
- To apply the Finite Element Methods in solving discrete systems, Eigen value problems.
- To formulate governing equations and solve using finite element methods.

Course Outcome:
The students will be able to

- Define mathematical modeling and finite element methods
- Demonstrate the steps of finite element methods in finding solution of Dynamic, Heat transfer, solid mechanic, discrete systems, fluid mechanics and eigen value problems.
- Analyze and construct mathematical modeling using Euler equation and Hamilton's principle.
- Use boundary conditions to solve problems constructed by finite element method.
- Apply calculus of variation, boundary conditions in finite element problems
- Apply numerical integration in evaluating finite element problems.

UNIT I - Introduction to FEM: Mathematical Models-Dynamic, heat transfer and solid mechanic problems, Introduction to Finite Element Method -The basic idea and features – Advantages and applications.
UNIT II - Calculus of variation: Fundamentals of calculus of variation- variational operation and First iteration -Fundamental lemma of variational calculus -Euler Equation-Natural and Essential Boundary Conditions-Hamilton's Principle.
UNIT III - Discrete Systems: Linear Elastic Spring-Torsion of Circular Shafts-Heat Transfer: Governing equations and Finite element Models.**Fluid Mechanics**: Governing Equations and Finite Element models-Analysis of Beams element.
UNIT IV - Eigen value problems: Formulation: Parabolic equation, hyperbolic equation - Finite Element Formulation - Heat transfer and Bar-like problem-Natural Vibration of Beams: Euler-Bernoulli beam theory-Stability of Beam.
UNIT V - Numerical Integration: Introduction - Coordinate Transformations- Integration over a Master Rectangular Element: Gauss points for linear, quadratic and cubic quadrilateral elements – Integration over a Master triangular element: Quadrature points and weights for triangular elements.

Reference Books:

1. 1.J.N. Reddy, "An introduction to the finite element method", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. O.C.Zienkiewicz. "The Finite Element method",.Tata Mc Graw Hill.1989.
3. C. S. Desai and John F.Abel., Introduction to Finite Elements Method, Litton Educational Publishing Inc.,2004
4. Erik G. Thompson. Introduction to Finite Element Method, John Wiley & Sons, 2000.
5. T. R. Chandrupatla and A. D. Belegundu, "Introduction to Finite Elements in Engineering", 2ndEdition, Prentice Hall, New Jersey, 1997.
6. Daryl L. Logan, "A First Course in the Finite Element Method", 2nd Edition, PWS Publishing Company, Boston, 1993.
7. K. C. Rockey, H. R. Evan, D. W. Griffiths, and D. A. Nethercot, "The Finite Element Method: A Basic Introduction", 2ndEdition, William Collins Sons & Co. Ltd., 1983.

17MA3003 FOUNDATIONS OF MATHEMATICS AND STATISTICS

Credits: 3:0:0

Course Objective:

- To equip the students with the concept of different kind of functions and Differential calculus
- To develop the students skills of the area of probability, statistics and Testing of Hypothesis.
- To understand the various application design of experiments.

Course Outcome:
The students will be able to

- Understand the basic concepts of binomial theorem.
- Classify the linear and quadratic equations.
- Apply the concept of integration in their engineering subjects**.**
- Apply the concept of probability in real life.
- Understand the properties of various distributions.
- Test the hypothesis of large sample problems

UNIT I - Algebra: Linear and quadratic equations- Binomial Theorem- Summation of series – coefficient of x^n - exponential function-logarithmic function.
UNIT II - Differential Calculus: Limits and Continuity- Differentiation–Product and Quotient Rule –Maxima and Minima of f(x).
UNIT III - Integral Calculus: Integration of standard functions – Methods of Integration – Integration by parts – Definite Integrals - Bernoulli's formula.
UNIT IV - Probability and distributions: Probability – Axiomatic definition of probability – Independent events –Binomial, Poisson Distributions — Normal Distribution – Properties of Normal Distribution —Importance of Normal Distribution —Normal probability curve – fitting Binomial, Poisson Distributions – problems (proofs and derivations not included).
UNIT V - Testing of hypothesis: One tailed and two tailed tests - Tests based on large samples –proportion and mean – Small samples – t, F, chi square distributions.

Reference Books:

1. Gupta S.P., "Statistical Methods", New Delhi, S.Chand & Co., 37th Edition 2009.
2. Veerarajan T, "Probability, Statistics and Random Processes", Second Edition, Tata McGraw Hill publishing company, 2003.
3. Kandasamy P., Thilagavathi K and Gunavathy K., "Numerical Methods", S.Chand & Co., 2009.
4. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Co., 2007.
5. Kapoor J.N. & Saxena H.C. "Mathematical Statistics", S.Chand & Company, 2006.
6. Kandasamy P., Thilagavathi K and Gunavathy K., "Engineering Mathematics", Volume I, S.Chand & Co., 2001.
7. Manickavasagam Pillai, "Algebra" , Volume I & II, S. Viswanathan publishers, 2002.

17MA3004 ADVANCED CALCULUS AND NUMERICAL METHODS

Credit 3:0:0

Course Objectives

- Generating plan for the students in the field of advanced calculus, application of Partial Differential Equations.
- To familiarize the students in the field of Calculus of Variations.
- Discriminate the application of Gaussian Quadrature in engineering Fields.

Course Outcomes

The students will be able to

- Relate their subject knowledge with their core subjects during their course of study.
- Revise the skills in solving heat and wave equations
- Recall Gaussian quadrature formula and its derivations in the engineering fields.
- Identify the skills in applying the Numerical Integrations.
- Apply higher order derivatives and several independent variables.
- Reconstruct the skills in application of Boundary Valued Problems.

UNIT I - One dimensional wave and heat equation: String, rods. Two-dimensional heat equation-finite, infinite, semi-circular and circular plates, simple problems in one dimensional wave equations.
UNIT II - Two-dimensional wave equations: Vibrating membrane, rectangular membrane, circular membrane, finding the steady state solutions ,Transmission line , simple problems.
UNIT III - Calculus of variation: Euler's equation, Isoperimetric problems,Functional dependant on its first and higher order derivatives and several independent variables, moving boundaries,
UNIT IV - Boundary value problems: Power, Jacobi methods, Given's method, Raleigh-Ritz, collocation, Galerkin methods, simple problems using boundary conditions.
UNIT V - Numerical integration: Simpson's rules, Romberg's method, Gaussian quadrature, Natural cubic spline functions formula, simple problems in numerical integrations.

Reference Books:

1. P.Kandasamy, K.Thilagavathy and K, Gunavathy, "Numerical methods", S.Chand & Company Ltd, Revised Edition, 2010.

2. Naveenkumar, “An Elementary course on Variational problems in calculus”, Narosa Publishing House, 2003.
3. B.S.Grewal, “Higher Engineering Mathematics” 42th Edition Khanna publisher, Delhi, 2012.
4. M.K.Venkataraman, “Higher Mathematics for engineering and Science”, National Publishing Company, 2002.
5. Curtis F-Gerald, “Applied Numerical Analysis”, 5th Edition, Adison Wesley Publishing Company, 2001.
6. E.Balagurusamy, “Computer Oriented Statistical and Numerical Methods”, MacMillan series, Madurai, 1988.
7. M.K.Jain, S.R.K.Iyengar and R.K.Jain, “Numerical methods for scientific and Engineering Computation”, 6th Edition, New Age International, 2005.

17MA3005 CALCULUS OF VARIATIONS AND VECTOR SPACES

Credits: 3:0:0

Course Objectives

To discover the knowledge of the students with the understanding of basic concepts of set theory.

- Relating the Z-transform to its applications.
- Explaining the students with skills in variational problems.
- Reconstructing the concepts of functions and vector spaces.

Course Outcomes:

The students will be able to

- Relate their subject knowledge with their engineering subjects during the course of study
- Identify the application of integral equations in their engineering fields.
- Choose the orthogonalization techniques for solving problems
- Interpret the results in the vector spaces and Inner Product Spaces.
- Justify the Z-Transforms and their applications in the engineering fields.
- Discover the interactive methods of solving equations of second kind.

UNIT I - Calculus of variations: Variational problems of fixed boundaries only simplest Variational problems – Euler equation - Brachisto Chrone problem – Variational problems involving several unknown functions .

UNIT II - Functional involving higher order derivatives: Functional involvingfirst and second order derivations –Functional involving two or more independent variables – Isoperimetric problems.

UNIT III - Linear integral equations: Fredholm and Volterra integral equations – Relation between differential and integral equations-Green’s function.Fredholm equation with separable kernal – Interactive method of solving equation of second kind –Properties of symmetric kernels.

UNIT IV - Vector spaces: Sets – Relations – Functions – Vector Spaces - Definition and examples of linear space – Linear dependence and independence –Basis and Dimension– definitions-simple problems .Inner product spaces-Orthogonalisation process.

UNIT V - Z–Transforms: Introduction, definition, linear property, damping rule, some standard results,Z-Transforms of standard functions, convolution theorem, convergence of Z-transforms, Inverse Z-Transform - Applications

Reference Books:

1. Grewal B S, “Higher Engineering Mathematics”42th Edition Khanna publishers, New Delhi, 2012.
2. Venkataraman M.K., “Higher Mathematics for engineering and Science”, National Publishing Company, 2002.
3. Hoffmann and Kunze, “Linear Algebra” second edition, Prentice Hall India Limited, 2002.
4. Tremblay J.P. and Manohar R., “Discrete Mathematical Structures with Applications to Computer Science”, McGraw Hill, 1997.
5. John Proakis G., “Digital Signal Processing”, Prentice Hall of India (P) Ltd., 1995.
6. Kenneth Rosen H., “Discrete mathematics and its Applications”, Tata McGraw –Hill Edition, 2005.
7. Kumaresan. S, “Linear Algebra”, Prentice-Hall of India Private Limited, 2000

17MA3006 GRAPH THEORY AND RANDOM PROCESS

Credits: 3:0:0

Course Objective:

- To provide the students with the main concepts of graph theory, graph representations and the basic classes of graphs.
- To introduce the fundamentals of probability theory and random processes and illustrate these concepts with engineering applications.
- To develop analytical capability and to impart knowledge in and Queuing theory and their applications in Engineering and Technology

Course Outcome:

The students will be able to

- Apply the abstract concepts of graph theory in modeling and solving non-trivial problems in different fields of study.
- Understand the description and behavior of random processes.
- Characterize probability models and function of random variables based on single & multiples random variables.
- Define, illustrate and apply the concepts of discrete and continuous random variables.
- Describe a random process in terms of its mean and correlation functions.
- Understand the concept of Queuing models and apply appropriate queuing modeling their subjects

UNIT I - Graph Theory: Graphs, Euler graph, Hamiltonian graph, Transportation network, coloring,
UNIT II - Trees: Trees - Minimal Spanning Trees – Prims Algorithm – Kruskal's Algorithm – Prim's Algorithm using Matrices
UNIT III - Random processes: Special classes, Stationary, Analytical representations, Weiner Process function, Auto correlation, cross Correlation, Properties,
UNIT IV - Ergodicity: Ergodicity, Mean Ergodic theorem, Correlation Ergodic process, Power spectral density and its properties.
UNIT V - Introduction of Queuing theory: Queuing model involving M/M/I: ∞/FIFO, M/M/C: ∞/FCFS, M/M/I: N/FCFS, M/M/C: N/FCFS (Derivations are not included – simple problems to be asked).

Reference Books:

1. Bernard Kolman, Robert C.busby, Sharo Cutler Ross, Discrete Mathematical Structures, Prentice Hall of India, 2004, 5th edition.
2. T.Veerarajan, Probability, Statistics and Random processes, Tata McGraw Hill Publishing company lt, 2006, 2nd edition.
3. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.
4. Alan Doerr, Kenneth Levasseur, Applied Discrete Structures For Computer Science, Galgotia Publishers Pvt.Ltd, 1st Edition, 1998.
5. Kenneth H. Rosen,Discrete Mathematics and Its Applications, Mcgraw Hill, 3rd Edition, 2005.
6. Murugesan K,Probability Theory and Random Processes, Anuradha Agencies, 1st Edition, 1998.
7. Henry Stark, John W. Woods, Probability and Random Processes with Applications to Signal Processing, Pearson Education Asia, 3rd Edition, 2012.

17MA3007 APPLIED STATISTICS

Credits: 3:0:0

Course Objective:

- To develop skills of the students in the area of probability, statistics and the multiple linear regression model
- To use estimated time series models to predict unknown observations ahead in time
- To recognize the difference between a population and a sample, and between a parameter and a statistic; identify the experimental unit in a sample.

Course Outcome:

The students will be able to

- Understand the technique, methodology and Application of statistics.
- Understand the basic concept of Time series.
- Apply regression analysis to their engineering problems
- Explain the essential components of experimental design.
- Design an experiment and conduct analysis of variance on experimental data, interpret the results and present them meaningfully.
- Analyze data by appropriately fitting, assessing, and interpreting a variety of statistical models

UNIT I - Statistics: Probability, Binomial, Poisson and Normal Distributions, Concepts of reliability, Serial and parallel systems .

UNIT II - Empirical Laws and Curve Fitting: Method of least squares, fitting a straight line, fitting exponential and power curve.

UNIT III - Time Series: Components of Time Series, Measurement of Trend, Method of Semi averages, Method of Moving Average, Method of Simple Averages, Ratio to Moving Average Method.

UNIT IV - Statistical Analysis: Multiple Regression of X_1 on X_2 and $X_{3,}$ Tests based on large samples, Small samples. The Mann Whitney U test.

UNIT V - Design of Experiments: Randomized block design, Latin square design, comparison of RBD and LSD.

Reference Books:

1. Gupta S.P., "Statistical Methods", New Delhi, S.Chand & Co., 37th Edition 2009.
2. Veerarajan T, "Probability, Statistics and Random Processes", Second Edition, Tata McGraw Hill publishing company, 2003.
3. Kandasamy P., Thilagavathi K and Gunavathy K., "Numerical Methods", S.Chand & Co., 2009
4. Richard A. Johnson, "Probability and Statistics For Engineers", Prentice Hall of India, 2005.
5. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Co., 2007.
6. Kapoor J.N. & Saxena H.C. "Mathematical Statistics", S.Chand & Company, 2006.
7. David P.Doane, Lori E.Seward, "Applied Statistics in Business and Economics", Tata McGraw Hill Publishing Company, 2007.

17MA3008 COMPUTATIONAL MATHEMATICS

Credits: 3:0:0

Course objective:

- To equip the students with the concept of Partial Differential Equations.
- To develop the skills with Eigen value and Boundary value problems.
- To equip the students with the knowledge in Numerical Methods for analysis and modeling.

Course outcome:

The students will be able to

- Understand the application of variations in engineering.
- Update the knowledge with Partial Differential Equations and its applications.
- Develop the skills in solving heat and wave equations.
- Understand the mathematical principles involved in real life problems.
- Apply the concept in modeling and analysis.
- Demonstrate the mathematical model with experimental data.

UNIT I - Calculus of variations: Euler's equation, Functional dependant on its first and second order derivatives.

UNIT II - Classification of partial differential equation of second order

Solution of Laplace equation by Liebmann method, Solution of Poisson equation by Liebmann method, differential Equation by Bender Schmidt method, Crank Nicholson method.

UNIT III - Initial value problems: Picard's method – Euler, Improved Euler and modified Euler methods.

UNIT IV - Eigen value problems: Power & Inverse power methods – Jacobi methods.

UNIT V - Boundary value problems: Raleigh-Ritz, collocation methods, Horner's, Muller's and Chebyshev's method, Graffe's root square method ,Gauss elimination, Gauss-Jordan, Relaxation methods, Newton Raphson methods, Newton-Cotes quadrature formula – Simpson's $1/3^{rd}$ and $3/8^{th}$ rules – Weddle's rule (Single & Double integral) – Gaussian quadrature formula, Natural cubic spline functions.

Reference Books:

1. Naveenkumar, "An Elementary course on Variational problems in calculus", Narosa Publishing House, 2003.
2. Veerarajan T., Ramachandran T., "Numerical Methods", Tata McGraw Hill, 2003.
3. Curtis F-Gerald, "Applied Numerical Analysis", 5th Edition, Addison Wesley Publishing Company, 2001.
4. Venkataraman M.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.
5. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Third edition, Brooks/Cole Publishing Company, California, 1994.
6. Grewal B S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
7. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical methods for scientific and Engineering Computation", 6th Edition, New Age International, 2005.

17MA3009 APPLIED GRAPH THEORY AND QUEUING THEORY

Credits: 3:0:0

Course Objective:

- To equip the students with the logics of different matrix representations of graphs and applications in software technology
- To learn about the soft computing techniques from random processes and different kind of correlations
- To understand the various idea of queuing theory models.

Course Outcome:

The students will be able to

- Apply shortest path algorithm in practical problems.
- Update the knowledge with properties of numbers.
- Develop the skills in solving state machine.
- Understand the different correlation involved in real life problems.
- Apply the concept of Gaussian process and its properties.
- Apply Queuing theoryconcepts in practical problems.

UNIT I - Graph theory: Basic Terminology, Some special simple graphs, Representations of graphs, Connectivity, Shortest path algorithm and Trees.

UNIT II - Number theory: Divisibility, primes, fundamental theorem of arithmetic, Division Algorithm, G.C.D & LCM.

UNIT III - Automata theory: Languages& Grammars, Phrase Structure Grammars & Types, Derivation trees, backus-Naur Form, Finite-state machines with outputs & types, Finite-state machines with no outputs, Regular sets, Kleene's theorem, Regular grammars.

UNIT IV - Random process: Classification of random processes, Special Classes, Average values of Random processes, Stationary, Autocorrelation Function, Cross-correlation Function & their properties, Ergodicity, Mean Ergodic Theroem – Gaussian Process & its properties.

UNIT V - Queuing theory: Characteristics of Queuing systems, Representation a queuing Model, Properties of the models (M/M/1): (∞/FIFO) and (M/M/k): (∞/FIFO) – simple problems

Reference Books:

1. Kenneth Rosen H., "Discrete mathematics and its Applications", Tata McGraw –Hill Edition, 2012.
2. Veerarajan T., "Probability, Statistics and Random Processes", Second edition, Tata McGraw-Hill, Sixth reprint 2009.
3. Bernard Kolman, Robert Busby C., Sharon Cutler Ross, "Discrete Mathematical Structures", Fifth Edition, Pearson Education, 2004.
4. Richard Williams H., "Probability, Statistics and Random Process for Engineers", CENGAGE Learning, 2009.

5. Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science", Prentice-Hall of India Private Ltd. 2004.
6. Handy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.
7. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.

17MA3010 GRAPH THEORY AND ALGORITHMS

Credits: 3:0:0

Course Objective:

- To provide the student with the understanding of basic concepts in Graph theory.
- To expose to the concepts of modeling and optimization.
- To set up optimization models from problem description and solving linear programming problems using the simplex method.

Course Outcome:

The students will be able to

- Relate their subject knowledge with their engineering subjects during the course of study.
- Apply the abstract concepts of graph theory in modeling and solving non-trivial problems in different fields of study.
- Understand Graph network problems.
- Develop a fundamental understanding of linear programming models
- Apply optimization techniques in their engineering subjects.
- Develop a linear programming model from problem description and apply the simplex method for solving linear programming problems.

UNIT I - Basics of graph theory: Graphs – Data structures for graphs – Sub graphs – Operations on Graphs Connectivity –Networks and the maximum flow – Minimum cut theorem –

UNIT II - Trees: Trees – Spanning trees – Rooted trees – Matrix representation of graphs.Eulerian graphs and Hamiltonian graphs – Standard theorems – Planar graphs – Euler's formula –

UNIT III - Coloring of Graphs: Five color theorem – Coloring of graphs – Chromatic number (vertex and edge) properties and examples – Directed graphs. Graph algorithm**:** Computer Representation of graphs –

Unit IV Basic graph algorithms: Minimal spanning tree algorithm – Kruskal and Prim's algorithm - Shortest path algorithms – Dijsktra's algorithm.

UNIT V - Linear Programming: Graphical methods – Simplex method (Artificial variables not included).

Reference Books:

1. Gupta S.C., Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2002.
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India (p) Ltd. 2004.
3. Kenneth Rosen H., "Discrete mathematics and its Applications", Tata McGraw –Hill Edition, 2012.
4. Kanti Swarup, Man Mohan, Gupta P.K., "Operations Research", Sultan Chand &Sons, 2000.
5. Walpole Myers, Myers, Ye, "Probability & Statistics for Engineers and Scientists".Pearson Education, first Indian reprint, 2002.
6. Gupta S.C., Kapoor V.K., "Fundamentals of Applied Statistics", Sultan Chand & Sons, 2002.
7. Veerarjan T., "Theory of Probability and Random Process", Tata McGraw Hill Publishing Company Science, PHI, 2005.

17MA3011 BIOSTATISTICS AND QUALITY CONTROL

Credits: 3:0:0

Course Objective:

- To explore the use of statistical methodology in designing, analyzing, interpreting, and presenting biological experiments and observations.
- To learn Testing of Hypothesis for analysis, design of experiments and available statistical tools of quality monitoring.

- To equip the students with the knowledge in quality control.

Course Outcome:

The students will be able to

- Relate their subject knowledge with their engineering subjects during the course of study.
- Apply sampling techniques to biological data.
- Design and conduct experiments, as well as to analyze and interpret data.
- Apply various techniques on examples/data in industries and modern engineering tools necessary for engineering practice using design of experiment.
- Understand and interpret results from Analysis of Variance (ANOVA), a technique used to compare means amongst more than two independent populations.
- Apply the techniques in SQC to biological data.

UNIT I – Statistics: Measures of central tendency, Dispersion, Binomial, Poisson, Normal distributions.
UNIT II – Distributions: Population, sample, one tailed and two tailed tests, Tests based on large samples, proportion and mean. Tests based on t, F, chi square distributions.
UNIT III - Design of experiments: Completely randomized design, and Randomized block design, Latin square design –comparison of RBD and LSD.
UNIT IV - Quality Control: Types of variation, types of control charts X chart, R Chart, C Chart, Advantages and Limitations of SQC
UNIT V - Acceptance sampling: Single acceptance sampling plan, double sampling plan, construction of a OC curve, AQL and LTPD.

Reference Books:

1. S.P. Gupta, Statistical Methods, Sultan Chand and sons., New Delhi, 2009.
2. T.Veerarajan, Probability, Statistics and Random Processes, TataMcGraw Hill, second edition, 2009.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S.Chand & Company Ltd, 2007.
4. Kandasamy P., Thilagavathi K and Gunavathi K., “Engineering Mathematics” Volume II (First revised and enlarged edition), S. Chand & Co., New Delhi, 2000.
5. Gupta S.C., Kapoor V.K., “Fundamentals of Applied Statistics”, Sultan Chand & Sons, 2002.
6. Veerarjan T., “Theory of Probability and Random Process”, Tata McGraw Hill, 2005.
7. Walpole Myers, Myers, Ye, “Probability & Statistics for Engineers and Scientists” Pearson Education, first Indian reprint, 2002

17MA3012 NUMERICAL METHODS AND BIOSTATISTICS

Credits: 3:0:0

Objective:

- To provide the students with the knowledge in numerical problems, Eigen values and Eigen vectors
- To enable the students to solve various engineering problems using numerical methods.
- To introduce the concept of probability distributions, specific discrete and continuous distributions with practical application in various Engineering and social life situations.

Outcome:

The students will be able to

- Acquaint with the basic concepts in numerical methods and their uses.
- Understand and apply basic techniques in descriptive statistics.
- Analyze and interpret data.
- Apply statistics in biological field.
- Analyze data pertaining to attributes and to interpret results.
- Solve different kinds of problems that occur in engineering.

UNIT – I: Numerical Methods: Bisection method, Newton-Raphson method, Gauss-Seidel iteration method, Gauss-Jordan method - Eigenvalues and Eigenvectors.
UNIT II - Interpolation: Linear Interpolation, polynomial interpolation, Difference tables, Gregory-Newton interpolation.

UNIT – III: Solution of differential equations: Trapezoidal rule, Simpson's rule, Newton's Three-eights rule. Euler's Method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoring and Stability of solution.
UNIT – IV: Statistics: Sampling, frequency distribution, measure of central tendency- Mean median and mode, measure of dispersion, Probability Distribution, binomial, Poisson.
UNIT – V: Curve fitting and correlation: Linear least square fit, nonlinear fit, polynomial fit, coefficient of correlation, multiple correlation, partial correlation, rank correlation.

Reference Books:

1. Balagurusamy E., "Computer Oriented Statistical and Numerical Methods", MacMillan series, Madurai, 2000.(Theory and problems only).
2. Rajaraman V., "Computer oriented numerical methods", Prentice-Hall publications, 2007.
3. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical methods for scientific and Engineering Computation", 6th Edition, New Age International, 2012.
4. Thangaraj . P, "Computer Oriented Numerical Methods", Prentice hall of India Pvt. Ltd, New Delhi, 2008.
5. Grewal B.S, "Higher Engineering Mathematics", 42th Edition, Khanna publishers, New Delhi 2012.
6. Kandasamy P., "Numerical Methods", S.Chand and Co, Reprint 2010.
7. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley Publications, 2008.

17MA3013 GRAPH THEORY AND PROBABILITY

Credits: 3:0:0

Objective:
- Understand Graphs and their properties in depth.
- Learn axioms of probability and distribution functions.
- Learn the nuances of fitting the distributions appropriately to get the best estimate.

Outcome:
The students will be able to
- Convert real life problems into appropriate graphs to find suitable solutions.
- Identify the graph structures applied in the existing fields and improve the efficiency of their application.
- Create new algorithms or improve the existing ones to get better efficiency.
- Apply probability concepts in day to day activities since most of the things are probabilistic.
- Apply the right distribution to the problems and give best solutions.
- Use Sampling Distributions for modeling their projects for getting best fit of the statistical averages.

UNIT I - Graph Theory: Graph terminology – Representing Graphs and Graph Isomorphism-connectivity- Euler and Hamiltonian paths.
UNIT II - Graph Coloring and Tree: Planar graphs – Graph Coloring– Chromatic number **–**Introduction to Trees – application of Trees- Tree traversal.
UNIT III - Spanning Tree: Spanning trees – Rooted trees -Shortest path algorithm Minimal spanning tree-– Kruskal and Prim's algorithms – DFS and BFS algorithms.
UNIT IV - Probability: Addition Law – Multiplication law – Conditional Probability. Distributions: Binomial, Poisson and Normal distributions.
UNIT V - Sampling distributions: Tests based on large samples, Student's t, F and chi-square test for Goodness of fit, Independence of attributes.

Reference Books:

1. Gupta S.C and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 2008.
2. Kenneth Rosen H, "Discrete mathematics and its Applications", Tata McGraw –Hill Edition, Seventh Edition, Reprint 2012.
3. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India, 2011.
4. Bondy A and Moorthy U, "Graph Theory and Applications", McMillan, London, Reprint 2013
5. Grewal B S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.

6. T.Veerarajan, Probability, Statistics and Random Processes, TataMcGraw Hill, second edition, 2009.
7. Kreyszig E., “Advanced Engineering Mathematics”, (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.

17MA3014 FUNDAMENTALS OF STATISTICS

Credits: 3:0:0

Course Objective:

- To develop the skills of the students in the area of Probability, Statistics and Conditional Probability.
- To provide the students the concepts in Probability Distributions and Testing of Hypothesis.
- To understand the basic concepts in ANOVA

Course Outcome:

The students will be able to

- Make logical conclusions using statistical concepts
- Gain knowledge in Probability.
- Gain knowledge in Probability Distributions
- Analyze samples for Testing of Hypothesis
- Use ANOVA to their engineering problem
- Understand the application of Baye’s theorem in engineering fields

UNIT I - Basic statistics: Measures of central tendency, Measures of Dispersion -Correlation and regression.
UNIT II - Probability and Random Variables: Axioms of probability– Independent events - Bayes’ Theorem– Discrete and Continuous random variable.
UNIT III - Probability Distributions: Theoretical Distributions - Binomial, Poisson and Normal distributions.
UNIT IV - Testing of hypothesis: Tests based on large samples –proportion and mean – Small samples – t, F, chi square distributions.
UNIT V - Design of experiments: Analysis of Variance– One factor classification – completely randomized design- - two way classification – Randomized block design - Latin square design – analysis of design for three factor of classification.

Reference Books:

1. S.P. Gupta, Statistical Methods, Sultan Chand and sons., New Delhi, 2009
2. T. Veerarajan, Probability, Statistics and Random Processes, Tata McGraw Hill, Second edition, 2009.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S.Chand & Company Ltd, 2007.
4. Grewal B S, “Higher Engineering Mathematics”, 42nd Edition, Khanna Publications, Delhi, 2012.
5. Gupta S.C., Kapoor V.K., “Fundamentals of Applied Statistics”, Sultan Chand & Sons, 2002.
6. Veerarjan T., “Theory of Probability and Random Process”, Tata McGraw Hill Publishing Company Science, PHI, 2005.

17MA3015 OPERATIONS RESEARCH TECHNIQUES

Credits: 3:0:0

Course Objective:

- To provide the students with the understanding of basic concepts in Operations Research.
- To develop the skills of students in Queuing models and network analysis.
- To develop the skills of students in sequencing and applications of simulation models.

Course Outcome:

The students will be able to

- Relate their subject knowledge with the engineering subjects.
- Apply sequencing problems for modeling.
- Understand queuing model techniques.
- Understand transportation and assignment problems.
- Understand network analysis.
- Understand simulation models.

UNIT I - Linear Programming Problem: Formulation of Linear Programming problem, Graphical Method solution to L.P.P, Simplex Method, Artificial variable technique and two-phase simplex method.
UNIT II - Duality and Sequencing: Duality, Dual and simplex method, Dual Simplex Method, Job sequencing, n jobs through two machines, n jobs through m machines and two jobs through m machines.
UNIT III - Transportation Model: Initial basic feasible solutions, moving towards optimality, Degeneracy, Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.
UNIT IV - Queuing model: Introduction to Queuing theory, Problems involving (M\M\1): (∞\FIFO), (M\M\c): (∞\FIFO) Models.
UNIT IV - Network analysis and Simulation models: PERT & CPM- network diagram-probability of achieving completion date- crash time- cost analysis. Elements of simulation model-Monte Carlo technique – applications.

Reference Books:

1. Handy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.
2. Natarajan A.M., Balasubramani P., Tamilarasi A., "Operations Research", Pearson Education, I Edn, 2003.
3. Srinivasan G., "Operations Research", Eastern Economy Edition, I Edn. 2007.
4. Winston, "Operations Research, Applications and Algorithms" , Cengage Learning, 4th Edition, 2004.
5. Sharma J.K., "Operations Research: Theory and Applications" (3rd Edition) Macmillan Company of India Ltd., 2008.
6. Goel.B.S. Mittal.S.K, "Operations Research" (19th Edition), Pragati Prakashass, 2002.
7. Panneerselvam.R.,"Operations Research", (2nd Edition), Phi Learning Pvt., Ltd., 2010.

17MA3016 STATISTICS AND NUMERICAL MATHEMATICS

Credits: 3:0:0

Course Objective:
Enable the students to

- Have the knowledge of basic concepts in Statistics.
- Understand the concepts in probability theory and distributions.
- Develops the technique of Numerical Solution of ordinary differential equations.

Course Outcome:
The students will be able to

- Apply the concepts in Statistics and Numerical methods.
- Define and recognize frequency distributions.
- Analyze the importance of probability distributions.
- Ability to apply correlation and regression analysis for decision-making.
- Have the skill of solving algebraic and transcendental equations.
- Apply numerical techniques for modeling.

UNIT I - Statistical Methods: Frequency distributions - Graphs of frequency Distribution – Measures of central Value: Mean, Median and Mode –Measures of Dispersion: Range, Quartile Deviation, Mean deviation and Standard Deviation.
UNIT II - Correlation and Regression: Correlation-Scatter diagram- Karl Pearson's coefficient of correlation - Spearman's rank correlation- Regression lines - Regression equations.
UNIT III - Probability and Distributions: Probability – Independent events - Conditional probability - Baye's theorem - Expectations - Distributions: Binomial, Poisson and Normal.
UNIT IV - Numerical Solution of Equations: The Solution of Numerical Algebraic and Transcendental Equations- Simultaneous linear algebraic equations – Direct methods of solution – Iterative methods of solution.
UNIT V - Numerical Solution of Differentiation and Integration: Numerical differentiation - Numerical integration – Numerical Solution of ordinary differential equations – Taylor series method – Euler's method – Fourth order Runge-kutta method.

Reference Books:

1. Gupta S.P., "Statistical Methods", 33rd Edition, Sultan Chand & Co., 2004.

2. Venkataraman M.K., “Numerical Methods in Science and Engineering”, Revised edition, The National Publishing Company, 2005.
3. Kandasamy P., Thilagavathy K., Gunavathy K., “Numerical Methods”, S. Chand & Co. Ltd. Reprint 2009.
4. Veerarajan T., Ramachandran T., “Numerical Methods with Programs in C”, Tata McGraw Hill Publishing Company Ltd, Second edition, 2006.
5. Gupta S.C., Kapoor V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, XI edition, New Delhi, 2002.
6. Veerarajan T., “Probability Statistics and Random Variables”, Tata McGraw-Hill, New Delhi, 2004.
7. Thangaraj. P, “Computer Oriented Numerical Methods”, Prentice hall of India pvt. Ltd, New Delhi, 2008.

17MA3017 DISCRETE MATHEMATICS

Credits: 3:0:0

Course Objective:
Enable the students to

- Develop logical thinking and computing skills
- Use knowledge of grammars in compiler design
- Apply the concepts of graph in circuits

Course Outcome:
The students will be able to

- To understand various proof methods
- Analyze the truth value of statements
- Compute optimal solution using graphs
- Determine the languages constructed by grammars
- Create new accepting devices
- Determine the languages accepted by machines

UNIT I - Logic: Propositional Equivalences - Predicates and Quantifiers – Tautology- Methods of Proof – Mathematical induction - Set operations – special functions- floor and roof functions.
UNIT II - Boolean Functions: Logic Gates- Minimization of circuits-Karnaugh map- Quine McCluskey method–Structural Induction-Relations and their Properties-Equivalence relation.
UNIT III - Graph Theory: Graph Terminology –Connectivity – Euler path and circuits- Hamiltonian Paths and circuit – Shortest Path Problems, Planar graphs, coloring graphs.
UNIT IV - Trees: Tree Traversal – Tree searching – undirected trees-Spanning Trees – Minimum Spanning Trees-Kruskals algorithm- Prims algorithm.
UNIT V - Finite Automata: Languages and Grammars –Chomsky hierarchy– Finite-State Machines with Output –Finite State Machines with No Output- Finite state automata.

Reference Books:
1. Kenneth Rosen H., “Discrete Mathematics and its Applications”, Tata McGraw-Hill, Edition 2012.
2. Edgar Goodaire G., Michael Parmeter M., “Discrete Mathematics with Graph Theory”, Third Edition, 2003.
3. Lipschultz, “Discrete Mathematics”, Schaum’s Series, 2002.
4. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, “Discrete Mathematical Structures”, 6^{th} Edition, Pearson Education, 2009.
5. Iyengar N.Ch.S.N., Chandrasekharan V., Venkatesh K.A. and Arunachalam P.S., “Discrete mathematics”, Vikas Publishing, 2003.
6. Swapan Kumar Sarkar, “A textbook of Discrete Mathematics”, S. Chand & Company, 2004.
7. LIU C.L; Mohapatra D.P, “Elements of discrete mathematics: A computer oriented approach”, TATA McGRAW-HILL publishing company limited, Third edition, 2009.
8. Girish Sharma, Manoj Singhal, “A text book of discrete mathematics”, A.K. publications, First edition 2010.

17MA3018 OPTIMIZATION TECHNIQUES

Credit: 3:0:0

Course objective:

To provide the student with the concept and an understanding of basic concepts in

- Linear and Non-linear programming problems,
- Dynamic and Integer Programming,
- Network techniques

Course outcome:

The students will be able to

- Explain the basic concepts of optimization and to formulate and solve linear programming problems
- Apply the concepts of Dynamic Programming
- Participate in the class room discussion on Non-linear Programming and application
- Explain and apply the concepts of Integer programming
- Explain and Demonstrate the basic concepts of PERT- CPM and their application
- Reproduce the network model

UNIT I - Linear Programming: Engineering applications of optimization – classification of optimization problems- **Linear programming**: Formulation of LPP, Solution to LPP by simplex method,

UNIT II - Integer programming: Cutting plane algorithm, Branch and bound technique,

UNIT III - Dynamic Programming: Air Cargo model, Capital budgeting problem,

UNIT IV - Non linear Programming: Lagrangian method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Geometric programming

UNIT V - Network Techniques: Shortest Path Model – Minimal Spanning Tree Problem – Maximal flow problem –Introduction to Genetic algorithm.

Reference Books:

1. S. S. Rao, "Engineering Optimization – Theory and Practice", NAI publishers, 2013.
2. R. Panneerselvam, "Operations Research", Prentice Hall of India Private Limited, NewDelhi, 2005
3. Kalymanoy Deb, "Optimization for Engineering Design", Prentice Hall of India Private Ltd., New Delhi, 2003
4. P.K.Gupta and D.S.Hira, "Practical Problems in Operations Research" – Sultan Chand & Sons, New Delhi, 2008.
5. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, New Delhi, 2000.
6. J.K.Sharma, "Operations Research – Theory and Applications", Macmillan India Ltd., 2007.
7. Hamdy A.Taha, "Operations Research – An Introduction", Prentice Hall of India, 2012.

17MA3019 ALGEBRA

Credits: 3:1:0

Course Objectives:

- To impart the knowledge of number theory and congruence.
- To equip the students with the knowledge of ring theory
- To learn about Unique Factorization Theorem.

Course Outcomes:

The students will be able to

- Apply knowledge of real numbers, their operations and basic properties.
- Develop the skills in solving systems of linear equations and find the greatest common divisor.
- Apply class equation and Sylow's theorems to solve different problems.
- Understand and apply the fundamental theorem of finite abelian groups.
- Define and work with the concepts of homomorphism and isomorphism.
- Get the knowledge of Euclidean domains, unique factorization domains.

UNIT I - Divisibility theory of integers: Divisibility in Integers, Division Algorithm, Euclidean Algorithm, Primes, Fundamental Theorem of Arithmetic,
UNIT II - The theory of Congruence's: Basic Properties of Congruence's, Linear Congruence's, Chinese Remainder Theorem, Fermat's Theorem, Wilson's Theorem, Euler's Phi Function, PrimitiveRoots.
UNIT III - Sylow's theorem: Sylow's Theorem for Abelian Groups,Cayley's Theorem, Permutation Groups,Class Equations, Sylow's Theorem.
UNIT IV - Direct products : Direct Products, Fundamental Theorem on Finite Abelian Groups.
UNIT V - Ring Theory: Ideals and Quotient Rings, Euclidean Ring, Principal Ideal Ring, Unique Factorization Theorem, Ring of Gaussian Integers, Introduction to Fields.

Reference Books:

1. HersteinI.N, "Topics in Algebra", Second Edition, Wiley India (P) Ltd., 2009.
2. John B.Fraleigh, "A First Course in Abstract Algebra", 7th Edition, Pearl Books, 2008.
3. David M.Burton, "Elementary Number theory", 7th Edition, McGraw-Hill Education(India) PVT.LTD., 2013
4. Alan Baker, "A Comprehensive course in Number theory", Cambridge University Press, 2013.
5. M K Sen, Shamik Ghosh, ParthasarathiMukhopadhyay, "Topics in Abstract Algebra", University Press, 2006.
6. Ivan Niven , Herbert S. Zuckerman , Hugh L Montgomery , "An Introduction To The Theory Of Numbers", 5th Edition, Wiley India Pvt Ltd, 2008.

17MA3020 ORDINARY DIFFERENTIAL EQUATIONS

Credits: 3:1:0

Course Objectives:
Enable the students to

- Understand the concepts of Linear and Nonlinear Differential Equations
- Analyze the existence of nonlinear differential equations
- Solve Boundary Value Problems

Course Outcomes:
The students will be able to

- Describe the method of successive approximations
- Classify the method of fixed point technique
- Understand and apply the method of Monotone Iterative Technique
- Develop the skills in analyze the Picard's Theorem
- Understand and evaluate the Gronwall's inequality
- Construct the applications of Sturm-Liouville Problem

UNIT I - Systems of Linear Differential Equations: Existence and Uniqueness Theorem, Fundamental Matrix.
UNIT II - Non homogeneous Linear Systems: Successive Approximations, Picard's Theorem, Examples, Fixed Point Method.
UNIT III - Analysis and Methods of Nonlinear Differential Equations: Existence Theorem, Extremal Solutions, Upper and Lower Solutions, Monotone Iterative Method and Method of Quasi linearization, Gronwall's Inequality, Bihari's Inequality, Variation of Parameters(Nonlinear Version).
UNIT IV - Boundary Value Problems: Sturm-Liouville Problem, Green's Functions.
UNIT V - Applications of BVP: Picard's Theorem, Stum's Comparision Theorem.

Reference Books:

1. Deo S.G, Lakshimikantham V and Raghavendra V, "Textbook of Ordinary Differential Equations", 2nd Edition, Tata McGraw-Hill Ltd., 2009.
2. Coddington E.A, "An introduction to Ordinary Differential Equations", Prentice Hall of India Ltd., New Delhi, 2009.
3. Jordan D.W and Smith P, "Nonlinear Ordinary Differential Equations: An introduction for Scientists and Engineers", 4th Edition, Oxford University press, 2009.
4. Ravi P, Agarwal and Donal O'regan, "An Introduction to Ordinary Differential

Equations”, Springer, 2012.
5. Henry Ricardo, “ A Modern Introduction to Differential Equations”, Houghton Miffince, 2002.
6. George F. Simmons, “Differential Equations with Applications and Historical notes”, TMH, 1991.

17MA3021 CLASSICAL MECHANICS

Credits: 3:1:0

Course Objectives:

- To equip the students with the concept of Lagrangian and Hamiltonian formulations.
- To understand the various methods of small oscillations and dynamics of rigid body.
- To understand the various applications of rigid body motions.

Course Outcomes:

The students will be able to

- Apply particle dynamics in practical problems.
- Update the knowledge with Lagrangian and Hamiltonian models.
- Develop the skills in solving small oscillational problems.
- Understand the variation techniques involved in real life problems.
- Apply the concept of rigid body motions in modeling and analysis.
- Demonstrate the mathematical model with experimental data.

Unit - I: Particle Dynamics: Basic Concepts, Constraints, Generalized Coordinates, Virtual Displacement, Virtual Work, D’Alembert’s Principle.
Unit-II: Lagrangian and Hamiltonian Formulations: Lagrange’s Equations, Rayleigh Function, Galilean Transformation, Legendre Transformation, Hamilton’s Equations, Ignorable Coordinates, Conservation Laws.
Unit - III: Small Oscillations: Stable and Unstable Equilibrium, Formulation of the Problem, The Orthogonality of Eigen Vectors, Normal Coordinates.
Unit – IV: Variation Techniques: Hamilton’s Principle, Principle of Least Action.
Unit-V: Dynamics of a Rigid Body: The Inertia Tensor, Angular Momentum, The Eulerian Angles, Euler’s Dynamical Equations for the Motion of a Rigid Body, Motion of a Symmetrical Top.

Reference Books:

1. Herbert Goldstein, Charles P.Poole, John Safko, “Classical Mechanics”,Pearson Education, 2012.
2. Vimal Kumar Jain, “Classical Mechanics”, Ane Books Pvt. Ltd., 2009.
3. GuptaS.L, Kumar V, SharmaH.V, “ Classical Mechanics”, PragatiPrakashan, 2008.
4. Sankara Rao K, “Classical Mechanics”, PHI, 2005.
5. GreenwoodD.T, “Classical Dynamics”, PHI, New Delhi, 1997.

17MA3022 REAL ANALYSIS

Credits: 3:1:0

Course Objectives:

- To equip the students with the knowledge in Archimedean property and Cauchy – Schwarz inequality.
- To generate the knowledge of basic concepts in Set theory.
- To impart the students with the knowledge of continuity and differentiability of real functions, and in Bolzano - Weierstrass theorem

Course Outcomes:

The students will be able to

- Understand the axiomatic foundation of real number system, in particular the idea of completeness and some of its consequences.
- Define and recognize the Archimedean property and Cauchy – Schwarz inequality.
- Describe the fundamental types of point sets, such as open sets, closed sets, compact sets and more generally, sets in higher dimensional spaces.

- Define and recognize the Bolzano – Weierstrass theorem and ability to apply the theorem in a correct mathematical way.
- Know how completeness, continuity and other notions are generalized from the real line to metric spaces.
- Demonstrate how the sequences of functions lead to the methods of convergence, especially uniform convergence.

UNIT I - Real Number system: Axioms – Unique factorization theorem - Least Upper Bound andGreatest Lower Bound - Archimedean property – Absolute values and the triangle inequality - Cauchy-Schwarz inequality.
UNIT II - Some Basic Notions of Set Theory: Cartesian product of two sets - Relations and functions – Composite functions – Finite and infinite sets - Countable and uncountable sets.
UNIT III - Euclidean Space R^n: Open balls and open sets in R^n – Closed sets – Adherent and accumulation points - Bolzona-WeierstrassTheorem - Cantor Intersection Theorem - Heine-Borel covering Theorem.
UNIT IV - Limits and Continuity: Convergent sequences in a metric space – Limit of a function - Continuous functions - Continuity of composite functions - Uniform Continuity – Fixed point theorem for contractions – Derivatives and continuity - Rolle's theorem - Mean value theorem for derivatives.
UNIT V - Sequence and series of functions: Pointwise convergence of sequences of functions - Uniform convergence – Cauchy condition for uniform convergence – Uniform convergence of infinite series of functions - Uniform convergence and differentiation – Sufficient condition for uniform convergence of a series.

Reference Books:

1. Apostol T. M, "Mathematical Analysis", Second Edition, Narosa Publishing House, 2009.
2. Malik S.C, Savita Arora, "Mathematical Analysis", Third Edition, New Age International Ltd., 2008.
3. Royden H and Patrick Fitzpatrick, "Real Analysis", 4th Edition, Macmillan, New York, 2010.
4. Walter Rudin," Principles of Mathematical Analysis", Tata McGraw Hill, 2013.
5. Bali N.P, "Real Analysis", Lakshmi Publications, 2009.

17MA3023 COMPLEX ANALYSIS

Credits: 3:1:0

Course Objectives:
Enable the students to
- explain the concept of analytic functions and contour integration
- determine the applications of Mappings
- develop the application of Residue Theorem

Course Outcomes:
The students will be able to
- Identify the applications of the analytic functions in other branches of mathematics
- Demonstrate the uses of the complex trigonometric functions in other branches
- Apply the concept of contour integration to engineering fields.
- Illustrate the uses of singularities in other branches
- Demonstrate the uses of mappings in physics.
- Get the knowledge of applications of Residue theorem in engineering fields.

UNIT I - Analytic functions: Derivatives of Complex Valued Functions-R Equations, Differentiability and Uniqueness of Power Series.
UNIT II - Elementary Functions: The Exponential Function, Trigonometric Function, Complex Hyperbolic Functions.
UNIT III - Complex Integration: Contour Integration, Cauchy's Integral formula, Uniqueness Theorem, Maximum Modulus Theorem, Simply Connected Region, Singularities, Laurent's Series Expansion,
UNIT IV - The calculus of Residues: Evaluation of Residues, Application of Residue theorem, Evaluation of Definite Integrals, Summation of Series,
UNIT V - Mappings: Conformal Mappings, Schwarz–Christoffel Transformation, Special Transformations, Bilinear Transformations.

Reference Books:

1. Anuradha Gupta, “Complex Analysis”, Ane Books Pvt. Ltd, New Delhi, 2011.
2. James Ward Brown, Ruel V. Churchill, “Complex Variables and Applications”, McGraw Hill pvt.Ltd., 2009.
3. Lars Ahlfors V, “Introduction to the Theory of functions of a Complex Variable”, (3rd edition) 2nd Reprint, McGraw Hill Co., New York, 2013.
4. Tang K.T, “Mathematical Methods for Engineers and Scientists: Complex Analysis, Determinants and Matrices”, Springer, 2007.
5. Dube K.K, “Fundamentals of Complex Analysis, Theory and Applications”, International publishing house pvt.ltd, 2009.

17MA3024 LINEAR ALGEBRA

Credits: 3:1:0
Pre-Requisite: 17MA3019 Algebra

Course Objectives:

- To provide the student with the understanding of basic concepts of Bases and Dimension.
- To learn various properties of Linear Transformations.
- To learn various properties of different canonical forms of matrix.

Course Outcomes:
The students will be able to strengthen their knowledge in

- Bases and Dimension
- Linear Transformations and its matrix forms.
- Minimal polynomials
- Different canonical forms of matrix
- Classification of quadratic forms
- Rank and signature.

UNIT I - Vector Spaces: Basic Concepts, Linear Independence, Bases and Dimension.
UNIT II - Linear Transformations: Algebra of Linear Transformations, Matrix Representation of Linear Transformations.
UNIT III - Diagonalization: Characteristic Roots, Characteristic Vectors, Minimal Polynomials.
UNIT IV - Canonical forms: Triangular Forms, Nilpotent Transformations, Jordan Forms, Rational Canonical Forms.
UNIT V - Algebra of Matrices: Trace and Transpose Determinants, Real Quadratic Forms, Classification of Quadratic Forms, Reduction, Sylvester’s Law, Rank and Signature**.**

Reference Books:

1. Herstein I.N, “Topics in Algebra”, Second Edition, Wiley India (P) LTD., 2009.
2. Kenneth Hoffman and Ray Kunze, “Linear Algebra”, Second Edition, Prentice Hall of India Private Limited, 2005.
3. Jimmie Gilbert, “Linear Algebra and Matrix Theory”, First Edition, Academic Press, 2005.
4. Jin Ho Kwak and Sungpyo Hong, “Linear Algebra”, Second Edition, Birkhauser Publication, 2005.
5. Klaus Janich, “Linear Algebra”, First Indian Reprint, Springer Publication, 2004.
6. Seymour Lipschutz and Marc Lars Lipson, “Theory and Problems of Linear Algebra”, Third Edition, Tata McGraw – Hill Publishing Company Ltd, 2006.
7. A.R. Vasishtha, “ Matrices”, Twentieth Edition, Krishna Prakashan Mandir, 1993.

17MA3025 TOPOLOGY

Credits: 3:1:0
Course Objectives:

- To acquire knowledge about topological space, metric space, continuity, connectedness, compactness, separation axioms and algebraic topology.
- To apply the basic concepts of topological spaces and define metric topology, continuity, connectedness, compactness and algebraic topology.

- To analyze the problems of connectedness and compactness and apply the basic concepts topology in it.

Course Outcomes:

The students will be able to

- Get the knowledge of topology and algebraic topology
- Apply the basic concepts of topology and define metric topology, continuity, connectedness, compactness.
- Construct the ideas of separation axioms.
- Get knowledge of characterizing new ideas in continuity, connectedness and compactness using the basic concepts of topology
- Demonstrate the relationship among all the separation axioms
- Understandthe basic concepts of fixed-point theorem.

UNIT I - Introduction: The Nature and Origin of Topology**,** Review of the Concepts in Sets: operations on sets, Cartesian products, Functions and equivalence relations. **Metric Spaces**: Review of the Basic Concepts**,** Continuous Functions, Complete Metric Spaces.

UNIT II - Topological Spaces: Basic concepts: Interior, closure and boundary – Examples and properties - Basis and Subbasis - Continuity and topological Equivalence - Subspaces: The Zariski topology – Properties of subspace topology.

UNIT III - Connectedness: Connected and disconnected spaces, Connected subsets of the real line – Compactness: Compact spaces and subspaces, compactness and continuity, Properties related to compactness

UNIT IV - Product Spaces: Finite and arbitrary products, Comparison of Topologies - Quotient Spaces.Separation axioms: T_0, T1, T2- Spaces, Regular Spaces, Normal spaces: Properties and theorems - Separation by Continuous Functions.

UNIT V - Algebraic Topology: The nature of algebraic topology, the Fundamental Group, Examples – the fundamental group of S^1 - the Brouwer Fixed Point Theorem and related results, Categories and Factors.

Reference Books

1. Fred H.Croom, "Principles of Topology", Cengage Learning, 2009.
2. Paul L.Shick, "Topology: Point set and Geometric", Wiley Inter Science, 2013.
3. James R.Munkres, "Topology", Second edition, Pearson Prentice Hall, 2008.
4. Murdeshwar M.G,"General Topology", New Age International Publisher, 2008.
5. Malik A.K, and Singh S.R, "Topology", International Publishing House Pvt.Ltd. 2012.
6. Stephen Willard, "General Topology", Dover Publications Inc., 2004.

17MA3026 PARTIAL DIFFERENTIAL EQUATIONS

Credits: 3:1:0

Pre-Requisite: 17MA3020 Ordinary Differential Equations

Course Objectives:

- To discuss about first order nonlinear partial differential equations
- To classify the first order nonlinear partial differential equations
  and second order partial differential equations
- To determine uses of one dimensional diffusion equation and analyze about boundary value problems

Course Outcomes:

The students will be able to

- Get the knowledge of Lagrange's method
- Get the knowledge of Cauchy method of characteristics
- Examine about Charpit's method
- Analyze about Dirichlet problem
- Get knowledge about separation of variables method
- Understand anddevelop the uses of method of Eigen functions.

UNIT I - First Order PDEs: Lagrange's Method, Cauchy Problem for First Order Partial Differential Equations, First Order Nonlinear Equations, Cauchy Method of Characteristics, Compatible Systems, Charpit's Method.

UNIT II - Second Order PDEs: Classifications, Canonical Forms, Derivation of Laplace, BVP, Separation of Variables, Dirichlet Problem.

UNIT III - Laplace equation: Solution of Laplace Equation in Cylindrical and Spherical Coordinates.
UNIT IV - Diffusion Equation: Diffusion Equation, Dirac-Delta Function, Separation of Variables Method, Solution of Diffusion Equation in Cylindrical and Spherical Coordinates.
UNIT V - Wave equation: One-Dimensional Wave Equation, Vibrating String, Variable Separable Solution, Two Dimensional Wave Equation, Method of Eigen Functions.
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Reference Books:

1. Sankara Rao K, "Introduction to Partial Differential Equations", 3rd Edition, PHI Learning .Ltd., 2011.
2. Hillen T, Leonard I.E and Van Roessel H, "Partial Differential Equations", Wiley, 2012.
3. Jianhong WU, "Theory and Applications of Partial Differential Equations", Springer, 2005.
4. Victor Henner, Tatyana Bolozerova and Mikhail Khenner, "Ordinary and Partial Differential Equations", A K Peters/CRC Press, 2013.
5. Robert C.Mcowen, "Partial Differential Equations: Methods and Applications", Pearson Education Asia, 2004.
6. Ian Naismith Sneddon, "Elements of Partial Differential Equations", Dover Publications, 2006.

17MA3027 FIELD THEORY

Credits: 3:1:0
Pre-Requisite: 17MA3019 Algebra.

Course Objectives:

- To provide the student with the understanding of basic concepts of different kind of rings
- To create knowledge in various properties of primitive polynomials.
- To equip the students with the knowledge of roots of polynomials, principles of Galois Theory and normal extension

Course Outcomes:
The students will be able to understand the proof techniques in

- Wedderburn Theorem on Finite Division Ring,
- Different kind of rings
- Eisenstein Irreducible Criterion,
- Extension of fields.
- Solvability by radicals.
- Galois Theory and Normal Extension.

UNIT I - Finite and infinite Field: Axioms of the fields, Infinite Fields and Finite Fields , Wedderburn'sTheorem on Finite Division
UNIT II - Polynomial Rings: Rings, Polynomial Rings, The Division Algorithm, Polynomial Rings over the Rational Field, PrimitivePolynomials, Gauss Lemma, Eisenstien Irreducible Criterion,
UNIT III - Field Extension: Extension of Fields, Algebraic Extension, Finite Extension, Minimal Polynomial,
UNIT IV - Splitting field: Roots of Polynomials, Splitting Field, Construction with Straight Edge and Compass, SimpleExtension
UNIT V - Galois Theory: Galois Group,FixedField, Normal Extension, Solvability by Radicals, Galois Group over Rationals.

Reference Books:

1. HersteinI.N, "Topics in Algebra", Second Edition, Wiley India (P) LTD., 2009.
2. Joseph A.Galilean, "Contemporary Abstract Algebra", Cengage learning, 2014.
3. Joseph Rotman, "Galois Theory", Second Edition, Springer, 2005.
4. Bhattacharya P.B, Jain S.K, Nagpaul S.R, " Basic Abstract Algebra", Second Edition, Cambridge University Press, 2012.
5. John M.Howie, "Fields and Galois Theory", Springer, 2008.

17MA3028 ADVANCED CALCULUS

Pre-Requisite: 17MA3022 Real Analysis.
Credits: 3:1:0

Course Objectives:

- To compose various properties of Riemann-Stieltjes Integral and formulate various conditions for Existence of Riemann Integrals
- To equip the students with the knowledge Directional Derivative, Continuity and the Total Derivative
- To understand the principles of Inverse and Implicit function theorems.

Course Outcomes:
The students will be able to strengthen their knowledge in

- Functions of Bounded Variation
- Riemann-Stieltjes Integral
- Lebesgue Integral
- Measurable Sets on the Real Line
- Convergence Theorems
- Inverse & Implicit Function Theorems.

UNIT I - Function of Bounded Variation: Functions of Bounded Variation – Total variation – Additive property of total variation - Function of bounded variation expressed as the difference of increasing functions - Rectifiable Curves
UNIT II - Riemann-Stieltjes Integral: Reduction to a Riemann Integral – Riemann's condition - Differentiation under the Integral Sign, Conditions for Existence of Riemann Integrals
UNIT III - Uniform Convergence and Integration: Uniform Convergence with example - Lebesgue Integral – Levi Convergence Theorems – Lebesgue dominated convergence theorem. ImproperRiemann Integrals
UNIT IV - The Directional Derivative: Measurable Functions - Measurable Sets on the Real Line - Riesz-Fischer Theorem - The Directional Derivative and Continuity - TheTotal Derivative - The Total Derivatives Expressed in Terms of Partial Derivatives,
UNIT V - Implicit function and extremum problems: Function with non-zero Jacobian determinant - Inverse Function Theorem, Implicit Function Theorem.

Reference Books:

1. Apostol T.M, "Mathematical Analysis", Second Edition, Narosa Publishing House, 2009.
2. Malik S.C, Savita Arora, " Mathematical Analysis", Third Edition, New Age international Ltd., 2008.
3. Royden H and Patrick Fitzpatrick, "Real Analysis", 4th Edition, Macmillan, New York, 2010.
4. Bali N.P, "Real Analysis", Lakshmi Publications, 2009.
5. Walter Rudin, "Principles of Mathematical Analysis", Third Edition, McGraw-Hill, New York, 2013

17MA3029 NUMERICAL ANALYSIS

Pre-Requisite: 17MA3020 Ordinary Differential Equations,
17MA3026 Partial Differential Equations,
17MA3024 Linear Algebra.
Credits: 3:1:0

Course Objectives:
Enable the students to

- Develop skills to use numerical methods to solve a linear system of equations, algebraic and transcendental equations
- Have a overview of different numerical methods of solving equations
- Analyze data using numerical methods

Course Outcomes:
The students will be able to

- Remember various numerical methods of solving problems
- Select a approximate a function using an appropriate numerical method
- Do error analysis for a given numerical method

- Compute a definite integral using an appropriate numerical method.
- Calculate the roots of an equation using numerical methods
- Solve ordinary differential equations using numerical methods

UNIT I - Numerical Solutions of Algebraic and Transcendental Equations: Method of Iteration and Newton-Raphson Method, Bisection method-Rate of Convergence.
UNIT II - Solutions of Systems of Linear Algebraic Equations: Gauss Elimination, LU Decomposition and Gauss –Jordan method-Gauss-Seidel Methods- Gauss Jacobi method.
UNIT III - Interpolation: Finite Differences, Lagrange Interpolation Formulae, Hermite Interpolation Formulae, Spline Interpolations, Linear Splines, Quadratic Splines and Cubic Splines.
UNIT IV - Numerical Calculus: Numerical Differentiation, Errors, Cubical Spline Method, Numerical Integration, Trapezoidal Rule, Simpson's one-third Rule, Simpson's Three-Eighth Rule, Boole's and Weddle's Rule, Use of Cubic Splines
UNIT V - Numerical Solutions of ODE: Numerical Solutions of ODE using Picard method, Euler method, Modified Euler method, Runge Kutta Methods, Predictor – Corrector Method.

Reference Books:

1. Sastry S.S, "Introductory Methods of Numerical Analysis", PHI, 2005.
2. Richard L.Burden, Douglas Faires J, "Numerical Analysis", 9th Edition, Cengage Learning India Private Limited, 2012.
3. Samuel D.Conte, Carl De Boor, "Elementary Numerical Analysis: An Algorithmic Approach", Third Edition, TMG, 2009.
4. Madhumangal Pal, "Numerical Analysis for Scientists and Engineers: Theory and C Programs", Narosa Publishing House, 2011.
5. Rama B.Bhat, Chakraverty S, Numerical Analysis in Engineering, Narosa Publishing House, 2004

17MA3030 FUNCTIONAL ANALYSIS

Pre-Requisite: 17MA3022 Real Analysis, 17MA3025 Topology,
17MA3024 Linear Algebra.
Credits: 3:1:0
Objectives

- To discover the knowledge of the students with the understanding of basic concepts of Banach spaces
- Identifying the usage of Closed, open mapping theorems and Various operators
- Classifying the application of normed linear spaces.

Outcomes
The students will be able to have Knowledge in applications of

- Justifying the method and application of Hahn-Banach Theorem,
- Relating the Open Mapping Theorem with other mathematical concepts.
- Synthesizing the Banach Fixed Point Theorem,
- Relating Orthonormal Basis with Hilbert space
- Justifying the Linear and Unitary Operators
- Indicating the Relation between Banach Spaces and Hilbert Spaces.

UNIT I - Normed linear spaces: Basic Concepts, Properties, Examples of a normed linear spaces, Banach Spaces, Linear Operators, Bounded and Continuous Linear Operators,
UNIT II - Linear Functionals: Hahn-Banach Theorem, Uniform boundedness Principle, Open Mapping Theorem, Closed Graph Theorem, Banach Fixed Point Theorem, Applications.
UNIT III - Hilbert Spaces: Inner Product Spaces, Hilbert Space, complex Hilbert space, real banach space, real Hilbert spaces, incomplete normed linear spaces, simple theorems.
UNIT IV - Relation between Banach Spaces and Hilbert Spaces: Orthonormal Basis, introduction and definitions, Representation of a Functional on a Hilbert Space, simple theorems.
UNIT V - Operator: Introduction, Definitions, standard results , self –adjoint, Normal and Unitary Operators, Hilbert –schmidt operators ,simple problems and theorems.

Reference Books:
1. Simmons G.F., “Introduction to Topology and Modern Analysis”, Tata McGraw Hill Publishing Company, 2009.
2. Thambar Nair M. “Functional Analysis: First Course”, PHI, 2002.
3. Peter D. Lax, “Functional Analysis”, Wiley Publishing Inc. 2014.
4. Francis Hirsch, Gilles Lacombe “Elements of Functional Analysis”, Springer, 2010.
5. Kreyszig E., “Introductory Functional Analysis with Applications”, John Wiley & Sons, New York, 2001.

17MA3031 CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

Credits: 3:1:0
Pre-Requisite: 17MA3020 Ordinary Differential Equations, **17MA3021** Classical Mechanics, **17MA3026** Partial Differential Equations, **17MA3024** Linear Algebra.

Course Objectives:
- Imparts ideas and techniques of calculus of variations and integral equations.
- Describes solution to different types of Integral equations.
- Have complete familiarity with Fredholm and Volterra Type Integral equations

Course Outcomes:
The students will be able to
- Explore the methods for finding maximum or minimum of a functional over a class of functions.
- Identify the applications of calculus and variations to engineering and science.
- Have the skills to solve the IVP & BVP using the techniques of Linear Integral equations.
- Solve differential equations using the techniques of integral equations.
- Know how to solve Fredholm and Volterra integral equations
- Define and recognize the characteristic numbers and eigen functions.

UNIT I - Variational problems with fixed boundaries: The Concepts of Variation and its properties Euler–Lagrange’s equation - Necessary and sufficient conditions for extrema – Functionals on higher order derivatives – functions of several independent variables- variational problems in parametric form.
UNIT II - Direct methods in Variational problems: Variational methods for Boundary Value Problems in Ordinary and Partial Differential equations, Simple problems and simple applications.
UNIT III - Integral Equations: Introduction - Linear and Non-linear Integral equations – Fredholm integral equation, Volterra Integral equation of the first and second kind.
UNIT IV - Conversion of Differential equations into integral equations: Method of converting an initial value problem into a Volterra integral equation – Alternative method of converting an initial value problem into a Volterra integral equation- Method of converting a boundary value problem into a Fredholm integral equation.
UNIT V - Integral equations with Special kinds of kernels: Solutions with Separable Kernels, Symmetric kernels and Resolvent Kernel - Characteristic numbers and Eigen functions.

Reference Books:
1. Gupta. A.S, “Calculus of Variations with Applications”, PHI , 2014.
2. Van Brunt, Bruce, “The Calculus of Variations”, Springer Publications, 2004.
3. Dr. Ajay Pratap, “Special Functions in Mathematics (Linear integral equations)”, University Science Press, New Delhi, 2011.
4. Andrei D. Polyanin, Alexander V. Manzhirov, “Handbook of Integral equations”, Chapman & Hall/CRC, 2008.
5. KanwalR.P, “Linear Integral Equations: Theory & Technique”, Springer, 2013.
6. Dr. Shanthi Swarup, “Integral equations”, 19th Edition, Krishna Prakashan Media Pvt Ltd, 2010.
7. Dr. Goyal, Linear Integral Equations, 19th Edition, Jaipur Publishing house, 2010.
8. Elgolts L, “Differential Equations & Calculus of Variation”, Mir Publisher, 1977.

17MA3032 - TENSOR ALGEBRA AND TENSOR CALCULUS

Pre-requisite: 17MA3024 Linear Algebra, **17MA3034** Differential geometry
Credits: 3:1:0

Course objective:

- To equip the students with the concept of generalization of vectors to tensors, tensor algebra.
- To learn about the fundamentals of tensor algebraic structures and tensor calculus.
- To understand the various idea of tensor with transformation coordinates.

Course outcome:
The students will be able to

- Apply vectors and tensors in practical problems.
- Update the knowledge with tensor algebra models.
- Develop the skills in solving tensor algebraic structures problems.
- Understand the tensor calculus involved in real life problems.
- Apply the concept of tensor with transformation coordinates in analysis.
- Demonstrate the physical law in to tensor calculus.

UNIT I - Tensor Algebra: Systems of Different orders – Kronecker Symbols – Transformation of coordinates in Sn – Invariants – Covariant and Contra variant vectors.
Unit II : **Classification of Tensor:** Tensors of Second Order – Mixed Tensors – Zero Tensor – Tensor Field – Algebra of Tensors – Equality of Tensors – Symmetric and Skew-symmetric tensors.
UNIT III - Multiplication: Outer multiplication, Contraction and Inner Multiplication – Quotient Law of Tensors – Reciprocal Tensor of Tensor – Relative Tensor – Cross Product of Vectors.
UNIT IV - Tensor Calculus: Riemannian Space – Christoffel Symbols and their properties
UNIT V - Tensor Calculus (contd): Covariant Differentiation of Tensors – Riemann-Christoffel Curvature Tensor – Intrinsic Differentiation-Geodesics.

Reference Books:

1. U.C. De, Absos Ali Shaikh and Joydeep Sengupta, *Tensor Calculus*, Narosa PublishingHouse, New Delhi, 2012.
2. Landsberg J.M, “Tensor: Geometry and Applications”, American Mathematical Society, 2012.
3. Charle Harper, Introduction to Mathematical Physics”, PHI Learning private limited, NewDelhi, 2012.
4. David C.Kay, “Schaum’s Outline of Tensor Calculus”, Schaum’s Outline, Revised Edition, 2011.
5. Springer C.E, “Tensor and Vector Analysis with Applications to Differential Geometry”, Dover Publications. Inc., New York, 2012.

17MA3033 CONTROL THEORY

Credits: 3:1:0
Pre-Requisite: 17MA3020 Ordinary Differential Equations,
17MA3021 Classical Mechanics, **17MA3026** Partial Differential Equations,
17MA3024 Linear Algebra.

Course Objectives:

- To distinguish linear & nonlinear systems
- To motivate the uses & concepts of Controllability
- To express optimal control in Matrix equation

Course Outcomes:
The students will be able to

- Comprehend the advanced concept in Control Theory
- Use linear & nonlinear systems appropriately
- Apply Controllability concept in their subjects
- Have knowledge about stability in linear & nonlinear systems
- Estimate stabilizability for various methods

- Compute & conclude optimal control for linear & nonlinear systems

UNIT I - OBSERVABILITY: Linear Systems,Observability Grammian, Constant Coefficient Systems, Reconstruction Kernel, NonlinearSystems.
UNIT II - CONTROLLABILITY: Linear Systems, Controllability Grammian, Adjoint Systems. Constant Coefficient Systems, Steering Function Nonlinear Systems.
UNIT III - STABILITY: Stability – Uniform Stability – Asymptotic Stability of Linear Systems - Linear Time Varying Systems – Perturbed Linear Systems – Nonlinear Systems.
UNIT IV - STABILIZABILITY: Stabilization via Linear Feedback Control – Bass Method – Controllable Subspace – Stabilization with Restricted Feedback.
UNIT V - OPTIMAL CONTROL: Linear Time Varying Systems with Quadratic Performance Criteria – Matrix Riccati Equation – Linear Time Invariant Systems – Nonlinear Systems.

Reference Books:

1. K. Balachandran and DauerJ.P, "Elements of Control Theory", Oxford: Alpha Science International, 2012.
2. Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Prentice Hall, 2009.
3. ZdzislawBubnicki, "Modern Control Theory", Springer, First Indian Reprint, 2007.
4. Donald E. Kirk, "Optimal Control Theory: An introduction", Dover publication inc, Dover Edition first, 2004.
5. Thomas A. Hughes, "Measurement and Control Basics", 4th Edition, International Society of Automation, 2006.

17MA3034 DIFFERENTIAL GEOMETRY

Pre-Requisite: 17MA3020 Ordinary Differential Equations
Credits: 3:1:0

Course Objectives:
- To understand classical concepts in the local theory of curves and Local Intrinsic Properties of Surface
- Students will be able to understand the property of Geodesics and Existence Theorems, Geodesic Parallels, and Gauss Bonnet Theorems.
- To provide the students with basic tools and competences regarding the analysis and applications of curves and surfaces in 3D.

Course Outcomes:
The students will be able to
- Analyze and solve complex problems using appropriate techniques from differential geometry.
- Apply problem solving with differential geometry to diverse situations in physics, engineering or other mathematical contexts.
- Apply differential geometry techniques to specific research problems in mathematics or other fields
- Apply the concepts of Geodesic on a Surface
- Understand the concept on Geodesic Parallels and Gauss Bonnet.
- Apply the knowledge on curves and surfaces in 3D.

UNIT I - Theory of Space Curves: Introduction, Definitions, Arc-length, Tangent, Normal and Binormal, The Curvature and Torsion of a curve given as the intersection of two surfaces.
UNIT II - Theory of Surfaces in Three Dimensional Euclidean Space: Contact between curves and surfaces, Tangent surface, involutes and evolutes, Intrinsic equations, fundamental existence theorem for space curves, Helices.
UNIT III - Metric: Definition of a surface, Curves on a surface, Surfaces of revolution, Helicoids, Metric, Direction coefficients, Families of curves, Isometric correspondence.
UNIT IV - Geodesics: Intrinsicproperties, Geodesics, Canonical geodesic equations, Normal property of geodesics, Existence theorems, Geodesic parallels.
UNIT V - Local Intrinsic Properties of a Surface: Geodesic curvature, Gauss-Bonnet theorem, Gaussian curvature, Surfaces of constant curvature.

Reference books

1. Willmore T.J., "An Introduction to Differential Geometry", Oxford University Press,(17^{th}Impression) New Delhi 2002. (Indian Print).
2. Andrew Pressley, "Elementary Differential Geometry", Springer 2004.
3. Thomas F. Banchoff and Stephen T., "Differential Geometry of Curves and Surfaces", A K Peters/CRC Press, 2010.
4. Thorpe J.A., "Elementary topics in Differential Geometry", under - graduate Texts in Mathematics, Springer - Verlag, 2004
5. Kumaresan S, "A Course in Differential Geometry and Lie Groups", Hindustan Book Agency, 2002.

17MA3035 MATHEMATICS FOR COMPETITIVE EXAMINATIONS

Credits: 3:0:0

Course Objectives:

- To motivate the students to give importance for numerical problems in Competitive Examinations.
- To develop the students with Short Cut Methods to solve the problems on Arithmetical Reasoning.
- To equip the students with the basic concepts Trigonometry, Data Analysis, Mathematical Operations, Permutation, Combination, Probability, Ratio & Proportion, Percentage, Average and Age Problems.

Course Outcomes:

The students will be able to

- Apply shortcut methods to solve the problems on numerical aptitude.
- Get self-training on solving problems in Elementary Algebra, Numbers, Data Analysis and Reasoning.
- Solve problems on ratio & proportion, average and age problems.
- Get knowledge on solving problems on profit& loss, square& square root, cube& cube root, series and Sequences.
- Solve problems on permutations, combinations and probability.
- Get to know the short cut methods to solve the arithmetical reasoning problems.

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UNIT I - Arithmetic: Ratio & Proportion, Percentage, Average, Profit & Loss, Time & Distance, Time &Work, Simple & Compound Interests, Elementary Mensuration, Allegation, Age Problems.

UNIT II - Algebra: Elementary Algebra, Partnership, Permutation & Combination, Series, Sequences, Fractions.

UNIT III - Number System: Problems on HCF, LCM, Square & Square Root, Cube & Cube Root, Mathematical Operations, Divisibility.

UNIT IV - Numerical Problems: Work & Wages, Pipes & Cistern, Train Problems, Boats & Streams, Clocks & Calendar, Height & Distance, Basic Trigonometry, Probability, Simple & Compound Interests

UNIT V - Data Interpolation: Data Analysis, Arithmetical Reasoning**.**

References:

1. Praveen R.V, "Quantity Aptitude and Reasoning", PHI, 2012.
2. Aggarwal R.S., "Quantitative Aptitude", 1^{st} Edition, S. Chand & Company Ltd., (New), 2010.
3. Edgar Thorpe, "Course in Mental Ability and Quantitative Aptitude: For Competitive Examinations", 2^{nd} Edition, Tata Mcgraw-Hill Publishing Company Limited, 2000.
4. Arun Sharma, "How To Prepare For Quantitative Aptitude For The CAT", 1^{st} Edition, Tata Mcgraw-Hill Publishing Company Limited, 2003.
5. Mittal P.K, "Numerical Ability And Quantitative Aptitude: For Competitive Examinations", Galgotia Publishers Pvt.Ltd, 2004.

17MA3036 PROBABILITY AND DISTRIBUTIONS

Credits: 3:1:0

Course Objectives:

- To understand the concepts of Multivariate, limiting and some special probability distributions, multivariate, limiting and special probability distributions.
- To apply the concepts of probability distributions in solving problems.
- To construct and to define limiting probability distributions and problems of probability distributions

Course Outcomes:
The students will be able to

- Define multivariate, limiting and special probability distributions.
- Get the knowledge of multivariate and special probability distributions.
- Demonstrate the steps involved in applying probability distributions.
- Understand the relationship between the statistics and probability distributions.
- Apply the probability distributions in decision-making.
- Construct real time problems using special probability distribution and limiting distributions.

UNIT I - Probability: Probability Set Function, Conditional Probability, Discrete and Continuous Random Variables, Expectation of a Random Variable, Chebyshev's Inequality.
UNIT II - Multivariate Distributions: Distributions of Two Random Variables, Conditional Distributions, Correlation and Regression, Independent Random Variables.
UNIT III - Some Special Distributions: Binomial, Poisson, Normal, Gamma, and Chi-Square Distributions**.**
UNIT IV - Functions of Random Variable: SamplingTheory, Transformations of Variables of the Discrete and Continuous type, Beta,t and F Distributions, Moment-Generating-Function Technique, The Distributions of $\overline{X}$ and nS^2/σ^2
UNIT V - Limiting Distributions: Convergence in Probability, Limiting Moment Generating function, The Central Limit Theorem, Some Theorems on Limiting Distributions.

Reference Books

1. Robert V.Hogg and Allen T.Craig, "Introduction to Mathematical Statistics", PearsonEducation, Asia, 5th Edition, 2005.
2. John A. Rice, "Mathematical Statistics and Data Analysis", Thomson Brooks/Cole, Third Edition,2007.
3. Ramachandran K. M, Chris P. Tsokos, "Mathematical Statistics with Applications" , Academic Press, 2009.
4. Ajay Goal, Alka Goal, "Mathematics and Statistics", Taxmann Allied Services Pvt. Ltd,2006.
5. Richard. J. Larsen, Monis L. Marx, "Introduction to Mathematical Statistics & its Applications", 5th Edition, Pearson Education, 2011.

17MA3037 STOCHASTIC PROCESSES

Pre-requisite: 17MA3036 Probability and Distributions
Credits: 3:1:0

Course Objectives:

- Learn stochastic process and its large variety from introduction to an intermediate level of application knowledge.
- Learn the stochastic processes in queues and understand different queue models.
- Understand stochastic processes on depth and find avenues for further research.

Course Outcomes:
The students will be able to

- Apply the concepts of stationarity and statistical averages in real time.
- Apply Markovian model stochastic processes and obtain solutions especially in the field of engineering
- Use power spectral density in signal processing and research
- Derive new queue models to provide better solutions.
- Find solutions for the untoward happening using the knowledge on reliability theory.
- Indulge in strong research to get solutions in all walks of life since everything is probabilistic.

UNIT I - Introduction: Specification of Stochastic Processes, Stationery Processes, Martingales.
UNIT II - Markov Chains: Definition and Examples, Bernoulli Trials, Classification of States and Chains, Non-homogeneous Chains.
UNIT III - Markov Processes: Poison Process, Birth and Death process, Randomization, Erlang Process, Brownian Motion, Wiener process. Renewal Process, Renewal Theorems, Markov Renewal Equation.
UNIT IV - Time Series: Introduction, Models of Time Series, Power Spectrum, Statistical Analysis of Time Series.

UNIT V - Stochastic Processes in Queuing & Reliability: Queuing Models**,** Birth and Death processes in Queuing Theory, Markovian Queuing Models, Non-Markovian Queuing Models, Reliability.

Reference Books

1. Samuel Karlin, Howard M.Taylor, " A First Course in Stochastic Processes", Second Edition, Academic Press, 2011.
2. P.W.Jones, P.Smith, "Stochastic Processes An Introduction", Arnold and copublished by Oxford University Press Inc. Newyork, 2009.
3. Erhan Cinlar, "Introduction to Stochastic Processes", Dover Publications, 2013.
4. Roy D.Yates, David J.Goodman, Probability and Stochastic Processes, Second Edition, Wiley India Pvt. Ltd., 2011.
5. J.Medhi, "Stochastic Processes", New Age Science, 3rd Revised Edition, 2009**.**
6. Sheldon M. Ross, Introduction to Probability models, 10th Edition, Academic Press, 2009.

17MA3038 FORMAL LANGUAGES AND AUTOMATA THEORY

Credits: 3:1:0

Course Objectives:

- Understand basic properties of theory of computation, deterministic and nondeterministic finite automata.
- Understanding Context free languages, grammars, and Normalising CFG.
- Have the knowledge of basic properties of Turing machines and computing with Turing machines.

Course Outcomes:

The students will be able to

- Apply the knowledge of machines and languages in relation to Computer Science.
- Apply their mathematical knowledge in computer applications and have the ability to solve computational problems.
- Design finite automata with outputs and prove their equivalence.
- Analyze the importance of regular sets and expressions.
- Define and recognize a PDA for a given CFL.
- Define and design a Turing machine for a given computation.

UNIT I - Theory of Computation: Basic concepts – Functions – Relations - Graphs and Trees, Languages – Grammars - Automata.

UNIT II - Finite Automata: Deterministic Accepters and Transition Graph - Languages and DFA- Non - deterministic accepters - Equivalence of NDFA and DFA.

UNIT III - Regular Languages: Regular Expressions -Regular Grammars - Pumping Lemma - Context-free Languages - Context-free Grammars - Chomsky Normal Form - Greibach Normal Form.

UNIT IV - Push down Automata: PDA for CFL - CFG for PDA - Pumping Lemma for CFL's – Closure properties for CFL's - Decision Algorithms for CFLs.

UNIT V - Turing Machines: TM as language accepters – TM as transducers – recursively enumerable languages – Context sensitive grammars and languages – relation between recursive and CSL.

Reference Books:

1. Peter Linz, "Introduction to Formal Languages and Automata", Fourth edition, Narosa Publishing House, 2010.
2. Kamala K, Rama R, "Introduction to Formal Languages, Automata Theory and Computation", Pearsorn Education India, 2009.
3. John E. Hopcraft and Jeffrey D.Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, New Delhi, 1987.
4. John.C.Martin, "Introduction to the Languages and the Theory of Computation", Third Edition, Tata McGrawHill, 2003.
5. Sipser M; "Introduction to the Theory of Computation", Singapore: Brooks/Cole, Thomson Learning, 1997.

17MA3039 FUZZY SET THEORY AND ITS APPLICATIONS

Credits: 3:1:0

Course Objectives:

- To acquire the knowledge about fuzzy sets, fuzzy numbers and fuzzy systems.
- To synthesis the ideas of fuzzy sets and fuzzy systems in reconstructing fuzzy decision making.
- To evaluate the fuzzy decision making, fuzzy neural networks problems by fuzzy sets and fuzzy systems.

Course Outcomes:

The students will be able to

- Understand the basic concepts of fuzzy sets, fuzzy numbers and fuzzy systems.
- Recognize the basic concepts of fuzzy sets, fuzzy numbers and fuzzy systems.
- Use the concepts of fuzzy sets, fuzzy numbers, fuzzy systems in fuzzy decision making.
- Employ the concepts of fuzzy sets and fuzzy numbers in defining fuzzy systems.
- Compare different type of fuzzy decision-making and choose appropriate decision-making system.
- Understand and justify the best fuzzy decision making techniques.

UNIT I - FUZZY SETS: Introduction, Crisp Sets, Fuzzy sets: Basic types, characteristics and significance of the paradigm shift - Alpha Cuts, Properties, Representation of Alpha Cuts and Extension Principle for Fuzzy Sets.
UNIT II - OPERATION ON FUZZY SETS: Types of Operations - Fuzzy Complements: Arbitrary complement function - Fuzzy Intersections: t-norms Fuzzy Unions: t-co-norms - combinations of operations and aggregation operations.
UNIT III - FUZZY ARITHMETIC: Fuzzy Numbers - Linguistic Variables - Arithmetic Operations - Interval Analysis - Arithmetic Operations on Fuzzy Numbers - Operations MIN and MAX - Lattice of Fuzzy Numbers - Fuzzy Equations.
UNIT IV - FUZZY SYSTEMS: General Discussion - Fuzzy Controllers: overview and example - Fuzzy Systems and Neural Networks -Fuzzy Neural Networks - Fuzzy Automata - Fuzzy Dynamical Systems: Example and illustrations.
UNIT V - FUZZY DECISION MAKING: General Discussion, Individual Decision Making, Multi person Decision Making, Multi criteria Decision Making, Multi stage Decision Making, Fuzzy ranking methods and fuzzy linear programming.

Reference Books:

1. George J.Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic Theory and Applications", PHI, New Delhi, 2005.
2. Zimmermann H.J., "Fuzzy Set Theory and its Applications", Kluwer Academic Publishers,2006.
3. WitoldPedrycz and Fernando Gomide, "An Introduction to Fuzzy Sets-Analysis and Design", Prentice-Hall of India Pvt. Ltd, 2005.
4. Hung T.Nguyen, ElbertA.Walker, "A First Course in Fuzzy Logic", Third Edition, Chapman&Hall/CRC, 2009.
5. John Yen Reza Langari, "Fuzzy Logic, Intelligence, Controle and Information", Pearson Education, 2005.
6. M.Ganesh, "Introduction to Fuzzy Sets and Fuzzy Logic", PHI, 2006.

17MA3040 RESEARCH METHODOLOGY

Credits: 3:1:0

Objectives

- To understand the research problems, research methods, techniques and tools.
- To learn different data analysis techniques.
- To write and present research reports.

Outcomes

The students will be able to

- Recognize the nature and importance of research.
- Learn the basis of research problem and understand the importance of literature review.
- Define research objectives and hypotheses setting.
- Recognize the research methods, techniques and tools.

- Analyse and test the data using statistical techniques and interpret the data.
- Report and present research findings.

UNIT I - Research: Meaning and philosophy of research, Nature and objectives of research, Importance of research, Paradigm of research, Characteristics of a good researcher.
UNIT II - Research problems: Types – basic and applied-formulation of research problem, Literature survey, Critical analysis of literature and review the research problem, Objectives, Hypothesis, types of hypothesis.
UNIT III - Research Methodology: Methods of research, designs of research: Experimental design- Research techniques, Sample design: Population, Types of sampling – Data collection: Types, validity, reliability of research tools, data collection methods.
UNIT IV - Measurement and scaling techniques: Analysis and Interpretation of data, Statistics for research: measures of central tendency, dispersion, skewness, correlation and regression analysis, source of error in measurement, testing of hypothesis.
UNIT V - Research Reports: Manuscript / thesis writing: steps, documentation, tables, diagrams – report presentation, Bibliography and References, Research ethics: Plagiarism, Originality in reporting research findings.

References:

1. Kothari C.R, 'Research Methodology, Methods and Techniques' 2nd edition, New Age International (P) Ltd, publishers, New Delhi (2004)
2. Ranjit Kumar, 'Research Methodology', Sage Publications, London, New Delhi (2006)
3. Panner Selvam R, 'Research Methodology', Prentice Hall of India, New Delhi, 2004
4. Abdhul Rahim F, Thesis writing: Manual for all Researchers, New Age International (2007)
5. Geoffrey R. Marczyk, 'Essentials of Research Design and Methodology', Wiley, (2005)

17MA3041 MATHEMATICAL THEORY OF ELASTICITY
(For Ph.D Course work)

Credits: 3:1:0

Course Objectives:
To teach the students about basic concepts in
- Stress,strain, Hook's law and Bending and Torsion
- Thermal stresses and Composite tubes
- Long circular cylinder and Composite material

Course Outcomes:
The students will be able to derive the mathematical formulation of
- Bending and torsion of bar
- Stress – strain relations
- Circular and elliptical bars
- Axis symmetric problems,
- Thin circular disk.
- Composite material.

UNIT I - Stress and Strain: The state of stress at a point-normal and shear stress-the plane stress-Differential equations of equilibrium. Deformations-rectangular strain-Interpretation of $\gamma_{xy,}\gamma_{yz,}\gamma_{xz}$, Stress–strain relations for linearly elastic solids- Generalized statement of Hooke's Law- Stress–strain relations for isotropic materials.
UNIT II - Bending and Torsion Straight beams and asymmetrical bending-Bending of curved beams(Winkler-Bach Formula)-Torsion of general prismatic bars-Solid sections-Circular and elliptical bars-Rectangular bars-Thin-walled tubes.
UNIT III - Axisymmetric problems: Stresses in composite tubes-shrink fits-Stresses due to gravitation- Rotating disks of uniform and variable thickness-Rotating shafts and cylinders.
UNIT IV - Thermal stresses: Thermo elastic stress- Strain relations- Equations of equilibrium- Strain-displacement relations-Some general results-Thin circular disk: Temperature symmetrical about centre-Long circular cylinder.
UNIT V - Introduction to composite materials: Stress-Strain Relations-Basic cases of elastic symmetry-Laminates-Ply stress and ply strain-Micro mechanics of composites-Pressure vessels-Transverse Stresses.

Reference Books:

1. L.S.Srinath,Advanced mechanics of solids, McGraw Hill Education India Pvt Ltd-18th Edition,2014.
2. Arthur P. Boresi, Ken P. Chong, James D. Lee, Elasticity in Engineering Mechanics, third edition, John Wiley &Sons, Inc., 2011.
3. Irving H.Shames and James, M.Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
4. H Sadd, Elasticity, Theory, Applications & Numerical:Martin Elsevier, 2005.
5. Wang, C.T, Applied Elasticity, McGraw–Hill Co., New York, 1993.
6. Timoshenko, S.P., and Goodier, J.N., Theory of Elasticity, McGraw-Hill, 1970.
7. P. D. S. Verma, Theory of Elasticity, Vikas Publishing House Pvt. Ltd., New Delhi, 1997.

17MA3042 SEMIGROUPS OF LINEAR OPERATORS AND APPLICATIONS

(For Ph.D Course work)

Credits: 3:1:0

Course Objectives:

- To provide the students about the knowledge in abstract Cauchy problem.
- To enable the students to analyze the spectral characteristics of compact operators and initial value problem
- To provide the student with the concept and the understanding of perturbations and approximations

Course Outcomes:

The students will be able to attain knowledge in

- Applications of semigroup Theory to partial differential equations
- Perturbations and approximations
- Applications of semigroup theory to regard a time-dependent PDE as an ODE on a function space.
- Nonlinear evolution equations
- Initial value problems
- Analytic semigroups.

UNIT I - Bounded linear operators: Uniformly continuous semigroups of bounded linear operators, Strongly continuous semigroups of bounded linear operators, The Hille-Yosida theorem, The Lumer Philips theorem.

UNIT II - Semigroups of compact operators: Semigroups of compact operators, Differentiability, Analytic semigroups, Fractional powers of closed operators.

UNIT III - Perturbations and approximations: Perturbations by bounded linear operators, Perturbations of infinitesimal generators of analytic semigroups, perturbations of infinitesimal generators of contraction semigroups.

UNIT IV - Abstract Cauchy problem: The homogeneous initial value problem, The inhomogeneous initial value problem, Regularity of mild solutions for analytical semigroups.

UNIT V - Nonlinear evolution equations: Lipschitz perturbation of linear evolution equations, Semi linear equations with compact semigroups, Semi linear equations with analytic semigroups.

Reference Books:

1. Reinhard Racke, Lectures on Nonlinear evolution equations: Initial value problems, Springer International publishing, Switzerland, 2015.
2. Hector O. Fattorini, Adalbert Kerber, The Cauchy Problem, Cambridge University Press, 2010.
3. K. Balachandran and J.P. Dauer, Elements of Control Theory, Narosa Publishing, New Delhi, 2012.
4. Klaus-Jochen Engel, Rainer Nagal, One-parameter semigroups for linear evolution equations, Springer-Verlag, New York, 2000.
5. R.F. Curtain and H. Zwart, Introduction to infinite Dimensional Linear Systems Theory, Springer-Verlag, New York, 1995.
6. J.A. Goldstein, Semigroups of Linear Operators and Applications, Oxford University Press, New York, 1985.
7. A. Pazy, Semigroups of Linear Operators and Applications to Partial Differential Equations, Springer-Verlag, New York, 1983.

17MA3043 COMPUTATIONAL METHODS AND APPLICATIONS

Credits 3:0:0

Course Objectives:

- To acquire knowledge of probability distributions, regression and correlation.
- To apply partial differential equations in problems water management.
- To learn different soft computing and data reduction techniques.

Course Outcomes:

The students will be able to

- Recognize the concepts of probability distributions.
- Model the water management problems using probability distributions.
- Apply regression and correlation in solving water management problems.
- Model and solve water management and water transportation problems using partial derivatives.
- Recognize different soft computing techniques.
- Use data reduction techniques in water management problems.

UNIT I - Probability distributions: Discrete and continuous probability distributions, parameter estimation, hypothesis testing, goodness of fit tests, Chi-square test and KS test.

UNIT II - Regression and correlation: Simple linear and multiple linear regression, curve fitting, evaluation of regression, confidence limits, histogram; scatter diagram.

UNIT III - Partial differential equations: Classification, nature of problems, concepts of finite difference method, finite difference schemes: solution of parabolic equations, pollutant transport, solution of elliptical equations, solution of Laplace equation and Poisson equation, flow through porous media, concepts of finite volume method.

UNIT IV - Soft computing techniques: Basics of artificial neural networks, fuzzy logic and their application in environmental and water resources management.

UNIT V - Data reduction technique: Factor analysis; application examples in environmental and water resources engineering.

References:

1. Rastogi, A.K., "Numerical Groundwater Hydrology", Penram International Publishing (India), 2006
2. Rao,S.S., "Applied Numerical Methods for Engineers and Scientists", Prentice-Hall, 2002.
3. Hoffman, J.D., ,**"**Numerical Methods for Engineers and Scientists**",** CRC Press, Special Indian Edition , 2011.
4. Kotteguda, N.T. and Renzo Resso, "Statistics, Probability and Reliabilityfor Civil and Environmental Engineers**"**, McGraw Hill Companies Inc., New York, (1998).
5. Schilling, R.J., and S.L. Harris, "Applied Numerical Methods forEngineering**",**CENGAGE Learning, India Edition, (2007).

17MA3044 APPLIED OPERATIONS RESEARCH

Credits: 3:1:0

Course Objectives:

- To acquire knowledge of linear programming, assignment and transportation problems
- To solve LPP using different methods and applying in management decisions.
- To learn different techniques of sequencing and replacement.

Course Outcomes:

The students will be able to

- Develop linear programming problems
- Find solutions of LPP and apply in management decisions.
- Recognize solutions of transportation problems.
- Apply Hungarian method in solving assignment problems.
- Apply sequencing and replacement models in management problems.
- Solve queuing and network problems using CPM and PERT techniques.

UNIT I - Linear Programming: Mathematical formulation of a LPP, Graphical Method, Simplex method - Two Phases Simplex Method, Artificial Variable Technique, Method Application to management decisions.
UNIT II - Transportation Problem: Initial basic feasible solution, NWC method, Least Cost Method, Vogel's Method, MODI, moving towards optimality without degeneracy, Degeneracy problems.
UNIT III - Assignment problem: Introduction, Hungarian Method & problems, unbalanced assignment problems, travel sales person problems.
UNIT IV - Sequencing and Replacement Model: Sequencing problem, processing of n jobs through 2 machines, 3 machines, - Replacement of items that deteriorate gradually with time, without time that fails completely – Individual & group replacement.
UNIT V - Queuing Theory: Introduction, (M | M | 1): (∞ | FIFO). Decision Theory**:**Frame work, pay off tables – decision criteria, Decision trees, Network Models, Network models for project analysis CPM, network construction and time analysis, cost time trade off, PERT, problems - crashing network, problems

References:

1. Paneer Selvam, "Operations Research", PHI learning Indian (P) ltd, 2nd Edition, 2011.
2. S.D.Sharma, "An Introduction – Fundamentals of Operations Research".
3. Kanti Swarup, Gupta and Manmohan, "Operations Research", Sultan Chand and Sons, 15th Edition, 2010.
4. J K Sharma, "Operations Research Theory & Applications", Macmillan, 4th Edition, 2009.
5. Hamdy A Taha, "Operations Research", Pearson, 8th Edition, 2008.

LIST OF COURSES

S.No.	Course Code	Name of the Course	Credits
1	16MA1001	Basic Mathematics for Sciences	3:1:0
2	16MA1002	Calculus and Transforms	3:1:0
3	16MA1003	Basic Mathematics for Computer Science	3:1:0
4	16MA1004	Applied Mathematics - Probability and Statistics	3:1:0
5	16MA1005	Applied Mathematics – Matrices and Calculus	3:1:0
6	16MA2001	Analytical Geometry, Fourier Series and Transforms	3:1:0
7	16MA2002	Applied Mathematics	3:1:0
8	16MA2003	Quantitative Techniques	3:1:0
9	16MA2004	Operations Research	3:1:0
10	16MA2005	Business Mathematics	3:1:0
11	16MA3001	Mathematical Theory of Elasticity	3:1:0
12	16MA3002	Semigroups of Linear Operators and Applications	3:1:0
13	16MA3003	Computational Methods and Applications	3:0:0
14	16MA3004	Applied Operations Research	3:1:0
15	16MA4001	Research Methodology	3:0:0

16MA1001 BASIC MATHEMATICS FOR SCIENCES

Credits: 3:1:0

Course Objectives:

To provide the students with the knowledge and understanding of the concepts in

- Trigonometry and Complex numbers.
- Matrices and Group theory.
- Statistics .
- Probability theory.

Course Outcome:

Ability to

- understand the circular functions and hyperbolic functions.
- apply matrix operations in the field of study.
- apply the basic concepts of Group theory in the field of study**.**
- gain the knowledge of applying statistical tools**.**

Course Descriptions:

Trigonometry: Trigonometric ratios, identities, Hyperbolic and circular functions and their relations**,** Properties of hyperbolic functions, Inverse functions **Complex Numbers:** Rectangular, polar and exponential forms of complex numbers, De-Moivre's Theorem, Powers, roots and log of complex numbers,. **Linear Algebra:** Eigen values and Eigen vectors, Characteristic equation, Cayley-Hamilton Theorem, Simultaneous linear equations, Condition for consistency. **Group Theory**: Binary Operations, Semi groups Monoids, Groups(Simple examples, simple Problems and properties only). **Statistics:** Introduction, Graphical representation of data, Measures of central tendency, Measures of dispersion, Correlation, Regression, Rank Correlation. **PROBABILITY**: Random experiment, Sample space, Events, Axiomatic approach for probability, Conditional probability, Baye's theorem.

Reference Books:
1. Robert E, Moyer Frank Ayres JR, "Trigonometry", 3rd Edition, Schaum's Outlines, Tata McGraw-Hill Edition, 2005.
2. Frank Ayres Jr, Elliott Mendelson, "Calculus", 3rd Edition, Schaum's Outline series, McGraw-Hill, INC., 1990.
3. Shanti Narayan, "Differential Calculus", S. Chand and Company, 2005.
4. Shanti Narayan, "Integral Calculus", S. Chand and Company, 2005.
5. Shanti Narayan and P. K. Mittal, "Text Book of Matrices", S. Chand and Company, 2011
6. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, 2012.
7. Dass H.K, "Advanced Engineering Mathematics", 18th Edition, S. Chand and Company, 2008.
8. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics", Volume II and III (6th Revised Edition), S. Chand & Co., New Delhi, 2006.
9. Gupta S.P, "Statistical Methods", Sultan Chand and Sons., New Delhi, 2009.

16MA1002 CALCULUS AND TRANSFORMS

Credits: 3:1:0

Course Objectives:
To equip the students with the knowledge and understanding of the concepts in
- Methods of differentiation .
- Methods of integration.
- Laplace Transforms and .
- Fourier Transforms.

Course Outcomes:
Ability to
- understand the applications of Calculus.
- gain the knowledge in transform techniques.
- apply differentiation and integration techniques in the field of study.

Course Descriptions:
Differential Calculus: Methods of differentiations, Mean Value theorems, Taylor's theorem, Taylor's series and Maclaurian's series, Series expansions of cosx, sinx, log(1+x), $(1+x)^n$. **Integral Calculus:** Methods of integration, Gamma and beta functions, Double and triple integrals, Jacobian, Applications to areas and volumes. **Differential Equations:** Linear differential equations of first order and Linear differential equations of second order(constant coefficients only), Applications to Newton's law of Cooling, Kirchoff's law of electrical circuits, Motion under gravity, Simple harmonic motion. **Laplace Transforms Fourier series and Fourier transforms:** Basic definitions, elementary properties and simple problems only.

Reference Books:
1. Frank Ayres Jr, Elliott Mendelson, "Calculus", 3rd Edition, Schaum's Outline series, McGraw-Hill, INC., 1990.
2. Shanti Narayan, "Differential Calculus", S. Chand and Company, 2005.
3. Shanti Narayan, "Integral Calculus", S. Chand and Company, 2005.
4. Shanti Narayan and P. K. Mittal, "Text Book of Matrices", S. Chand and Company, 2011
5. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, 2012.
6. Dass H.K, "Advanced Engineering Mathematics", 18th Edition, S. Chand and Company, 2008.

16MA1003 BASIC MATHEMATICS FOR COMPUTER SCIENCE

Credits: 3:1:0

Course Objectives:

- To update the students with the basic knowledge and an understanding of algebra.
- To equip the students with the knowledge of calculus.
- To teach the students about the techniques of matrix algebra.
- To provide the students about the basic concepts of vector analysis.

Course Outcomes:

Ability to

- relate their subject knowledge with their subjects during the course of study.
- know the applications of matrices.
- understand the techniques involved in calculus.

Course Descriptions:

Algebra: Set Theory, Relations and functions, Trigonometric identities, Partial fractions. **Matrices:** Introduction, Matrix operations, The trace and the determinant of a matrix, Properties of determinants (excluding the proof), The inverse and the rank of a matrix, Special types of square matrices, Eigen values and Eigen vectors(problems only). **Calculus:** Differentiation from the first principle, Rules of differentiation, Implicit differentiation, Logarithmic differentiation, Methods of integration, Integration by parts. **Vectors:** Scalars and vectors, Operations on vectors, Magnitude of a vector, Differentiation of vectors, Curves in space, Velocity and acceleration, Scalar and Vector point functions, Gradient, Divergence, Curl, Physical interpretations, Solenoidal and irrotational fields, Laplacian operator, Integration of vectors.

Reference Books

1. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. James Steward, "Calculus", 5th Edition, Thomson Brooks/Cole, Micro Print Pvt. Ltd, Chennai, 2003.
3. Riley K.F, Hobson M.P, and Bence S.J, "Mathematical Methods for Physics and Engineering", 2nd Edition, Cambridge Low – Price Editions, Cambridge University Press, 2004.
4. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics", Volume II and III (6th revised edition), S. Chand & Co., New Delhi, 2006.
5. T. Veerarajan., "Engineering Mathematics", (Updated Second Edition), Tata McGraw Hill, New Delhi, 2009.

16MA1004 APPLIED MATHEMATICS - PROBABILITY AND STATISTICS

Credits: 3:1:0

Objective:

This course will:

- Develop the basic skills of Permutations & combinations.
- Present the basic concepts in Probability.
- Provide the basic concept in Probability Distribution.
- Develop the skills of Statistical Measures.
- Provide the basic ideas in Correlation and Regression.

Outcome:

Students will have ability:

- To use technique, methodology and application in statistics.
- To apply the knowledge gained in Probability theory in engineering fields.
- To apply the knowledge in Probability Distribution
- To apply their knowledge gathered in Statistical Measures to life sciences.
- To apply the knowledge in collection, presentation and tabulation of data.
- To make simple decision making models using Correlation and Regression.

Course contents:

Permutation &combinations: Determining the size of an experiment, The number of ways to assemble chips in a controller, Selection of machine for an experiment, The number of choices of new researchers. Data Analysis on the requirement and waste of Food, consumption of Electricity, level of satisfaction of Food and the recharge of the Ground Water. **Probability**: Random selection results in the equally likely case, Possibilities of Mutually Exclusive Events, Compare the accuracy of two schemes for sending messages, Decision making. **Distribution**: Binomial distribution, Poisson distribution, Normal distribution. **Descriptive Statistics**: Visually inspecting data to improve product quality, The interpretation of the sample measures as a balance point, Comparison of the variabilities of data. **Correlation and regression**: Strength of relation between two variables, Relation between two variables by assigning ranks, Estimating the relationships among variables.

Reference books:

1. Richard A. Johnson, "Probability and Statistics for Engineers" 8^{th} Edition.
2. S.P.Gupta, "Statistical Methods".
3. Veerarajan T, Probability statistics and Random process, Tata McGraw Hill, 2^{nd} edition, 2006.

Excel activities:

1. Counting Principle using excel
2. Generating Factorial, Permutation and Combination using excel
3. Finding Probability using excel
4. Simulating dice throws in excel
5. Probability distribution Using Excel
6. Create diagrams and Charts using excel
7. Calculate statistical measures and dispersion using excel
8. Scatter diagram using excel
9. Correlation between two variables using excel
10. Find the Linear regression for the given data in excel

16MA1005 APPLIED MATHEMATICS – MATRICES AND CALCULUS

Credits: 3:1:0

Course Objective:

This course will:

1. Present basic concepts of Matrices and Matrix Algebra.
2. Present methods of solving systems of Linear Equations.
3. Presents applications of Differentiations and Integrations.
4. Present basic concepts of Sequences and Series.

Course Outcome:

Students will have ability:

1. To manipulate matrices and to do matrix algebra.
2. To solve systems of linear equations.
3. To apply the concept of differentiations and integrations in real life problems.

Course Contents:

Matrix Algebra: Introduction – Characteristic Equations – Eigen values and Eigen vectors-Matrix.-Diagonalization – Quadratic Forms - Reduction to Canonical forms - Financial Matrices - Matrix in Fibonacci matrices - Cryptography matrices - Input-output Matrices

Theory of Equations: Relation between coefficients and roots. Irrational and imaginary roots occur in pairs – symmetric functions of the roots – transformation of equations – Reciprocal equations and formation of equation whose roots are given. Finding forces
located in the beams - using matrices and equations.

Differential Calculus: Curvature in Cartesian co-ordinates – Center and radius of curvature – Circle of curvature- Evolutes – Envelopes – Evolutes as envelope of normals.

Integration: Double integration – Change of order of integration – Change of variables between Cartesian and polar coordinates – Triple integrals in Cartesian co-ordinates – Area as double integral – Volume as triple integral.

Sequence and Series: Introduction-Arithmetic, Geometric and Harmonic sequences, Arithmetic, Geometric and Harmonic series, sequences, Geometric series, Harmonic sequence, Honey bee hive problem, Applications in Finance-Simple and Compound Interest, interest portion of monthly payments made to pay off an automobile and home loan, Accommodation of seats in an auditorium, list of maximum daily temperatures in one area for a month, Area enclosed by a region.

References:

1. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. Kandasamy P, Thilagavathi K and Gunavathi K, "Engineering Mathematics", 9th Revised Edition, S Chand & Co, New Delhi, 2010.
3. Ramana B.V, " Higher Engineering mathematics", McGraw Hill Education Private Limited, India, 2015.
4. Ralph P. Grimaldi, B.V. Ramana "Discrete and Combinatorial Mathematics", Fifth Edition, Pearson, 2003
5. Chester Piascik "Applied finite mathematics for business and the social and natural sciences", West Publishing Company, 1992.
6. A. Gangadharan, "Engineering Mathematics, Vol I" PHI Learning Private Limited, New Delhi, 2010.
7. V.Sundaresan , S.D.Jeyaseelan " An Introduction to Business Mathematics , S. Chand & Company Ltd, 2010.

Websites:

1. www.algebra.org/lessons/lesson.aspx?file=Algebra_seqseriesApps.xml
2. www.emathzone.com/tutorials/algebra/application-of- arithmetic-sequence- and-series.html
3. http://www.tutor-homework.com/Math_Help/college_algebra/m6l4notes1.pdf

16MA2001 ANALYTICAL GEOMETRY, FOURIER SERIES AND TRANSFORMS

Credits: 3:1:0

Course Objectives:

- To provide the students about the basic concepts in Fourier series.
- To orient the students to know about the application of Harmonic analysis.
- To teach the fundamental concepts of Laplace Transforms to the students.

Course Outcomes:

Ability to

- relate the properties of Fourier series with their subjects during their course of study.
- apply the knowledge in Fourier series in their fields.
- have the knowledge in solving problems using Laplace Transforms.
- know the transform techniques.

Course Descriptions:

Analytical Geometry: Direction cosines and ratios, Angle between two lines, Equation of a plane, Equation of a straight line, Co-planar lines, shortest distance between skew lines. **Laplace Transforms:** Transforms of elementary functions, Properties of Laplace transforms, Transforms of periodic functions, Transforms of special functions, Transforms of derivatives, Transforms of integrals, Multiplication by t^n, Division by t, Evaluation of Integrals by Laplace transforms, Inverse Laplace transforms of standard functions, Method of Partial fractions. **Fourier Series**: Euler's formula, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of Interval. **Half Range Fourier series:** Typical wave forms, Harmonic analysis. **Fourier transforms**: Fourier integral Theorem–Inverse transform-Properties- simple problems.

Reference Books:

1. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition), Khanna Publisher, New Delhi, 2012.
2. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
3. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics", Volume II and III (6th Revised edition), S. Chand & Co., New Delhi, 2006.
4. H.K.Dass., "Advanced Engineering Mathematics", (18th Revised Edition), S.Chand & Co., New Delhi, 2008
5. K.F.Riley., M.P.Hobson., S.J.Bence., "Mathematical Methods for Physics and Engineering", (2nd Edition), Cambridge University Press, 2004.

16MA2002 APPLIED MATHEMATICS

Credits: 3:1:0

Course Objectives:

- To provide the students about the knowledge of three dimensional geometry.
- To orient the students to know the techniques in Calculus.
- To teach the students about the applications of matrices.

Course Outcomes:

Ability to

- relate the properties of sphere, cone and cylinder with their subjects during the course of study.
- apply the knowledge in Eigen values and Eigen vectors in their fields.
- have the knowledge in solving optimization problems.

Course Descriptions:
Analytical Geometry: Sphere, Plane section of a sphere, Tangent plane, Cone, Right circular cone, Cylinder, Right circular cylinder. **Matrices:** Real matrices, Eigen values and Eigen vectors, Properties, Cayley-Hamilton Theorem, Orthogonal transformation, Diagonal form, Quadratic form, Canonical form. **Calculus:** Curvature, Centre and radius of curvature, Circle of curvature, Evolutes, Envelopes, Evolute as envelope of normals, Partial derivatives, Euler's theorem, Total derivatives, Jacobians, Taylor's expansion, Maxima and minima, Double integrals, Triple integrals, Area as double integral, Volume as triple integral.

Reference Books:

1. Ramana B.V, " Higher Engineering Mathematics", Tata McGraw Hill Publishing House, New Delhi, 2007.
2. Glyn James, " Advanced Engineering Mathematics", 7th Edition, Pearson Education, 2007.
3. Jain R.K and Iyenger S.R.K, " Advanced Engineering Mathematics" 3rd Edition, Narosa Publishing House, 2007.
4. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition), Khanna Publisher, New Delhi, 2012.
5. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
6. H.K.Dass., "Advanced Engineering Mathematics", (18th Revised Edition), S.Chand & Co., New Delhi, 2008

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16MA2003 QUANTITATIVE TECHNIQUES

Credit 3:1:0

Course Objectives:
- To enable the students to acquire knowledge of matrices and sets.
- To provide the students about the concepts of financial analysis.
- To teach the students about the statistical parameters.

Course Outcomes:
Ability to
- apply matrix techniques to the Business models.
- use statistical tools.
- acquire the knowledge in applications of the index numbers.

Course Descriptions:
Matrices: Introduction, Types of matrices, Operations of matrices, Determinants, Rank of a square matrix, Simultaneous linear equations. **Set theory**: Introduction, Operations of sets, Venn Diagrams, Relations and functions. **Problems on Finance**: Mathematics of Finance, Simple and Compound Interests. **Statistics:** Meaning, Scope, Limitations of Statistics, Data Collection, Presentation of data by Diagrammatic and Graphical Methods, Formation of Frequency Distribution, Measures of Central tendency, Measures of deviations, Measures of Variation, **Time Series:** Methods of Measuring Trend and Index numbers.

Reference Books:

1. J.K Thukral, "Business Mathematics for BBA", Scholar Tech Press, 2015.
2. J.K.Singh, "Business Mathematics", Himalaya Publishing House Pvt Ltd, 2013.

3. Sundaresan and Jayaseelan, “An Introduction to Business Mathematics and Statistical Methods”, Sultan Chand and Sons , 2010.
4. S.P.Gupta , “Statistical Methods”, Sultan Chand and Sons, 2012.
5. R.S.N. Pillai, Mrs. Bhagavathi, “Statistics – Theory and Practice”, Sultan Chand and Sons, 2010.
6. Grewal B.S, “Higher Engineering Mathematics”, (42nd Edition), Khanna Publisher, New Delhi, 2012.

16MA2004 OPERATIONS RESEARCH

Credit 3:1:0

Course Objective:

- To enable the students to learn the techniques of Operations Research
- To know the applications of OR in business management
- To understand the impact of decision making using OR

Course Outcomes:

Ability to

- apply LP models in business problems.
- understand the techniques of Transportation and Assignment problems in Management.
- gain knowledge in decision making problems.

Course Descriptions:

Linear programming: Mathematical formulation, Graphical solution, Simplex method, Duality in linear programming, Applications in management decision making. **Transportation problem**: Introduction, Initial solution, North west corner method, Least cost method, Vogel’s approximation method, Optimal solution, MODI method, Degeneracy in transportation problem. **Assignment problem**: Introduction, Hungarian method, Travelling salesman problem. **Game theory**: Two person zero-sum games, Maximum- minimum principle, Games without saddle points, Mixed strategies, Graphic method. **Queuing theory**: Introduction, (M/M/1):(∞/FIFO) model.

Reference Books:

1. Bhaskar S, “Operations Research”, Anurradha Publications, 2013.
2. Kapoor V.K, “Operations Research”, Sultan Chand & sons, New Delhi, 2013.
3. Vittal P.R, “Operations Research”, Margham Publications, 2012.
4. Kanti Swarup, Gupta and Manmohan, “Operations Research”, Sultan Chand, New Delhi , 2011.
5. Gupta P.K and. Hira D.S, “Operations Research”, Sultan Chand, New Delhi, 2008.

16MA2005 BUSINESS MATHEMATICS

Credits 3:1:0

Course Objectives:

- To enable the students to apply mathematical knowledge to solve business problems.
- To teach the application of mathematics to finance related problems.
- To equip the students with the knowledge of set theory.

Course Outcomes:

Ability to

- apply progression techniques in business models.
- solve the modern business problems using matrices.
- Develop management models using calculus and LP techniques.

Course Descriptions:
Progressions: Numerical sequences, Arithmetic progression, Geometric progression, Summations. **Finance**: Simple and Compound Interests, Effective rate of Interest, Sinking Fund, Annuity, Present Value, Discounting of Bills, True Discount, Banker's Gain**. Set Theory**: Introduction, types of sets, Operations of sets, Relations, Functions, Constants and Variables. **Matrices:** Introduction, Types of matrices, Operations of matrices, Inverse of a Matrix , Rank of Matrix. **Calculus:** Differentiation and integration of Algebraic Functions, e^x and logx , Second Order Derivatives, Maxima and Minima, Integration by Parts. **Linear Programming Problem:** Introduction, Mathematical formulation of an LPP, Solving an LPP by Graphical Method.

Reference Books:

1. Navanitham P.A, "Business Mathematics & Statistics", Jai Publishers, Trichy, 2013.
2. Sundaresan and Jayaseelan, "Introduction to Business Mathematics", Sultan Chand & Co Ltd, New Delhi, 2010.
3. Sanchetti D.C and Kapoor V.K, "Business Mathematics", Sultan Chand & Co Ltd, New Delhi, 2014.
4. Ranganath G.K, Sampamgiram C.S and Rajan Y, "A Text book of Business Mathematics", Himalaya Publishing House,2014.
5. Jayaprakash Reddy R, "Business Mathematics", APH Publishing Corporation, 2012.

16MA3001 MATHEMATICAL THEORY OF ELASTICITY

Credits: 3:1:0

Course Objectives:
To impart knowledge on
- Stress, strain and Hook's law.
- Bending and Torsion.
- Thermal stresses and composite material.

Course Outcomes:
Ability to
- Develop the mathematical formulation of Bending and torsion of bar.
- Design the analytical model of axis symmetric problems.
- Model and analyze the composite materials.

Course Descriptions:
Stress and Strain: The state of stress at a point-normal and shear stress-the plane stress-Differential equations of equilibrium. Deformations-rectangular strain-Interpretation of $\gamma_{xy},\gamma_{yz},\gamma_{xz}$, Stress–strain relations for linearly elastic solids- Generalized statement of Hooke's Law- Stress–strain relations for isotropic materials. **Bending and Torsion:** Straight beams and asymmetrical bending-Bending of curved beams(Winkler-Bach Formula) Torsion of general prismatic bars-Solid sections-Circular and elliptical bars-Rectangular bars-Thin-walled tubes. **Axisymmetric problems**: Stresses in composite tubes-shrink fits-Stresses due to gravitation, Rotating disks of uniform and variable thickness-Rotating shafts and cylinders. **Thermal stresses:** Thermo elastic stress, Strain relations, Equations of equilibrium, Strain-displacement relations, Some general results-Thin circular disk: Temperature symmetrical about centre-Long circular cylinder. **Introduction to composite materials:** Stress-Strain Relations-Basic cases of elastic symmetry-Laminates-Ply stress and ply strain-Micro mechanics of composites-Pressure vessels-Transverse Stresses.

Reference Books:
1. Srinath,L.S, "Advanced mechanics of solids", McGraw Hill Education India Pvt Ltd, 18th Edition,2014.
2. Arthur P. Boresi, Ken P. Chong, James D. Lee, "Elasticity in Engineering Mechanics", 3rd Edition, John Wiley &Sons, Inc., 2011.
3. Irving, H, Shames and James, M.Pitarresi, "Introduction to Solid Mechanics", Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
4. Martin, H, Sadd, "Elasticity, Theory, Applications & Numerical", Elsevier, 2005.
5. Wang, C.T, "Applied Elasticity", McGraw–Hill Co., New York, 1993.
6. Sokolnikoff, I.S, "Mathematical theory of Elasticity", Krieger Publishing Company,1983.
7. Verma, P. D. S, "Theory of Elasticity", Vikas Publishing House Pvt. Ltd., New Delhi, 1997.

16MA3002 SEMIGROUPS OF LINEAR OPERATORS AND APPLICATIONS

Credits: 3:1:0

Course Objectives:

To impart knowledge on

- The fundamental concepts of semigroups.
- The application of abstract Cauchy problem.
- The idea of nonlinear evolution equations.

Course Outcomes:

Ability to

- To get knowledge in applications of semigroup Theory to partial differential equations.
- To understand the concept of perturbations and approximations.
- To get knowledge in applications of nonlinear evolution equations.

Course Descriptions:

Bounded linear operators: Uniformly continuous semigroups of bounded linear operators, Strongly continuous semigroups of bounded linear operators, The Hille-Yosida theorem, The Lumer Philips theorem. S**emigroups of compact operators:** Semigroups of compact operators, Differentiability, Analytic semigroups, Fractional powers of closed operators. P**erturbations and approximations:** Perturbations by bounded linear operators, Perturbations of infinitesimal generators of analytic semigroups, perturbations of infinitesimal generators of contraction semigroups. **Abstract cauchy problem:** The homogeneous initial value problem, The inhomogeneous initial value problem, Regularity of mild solutions for analytical semigroups. **Nonlinear evolution equations:** Lipschitz perturbation of linear evolution equations, Semilinear equations with compact semigroups, Semilinear equations with analytic semigroups.

Reference Books:
1. Reinhard Racke, "Lectures on Nonlinear evolution equations: Initial value problems", Springer International publishing, Switzerland, 2015.
2. Hector O. Fattorini and Adalbert Kerber, "The Cauchy Problem", Cambridge University Press, 2010.
3. Balachandran. K and Dauer J.P, "Elements of Control Theory", Narosa Publishing, New Delhi, 2012.
4. Klaus-Jochen Engel, Rainer Nagal, "One-parameter semigroups for linear evolution equations", Springer-Verlag, New York, 2000.

5. Curtain R.F and Zwart H, "Introduction to infinite Dimensional Linear Systems Theory", Springer-Verlag, New York, 1995.
6. Goldstein J.A, "Semigroups of Linear Operators and Applications", Oxford University Press, New York, 1985.
7. Pazy.A , "Semigroups of Linear Operators and Applications to Partial Differential Equations", Springer-Verlag, New York, 1983.

16MA3003 COMPUTATIONAL METHODS AND APPLICATIONS

Credits 3:0:0

Course Objectives:

- To impart mathematical and computing knowledge to address problems in environmental and water resources engineering
- To develop skills in computational techniques and programming for developing and validating simple models

Course Outcomes: Ability to

- understand the concepts of probability distributions, numerical and computational methods
- assess, predict and forecast parameters using soft computing techniques
- solve the engineering problems using the learnt concepts

Course Descriptions:

Review of basic concepts of probability and probability distributions; discrete and continuous probability distributions, parameter estimation, hypothesis testing, goodness of fit tests, Chi-square test and KS test, **regression and correlation**: simple linear and multiple linear regression, curve fitting, evaluation of regression, confidence limits, histogram; scatter diagram. **partial differential equations**: classification, nature of problems, concepts of finite difference method, finite difference schemes: solution of parabolic equations, pollutant transport, solution of elliptical equations, solution of Laplace equation and Poisson equation, flow through porous media, concepts of finite volume method; **soft computing techniques**: basics of artificial neural networks, fuzzy logic and their application in environmental and water resources management; **data reduction technique**: factor analysis; application examples in environmental and water resources engineering.

References:

1. Rastogi, A.K., "Numerical Groundwater Hydrology", Penram International Publishing (India), 2006
2. Rao,S.S., "Applied Numerical Methods for Engineers and Scientists", Prentice-Hall, 2002.
3. Hoffman, J.D., , **"**Numerical Methods for Engineers and Scientists**",** CRC Press, Special Indian Edition , 2011.
4. Kotteguda, N.T. and Renzo Resso, "Statistics, Probability and Reliability for Civil and Environmental Engineers**"**, McGraw Hill Companies Inc., New York, (1998).
5. Schilling, R.J., and S.L. Harris, "Applied Numerical Methods for Engineering**",** CENGAGE Learning, India Edition, (2007).
6. Stephen A, T., "Hydrology for Water Management", A.A.Balkema Rotten Publications,1999.

16MA3004 APPLIED OPERATIONS RESEARCH

Credits: 3:1:0

Course Objectives:

- To understand the systematic approach to allocate scare resources and optimising people, materials and money
- To take managerial decision scientifically.

Course Outcomes:

On completion of this course, the student will be able to

- Develop linear programming
- Determine optimal solutions to a variety of mathematical programming problems, and
- Present managerial recommendations based on optimal solutions.

Course Descriptions:

Linear Programming: Mathematical formulation of a LPP, Graphical Method, Simplex method - Two Phases Simplex Method, Artificial Variable Technique, Method Application to management decisions. **Transportation Problem:** Initial basic feasible solution, NWC method, Least Cost Method, Vogel's Method, MODI, moving towards optimality without Degeneracy **Assignment problem:** Introduction, Hungarian Method & problems, Sequencing and Replacement Model: Sequencing problem, processing of n jobs through 2 machines, 3 machines, - Replacement of items that deteriorate gradually with time, without time that fails completely – Individual & group replacement .

Queuing Theory: Introduction, (M | M | 1): (infinity | FIFO). **Decision Theory :** Frame work, pay off tables – decision criteria, Decision trees, Network Models, Network models for project analysis CPM, network construction and time analysis, cost time trade off, PERT, problems - crashing network, problems

References:

1. Paneer Selvam, "Operations Research", PHI learning Indian (P) ltd, 2nd Edition, 2011.
2. S.D.Sharma, "An Introduction – Fundamentals of Operations Research".
3. Kanti Swarup, Gupta and Manmohan, "Operations Research", Sultan Chand and Sons, 15th Edition, 2010.
4. J K Sharma, "Operations Research Theory & Applications", Macmillan, 4th Edition, 2009.
5. Hamdy A Taha, "Operations Research", Pearson, 8th Edition, 2008.
6. Goel B.S.,Mittal S.K. "Opearations Research", (19th Edition) Pragati Prakashass, 2002.
7. Winston, "Operations Research, Applications and algorithms", Cenagage Learning, 4th Edition,2004.
8. Srinivasan G, "Operations Research", Eastern Economy Edition, 1st Edition, 2007.

16MA4001 RESEARCH METHODOLOGY

Credits : 3:0:0

Objectives

- To introduce various concept of Research Methodology
- To study the techniques and tools for research
- To understand the ethics in research and prepare reports

Outcomes

- Review the current research based on literature and identify a research gap, define research problem, formulate hypothesis and methodology for research

- Gain hands on experience in the Usage of various techniques and statistical tools for research
- Gain competency in writing literature review article/conference

Course Description

Research problems, types – basic and applied-formulation of research problem, research process, literature review, methods of research and experimental design- types of sample design, Measurement and scaling techniques, Analysis and Interpretation of data, Statistics for research,- measures of central tendency, dispersion, skewness, correlation and regression analysis, source of error in measurement, testing of hypothesis, manuscript / thesis writing – report presentation, research ethics.

References:

1. Kothari C.R, 'Research Methodology, Methods and Techniques' 2nd edition, New Age International (P) Ltd, publishers, New Delhi (2004)
2. Ranjit Kumar, 'Research Methodology', Sage Publications, London, New Delhi (2006)
3. Panner Selvam R, 'Research Methodology', Prentice Hall of India, New Delhi, 2004
4. Abdhul Rahim F, Thesis writing: Manual for all Researchers, New Age International (2007)
5. Geoffrey R. Marczyk, 'Essentials of Research Design and Methodology', Wiley, (2005)

LIST OF SUBJECTS

Sub. Code	Name of the Subject	Credits
15MA3001	Algebra	3:1:0
15MA3002	Ordinary Differential Equations	3:1:0
15MA3003	Classical Mechanics	3:1:0
15MA3004	Real Analysis	3:1:0
15MA3005	Complex Analysis	3:1:0
15MA3006	Linear Algebra	3:1:0
15MA3007	Topology	3:1:0
15MA3008	Partial Differential Equations	3:1:0
15MA3009	Field Theory	3:1:0
15MA3010	Advanced Calculus	3:1:0
15MA3011	Numerical Analysis	3:1:0
15MA3012	Functional Analysis	3:1:0
15MA3013	Calculus of Variations and Integral Equations	3:1:0
15MA3014	Tensor Algebra and Tensor Calculus	3:1:0
15MA3015	Control Theory	3:1:0
15MA3016	Differential Geometry	3:1:0
15MA3017	Mathematics for Competitive Examinations	3:0:0
15MA3018	Probability and Distributions	3:1:0
15MA3019	Stochastic Processes	3:1:0
15MA3020	Formal Languages and Automata Theory	3:1:0
15MA3021	Fuzzy Set Theory and its Applications	3:1:0
15MA3022	Research Methodology and Biostatistics	3:0:0

15MA3001 ALGEBRA

Credits: 3:1:0

Course Objectives:

To provide the students with the concept and the understanding in

- Number Theory,
- Group Theory,
- Ring Theory.

Course Outcomes:

Students will be able to have knowledge in

- Fundamental Theorem of Arithmetic,
- Fundamental Theorem on Finite Abelian Groups,
- Unique Factorization Theorem.

Course Contents:

Number Theory: Divisibility in Integers, Division Algorithm, Euclidean Algorithm, Primes, Fundamental Theorem of Arithmetic, Congruences, Basic Properties of Congruence's, Linear Congruences, Chinese Remainder Theorem, Fermat's Theorem, Wilson's Theorem, Euler's Phi Function, Primitive Roots. **Group Theory**: Sylow's Theorem for Abelian Groups, Cayley's Theorem, Permutation Groups, Class Equations, Sylow's Theorem, Direct Products, Fundamental Theorem on Finite Abelian Groups. **Ring Theory:** Ideals and Quotient Rings, Euclidean Ring, Principal Ideal Ring, Unique Factorization Theorem, Ring of Gaussian Integers, Introduction to Fields.

Reference Books:

1. Herstein I.N, "Topics in Algebra", Second Edition, Wiley India (P) Ltd., 2009.
2. John B.Fraleigh, "A First Course in Abstract Algebra", 7th Edition, Pearl Books, 2008.
3. David M.Burton, "Elementary Number theory", 7th Edition, McGraw-Hill Education(India) PVT.LTD., 2013
4. Alan Baker, "A Comprehensive course in Number theory", Cambridge University Press, 2013.
5. M K Sen, Shamik Ghosh, Parthasarathi Mukhopadhyay, "Topics in Abstract Algebra", University Press, 2006.
6. Ivan Niven , Herbert S.Zuckerman , Hugh L Montgomery , "An Introduction To The Theory Of Numbers", 5th Edition, Wiley India Pvt Ltd, 2008.

15MA3002 ORDINARY DIFFERENTIAL EQUATIONS

Credits: 3:1:0

Course Objectives: To equip the students with the knowledge in

- Linear Differential Equations,
- Nonlinear Differential Equations,
- Boundary Value Problems

Course Outcomes: Students will be able to know the applications of

- Picard's Theorem,
- Gronwall's Inequality,
- Sturm-Liouville Problem

Course Contents:

Systems of Linear Differential Equations, Existence and Uniqueness Theorem, Fundamental Matrix, Non homogeneous Linear Systems, Successive Approximations, Picard's Theorem, Examples, Fixed Point Method, Analysis and Methods of Nonlinear Differential Equations, Existence Theorem, Extremal Solutions, Upper and Lower Slutions, Monotone Iterative Method and Method of Quasilinearization, Gronwall's Inequality, Bihari's Inequality,Variation of Parameters(Nonlinear Version), Boundary Value Problems, Sturm-Liouville Problem, Green's Functions, Applications of BVP, Picard's Theorem, Stum's Comparision Theorem.

Reference Books:

1. Deo S.G, Lakshimikantham V and Raghavendra V, "Textbook of Ordinary Differential Equations", 2nd Edition, Tata McGraw-Hill Ltd., 2009.
2. Coddington E.A, "An introduction to Ordinary Differential Equations", Prentice Hall of India Ltd., New Delhi, 2009.
3. Jordan D.W and Smith P, "Nonlinear Ordinary Differential Equations: An introduction for Scientists and Engineers", 4th Edition, Oxford University press, 2009.
4. Ravi P, Agarwal and Donal O'regan, "An Introduction to Ordinary Differential Equations", Springer, 2012.
5. Henry Ricardo, " A Modern Introduction to Differential Equations", Houghton Miffince, 2002.
6. George F. Simmons, "Differential Equations with Applications and Historical notes", TMH, 1991.

15MA3003 CLASSICAL MECHANICS

Credits: 3:1:0

Course Objectives:

To teach the students about basic concepts in

- Particle Dynamics,
- Lagrangian and Hamiltonian Formulations,
- Variation Techniques,
- Dynamics of a Rigid Body.

Course Outcomes:

Students will be able to derive

- Lagrange's Equations of Motion of a Particle,
- Hamilton's Equations,
- Euler's Dynamical Equations for the Motion of a Rigid Body.

Course Contents:

Particle Dynamics: Basic Concepts, Constraints, Generalized Coordinates, Virtual Displacement, Virtual Work, D'Alembert's Principle. **Lagrangian and Hamiltonian Formulations:** Lagrange's Equations, Rayleigh Function, Galilean Transformation, Legendre Transformation, Hamilton's Equations, Ignorable Coordinates, Conservation Laws. Small Oscillations: Stable and Unstable Equilibrium, Formulation of the Problem, The Orthogonality of Eigen Vectors, Normal Coordinates. **Variation Techniques:** Hamilton's Principle, Principle of Least Action. **Dynamics of a Rigid Body:** The Inertia Tensor, Angular Momentum, The Eulerian Angles, Euler's Dynamical Equations for the Motion of a Rigid Body, Motion of a Symmetrical Top.

Reference Books:

1. Herbert Goldstein, Charles P.Poole, Jhon Safko, "Classical Mechanics", Pearson Education, 2012.
2. Vimal Kumar Jain, " Classical Mechanics", Ane Books Pvt. Ltd., 2009.
3. Gupta S.L, Kumar V, Sharma H.V, " Classical Mechanics", Pragati Prakashan, 2008.
4. Sankara Rao K, " Classical Mechanics", PHI, 2005.
5. Greenwood D.T, "Classical Dynamics", PHI, New Delhi, 1997.

15MA3004 REAL ANALYSIS

Credits: 3:1:0

Course Objectives:

To familiarize the students about the basic concepts in

- Real Number System,
- Set Theory,
- Euclidean Space

Course Outcomes:

Students will be able to understand

- The Archimedean Property,
- Bolzona –Weierstrass Theorem,
- Uniform Convergence.

Course Contents:

Real Number system: Axioms, Least Upper Bound and Greatest Lower Bound , Archimedean property, Cauchy-Schwarz inequality. **Some Basic Notions of Set Theory**: Relations and Functions, Countable and uncountable sets. **Euclidean Space R^n**: Bolzona-Weierstrass Theorem, Cantor Intersection Theorem, Heine-Borel covering Theorem, Continuity, Uniform Continuity, Differentiability, Mean value theorems, Sequence and series of functions, Uniform convergence, Uniform convergence &Differentiation.

Reference Books:

1. Apostol T.M, "Mathematical Analysis", Second Edition, Narosa Publishing House, 2009.
2. Malik S.C, Savita Arora, "Mathematical Analysis", Third Edition, New Age International Ltd., 2008.
3. Royden H and Patrick Fitzpatrick, "Real Analysis", 4th Edition, Macmillan, New York, 2010.
4. Walter Rudin," Principles of Mathematical Analysis", Tata McGraw Hill, 2013.
5. Bali N.P, "Real Analysis", Lakshmi Publications, 2009.

15MA3005 COMPLEX ANALYSIS

Credits: 3:1:0

Course Objectives:

- To provide the students with the understanding of basic concepts in Analytic functions.
- To equip the students with the knowledge in Contour Integration.
- To present the students about conformal Mappings and applications

Course Outcomes:

- Students will be able to understand the applications of complex variables to other branches of mathematics.
- Knowledge in finding the use of conformal mappings to Physics and Engineering fields.
- Students are able to develop mathematical models using the knowledge acquired in complex analysis.

Course Contents:

Analytic functions: Derivatives of Complex Valued Functions,C-R Equations, Differentiability and Uniqueness of Power Series. **Elementary Functions:** The Exponential Function, Trignometric Function,Complex Hyperbolic Functions. **Complex Integration:** Contour Integration, Cauchy's Integral formula, Uniqueness Theorem, Maximum Modulus Theorem, Simply Connected Region, Singularities, Laurent's Series Expansion, **The calculus of Residues:**– Evaluation of Residues, Application of Residue theorem, Evaluation of Definite Integrals,Summation of Series, Conformal Mappings, Schwarz–christoffel Transformation, Special Transformations, Bilinear Transformations.

Reference Books:

1. Anuradha Gupta, "Complex Analysis", Ane Books Pvt. Ltd, New Delhi, 2011.
2. James Ward Brown, Ruel V. Churchill, "Complex Variables and Applications", McGraw Hill pvt.Ltd., 2009.
3. Lars Ahlfors V, "Introduction to the Theory of functions of a Complex Variable", (3rd edition) 2nd Reprint, McGraw Hill Co., New York, 2013.
4. Tang K.T, "Mathematical Methods for Engineers and Scientists: Complex Analysis, Determinants and Matrices", Springer, 2007.
5. Dube K.K, "Fundamentals of Complex Analysis, Theory and Applications", International publishing house pvt.ltd, 2009.

15MA3006 LINEAR ALGEBRA

Pre-Requisite: 15MA3001 Algebra

Credits: 3:1:0

Course Objectives:
To develop the skills of the students in

- Vector Spaces,
- Linear Transformations,
- Cononical forms,
- Algebra of Matrices

Course Outcomes:
Students will be able to enhance their problem solving techniques in

- Finding Eigen values and Eigen vectors,
- Evaluating Determinants,
- Matrix computations.

Course Contents:
Vector Spaces: Basic Concepts, Linear Independence, Bases and Dimension. **Linear Transformations**: Algebra of Linear Transformations, Characteristic Roots, Minimal Polynomials, Characteristic Vectors, Matrix Representation of Linear Transformations. **Canonical forms:** Triangular Forms, Nilpotent Transformations, Jordan Forms, Rational Canonical Forms. **Algebra of Matrices**: Trace and Transpose, Determinants, Real Quadratic Forms, Classification of Quadratic Forms, Reduction, Sylvester's Law, Rank and Signature**.**

Reference Books:

1. Herstein I.N, "Topics in Algebra", Second Edition, Wiley India (P) LTD., 2009.
2. Kenneth Hoffman and Ray Kunze, "Linear Algebra", Second Edition, Prentice Hall of India Private Limited, 2005.
3. Jimmie Gilbert, "Linear Algebra and Matrix Theory", First Edition, Academic Press, 2005.
4. Jin Ho Kwak and Sungpyo Hong, "Linear Algebra", Second Edition, Birkhauser Publication, 2005.
5. Klaus Janich, "Linear Algebra", First Indian Reprint, Springer Publication, 2004.
6. Seymour Lipschutz and Marc Lars Lipson, "Theory and Problems of Linear Algebra", Third Edition, Tata McGraw – Hill Publishing Company Ltd, 2006.

15MA3007 TOPOLOGY

Credits: 3:1:0

Course Objectives:
To discuss the students with the basic concepts and understanding in

- Metric Spaces,
- Topological Spaces,
- Applications of Topology

Course Outcomes: Students will be able to apply the notion of topology to

- Geometry,
- Algebra,
- Fixed Point Theorem.

Course Contents:
Introduction: The Nature and Origin of Topology**,** Review of the Concepts in Sets and Functions. **Metric Spaces**: Review of the Basic Concepts**,** Continuous Functions, Complete Metric Spaces. **Topological Spaces:** Basic concepts, Basis, Subbasis, Continuity and topological Equivalence, Subspaces. Connectedness, Compactness, Product Spaces, Comparison of Topologies, Quotient Spaces. **Separation axioms:** T_0, T1, T2 - Spaces, Regular Spaces, Normal spaces, Separation by Continuous Functions. **Algebraic Topology:** Nature, The Fundamental Group, Examples, The Brouwer Fixed Point Theorem, Categories and Functors. **.**

Reference Books

1. Fred H.Croom, “Principles of Topology”, Cengage Learning, 2009.
2. Paul L.Shick, “Topology: Point set and Geometric”, Wiley Inter Science, 2013.
3. James R.Munkres, ”Topology”, Second edition, Pearson Prentice Hall, 2008.
4. Murdeshwar M.G, “General Topology”, New Age International Publisher, 2008.
5. Malik A.K,and Singh S.R, “Topology”, International Publishing House Pvt.Ltd. 2012.
6. Stephen Willard, “General Topology”, Dover Publications Inc., 2004.

15MA3008 PARTIAL DIFFERENTIAL EQUATIONS

Pre-Requisite: 15MA3002 Ordinary Differential Equations

Credits: 3:1:0

Course Objectives:
To train the students in solving the problems of

- First order partial differential equations,
- Second order partial Differential equations,
- Wave and Heat equations

Course Outcomes: Students will be able to familiarize

- Cauchy Method of Characteristics,
- Charpit's Method,
- Separation of variables method,
- Method of Eigen Functions.

Course Contents:
First Order PDEs: Lagrange's Method, Cauchy Problem for First Order Partial Differential Equations, First Order Nonlinear Equations, Cauchy Method of Characteristics, Compatible Systems, Charpit's Method. **Second Order PDEs:** Classifications, Canonical Forms, Derivation of Laplace, BVP, Separation of Variables, Dirichlet Problem, Solution of Laplace Equation in Cylindrical and Spherical Coordinates, Diffusion Equation, Dirac-Delta Function, Separation of Variables Method, Solution of Diffusion Equation in Cylindrical and Spherical Coordinates, One-Dimensional Wave Equation, Vibrating String, Variable Separable Solution, Two Dimensional Wave Equation, Method of Eigen Functions.
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Reference Books:

1. Sankara Rao K, "Introduction to Partial Differential Equations", 3rd Edition, PHI Learning Pri. Ltd., 2011.
2. Hillen T, Leonard I.E and Van Roessel H, "Partial Differential Equations", Wiley, 2012.
3. Jianhong WU, "Theory and Applications of Partial Differential Equations", Springer, 2005.
4. Victor Henner, Tatyana Bolozerova and Mikhail Khenner, "Ordinary and Partial Differential Equations", A K Peters/CRC Press, 2013.
5. Robert C.Mcowen, "Partial Differential Equations: Methods and Applications", Pearson Education Asia, 2004.
6. Sneddon I.N, "Elements of Partial Differential Equations". Dover Publications, 2006.

15MA3009 FIELD THEORY

Pre-Requisite: 15MA3001 Algebra.

Credits: 3:1:0

Course Objectives: To empower the students with knowledge and understanding in

- Polynomial Rings,
- Extension of Fields,
- Golois Theory.

Course Outcomes: Students will be able to understand the proof techniques in

- Wedderburn Theorem on Finite Division Ring,
- Eisenstein Irreducible Criterian,
- Solvability by radicals.

Course Contents:

Axioms of the fields, Infinite Fields and Finite Fields , Wedderburn's Theorem on Finite Division Rings, Polynomial Rings, The Division Algorithm, Polynomial Rings over the Rational Field, Primitive Polynomials, Gauss Lemma, Eisenstien Irreducible Criterian, Extension of Fields, Algebraic Extension, Finite Extension, Minimal Polynomial, Roots of Polynomials, Splitting Field, Construction with Straight Edge and Compass, Simple Extension , Galois Theory, Galois Group, Fixed Field, Normal Extension, Solvability by Radicals, Galois Group over Rationals.

Reference Books:

1. Herstein I.N, "Topics in Algebra", Second Edition, Wiley India (P) LTD., 2009.
2. Joseph A.Galilean, "Contemporary Abstract Algebra", Cengage learning, 2014.
3. Joseph Rotman, "Galois Theory", Second Edition, Springer, 2005.
4. Bhattacharya P.B, Jain S.K, Nagpaul S.R, " Basic Abstract Algebra", Second Edition, Cambridge University Press, 2012.
5. John M.Howie, "Fields and Galois Theory", Springer, 2008.

15MA3010 ADVANCED CALCULUS

Pre-Requisite: 15MA3004 Real Analysis.

Credits: 3:1:0

Course Objectives: To equip the students with the basic concepts and understanding in
- Riemann Integration,
- Improper integrals,
- Lebesque Integrals,
- The Directional Derivative.

Course Outcomes: Students will be able to strengthen their knowledge in
- Differentiation & Integration,
- Uniform Convergence,
- Convergence Theorems,
- Inverse & Implicit Function Theorems.

Course Contents:
Functions of Bounded Variation and Rectifiable Curves, Riemann-Stieltjes Integral, Reduction to a Riemann Integral, Differentiation under the Integral Sign, Criteria for Existence of Riemann Integrals, Uniform Convergence and Integration, Lebesgue Integral, Convergence Theorems, Improper Riemann Integrals, Measurable Functions, Measurable Sets on the Real Line, Riesz-Fischer Theorem, The Directional Derivative, Directional Derivative and Continuity, the Total Derivative, The Total Derivatives Expressed in Terms of Partial Derivatives, Inverse Function Theorem, Implicit Function Theorem.

Reference Books:

1. Apostol T.M, " Mathematical Analysis", Second Edition, Narosa Publishing House, 2009.
2. Malik S.C, Savita Arora, " Mathematical Analysis", Third Edition, New Age international Ltd., 2008.
3. Royden H and Patrick Fitzpatrick, "Real Analysis", 4th Edition, Macmillan, New York, 2010.
4. Bali N.P, "Real Analysis", Lakshmi Publications, 2009.
5. Walter Rudin, "Principles of Mathematical Analysis", Third Edition, McGraw-Hill, New York, 2013

15MA3011 NUMERICAL ANALYSIS

Pre-Requisite: 15MA3002 Ordinary Differential Equations,
15MA3008 Partial Differential Equations,
15MA3006 Linear Algebra.

Credits: 3:1:0

Course Objectives:

- To derive appropriate numerical methods to solve algebraic and transcendental equations,
- To develop appropriate numerical methods to solve a linear system of equations,
- To code various numerical methods in a modern computer language,

Course Outcomes: Students will be able to

- approximate a function using an appropriate numerical method,
- perform an error analysis for a given numerical method,
- calculate a definite integral using an appropriate numerical method.

Course Contents:

Numerical Solutions of Algebraic and Transcendental Equations: Method of Iteration and Newton-Raphson Method, Rate of Convergence. **Solutions of Systems of Linear Algebraic Equations**: Gauss Elimination, LU Decomposition and Gauss-Seidel Methods. **Interpolation:** Finite Differences, Lagrange Interpolation Formulae, Error in the Formula, Hermite Interpolation Formulae, Spline Interpolations, Linear Splines, Quadratic Splines and Cubic Splines. **Numerical Calculus:** Numerical Differentiation, Errors, Cubical Spline Method, Numerical Integration, Trapezoidal Rule, Simpson's one-third Rule, Simpson's Three-Eighth Rule, Boole's and Weddle's Rule, Use of Cubic Splines, Numerical Solutions of ODEs using Picard, Euler, Modified Euler, and Runge Kutta Methods, Predictor – Corrector Method.

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Reference Books:

1. Sastry S.S, "Introductory Methods of Numerical Analysis", PHI, 2005.
2. Richard L.Burden, Douglas Faires J, "Numerical Analysis", 9th edition, Cengage Learning India Private Limited, 2012.
3. Samuel D.Conte, Carl De Boor, "Elementary Numerical Analysis: An Algorithmic Approach", Third Edition, TMG, 2009.
4. Madhumangal Pal, "Numerical Analysis for Scientists and Engineers: Theory and C Programs", Narosa Publishing House, 2011.
5. Rama B.Bhat, Chakraverty S, Numerical Analysis in Engineering, Narosa Publishing House, 2004

15MA3012 FUNCTIONAL ANALYSIS

Pre-Requisite: 15MA3004 Real Analysis, 15MA3007 Topology, 15MA3006 Linear Algebra.

Credits: 3:1:0

Course Objectives: To provide the students with the concepts and the understanding in

- Banach spaces,
- Operators & Functionals,
- Hilbert spaces.

Course Outcomes: Students will be able to have Knowledge in Applications of

- Hahn-Banach Theorem,
- Open Mapping Theorem,
- Banach Fixed Point Theorem,
- Orthonormal Basis.

Course Contents:

Normed linear spaces: Basic Concepts, Properties, Banach Spaces, Linear Operators, Bounded and Continuous Linear Operators, Linear Functionals, Hahn-Banach Theorem, Uniform boundedness Principle, Open Mapping Theorem, Closed Graph Theorem, Banach Fixed Point Theorem, Applications. **Hilbert Spaces:** Inner Product Spaces, Hilbert Space, Relation Between Banach Spaces and Hilbert Spaces, Orthonormal Basis, Representation of a Functional on a Hilbert Space, Adjoint of an Operator, Normal and Unitary Operators.

Reference Books:

1. Simmons G.F., "Introduction to Topology and Modern Analysis", Tata McGraw Hill Publishing Company, 2009.
2. Thambar Nair M. "Functional Analysis: First Course", PHI, 2002.
3. Peter D. Lax, "Functional Analysis", Wiley Publishing Inc. 2014.
4. Francis Hirsch, Gilles Lacombe "Elements of Functional Analysis", Springer, 2010.
5. Kreyszig E., "Introductory Functional Analysis with Applications", John Wiley & Sons, New York, 2001.

15MA3013 CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

Pre-Requisite: 15MA3002 Ordinary Differential Equations, 15MA3003 Classical Mechanics, 15MA3008 Partial Differential Equations, **15MA3006** Linear Algebra.

Credits: 3:1:0

Course Objectives:

- To enlighten the students in solving the problems related with
- Calculus of variations
- Fredholm type integral equations
- Volterra type integral equations

Course Outcomes:

- Students will be able to explore methods for finding maximum or minimum of a functional over a class of functions.
- Students will be able to identify the applications of Calculus of Variations to Engineering & Science.
- Students will have the skills to solve the IVP & BVP using the techniques of Linear Integral Equations.

Course Contents:

Calculus of Variations: The Concepts of Variation and its Properties, Euler–Lagrange's Equation, Necessary and Sufficient Conditions for Extrema, Variational Methods for Boundary Value Problems in Ordinary and Partial Differential Equations, Simple Problems and Simple Applications**. Integral Equations:** Introduction, Linear and Non-linear Integral Equations, Special Kinds of Kernels, Solution of the Integral Equation, Linear Integral Equation of the First and Second kind of Fredholm and Volterra type, Solutions with Separable Kernels. Characteristic Numbers and Eigen Functions, Resolvent Kernel.

Reference Books:

1. Gupta A.S, "Calculus of Variations with Applications", PHI, 2014.
2. Van Brunt, Bruce, "The Calculus of Variations", Springer Publications, 2004.
3. Dr. Ajay Pratap, "Special Functions in Mathematics (Linear integral equations)", University Science Press, New Delhi, 2011.
4. Andrei D. Polyanin, Alexander V. Manzhirov, "Handbook of integral equations", Chapman & Hall/CRC, 2008.
5. Kanwal R.P, "Linear Integral Equations: Theory & Technique", Springer, 2013.
6. Dr. Shanthi Swarup, "Integral equations", 19^{th} edition, Krishna Prakashan Media Pvt Ltd, 2010.
7. Dr. Goyal, "Linear Integral Equations", 19^{th} edition, Jaipur Publishing House, 2010.
8. Elgolts L, "Differential Equations & Calculus of Variation", Mir Publisher, 1977.

15MA3014 TENSOR ALGEBRA AND TENSOR CALCULUS

Pre-requisite: 15MA3006 Linear Algebra, 15MA3016 Differential geometry

Credits: 3:1:0

Course Objectives:
- To generalize the notion of vectors to tensors.
- To give the comprehensive account of the fundamental concepts of tensor algebra and tensor calculus.
- To develop the idea of tensor with respect to certain transformation of coordinates.

Course Outcomes:
- Knowledge in applications of Tensor calculus to Differential geometry, Mechanics and Physics.
- Knowledge in Tensor Calculus for transforming some physical laws into laws of general theory of relativity.

Course Contents:
TENSOR ALGEBRA: Systems of Different orders, Kronecker Symbols, Transformation of coordinates in space, Invariants, Covariant and Contra variant vectors, Tensors of Second Order Mixed Tensors, Zero Tensor, Tensor Field, Algebra of Tensors, Equality of Tensors, Symmetric and Skew-symmetric tensors,Outer multiplication, Contraction and Inner Multiplication, Quotient Law of Tensors, Reciprocal Tensor of Tensor, Relative Tensor, Cross Product of Vectors. **TENSOR CALCULUS:** Riemannian Space, Christoffel Symbols, properties, Covariant Differentiation of Tensors, Riemann-Christoffel Curvature Tensor, Intrinsic Differentiation, Geodesics, Riemannian Coordinates and Geodesic Coordinates.

Reference Books

1. De U.C, Absos Ali Shaikh and Joydeep Sengupta, “Tensor Calculus”, Narosa Publishing House, New Delhi, 2012.
2. Landsberg J.M, “Tensors: Geometry and Applications”, American mathematical Society, 2012.
3. Charle Harper, “ Introduction to Mathematical Physics”, PHI Learning private Limited, New Delhi, 2012.
4. David C.Kay, “Schaum’s Outline of Tensor Calculus”, Schaum’s Outline, Revised Edition, 2011.
5. Springer C.E, “Tensor and Vector Analysis with Applications to Differential Geometry”, Dover Publications.Inc., New York, 2012.

15MA3015 CONTROL THEORY

Pre-Requisite: 15MA3002 Ordinary Differential Equations, 15MA3003 Classical Mechanics, 15MA3008 Partial Differential Equations, 15MA3006 Linear Algebra.

Credits: 3:1:0

Course Objectives:
- To teach the fundamental concepts of Controllability to the students
- To provide the students about the knowledge in Stabilizability
- To motivate the students to know about the Optimal Control

Course Outcomes:
- Students will be able to understand the advanced concept in Control Theory
- Students are able to apply Controllability concept in their subjects
- Students are able to understand the applications of Controllability**.**

Course Contents:
OBSERVABILITY: Linear Systems, Observability Grammian, Constant Coefficient Systems, Reconstruction Kernel, Nonlinear Systems. CONTROLLABILITY: Linear Systems, Controllability Grammian, Adjoint Systems. Constant Coefficient Systems, Steering Function Nonlinear Systems. STABILITY: Stability – Uniform Stability – Asymptotic Stability of Linear Systems - Linear Time Varying Systems – Perturbed Linear Systems – Nonlinear Systems. STABILIZABILITY: Stabilization via Linear Feedback Control – Bass Method – Controllable Subspace – Stabilization with Restricted Feedback. OPTIMAL CONTROL: Linear Time Varying Systems with Quadratic Performance Criteria – Matrix Riccati Equation – Linear Time Invariant Systems – Nonlinear Systems.

Reference Books:

1. K. Balachandran and Dauer J.P, “Elements of Control Theory”,Oxford:Alpha Science International, 2012.
2. Katsuhiko Ogata, “Modern Control Engineering”, 5th Edition, Prentice Hall, 2009.
3. Zdzislaw Bubnicki, “Modern Control Theory”, Springer, First Indian Reprint, 2007.
4. Donald E. Kirk, “Optimal Control Theory: An introduction”, Dover publication inc, Dover Edition first, 2004.
5. Thomas A. Hughes, “Measurement and Control Basics”, 4th Edition, International Society of Automation, 2006.

15MA3016 DIFFERENTIAL GEOMETRY

Pre-Requisite: 15MA3002 Ordinary Differential Equations

Credits: 3:1:0

Course Objectives:

- Students will be expected to understand classical concepts in the local theory of curves and surfaces.
- Appreciate the distinction between intrinsic and extrinsic aspects of surface geometry.
- To provide the students with basic tools and competences regarding the analysis and applications of curves and surfaces in 3D.

Course Outcomes:

- Analyse and solve complex problems using appropriate techniques from differential geometry.
- Apply problem-solving with differential geometry to diverse situations in physics, engineering or other mathematical contexts.
- Apply differential geometry techniques to specific research problems in mathematics or other fields

Course Contents:

Theory of Space Curves : Arc-length, Tangent and Osculating Plane, Tangent, Normal and Binormal, The Curvature and Torsion, Intrinsic Equations of Space Curves – Fundamental Existence Theorem – Helices. **Local Intrinsic Properties of Surfaces:** Curves on surfaces Helicoids – Metric on a surface. **Geodesic on a Surface**: Families of Curves, Intrinsic Properties, Geodesics and their Differential equations. Normal property of Geodesics, Existence Theorems, Geodesic Parallels, Geodesic curvature, Gauss Bonnet Theorems, Gaussian curvature, Surface of Constant Curvature.

Reference books

1. Willmore T.J., “An Introduction to Differential Geometry”, Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print).
2. Andrew Pressley, “Elementary Differential Geometry”,Springer, 2004.
3. Thomas F. Banchoff and Stephen T., “Differential Geometry of Curves and Surfaces”, A K Peters/CRC Press, 2010.
4. Thorpe J.A., “Elementary topics in Differential Geometry”, under - graduate Texts in Mathematics, Springer - Verlag ,2004
5. Kumaresan S, “A Course in Differential Geometry and Lie Groups”, Hindustan Book Agency ,2002.

15MA3017 MATHEMATICS FOR COMPETITIVE EXAMINATIONS

Credits: 3:0:0

Course Objectives:

- To train the students for solving problems on Arithmetic and Mensuration.
- To motivate the students to give importance for numerical problems in Competitive Examinations.
- To equip the students with Short Cut Methods to solve the problems on Arithmetical Reasoning.

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Course Outcomes:

Students will be able to get self training on solving problems in

- Elementary Algebra,
- Numbers,
- Data Analysis,
- Reasoning.

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Course Contents:

Problems on HCF,LCM, Prmutation & Combination, Probability, Ratio &Proportion, Percentage, Average, Age Problems, Profit & Loss, Square & Square Root, Cube & Cube Root, Series, Sequences, Fractions, Elementary Algebra, Partnership, Simple & Compound Interests, Time & Work, Work & Wages, Pipes & Cistern, Allegation, Train Problems, Boats & Streams, Elementary Mensuration, Clocks & Calendar, Time & Distance, Height & Distance, Basic Trigonometry, Data Analysis, Mathematical Operations, Divisibility, Number System and Arithmetical Reasoning**.**

References:

1. Praveen R.V, "Quantity Aptitude and Reasoning", PHI, 2012.
2. Aggarwal R.S., "Quantitative Aptitude", 1st Edition, S. Chand & Company Ltd., (New), 2010.
3. Edgar Thorpe, "Course In Mental Ability And Quantitative Aptitude: For Competitive Examinations", 2nd Edition, Tata Mcgraw-Hill Publishing Company Limited, 2000.
4. Arun Sharma, "How To Prepare For Quantitative Aptitude For The CAT", 1st Edition, Tata Mcgraw-Hill Publishing Company Limited, 2003.
5. Mittal P.K, "Numerical Ability And Quantitative Aptitude: For Competitive Examinations", Galgotia Publishers Pvt.Ltd, 2004.

15MA3018 PROBABILITY AND DISTRIBUTIONS

Credits: 3:1:0

Course Objectives:

- To introduce new techniques for carrying out probability calculations and identifying probability distributions.
- Motivate in students an intrinsic interest in statistical thinking.
- Provide a foundation and motivation for exposure to statistical ideas subsequent to the course.

Course Outcomes:

- Knowledge in the technique and applications of probability theory.
- The student is able to understand the significance of the connection between statistics and probability and their applicability to the real world.
- Develop an appreciation for the use of statistics in decision making, and an appreciation of its limitations.

Course Contents:

Probability: Probability Set Function, Conditional Probability, Discrete and Continuous Random Variables, Expectation of a Random Variable, Chebyshev's Inequality. **Multivariate Distributions**: Distributions of Two Random Variables, Conditional Distributions, Correlation and Regression, Independent Random Variables. **Some Special Distributions:** Binomial, Poisson, Normal, Gamma, and Chi-Square Distributions**. Functions of Random Variable:** Sampling Theory, Transformations of Variables of the Discrete and Continuous type, Beta, t and F Distributions, Moment-Generating-Function Technique, The Distributions of $\overline{X}$ and nS^2/σ^2. **Limiting Distributions:** Convergence in Probability, Limiting Moment Generating function, The Central Limit Theorem, Some Theorems on Limiting Distributions.

Reference Books

1. Robert V.Hogg and Allen T.Craig, "Introduction to Mathematical Statistics", Pearson Education, Asia, 5th Edition, 2005.
2. John A.Rice, "Mathematical Statistics and Data Analysis", Thomson Brooks/Cole, Third Edition, 2007.
3. Ramachandran K.M, Chris P.Tsokos, "Mathematical Statistics with Applications", Academic Press,2009.
4. Ajay Goal, Alka Goal, "Mathematics and Statistics", Taxmann Allied Services Pvt. Ltd, 2006.
5. Richard. J. Larsen, Monis L. Marx, "Introduction to Mathematical Statistics & its Applications", 5th Edition, Pearson Education, 2011.

15MA3019 STOCHASTIC PROCESSES

Pre-requisite: 15MA3018 Probability and Distributions

Credits: 3:1:0

Course Objectives:

- To present a systematic introductory account of several principal areas in stochastic processes.
- To attract and interest of students of pure mathematics in the rich diversity of applications of stochastic processes.
- To make the student who is more concerned with application aware of the relevance and importance of stochastic processes.

Course Outcomes:

- Knowledge in applications of stochastic processes to engineering, physics, biology and medicine.
- Knowledge in applications of stochastic processes to psychology and social sciences.
- Knowledge in applications of stochastic processes to other branches of mathematical Analysis.

Course Contents:

Introduction: Specification of Stochastic Processes, Stationery Processes, Martingales. **Markov Chains**: Definition and Examples, Bernoulli Trials, Classification of States and Chains,Non-homogeneous Chains. **Markov Processes:** Poison Process, Birth and Death process, Randomization, Erlang Process, Brownian Motion, Wiener process. Renewal Process, Renewal Theorems, Markov Renewal Equation. **Time Series:** Introduction, Models of Time Series, Power Spectrum, Statistical Analysis of Time Series. **Stochastic Processes in Queuing &Reliability:** Queuing Models**,** Birth and Death processes in Queuing Theory, Markovian Queuing Models, Non-Markovian Queuing Models, Reliability.

Reference Books

1. Samuel Karlin, Howard M.Taylor, " A First Course in Stochastic Processes", Second Edition, Academic Press, 2011.
2. P.W.Jones, P.Smith, "Stochastic Processes An Introduction", Arnold and copublished by Oxford University Press Inc. Newyork, 2009.
3. Erhan Cinlar, "Introduction to Stochastic Processes", Dover Publications, 2013.
4. Roy D.Yates, David J.Goodman, Probability and Stochastic Processes, Second Edition, Wiley India Pvt. Ltd., 2011.
5. J.Medhi, "Stochastic Processes", New Age Science, 3rd Revised edition, 2009**.**
6. Sheldon M. Ross, Introduction to Probability models, 10th Edition, Academic Press, 2009.

15MA3020 FORMAL LANGUAGES AND AUTOMATA THEORY

Credits: 3:1:0

Course Objectives:

To provide the students with the concepts and the understanding in

- Theory of Computation
- Finite Automata
- PDA and Turing Machine.

Course Outcomes:

- Students will be able to have the Knowledge of Machines and languages in relation to Computer Science
- Students will apply their mathematical knowledge in Computer Applications
- Students will have the ability to solve computational problems

Course Contents:

Basic Concepts: Functions, Relations, Graphs and Trees, Languages, Grammars, Automata. **Finite Automata:** Deterministic Accepters and Transition Graph, Languages and DFA, Non - deterministic accepters, Equivalence of NDFA and DFA. **Regular Languages:** Regular Expressions, Regular Grammars, Pumping Lemma, Context-free Languages, Context-free Grammars, Chomsky Normal Form, Greibach Normal Form. **Pushdown Automata**: PDA for CFL, CFG for PDA, Pumping Lemma for CFL's, Decision Algorithms for CFLs, Turing Machines.

Reference Books:

1. Peter Linz, "Introduction to Formal Languages and Automata", Fourth edition, Narosa Publishing House, 2010.
2. Kamala K, Rama R, "Introduction to Formal Languages, Automata Theory and Computation", Pearsorn Education India, 2009.
3. John E.Hopcraft and Jeffrey D.Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, New Delhi, 1987.
4. John.C.Martin, "Introduction to the Languages and the Theory of Computation", Third Edition, Tata McGrawHill, 2003.
5. Sipser M; "Introduction to the Theory of Computation", Singapore: Brooks/Cole, Thomson Learning, 1997.

15MA3021 FUZZY SET THEORY AND ITS APPLICATIONS

Credits: 3:1:0

Course Objectives:

To provide the students about the concepts in understanding

- Fuzzy sets ,
- Fuzzy Numbers,
- Fuzzy Systems
- Fuzzy Decision Making

Course Outcomes:

Students will be familiar with the applications of fuzzy mathematics to

- Controllers,
- Decision Making Systems,
- Neural Networks.

Course Contents:

FUZZY SETS: Introduction, Crisp Sets, Alpha Cuts, Representation of Alpha Cuts, Extension Principle for Fuzzy Sets. OPERATION ON FUZZY SETS: Types of Operations, Fuzzy Complements, Fuzzy Intersections, Fuzzy Unions, t-norms, t-co-norms. FUZZY ARITHMETIC: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations, Interval Analysis, Arithmetic Operations on Fuzzy Numbers, Operations MIN and MAX, Lattice of Fuzzy Numbers, Fuzzy Equations. FUZZY SYSTEMS: General Discussion, Fuzzy Controllers, Fuzzy Systems and Neural Networks, Fuzzy Neural Networks, Fuzzy Automata, Fuzzy Dynamical Systems. FUZZY DECISION MAKING*:* General Discussion, Individual Decision Making, Multiperson Decision Making, Multicriteria Decision Making, Multistage Decision Making.

Reference Books:

1. George J.Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic Theory and Applications", PHI, New Delhi, 2005.
2. Zimmermann H.J., "Fuzzy Set Theory and its Applications", Kluwer Academic Publishers, 2006.
3. Witold Pedrycz and Fernando Gomide, "An Introduction to Fuzzy Sets-Analysis and Design", Prentice-Hall of India Pvt. Ltd, 2005.
4. Hung T.Nguyen, Elbert A.Walker, "A First Course in Fuzzy Logic", Third Edition, Chapman&Hall/CRC, 2009.
5. John Yen Reza Langari, "Fuzzy Logic, Intelligence, Controle and Information", Pearson Education, 2005.
6. M.Ganesh, "Introduction to Fuzzy Sets and Fuzzy Logic", PHI, 2006.

15MA3022 RESEARCH METHODOLOGY AND BIOSTATISTICS

Credits: 3:0:0

Course Objectives:

- This course is designed for imparting knowledge of biostatistics in biological systems
- To develop skill in preparation of reports, writing research communications and thesis interpret and analyze the experimental data using different bio-statistical tools.

Course Outcomes:

- After the completion of the course, students will be able to analyze and apply appropriate statistical tests for a given set of data.
- They will gain the ability to program for analysis of variables in biological systems.

Course Contents:

Methodology: Scientific writing in research- Definition, importance and meaning of research, characteristics of research- Scientific writing- characteristics; Logical format for writing thesis and papers; Research ethics. **Statistics:** Measures of central tendency- mean, median, mode; Measures of deviation- average deviation, standard deviation; correlation, **Testing a Hypothesis:** Null hypothesis, errors, level of significance, tests of significance - Chi-square t-test, F-test and Z-test; ANOVA and correlation studies.

Reference Books:

1. Wayne W. Daniel, "Biostatistics", Seventh edition, Wiley, 2013.
2. Khan and Khanum, "Fundamental of Biostatistics", Ukaaz Publications, 2004.
3. John M. Lachin, "Biostatistical Methods", Willey, 2011.
4. Kothari, C.R., "Research Methodology", Willey Eastern Ltd, 2005.
5. Jonathan Anderson, "Thesis and Assignment Writing", Fourth edition, John Wiley and Sons, 2002.
6. Dass H.K, "Advanced Engineering Mathematics", S. Chand & Company Ltd., 2008.

LIST OF SUBJECTS

Subject Code	Name of the Subject	Credit
13MA304	Research Methodology for Mathematics	4:0:0
13MA305	Analysis and Lattices	4:0:0
13MA306	Advanced Algebra	4:0:0
13MA307	Advanced Optimization	4:0:0
13MA308	Algebraic Topology	4:0:0
13MA309	Banach Algebra and Spectral Theory	4:0:0
13MA310	Mathematical Modeling	4:0:0
13MA311	Fuzzy Sets and Systems	4:0:0
13MA312	Optimization Techniques	4:0:0
14MA1001	Basic Mathematics for Engineering	3:1:0
14MA1002	Calculus and Statistics	3:1:0
14MA2001	Vector Calculus and Complex Analysis	3:1:0
14MA2002	Fourier Series and Applications	3:1:0
14MA2003	Mathematical Transforms	3:1:0
14MA2004	Laplace Transforms, Fourier Series and Transforms	3:1:0
14MA2005	Mathematical Foundation	3:0:0
14MA2006	Numerical Mathematics and Computing	3:1:0
14MA2007	Probability and Random Process	3:1:0
14MA2008	Probability and Statistics	3:1:0
14MA2009	Statistical Data Analysis and Reliability Engineering	3:1:0
14MA2010	Discrete Mathematics	3:1:0
14MA2011	Probability and Queuing Theory	3:1:0
14MA2012	Numerical Methods	3:1:0
14MA2013	Applied Linear Algebra	3:1:0
14MA2014	Fuzzy Sets and Logic	3:1:0
14MA2015	Probability, Random Process and Numerical Methods	3:1:0
14MA2016	Sampling Techniques	3:1:0
14MA2017	Operations Research-I	3:1:0
14MA2018	Operations Research-II	3:1:0
14MA3001	Matrix Computations	3:0:0
14MA3002	Finite Element Methods	3:0:0
14MA3003	Foundations of Mathematics and Statistics	3:0:0
14MA3004	Advanced Calculus and Numerical Methods	3:0:0
14MA3005	Calculus of Variations and Vector Spaces	3:0:0
14MA3006	Graph Theory and Random Process	3:0:0
14MA3007	Applied Statistics	3:0:0
14MA3008	Computational Mathematics	3:0:0
14MA3009	Applied Graph Theory and Queuing Theory	3:0:0
14MA3010	Graph Theory and Algorithms	3:0:0
14MA3011	Biostatistics and Quality Control	3:0:0
14MA3012	Numerical Methods and Biostatistics	3:0:0
14MA3013	Graph Theory and Probability	3:0:0
14MA3014	Fundamentals of Statistics	3:0:0
14MA3015	Operations Research Techniques	3:0:0
14MA3016	Statistics and Numerical Mathematics	3:0:0
14MA3017	Discrete Mathematics	3:0:0
14MA3018	Optimization Techniques	3:0:0

13MA304 RESEARCH METHODOLOGY FOR MATHEMATICS

Credits: 4:0:0

Course Objectives:

- To learn about the introduction to research, literature reviews.
- To learn about research designs and data analysis and various problem solving methods.
- To learn about how to write research papers and presentation methodology.
- To learn about the methods of proof, testing of hypothesis, LaTex and Matlab.

Course Outcome:

- Knowledge in writing research papers.
- Knowledge in Latex text editor to write research papers.
- Knowledge in the uses of Matlab commands.

Unit I

Introduction To Research Methodology: Introduction – Objective of Research – Types of Research – Research Methods Vs Methodology – Criteria of Good Research – Selecting The Problems – Technique Involved In Defining The Problems – Need For Research Design – Different Research Designs.

Unit II

Thesis Writing: Planning The Thesis – Selecting Topics – Reviewing The Literature – Designing The Study and Chapter Outline.

Writing The Thesis: The General Format – Page and Chapter Format – The Use of Quotations – Foot Notes – Tables and Figures – Referencing – Appendixes.

UNIT III

Proof Methods and Induction: Formal Proofs- Direct Proof, Proof By Contradiction, Proof By Cases, Structured Proofs, Paragraph Proofs- Some Illustrations- Counter Examples- False Proofs- Inductive Proofs- Some Illustrations- Double Induction and Strong Induction- Illustrations- Well Ordering- Simple Problems On Recursive Data Types.

Testing of Hypothesis: Basics of Hypothesis- Tests Based on t, F and Chi- Square Distributions.

UNIT IV

LaTex: Introduction To Latex, Sentence and Paragraphs, Document, Sectioning Displayed Materials, Running Latex, Mathematical Formulas, Mathematical Symbols, Defining Comments and Environments.

UNIT V

Matlab: Starting With Matlab - Working In The Command Window, Arithmetic Operations With Scalars. Creating Arrays–One Dimensional Arrays (Vector), Two Dimensional Arrays (Matrix), Mathematical Operations With Arrays-Addition and Subtraction, Multiplication and Built In Math Functions. Function and Function Files-Creating Function File, Using Function File, Examples of Simple Function Files. Three-Dimensional Plots- Line, Mesh and Surface Plots. Polynomials- Value and Roots of Polynomial. Curve Fitting-Curve Fitting With Polynomials, The Poly Fit.

Text Books:

1. C. R. Kothari, “Research Methodology: Methods and Techniques”, New Age International, 2008.
2. J. Anderson, B.H. Durston and M. Poole, “Thesis and Assignment Writing”, Wiley Eastern Limited, New Delhi, 1980.
3. Rajendra Akerkar and Rupali Akerkar, “ Discrete Mathematics”, Pearson, 2008
4. LATEX a document preparation system/Lesile Lamport by Duane Bibby, Second Edition, Addision-Wesely, London(1994).
5. MATLAB an introduction with applications by Amos Gilat, John Wiley&Sons, Singapore, 2004.

Reference Books:

1. A guide to MATLAB by H.Kopka and P.W.Daly, Third Edition, Adision-Wesely, London (1999).
2. Getting started with MATLAB –A quick introduction for Scientists and Engineers by R. Pratap, Oxford University Press, New Delhi,2006.

3. R.Burns, “Introduction to Research Methods”, Addison Wesley Longman, 3rd edition, 1997.

13MA305 ANALYSIS AND LATTICES

Credits: 4:0:0

Course Objective: To provide the students with the concept and the understanding in

- Topological vector spaces.
- Completeness and Convexity in topological vector spaces,
- Duality concept in Banach spaces and Lattices.

Course Outcome: Knowledge in

- the applications of Baire category,
- applications of Open mapping theorem, Bilinear mapping and Holomorphic functions,
- Applications of the Representation theorem for Boolean algebras.

Unit I

Topological Vector Spaces: Introduction – Separation Properties – Linear Mappings – Finite dimensional spaces – Metrization – Boundedness and continuity – Semi norms and Local convexity – Quotient spaces – Examples.

Unit II

Completeness: Baire Category – Baire’s theorem- Equicontinuity- The Banach Steinhaus Theorem – Applications- The Open Mapping Theorem – Applications- The Closed Graph Theorem – Bilinear Mappings.

Unit III

Convexity: The Hahn Banach Theorem – Applications - Weak Topologies – Applications-The weak topology of a topological vector space-Compact Convex sets – Weak* topology-The Krein Milman Theorem-Vector valued integration – Holomorphic Functions.

Unit IV

Banach Spaces: The normed dual of a Normed space – Duality-Second dual of a Banach space– Annihilators – Duals of subspaces and of quotient spaces – Adjoints – Properties-Compact Operators- Spectrum- Applications.

Unit V

Lattices: Definition and Examples of Lattices – Properties of Lattices – Lattices as Algebraic system – Lattice Isomorphism – Bounded, Complemented and Distributive Lattices.
Boolean Algebra: Definitions and Basic Properties – Representation Theorem.

Text Books

1. Walter Rudin “Functional Analysis”, Tata McGraw-Hill Publishing Company Ltd. New Delhi, 2006.
2. Babu Ram, “Discrete Mathematics”, Pearson, Education, New Delhi, 2011.

Reference Books:

1. Semyour Lipschutz and Marc Lipson, “Discrete Mathematics”, Tata McGraw – Hill Publishing Company Limited, New Delhi 2006 (Indian Adapted Edition).
2. Simmons G.F, “ Introduction to Topology and Modern Analysis”, Tata McGraw-Hill Publishing Company Ltd. New Delhi, 2009.

13MA306 ADVANCED ALGEBRA

Credit: 4:0:0

Course Objective: Aiming to provide the basic tools and exposure to the students who intend to pursue research in

- Commutative Ring Theory,
- Module theory,
- Radical Theory.

Outcome: Knowledge in

- Characterization of Prime ideals and Primary Decompositions,
- Applications of Radical Theory,
- Density and Structure Theorems.

Unit I

Rings and Ideals: Definitions and Examples – Ideals – Quotient Rings and Homomorphisms – The Field of Quotients – Minimal and Maximal Conditions – Primary Decomposition – Unique Factorization Domains – Polynomial Rings.

Unit II

The Classical Radical: Nilpotent Ideals and The Radicals – The Radical of Related Rings – Artinian Rings – Direct Sum Decompositions – Ideals In Semi Simple Rings – Matrix Rings – The Wedderburn Theorem.

Unit III

Modules: Preliminaries –Schreier's Theorem-Jordon Holder Theorem- Direct Sum and Free Modules – Fundamental Theorem of Abelian Groups-Projective Modules – Basic tool of Homological Algebra-Homomorphism – Tensor Products – Examples –K-Algebras.

Unit IV

The Jacobson Radical: Definition and Properties of Jacobson Radical – Jacobson Radical Related Theorems – Primitive Rings – Schur's Lemma- Jacobson Density Theorem – Structure Theorem – Corollary-Applications.

Unit V

Radicals: Radical Ideals **-**The Levitzki Radical and its Properties - Brown McCoy Radical and its Properties - Amitsur's Properties – Results of Nagata – Relations Among The Radicals – More About Radical Properties.

Textbook:

1. Mary Gray, "A Radical Approach to Algebra", Addition-Wesley Publishing Company, London, 1970.

Reference Books:

1. Artin M., "Algebra", Prentice Hall of India, 1991.
2. Bhattacharya P.B., Jain S.K. and Nagpaul S.R., "Basic Abstract Algebra" (II Edition) Cambridge University Press, 1997 (Indian Edition).
3. Malik D.S., Mordeson J.N. and Sen M.K., "Fundamentals of Abstract Algebra", McGraw Hill (International Edition), New York. 1997.
4. N. S. Gopalakrishnan, "Commutative Algebra", Oxonian Press, 1984.
5. Irving Kaplansky, "Commutative rings", Allyn and Bacon, 1974.
6. H. Matsumura, "Commutative Ring Theory", Cambridge University Press, 1989

13MA307 ADVANCED OPTIMIZATION

Credit: 4:0:0

Course Objective: To provide the students with the concept and understanding of

- basic concepts in nontraditional optimization Techniques for Analysis and Modeling,
- genetic algorithm,
- Differential evolution algorithm.

Course Outcome: Knowledge in applications of

- optimization techniques,
- optimization using genetic algorithms,
- Evolution algorithm.

UNIT I

Constrained Optimization Algorithms: Kuhn Tucker Conditions- Transformation Methods – Sensitivity Analysis – Direct Search For Constrained Minimization- Variable Elimination Method- Complex Search Method – Random Search Method.

UNIT II

Genetic Algorithms For Optimum: Basic Concepts and Definitions-Fundamental of Genetic Algorithms-Operators – Reproduction – Mutation – Cross Over – Evolution Strategies- Working Principles-Difference Between Gas and Traditional Methods- Similarities Between Gas and Traditional Methods- Gas For Constrained Optimization-Genetic Algorithm For Sequencing –Type Problems – Applications.

UNIT III

Differential Evolution Algorithm and Particle Swarm Optimization-- Differential Evolution Algorithm: Generation of An Initial Population-Generation of A Donor Design – Cross Over Operations To Generate The Trail Design –Acceptance and Rejection of The Trail Design- DE Algorithms**.** Particle Swarm Optimization: Swarm Behavior and Terminology – Particle Swarm Optimization Algorithm and Problems Oriented Towards Research.

UNIT IV

Ant Colony Optimization: Natural Motivation – Ant Algorithm – Network – The Ant – Initial Population – Ant Movement –Ant Tours – Pheromone – Evaporation – Introduction To TABU Search Ant Behavior –ACO Algorithm For Travelling Sales Man Problem – ACO Algorithm For Design Optimization.– Sample Problem**.**

UNIT V

Discrete Variable Optimum Design: Basic Concepts and Definitions-Definition of Mixed Variable Optimum-Classification-Over View of Solution-Branch and Bound Method-Simulated Annehealing-Dynamic Round off Method- Selection of A Method-Adaptive Numerical Method For Discrete Variable Optimization

Text Books:

1. Kalyanmoy Deb, "Optimization for Engineering Design –Algorithms and examples" , Prentice – Hall of India private limited, New Delhi, 2003.
2. Jasbir S. Arora, "Introduction to optimum design", third edition, Elsevier American press, Oxford,UK,2012

Reference Books:

1. Rao. S.S. "Engineering Optimization, Theory and Practice", New age International (p) Ltd., New Delhi. Reprint 2002.
2. Goldberg, D.E., "Genetic Algorithm in Search, Optimization and Machine Learning", Addison – Wesley, 1989.
3. Rajasekaran S and Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm", Prentice Hall of India Pvt. Ltd, Delhi, 2003.

13MA308 ALGEBRAIC TOPOLOGY

Credits: 4:0:0

Course Objective: To provide the students about the concepts in understanding

- Homotopy Theory,
- Fundamental of groups,
- Separation theorems,
- Applications to groups and surfaces.

Course Outcome: Knowledge in

- Homotopy of paths,
- Jordan separation Theorem and Jordon curve theorem,
- Homology of surfaces and construction of compact surfaces.

Unit I

Homotopy: Homotopy of paths - Punctured Plane -The fundamental group- First Homotopy group- Simply Connected - Covering spaces - The fundamental group of the circle-Retraction and fixed points-Brouwer fixed point theorem for the disc.

Unit II

THE Fundamental Group: The fundamental theorem of Algebra-The Borsuk-Ulam Theorem- Deformation Retracts and Homotopy Type- The fundamental Group of S^n – Fundamental Groups of some surfaces.

Unit III

Separation Theorems: Jordan Separation Theorem- Nulhomotopy lemma- A general separation theorem - Invariance of Domain- Homotopy Extension lemma-The Jordan Curve Theorem- Imbedding Graphs in the plane.

Unit IV

Applications to Groups: Direct sums of Abelian Groups- Extension Condition - Free Products of Groups- Uniqueness of Free products - Free Groups- The Seifert van Kampen Theorems- The fundamental Group of a Wedge of Circles.

Unit V:

Classification of Surfaces*:* Fundamental Groups of surfaces- Mobius band- Homology of surfaces- First homology group-Cutting and Pasting- Elementary Operations on schemes-The Classification Theorem – Construction of Compact Surfaces.

Text Book

1. Munkers J.R, “Topology”, Second Edition, Pearson Education, New Delhi, 2008.

Reference Book:

1. James Dugundji, “Topology”, University Book Stall, New Delhi, 1993.

13MA309 BANACH ALGEBRA AND SPECTRAL THEORY

Credits: 4:0:0

Course Objective: To provide the students about the concepts in understanding

- Banach algebra,
- Calculus in Banach algebras,
- Commutative Banach algebra, Hilbert spaces and operators.

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Course Outcome: Knowledge in

- Applications of Gelfand Mazur theorem and Gelfand Naimark theorem,
- Applications of Gelfand transforms and Spectral theorem,
- Eigen values of Normal operators.

Unit I

Banach Algebras: Introduction–Complex Algebra - Banach space - Banach Algebra- Homomorphisms–Gleason, Kahane, Zelako Theorem-Basic Properties of Spectra – Spectral Radius-Gelfand Mazur Theorem-Some Lemmas and Applications.

Unit II
Calculus: Introduction - Differentiation –Continuously differentiable- Difference Quotients-Commutators-The Inverse Function Theorem- Diffeomorphism-The exponential function-Group of Invertible Elements.

Unit III
Commutative Banach Algebra: Ideals -Homomorphism –Quotient Algebras-Wiener's Lemma- Gelfand Transforms- Involutions – Gelfand Naimark Theorem-Applications To Non-Commutative Algebras – Positive Linear Functionals.

Unit IV
Hilbert Spaces: Basic Facts– Conjugate linear isometry-Bounded Operators –Involution- Adjoints and their properties-A Commutativity Theorem – Resolutions of The Identity – Essential supremum-The algebra $L^{\infty}(E)$-Spectral Theorem.

Unit V
Operators: The symbolic calculus of Normal Operators- Invariant Subspaces -Eigen Values of Normal Operators – Positive Operators and Square Roots – Polar Decomposition-Group of Invertible Operators – Characterization of B* Algebra.

Text Book

1. Walter Rudin, "Functional Analysis", Tata McGraw Hill, New Delhi, 2006.

Reference Book:

1. Walter Rudin, "Real and Complex Analysis", McGraw Hill International Editions, 1987.
2. Kreyszig, "Introductory Functional Analysis with Applications", John Wiley & Sons,1989.

13MA310 MATHEMATICAL MODELING

Credits: 4:0:0

Course Objective: To provide the student with the concept and the understanding in

- Mathematical Models,
- Simulation Modeling,
- Graph Theory Models and Modeling with Differential equations.

Course Outcome: Knowledge in

- Geometric modeling,
- Simulation modeling and probabilistic modeling,
- Mathematical programming and Numerical approximation methods.

Unit I
Modeling Process: Introduction- Mathematical Models – Vehicular stopping distance- Modeling using Proportionality – Kepler's Third law-Modeling using Geometric Similarity-Rain drops from motionless cloud-Modeling the size of the terror bird.

Unit II
Simulation Modeling*:* Introduction- Simulating deterministic behavior- Area under a curve-Generating random numbers-Simulating probabilistic behavior-Inventory model- Gasoline and Consumer Demand- Queuing models.

Unit III
Discrete Probabilistic Modeling: Introduction-Probabilistic Modeling with Discrete Systems- Voting Tendencies-Modeling Components and System Reliability- Series Systems-Parallel systems- Series and parallel combinations-Linear Regression**.**

Unit IV

Modeling Using Graph Theory: Introduction-Graphs as Models-Euler's problem-Describing Graphs- Graph Model-Using Graph Models to solve problems- Shortest path problems-Maximum flow problems-Connections to Mathematical Programming.

Unit V

Modeling with a Differential Equation: Introduction-Population Growth-prescribing Drug Dosage-Braking Distance Revisited-Graphical Solutions of Autonomous Differential Equations- Numerical Approximation Methods- Separation of Variables and Linear Equations**.**

Text Book

1. Frank R.Giordano, William P.Fox, Steven B.Horton, Maurice D.Weir, "Mathematical Modeling Principles and Applications", Cengage Learning, New Delhi, 2009.

Reference Books:

1. Elizabeth S.Allman and John A.Rhodes, "Mathematical Models in Biology an Introduction", Cambridge University Press, 2004.
2. K.Thangavel and P.Balasubramaniam, "Computing and Mathematical Modeling", Narosa Publishing House, 2006.

13MA311 FUZZY SETS AND SYSTEMS

Credits: 4:0:0

Course Objective: To provide the students about the concepts in understanding

- Fuzzy sets ,
- Fuzzy Numbers,
- Fuzzy Systems,
- Fuzzy decision making problems.

Course Outcome: Students will be familiar with the applications fuzzy mathematics to

- Controllers,
- Decision making systems,
- Neural networks .

Unit I

FUZZY SETS: Introduction- Crisp Sets- An over view-Fuzzy Sets – Basic types and basic concepts-Characteristics and significance of Paradigm Shift-Additional properties of Alpha Cuts- Representation of Alpha Cuts- Extension Principle for Fuzzy Sets.

Unit II

OPERATION ON FUZZY SETS: Types of Operations- Fuzzy Complements- Fuzzy Intersections- Fuzzy Unions - t-norms- t-co-norms - Combination and Aggregation of Operations.

Unit III

FUZZY ARITHMETIC: Fuzzy Numbers-Linguistic Variables-Arithmetic Operations On Intervals- Interval Analysis- Arithmetic Operations On Fuzzy Numbers- Operations MIN and MAX-Lattice of Fuzzy Numbers-Fuzzy Equations.

Unit IV

FUZZY SYSTEMS: General Discussion- Fuzzy Controllers-An over view- Fuzzy Controllers-An Example -Fuzzy Systems and Neural Networks-Fuzzy Neural Networks-Fuzzy Automata – Fuzzy Dynamical Dystems.

Unit V:

FUZZY DECISION MAKING*:* General Discussion- Individual Decision Making-Multiperson Decision Making-Multicriteria Decision Making- Multistage Decision Making- Fuzzy Ranking Methods- Fuzzy Linear Programming.

Text Books

1. George J.Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic Theory and Applications", PHI, New Delhi, 2005.

Reference Books:

1. Zimmermann H.J., "Fuzzy Set Theory and its Applications", Dordrecht, Kluwer,1985.
3. Witold Pedrycz and Fernando Gomide, "An Introduction to Fuzzy Sets-Analysis and Design", Prentice-Hall of India Pvt. Ltd, 2005.

13MA312 OPTIMIZATION TECHNIQUES

Credit: 4:0:0

Course Objective: To provide the student with the concept and an understanding

- basic concepts in Operations Research Techniques for Analysis and Modeling,
- basic concepts in Queuing Models,
- basic concept in Network Modeling.

Course Outcome: Students can get the knowledge for solving

- socially relevant problems,
- transportation problems,
- assignment and sequencing problems.

Unit I

Linear Programming Problem: The Linear Programming Problem - Introduction, Formulation of Linear Programming Problem, Graphical Solution To L.P.P, Simplex Method, Artificial Variable Techniques, Two Phase Method, Variants of The Simplex Method.

Unit II

Duality & Transportation: Duality In Linear Programming - Concept of Duality, Fundamental Properties of Duality, Duality & Simplex Method, Dual Simplex Method.- Integer Programming- Gomary's Solution Simple Applications

The Transportation Problem: Introduction, Transportation Model, Finding Initial Basic Feasible Solutions, Moving Towards Optimality, Degeneracy.

Unit III

Assignment & Sequencing: Assignment Problem - Introduction, Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment. Sequencing - Job Sequencing, n Jobs Through Two Machines, Two Jobs Through m - machines, n Jobs Through m Machines.

Unit IV

Queuing Models: Introduction- Definition and Derivations of Terms In Queuing Model, Problems using the models M/M/I :/FIFO and M/M/c : FIFO.

Unit V

Network Model & Simulation: Network Analysis– PERT & CPM- Network Diagram-Probability of Achieving Completion Date- Crash Time- Cost Analysis. Simulation Models. Elements of Simulation Model-Monte Carlo Technique – Applications.

Text Book:

1. Taha A.H, "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi.2010.

Reference Books:

1. Winston, “Operations Research, Applications and Algorithms”, Cengage Learning, 2004/ 4th Edn.
2. Natarajan A.m. Balasubramani P., Tamilarasi A., “Operations Research”, Pearson Education, I Edn.2003
3. Kanti Swarup, Manmohan , P.K. Gupta “Operation Research” – Sultan Chand & Sons., 14th Edn. 2008.

14MA1001 BASIC MATHEMATICS FOR ENGINEERING
(Common to all branches in B.Tech)

Credits: 3:1:0

Objective:

- To provide the students with the basic knowledge and an understanding of algebra.
- To equip the students with the knowledge of calculus.
- To teach the students about the techniques of matrix algebra.

Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.
- Students are able to know the applications of matrices.
- Students are able to understand the techniques involved in calculus.

Algebra: Simple functions and equations- Trigonometric identities- Coordinate geometry-Partial fractions-Binomial expansions- **Calculus:** Differentiation from the first principle-Rules of differentiation-Implicit differentiation-Logarithmic differentiation-Methods of integration-Integration by parts. **Taylors Series and Partial Differentiation:** Taylor’s series for functions of one variable-Standard Maclaurin’s series-Partial derivatives-Taylor’s series for functions of two variables. **Vectors:** Scalars and vectors- Operations on vectors- Magnitude of a vector- Equations of lines and planes. **Matrix Algebra:** Introduction -Matrix operations- The trace and the determinant of a matrix- Properties of determinants(excluding the proof)- The inverse and the rank of a matrix-Special types of square matrices-Eigen values and Eigen vectors(problems only).

Reference Books

1. Grewal B.S, “Higher Engineering Mathematics”, 42nd Edition, Khanna Publications, Delhi, 2012.
2. James Steward, “Calculus”, 5th Edition, Thomson Brooks/Cole, Micro Print Pvt. Ltd, Chennai, 2003.
3. Riley K.F, Hobson M.P, and Bence S.J, “Mathematical Methods for Physics and Engineering, 2nd Edition, Cambridge Low – Price Editions, Cambridge University Press, 2004.
4. Hepzibah Christinal A, Selvamani R, and Porselvi K, “Basic Engineering Mathematics”, HIS Publications, Coimbatore, 2011.
5. “ Lecture Notes on Basic Mathematics to Engineering”, Department of Mathematics, Karunya University, Karunya Nagar, Coimbatore, 2013.

14MA1002 CALCULUS AND STATISTICS
(Common to all branches in B.Tech)

Credits: 3:1:0

Objective:

- To provide the students with the concept and an understanding of Differential equations.
- To teach the students about the art of Multiple integrations.
- To enlighten the students about the use of statistical parameters.

Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.
- Students are able to develop their skills in evaluating multiple integrals.
- Students are able to know the applications of statistics to modeling and analysis.

Ordinary differential equations: Higher order linear differential equations with constant coefficients-Methods of variation of parameters-Simultaneous first order linear equations with constant coefficient. **Multiple integrals:**

Double integrals-Triple integrals- B**eta and gamma integrals:** Definitions-Properties-Relation between beta and gamma integrals-Evaluation of definite integrals in terms of beta and gamma functions. P**artial differential equations:** Formations -Solution of partial differential equations-Lagrange's linear equation-Non-linear equations of first order (excluding Charpit's method)-Homogenous linear equations with constant coefficients. **Statistics:** Introduction–Graphical representation of data-Measures of central tendency-Measures of dispersion- Correlation-Regression-Rank Correlation.

Reference Books

1. Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, New Delhi, 2012.
2. Veerarajan T, " Engineering Mathematics", Tata McGraw Hill, New Delhi, 2011.
3. Kandasamy P, Thilagavathi K and Gunavathi K, "Engineering Mathematics", 9th Revised Edition, S Chand & Co, New Delhi, 2010.
4. Dass H.K., "Advanced Engineering Mathematics", (18th Revised Edition), S. Chand & Co., New Delhi, 2008.
5. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.

14MA2001 VECTOR CALCULUS AND COMPLEX ANALYSIS

Credits: 3:1:0

Objective:

- To teach the students about the basic concepts of vector calculus.
- To provide the students about the application of vector fields.
- To provide the students about the basic concepts of the complex variables.

Outcome:

- Students are able to know the application of Stokes theorem.
- At the end of the course students are able to relate their knowledge in complex variables with their engineering subjects during their course of study.
- Students are able to apply transformation techniques.

Course Description:

Vector Differentiation**:** Differentiation of vectors–Curves in space-Velocity and acceleration-Scalar and Vector point functions–Gradient–Divergence-Curl–Physical interpretations- Solenoidal and irrotational fields-Laplacian operator. Vector Integration: Integration of vectors – Line Integral–Simple problems-Surface Integral–problems on Greens theorem, Stoke's theorem, Gauss divergence theorem. Analytic functions: Limit of a complex function–Derivative of f (z)–Cauchy Riemann equations-Harmonic functions. Transformations: Standard transformations z+c, cz, 1/z,-Bilinear transformation-Conformal transformation-Special conformal transformations-Schwarz-Christoffel Transformation. Complex Integration: Line integral of f (z)-Cauchy's theorem–Cauchy's Integral formula–Morera's theorem-Taylor's series –Laurent's series–Zero's and Singularities of an analytic function–Residue theorem–Evaluation of real definite Integrals.

Reference Books:

1. Grewal B.S., "Higher Engineering Mathematics" , (42nd Edition) Khanna Publishers, New Delhi, 2012.
2. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
3. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
4. T. Veerarajan., "Engineering Mathematics", (Updated Second Edition), Tata McGraw Hill, New Delhi, 2009.
5. H.K.Dass., "Advanced Engineering Mathematics", (18th Revised Edition), S. Chand & Co., New Delhi, 2008.

14MA2002 FOURIER SERIES AND APPLICATIONS

Credits: 3:1:0

Objective:

- To provide the students about the basic concepts in Fourier series.
- To orient the students to know about the application of Harmonic analysis.
- To teach the students about the solutions of wave and heat equations.

Outcome:

- Students are able to relate the properties of Fourier series with their engineering subjects during their course of study.
- Students are able to gain the knowledge in vibrations of stretched strings.
- Students are able to apply the knowledge in Fourier series in science and technology.

Course Description:

Fourier series: Euler's formula – Conditions for a Fourier expansion – Functions having points of discontinuity-Change of Interval. **Half Range Fourier series:** Typical wave forms - Complex form of Fourier series –Harmonic analysis. **One Dimensional Wave Equation:**Vibrations of stretched string – D Alembert's solution of the wave equation. **One dimensional heat flow:** Solution of the heat equation – Steady state conditions. **Two dimensional heat flow**: Solution of Laplace Equation (Cartesian form only) – Temperature distribution.

Reference Books:

1. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition), Khanna Publisher, New Delhi, 2012.
2. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
3. Kandasamy P., Thilagavathi K and Gunavathi K., "Engineering Mathematics" Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
4. H.K.Dass., "Advanced Engineering Mathematics", (18th Revised Edition), S.Chand & Co., New Delhi, 2008
5. K.F.Riley., M.P.Hobson., S.J.Bence., 'Mathematical Methods for Physics and Engineering", (2nd Edition), Cambridge University Press, 2004.

14MA2003 MATHEMATICAL TRANSFORMS

Credits: 3:1:0

Objective:

- To teach the fundamental concepts of Laplace Transforms to the students
- To provide the students about the knowledge in Fourier and Z-transforms.
- To motivate the students to know about the applications of Mathematical Transforms.

Outcome:

- Students have the knowledge in solving engineering problems using Laplace Transforms.
- Students are able to know the transform techniques.
- Students will solve difference and differential equations problems in their engineering fields.

Course Description:

Laplace transforms: Transforms of elementary functions–Properties of Laplace transforms–Transforms of periodic functions–Transforms of special functions–Transforms of derivatives–Transforms of integrals-Multiplication by t^n-Division by t–Evaluation of Integrals by Laplace transforms – Inverse Laplace transforms of standard functions-Method of Partial fractions – properties -Convolution theorem – Solving Differential Equations. **Fourier transforms**: Fourier integral Theorem–Inverse transform-Properties– Convolution– Parseval's Identity– Relation between Fourier and Laplace transforms–Fourier transforms of the derivatives of a function. **Z-transforms**: **S**tandard z transforms–Standard results – Shifting U_n to the Right–Multiplication by n -Initial value and Final value theorems–Convolution theorem-Convergence of z- transforms.

Reference Books:

1. Grewal B.S., “Higher Engineering Mathematics”, (42^{nd} Edition), Khanna Publishers, New Delhi, 2012.
2. Kandasamy P., Thilagavathi K and Gunavathi K., “Engineering Mathematics” Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
3. Kreyszig E., “Advanced Engineering Mathematics”, (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
4. H.K.Dass., “Advanced Engineering Mathematics”, (18^{th} Revised Edition), S. Chand & Co., New Delhi, 2008.
5. K.F.Riley., M.P.Hobson., S.J.Bence., ‘Mathematical Methods for Physics and Engineering”, (2^{nd} Edition), Cambridge University Press, 2004.

14MA2004 LAPLACE TRANSFORMS, FOURIER SERIES AND TRANSFORMS

Credits: 3:1:0

Objective:

- To teach the students about the fundamental concepts of Fourier series,
- To equip the students with the knowledge of the Laplace and Fourier transforms.
- To develop the students in acquiring transform techniques.

Outcome:

- Students have the knowledge of applying Laplace and Fourier Transforms in a growing number of fields.
- Students have the capacity to apply the knowledge gathered in the subject to Signal processing.
- Students apply the transform techniques to their engineering subjects.

Course Description:

Laplace transforms: Transforms of elementary functions–Properties of Laplace transforms–Transforms of periodic functions–Transforms of special functions–Transforms of derivatives–Transforms of integrals-Multiplication by t^n-Division by t –Evaluation of Integrals by Laplace transforms. Inverse Laplace transforms: Inverse transforms of standard functions**-**Method of Partial fractions–properties–Convolution theorem–Application to Differential Equations. **Fourier series:** Euler’s formula–Conditions for a Fourier expansion–Functions having points of discontinuity–Change of Interval–Even and odd functions. Half range Fourier series**:** – Typical wave forms – Complex form of Fourier series–Harmonic analysis. **Fourier transforms:** Fourier integral Theorem– Inverse transform-Properties–Convolution–Parseval’s Identity–Relation between Fourier and Laplace transforms–Fourier transforms of the derivatives of a function.

Reference Books:

1. Grewal B.S., “Higher Engineering Mathematics”, (42^{nd} Edition), Khanna Publishers New Delhi, 2012.
2. Kandasamy P., Thilagavathi K and Gunavathi K., “Engineering Mathematics” Volume II and III (6th revised Edition), S. Chand & Co., New Delhi, 2006.
3. Kreyszig E., “Advanced Engineering Mathematics”, (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.
4. H.K.Dass., “Advanced Engineering Mathematics”, (18^{th} Revised Edition), S. Chand & Co., New Delhi, 2008.
5. K.F.Riley., M.P.Hobson., S.J.Bence., ‘Mathematical Methods for Physics and Engineering”, (2^{nd} Edition), Cambridge University Press, 2004.

14MA2005 MATHEMATICAL FOUNDATION

Credits: 3:1:0

Objective:

- To provide the students about the basic concepts in trigonometry.
- To enlighten the students about the need of matrices.

- To equip the students about the skills in differentiation and integration.

Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during their course of study.
- Understanding the foundations of trigonometry.
- Students are able to solve the problems in calculus.

Course Description:

Trigonometry: Expansions of sinnθ, cosnθ and tannθ. Hyperbolic functions–Separating real and imaginary parts. **Matrices:** Rank of a matrix–Eigen values and Eigen vectors – Cayley Hamilton theorem. **Calculus:** Differentiation from the first principle–Rules of differentiation: Addition rule– Product Rule – Quotient rule–Chain rule–Implicit differentiation–Logarithmic differentiation – Curvature in Cartesian coordinates. Integration- Integration of standard functions- Bernoulli's Formula. Differential equations**:** Second order linear differential equations with constant coefficients.

Reference Books:

1. Veerarajan T., "Engineering Mathematics", (4th Edition) Tata McGraw Hill, New Delhi, 2009.
2. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Vol.I" S.Chand & Co. New Delhi, 2009.
3. K.F.Riley., M.P.Hobson., S.J.Bence., 'Mathematical Methods for Physics and Engineering", (2^{nd} Edition), Cambridge University Press, 2004.
4. A. Hepzibah, R. Selvamani, K. Porselvi, "Basic Engineering Mathematics", HSI Publications, Coimbatore, 2011.
5. A. Singaravelu, Engineering Mathematics, Meenakshi Publications, 2001.
6. Moorthy M B K, Subramaniyam N, Engineering Mathematics II, VRB Publishers, 2005.

14MA2006 NUMERICAL MATHEMATICS AND COMPUTING

Credits: 3:1:0

Objective:

- To teach the students about the use of Taylor's series in solving problems.
- To equip the students with different computing techniques.
- To familiarize the students about the convergence of computational methods.

Outcome:

- Students are able to apply the knowledge in numerical methods in their engineering fields.
- Students are able to apply interpolation techniques during the course of their study.
- Students are capable of solving their engineering problems using numerical methods.

Course Description:

Application of Taylor's series: Nested multiplication-Rounding and Chopping-pseudocode- Simple Numerical problems using Taylor's series- Representation of numbers in different bases. **Locating Roots of Equations:** Bisection Method-Bisection Algorithm and pseudocode--Convergence of Bisection Method-Newton's method-Geometry of Newton's method-Pseudocode-Convergence Analysis. **Interpolation:** Polynomial interpolation-Existence-Newton interpolating polynomial- Nested form- Calculating Newton interpolating formula using divided difference-Lagrange interpolating polynomial-Errors in polynomial interpolation. **Numerical Integration:** Trapezoidal rule- Error analysis-Recursive Trapezoidal formula-Romberg Algorithm- Simpson's rule-Gaussian Quadrature Formulas. Approximation by Spline Functions**:** First degree spline–examples-Second degree splines–Natural cubic splines–B splines.

Reference Books:

1. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Cengage Learning Brooks/Cole Publishing Company, California, 2012.

2. M.K.Jain., Iyengar. S.R.K., Jain R.K., “Numerical Methods for Scientific and Engineering Computation”, (6th Edition), New Age International., 2012.
3. Rajasekaran. S., “Numerical Methods in Science and Engineering: A Practical Approach”, S. Chand publishers, 2003.
4. Ralph G. Stanton., “Numerical Methods for Science and Engineering”, (1st Edition), Prentice Hall of India Pvt. Ltd., 1988.
5. Kandasamy. P., Thilagavathy K., “Numerical Methods”, S. Chand & Co. Ltd., 2010.

14MA2007 PROBABILITY AND RANDOM PROCESS

Credits: 3:1:0

Objective:

- To develop the skills of the students in the area of Probability.
- To provide the students with an understanding of basic concept in Random Process.
- To learn the application Central limit theorem.

Outcome:

- The students are able to apply the knowledge gained in Probability theory in engineering fields.
- Students are able to make simple mathematical descriptions or modeling of random signals.
- Students are able to apply the Random process techniques to signal processing.

Course Description:

Probability Theory:Axioms of probability, Joint and conditional probabilities, Theorem of Total Probability-Baye’s Theorem, One-Dimensional random variables, Two-Dimensional random variables. Functions of one random variable, Characteristic Function, Moment generating Function, Tchebysheff Inequality, Central limit theorem. **Random process**: Wide-sense stationarity, Strict-sense stationarity, Mean Ergodic Process, Correlation Ergodic Process, Power Spectral Density Function, Linear systems, Gaussian Process, Poisson process.

Reference Books:

1. T.Veerarajan, “Probability, Statistics and Random Process” Tata Mc Graw Hill, Second edition, 2009.
2. Kapur J.N. and Saxena H.C., “Mathematical Statistics”, S. Chand & Co. Ltd., New Delhi. 2003.
3. S.C.Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Co., 2009.
4. Kandasamy P. , Thilagavathy, Gunavathy, “Probability, Random Process and Queuing Theory, S. Chand & Co. New Delhi, 2007.
5. H. Stark and J.W. Woods: “Probability, Random process and Estimation theory for Engineers”, Pearson Education Asia, third edition, 2002.

14MA2008 PROBABILITY AND STATISTICES

Credits: 3:1:0

Objective:

- To develop the skills of the students in the area of Probability and Statistics.
- To equip the students with an understanding of basic concepts in Testing of Hypothesis.
- To learn the design of experiments and Latin square design.

Outcome:

- Knowledge in the Technique, Methodology and Application in Statistics.
- A basic knowledge in collection, presentation and tabulation of data.
- Students are able to apply their knowledge gathered in the subject to life sciences.

Course Description:

Statistics: Frequency distribution and measures of central tendency–measures of dispersion-Linear correlation–Regression lines. **Probability:** Axioms of probability–Conditional probability –Baye’s theorem–Theoretical distributions–Binomial, Poisson, Normal Distributions- Properties– joint distribution–conditional probability distribution–Independent random variables. **Testing of Hypothesis:** Tests of Significance-large sample tests-difference of means- difference of proportion–small sample test– t test– Chi square test. **Design of Experiments:** analysis of variance–one factor classification- two factors classification - completely randomized design–randomized block design– Latin square design.

Reference Books:

1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2008.
2. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2008.
3. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.
4. Veerarajan, T., Probability, Statistics and Random Processes, TataMcGrawHill, 2nd Edition, 2009.
5. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition) , Khanna Publishers New Delhi, 2012.

14MA2009 STATISTICAL DATA ANALYSIS AND RELIABILITY ENGINEERING

Credits: 3:1:0

Objective:

- To provide the students about the concepts in statistics and reliability engineering.
- To learn sampling techniques.
- To develop the students skill in quality control.

Outcome:

- Knowledge in technique and methodology of solving problems in the design of experiments.
- Students are able to understand the reliability engineering problems.
- Students are able to apply their subject knowledge in their engineering subjects.

Course Description:

Correlation Analysis: Correlation coefficient–Rank correlation-Method of least squares- Linear, Parabolic and Logarithmic curve– regression coefficients. **Testing of Hypothesis**: one tailed and two tailed tests- Large sample tests for proportion and mean – Small Sample tests. **Design of experiments** – analysis of variance for one factor and two factors of classification - completely randomized design-– randomized block design – Simple Latin Square Design. **SQC**: Types of variation – types of control charts – X chart, R. Chart, Sigma Chart, Advantages and Limitations of SQC – Acceptance sampling – Single sampling plan, Double sampling plan, Construction of a OC curve – Six σ concepts. **Reliability engineering**: Concepts of reliability, hazard function, series and parallel systems, reliability of Markovian systems, maintainability, preventive maintenance.

Reference Books:

1. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi, 2008.
2. Gupta, S.C., and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, New Delhi, 2008.
3. Gupta, S.P, "Statistical Methods", Sultan Chand and Sons, New Delhi, 2008.
4. Balagurusamy, E., "Reliability Engineering", Tata McGraw-Hill Publishing Co., New Delhi, Fourth Reprint, 2003.
5. Grewal B.S., "Higher Engineering Mathematics", (42nd Edition), Khanna Publishers New Delhi, 2012.

14MA2010 DISCRETE MATHEMATICS

Credits: 3:1:0

Objective:

- To provide the student with the concept and the understanding of basic concepts in logical relations and digraphs.
- To learn lattices and Boolean algebra.
- To equip the students with the basic concepts in Graph theory.

Outcome:

- Students will be able to develop the fundamental ideas of discrete mathematics.
- Students are able to understand the concepts of coding and decoding.
- Students are able to develop modeling for computer science and engineering problems.

Course Description:

Basic Algebra: Sets and subsets – operation on sets – sequences – division in the integers – matrices – logical operations–conditional statements –Mathematical induction – Recurrence relation. **Relations and digraph:** Products sets and partitions – relations and digraphs – paths in Relations and digraphs– properties of relations – equivalence relations– operations on relations – transitive closure and Warshall's algorithm. **Order relations and structures:** Partially ordered sets – external elements of partially ordered sets–lattices–finite Boolean algebras–functions on Boolean algebra. **Trees**:labeled trees– undirected trees – minimal spanning trees. Graph theory: Graphs –Euler paths and circuits–Hamiltonian Paths and circuits–transport networks-Coloring Graphs. **Groups and coding:** Semi-groups and groups: binary operations revisited – semi-groups–groups– Groups and coding: coding of binary information.

Reference Books:

1. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 6th Edition, Pearson Education, 2009.
2. Iyengar N.Ch.S.N., Chandrasekharan V., Venkatesh K.A. and Arunachalam P.S., "Discrete mathematics", Vikas Publishing, 2003.
3. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill, 5^{th} Edition, 2003.
4. Swapan Kumar Sarkar, "A Text Book of Discrete Mathematics", S.Chand & Company, 2009.
5. Nanda S, "Discrete Mathematics", Allied Publishers, 2002.

14MA2011 PROBABILITY AND QUEUING THEORY

Credits: 3:1:0

Objective:

- To develop the skills of the students in the area of Probability and Queuing theory.
- To provide the students about the basic concepts in testing of hypothesis.
- To equip the students about the techniques in Queuing theory.

Outcome:

- Students will be able to gain knowledge in Probability and Queuing theory.
- Students will be able to make simple mathematical descriptions or modeling.
- Students are able to solve the problems in Queuing theory.

Course Description:

Probability: Axioms of probability – Joint and conditional probabilities –Independent events- Theorem of Total Probability-Baye's Theorem- One-Dimensional discrete random variables- One-Dimensional continuous random variables-Two-Dimensional discrete random variables- Two-Dimensional continuous random variables. **Testing of hypothesis:** one tailed and two tailed tests - Tests based on large samples –proportion and mean- Tests based on

Small samples – Tests based on t, F, chi square distributions. **Queuing theory**: Charecteristics of Queueing systems, Representation a queuing Model, Problems on the models (M/M/1): (∞/FIFO) and (M/M/k): (∞/FIFO).

Reference Books:

1. T.Veerarajan, "Probability statistics and Random Process" Tata Mc Graw Hill, Second edition, 2009.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics Sultan Chand & Co., 2009.
3. Kapur J.N. and Saxena H.C., "Mathematical Statistics", S. Chand & Co. Ltd., New Delhi. 2003.
4. Kanti Swarup, Manmohan, Gupta P.K., "Operations Research" Sultan Chand &Sons., 14th Edition. 2008.
5. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.

14MA2012 NUMERICAL METHODS

Credits: 3:1:0

Objective:

- To provide the knowledge in solving different types of equations.
- To equip the students with interpolation techniques.
- To learn numerical differentiation and numerical integration.

Outcome:

- Students will be able to relate their subject knowledge with their experiments during their course of study.
- Students are able to solve their engineering problems using interpolation techniques.
- Students are able to identify the numerical techniques for their engineering problem.

Course Description:

Empirical formulae and curve fitting: Principle of least squares - fitting a straight line, a parabola and exponential curve. **Solutions of algebraic and transcendental equations**: Newton- Raphson method, Gauss elimination method, Gauss-Jordan method, Gauss-Jacobi, Gauss-Seidel method. **Interpolation:** Finite differences - Newton forward Interpolation, Newton backward Interpolation, Gauss forward interpolation formula, Gauss backward interpolation formula, Lagrange's Interpolation formula. **Numerical integration:** Trapezoidal rule and Simpson's rule. Numerical solution for ordinary differential equation.

Reference Books:

1. Venkataraman M.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.
2. Kandasamy P., "Numerical Methods", S.Chand and Co, Reprint 2010
3. M.K.Jain., Iyengar. S.R.K., Jain R.K., "Numerical Methods for Scientific and Engineering Computation", (6th Edition), New Age International, 2012.
4. Rajasekaran. S., "Numerical Methods in Science and Engineering: A Practical Approach", S. Chand publishers, 2003.
5. Ralph G. Stanton., "Numerical Methods for Science and Engineering", (1^{st} Edition), Prentice Hall of India Pvt. Ltd., 1988.

14MA2013 APPLIED LINEAR ALGEBRA

Credits: 3:1:0

Objective:

- To provide the student with the understanding of basic concepts in linear transformations and advanced matrix theory.
- To develop the skills of students in Linear Algebra.
- To learn the applications of Linear Algebra.

Outcome:

- Students will be able to apply the concepts of vectors and matrices in their engineering subjects.
- Students are to able to apply their knowledge in the subject to Computer graphics.
- Students are able to know about Matrix decompositions.

Course Description:

Vector Spaces: Vectors in R^n- Linear combinations and Linear independence- Vector spaces-sub spaces-Basis and dimension- coordinates and change of basis- Application to Differential equations. Linear transformations- The null space and Range- Isomorphisms- Matrix representation of a Linear transformation- Similarity- Application to Computer graphics. **Eigen Values and Eigen Vectors**: Introduction– properties of Eigen values- Diagonalization- Application to the system of linear differential equations and Markov chains. **Inner Product Spaces**: The dot product in R^n- Inner product spaces- Orthonormal spaces- Orthogonal complements- Application to least squares approximation- Simple problems. **Quadratic Forms**: Diagonalization of symmetric matrices- Quadratics forms- simple problems- Application to Singular Value Decomposition.

Reference Books:

1. Jim Defranza and Daniel Gagliardi, "Introduction to Linear Algebra with applications", Tata McGraw-Hill Edition, New Delhi, 2012.
2. Seymour Lipschutz, Marc Lipson, "Schaum's Outline of Theory and Problems of Linear Algebra", Schaum's outline series, 2001.
3. Kumaresan.S., "Linear Algebra: A Geometric Approach", PHI Pvt., Ltd., 2001.
4. Jimmie Gilbert, Linda Gilbert., " Linear Algebra and Matrix Theory" (1st Edition), Academic Press, 2005.
5. Kenneth Hoffman, Ray Kunze, "Linear Algebra", (2nd Edition), Prentice Hall of India Pvt., Ltd., 2002.

14MA2014 FUZZY SETS AND LOGIC

Credits: 3:1:0

Objective:

- Teaching the fundamental concepts of fuzzy sets and fuzzy logic.
- To provide the students about the applications fuzzy sets and fuzzy logic.
- To learn fuzzification and defuzzificztion.

Outcome:

- Students will have the knowledge of applying fuzzy sets and fuzzy logic in their fields.
- Students will have the knowledge of fuzzification of a crisp concept.
- Students will have the knowledge of defuzzification of a fuzzy concept.

Course Description:

Classical to Fuzzy: Introduction- Crisp sets- an overview- fuzzy sets and types- fuzzy sets and basic concepts- Alpha cuts- Representation of fuzzy sets. Operations on fuzzy sets- Types of operations- fuzzy complements- fuzzy intersections and t-Norms- fuzzy union and t-Co-norms- **Fuzzy Arithmetic**: Fuzzy Numbers- Linguistic variables- Arithmetic operations on intervals-arithmetic operations on fuzzy numbers- lattice of fuzzy numbers- fuzzy equations. **Fuzzy Logic**: Classical Logic-an overview-Multivalued logics-fuzzy propositions- fuzzy quantifiers- Linguistic Hedges-conditional fuzzy propositions- inferences. **Fuzzy Systems**: Fuzzy controllers- an overview- fuzzification-defuzzification-fuzzy rule base- fuzzy inference- defuzzification methods- fuzzy neural networks- fuzzy automata.

Reference Books:

1. George J. Klir and Bo Yuan "Fuzzy Sets and Fuzzy Logic, Theory and Applications", Prentice – Hall of India, Pvt. Ltd., New Delhi, 2005.
2. James J. Buckley, Esfaniar Eslami., "An Introduction to Fuzzy Logic and Fuzzy Sets", (3rd Edition), Springer-Verlog, 2011.
3. Ganesh M., "Introduction to Fuzzy sets and Fuzzy Logic", (1st Edition), Prentice Hall of India Pvt., Ltd., 2006.

4. H J Zimmermann, Hans Jurgen Zimmerman, “Fuzzy Set Theory- And Its Applications”, Springer, 2001.
5. Timothy J. Ross., “Fuzzy Logic with engineering applications”, 3rd Edition, John Wiley, 2010.

14MA2015 PROBABILITY, RANDOM PROCESS AND NUMERICAL METHODS

Credits: 3:1:0

Objective:

- To develop the skills of the students in the area of Probability and Random Process.
- To learn numerical methods.
- To equip the students with the basic concepts of Random process.

Outcome:

- Students will be able to gain knowledge in Probability theory.
- Students will be able to make simple mathematical descriptions or modeling of random signals.
- Students are able to apply numerical methods for scientific computing.

Course Description:

Probability : Axioms of probability – conditional probability –Independent events-Theorem of Total Probability-Baye’s Theorem- Random variables, Binomial, Poisson, Normal and exponential distributions, MGF, Moments, Tchebysheff Inequality, Problems based on Central limit theorem. **Random process**:Basics of Random Processes, wide sense, strict Sense stationary processes, Ergodicity, Mean Ergodic Process-Correlation Ergodic Process. **Numerical Methods**: Newton’s forward and backward difference formula, Trapezoidal rule and Simpson’s rule, Taylor series, Euler’s method , Fourth order Runge-Kutta method to solve first and second order differential equations.

Reference Books:

1. Veerarajan, T., “Probability, Statistics and Random Process” Tata McGraw Hill, Second edition, 2009.
2. Stark, H. and J.W. Woods: “Probability, Random process and estimation theory for Engineers”, Pearson Education Asia, Third edition, 2002.
3. Gupta, S.C., and V.K.Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 2008.
4. Venkataraman M.K., “Numerical methods in Science and Engineering”, National Publishing Company, Revised Edition, 2005.
5. Curtis F-Gerald, “Applied Numerical Analysis”, 5th edition, Addison Wesley Publishing Company, 2001.

14MA2016 SAMPLING TECHNIQUES

Credits: 3:1:0

Objective:

- To develop skills of the students in the area of probability and statistics using SPSS.
- To understand the applications of the design experiments.
- To learn ANOVA.

Outcome:

- Students will be able relate their subject knowledge in techniques, methodology and statistics with their engineering subjects during the course of study.
- Students are able to use ANOVA to their engineering problem.
- Students are able to use SPSS packages to their engineering problems.

Course Description:

Random Sampling: Stratified, Systematic and Cluster Samplings, Non-random sampling, Judgment, Quota, Convenience sampling. **Testing of Hypothesis**: Large sample tests, Difference of Means , Difference of proportion, ,Small Samples , Student’s t test , F Test ,Chi square test, **SQC**: Types of variation – Types of control charts – X, R, Sigma and C charts- Acceptance Sampling:, Single and Double sampling plans. **Design of Experiments**: CRD, RBD and LSD, SPSS - Basics of SPSS, data creation and saving, opening of the Data file, defining the attributes of variables, Univariate Analysis, Graphs (Bar, Line, Area and Pie), Comparing the Means of independent samples Paired t-test, One way ANOVA using SPSS.

Reference Books:

1. Gupta S.C. and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand Sons, 2007.
2. Gupta S.C. and V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand & Sons, 2007.
3. Gupta S.P., "Statistical Methods", Sultan Chand and sons, New Delhi, 2009.
4. Vijay Gupta, SPSS for Beginners SPSS versions 7.x through 10.0., VJ Books Inc, 1999.
5. Dennis Howitt and Duncan Cramer " Introduction to SPSS in Psychology", 3rd Edition, PHI, 2005.

14MA2017 OPERATIONS RESEARCH - I

Credits: 3:1:0

Objective:

To provide the student with the concept and an understanding of basic concepts in

- Linear Programming techniques,
- Job sequencing problems,
- Transportation and assignment problems.

Outcome:

- Students are able to relate their subject knowledge with the engineering subjects.
- Students are able to apply their knowledge in sequencing to their engineering problems.
- Students are able to develop their skills decision making analysis.

Course Description:

Linear programming problem: Formulation of LPP - Graphical Method - Simplex Method - Artificial variable technique and two phase simplex method. Duality - Dual and simplex method - Dual Simplex Method – **Sequencing**: Job sequencing - n jobs through two machines - n jobs through m machines and two jobs through m machines. **Transportation problem**: Transportation Model, finding initial basic feasible solutions, moving towards optimality, Degeneracy. **Assignment Problem**: Solution of an Assignment problem, Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment.

Reference Books:

1. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.
2. Kanti Swarup, Manmohan, Gupta P.K., "Operations Research" Sultan Chand &Sons., 14th Edn.2008.
3. Natarajan A.M., Balasubramani P., Thamilarasi A., "Operations Research", Pearson Education, I Edn, 2003.
4. Srinivasan G., "Operations Research", Eastern Economy Edition, I Edn. 2007.
5. Winston, "Operations Research, Applications and Algorithms" – Cengage Learning, 4th Edition, 2004.

14MA2018 OPERATIONS RESEARCH- II

Credits: 3:1:0

Objective:

To provide the students with the concept and an understanding of basic concepts in

- Inventory models,
- PERT/CPM and Simulation,
- Queuing theory,
- Game theory,
- Replacement problems.

Outcome:

- Students are able to relate their subject knowledge with the engineering subjects.
- Students are able to apply their knowledge in Analysis and Modeling.
- Students are able to use Monte Carlo technique to solve their engineering problems.

Course Description:

Inventory models: Economic order quantity models-techniques in inventory management-ABC analysis. **Network analysis:** PERT & CPM- network diagram-probability of achieving completion date- crash time- cost analysis. **Simulation models:** Elements of simulation model -Monte Carlo technique – applications. **Queuing model:** problems involving (M\M\1): (∞\FIFO) , (M\M\c): (∞\FIFO) Models. **Decision Models**: game theory –two person Zero sum game,-graphical solution-algebraic solution- **Replacement models:** models based on models that gradually detoriate with time-whose maintenance cost increase with time-Replacement of items that fail suddenly and completely.

Reference Books:

1. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.
2. Kanti Swarup, Manmohan, Gupta P.K., "Operations Research" Sultan Chand &Sons., 14th Edn.2008.
3. Natarajan A.M., Balasubramani P., Thamilarasi A., "Operations Research", Pearson Education, I Edn, 2003.
4. Srinivasan G., "Operations Research", Eastern Economy Edition, I Edn. 2007.
5. Winston, "Operations Research, Applications and Algorithms" – Cengage Learning, 4th Edition, 2004.

14MA3001 MATRIX COMPUTATIONS

Credits: 3:0:0

Objective:

- To provide the students with the understanding of matrix decompositions.
- To equip the students with matrix decomposition algorithms.
- To learn matrix decomposition methods.

Outcome:

- Students will be able to apply the matrix decomposition techniques in their engineering subjects.
- Updating the knowledge in advanced matrix theory.
- Students are able to develop the skills in matrix computations.

Course Description:

Cholesky Decomposition: Linear Equations-Simple Electrical circuit problem-partitioning matrices- Systems of linear equations-Triangular systems- Positive Definite Systems- Cholesky Decomposition- Cholesky Decomposition Theorem- Cholesky algorithm. **LU Decomposition**: Gaussian Elimination Method- LU Decomposition Theorem- LDV Decomposition Theorem- Gaussian Elimination with pivoting. **QR Decomposition**: The discrete least squares problem-orthogonal matrices-Rotators-Reflectors-QR decomposition-Solving least squares problems by using QR decomposition-Complex rotators-complex reflectors. **The Gram-Schmidt Method**: Orthonormal vectors- Classical Gram Schmidt Algorithm- Modified Gram Schmidt Algorithm- The discrete least squares problems- The continuous least squares problems. Singular Value **Decomposition (SVD):** SVD Theorems- Computing the SVD- SVD and the least squares problems-The pseudo inverse.

Reference Books:

1. David S.Watkins, "Fundamentals of Matrix Computations", John Wiley & Sons, Singapore. 2004.
2. Richard Bronson, "Matrix Operations", (2^{nd} Edition), Schaum's Outline Series, McGraw Hill, New Delhi 2011.
3. David W. Lewis., "Matrix Theory", (1^{st} Edition), Allied Publishers Pvt., Ltd., 1995.
4. Jimmie Gilbert, Linda Gilbert, "Linear Algebra and Matrix Theory", (1^{st} Edition), Academic Press, 2005.

5. L. N. Trefethen and D. Bau, Numerical Linear Algebra, SIAM, 1997.
6. G. H. Golub and C. F. Van Loan, Matrix Computations, 3rd Ed., John Hopkins University Press, 1996.
7. J. W. Demmel, Applied Numerical Linear Algebra, SIAM, 1997.

14MA3002 FINITE ELEMENT METHODS

Credits: 3:0:0

Objective:

- A concise introduction to the elementary concepts of FEM.
- To provide the models of finite element methods.
- To learn the applications of FEM to heat flow and solid mechanics problems.

Outcome:

- Students are able to gain the knowledge in FEM.
- Developing finite element formulation for analysis of a variety of engineering problems.
- Students are able to apply FEM to electrostatics of 1-D bars, cables, heat conduction and porous media flow, torsion, electric potential.

Course Description:

Introduction to FEM: Mathematical Models-Dynamic, heat transfer and solid mechanic problems, Introduction to Finite Element Method -The basic idea and features. **Calculus of variation**: Fundamentals of calculus of variation-Euler Equation-Natural and Essential Boundary Conditions-Hamilton's Principle. **Discrete Systems**: Linear Elastic Spring-Torsion of Circular Shafts-Heat Transfer: Governing equations and Finite element Models. **Fluid Mechanics**: Governing Equations and Finite Element models-Analysis of Beams element. **Eigen value problems**: Formulation-Finite Element Formulation-Heat transfer and Bar-like problem-Natural Vibration of Beams-Stability of Beam. **Numerical Integration**: Coordinate Transformations-Integration over a Master Rectangular Element and a Master triangular element.

Reference Books:

1. J.N. Reddy, "An introduction to the finite element method", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. O.C.Zienkiewicz. "The Finite Element method",. Tata Mc Graw Hill.1989.
3. C. S. Desai and John F.Abel., Introduction to Finite Elements Method, Litton Educational Publishing Inc.,2004
4. Erik G. Thompson..Introduction to Finite Element Method, John Wiley & Sons, 2000..
5. T. R. Chandrupatla and A. D. Belegundu, "Introduction to Finite Elements in Engineering", 2nd Edition, Prentice Hall, New Jersey, 1997.
6. Daryl L. Logan, "A First Course in the Finite Element Method", 2nd Edition, PWS Publishing Company, Boston, 1993.
7. K. C. Rockey, H. R. Evan, D. W. Griffiths, and D. A. Nethercot, "The Finite Element Method: A Basic Introduction", 2nd Edition, William Collins Sons & Co. Ltd., 1983.

14MA3003 FOUNDATIONS OF MATHEMATICS AND STATISTICS

Credits: 3:0:0

Objective:

- To develop the skills of the students in the area of probability and statistics.
- To know more about descriptive and inferential statistics.
- To understand the various application design of experiments.

Outcome:

- Knowledge in the technique, methodology and Application of statistics.
- A basic understanding in collection, presentation and drawing conclusion about

biological data.

- Students are able to apply the subject knowledge in their engineering subjects**.**

Course Description:

Algebra: Linear and quadratic equations**-** Binomial Theorem- Summation of series – coefficient of x^n - exponential function-logarithmic function. **Differential Calculus:** Limits and Continuity**-** Differentiation–Product and Quotient Rule –Maxima and Minima of f(x). **Integral Calculus**: Integration of standard functions – Methods of Integration – Integration by parts – Definite Integrals - Bernoulli's formula. **Probability and distributions:** Probability – Axiomatic definition of probability – Independent events –Binomial, Poisson Distributions — Normal Distribution – Properties of Normal Distribution —Importance of Normal Distribution —Normal probability curve – fitting Binomial, Poisson Distributions – problems (proofs and derivations not included). **Testing of hypothesis:** one tailed and two tailed tests - Tests based on large samples –proportion and mean – Small samples – t, F, chi square distributions.

Reference Books:

1. Gupta S.P., "Statistical Methods", New Delhi, S.Chand & Co., 37th Edition 2009.
2. Veerarajan T, "Probability, Statistics and Random Processes", Second Edition, Tata McGraw Hill publishing company, 2003.
3. Kandasamy P., Thilagavathi K and Gunavathy K., "Numerical Methods", S.Chand & Co., 2009.
4. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Co., 2007.
5. Kapoor J.N. & Saxena H.C. "Mathematical Statistics", S.Chand & Company, 2006.
6. Kandasamy P., Thilagavathi K and Gunavathy K., "Engineering Mathematics", Volume I, S.Chand & Co., 2001.
7. Manickavasagam Pillai, "Algebra" , Volume I & II, S. Viswanathan publishers, 2002.

14MA3004 ADVANCED CALCULUS AND NUMERICAL METHODS

Credits: 3:0:0

Objective:

- To familiarize the students in the field of advanced calculus, application of Partial Differential Equations.
- To learn Numerical integration techniques.
- To understand Eigen and boundary value problems with engineering applications.

Outcome:

- Students will be able to relate their subject knowledge with their core subjects during their course of study.
- Developing the skills in solving heat and wave equations.
- Students are able to apply Gaussian quadrature formula and its derivations in the engineering fields.

Course Description:

One dimensional wave and heat equation- string, rods. Two dimensional heat equation-finite, infinite, semicircular and circular plates- **Calculus of variation**- Euler's equation, Functional dependant on its first and higher order derivatives and several independent variables, moving boundaries, eigen and boundary value problems-Power, Jacobi methods, Given's method, Raleigh-Ritz, collocation, Galerkin methods. **Numerical integration**-Simpson's rules, Romberg's method, Gaussian quadrature, Natural cubic spline functions formula.

Reference Books:

1. P.Kandasamy, K.Thilagavathy and K, Gunavathy, "Numerical methods", S.Chand & Company Ltd, Revised Edition, 2010.
2. Naveenkumar, "An Elementary course on Variational problems in calculus", Narosa Publishing House, 2003.
3. B.S.Grewal, "Higher Engineering Mathematics"42^{th} Edition Khanna publisher, Delhi, 2012.
4. M.K.Venkataraman,"Higher Mathematics for engineering and Science", National Publishing Company, 2002.
5. Curtis F-Gerald, "Applied Numerical Analysis", 5th edition, Adison Wesley Publishing Company, 2001.

6. E.Balagurusamy, “Computer Oriented Statistical and Numerical Methods”, MacMillan series, Madurai, 1988.
7. M.K.Jain, S.R.K.Iyengar and R.K.Jain, “Numerical methods for scientific and Engineering Computation”, 6th Edition, New Age International, 2005.

14MA3005 CALCULUS OF VARIATIONS AND VECTOR SPACES

Credits: 3:0:0

Objective:

- To provide the students with the understanding of basic concepts of set theory.
- To learn Z-transforms and its applications.
- To equip the students with skills in variational problems.

Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during the course of study.
- Students are able to identify the application of integral equations in their engineering fields.
- Understanding Orthogonalization techniques.

Course Description:

Calculus of variations: Variational problems of fixed boundaries only simplest Variational problems – Euler equation - Brachisto Chrone problem – Variational problems involving several unknown functions – Functional involving first and second order derivations –Functional involving two or more independent variables – Isoperimetric problems. **Linear integral equations**: – Fredholm and Volterra integral equations – Relation between differential and integral equations- Green’s function. Fredholm equation with separable kernal – Interactive method of solving equation of second kind –Properties of symmetric kernels. **Vector spaces**: Sets – Relations – Functions – Vector Spaces - Definition and examples of linear space – Linear dependence and independence –Basis and Dimension–**Inner product spaces:** Orthogonalisation process**. Z–Transforms:** Z-Transforms of standard functions-Inverse Z-Transform - Applications

Reference Books:

1. Grewal B S, “Higher Engineering Mathematics”42th Edition Khanna publishers, New Delhi, 2012.
2. Venkataraman M.K., “Higher Mathematics for engineering and Science”, National Publishing Company, 2002.
3. Hoffmann and Kunze, “Linear Algebra” second edition, Prentice Hall India Limited, 2002.
4. Tremblay J.P. and Manohar R., “Discrete Mathematical Structures with Applications to Computer Science”, McGraw Hill, 1997.
5. John Proakis G., “Digital Signal Processing”, Prentice Hall of India (P) Ltd., 1995.
6. Kenneth Rosen H., “Discrete mathematics and its Applications”, Tata McGraw –Hill Edition, 2005.
7. Kumaresan. S, “Linear Algebra”, Prentice-Hall of India Private Limited, 2000

14MA3006 GRAPH THEORY AND RANDOM PROCESS

Credits: 3:0:0

Objective:

- To provide the students with the understanding of basic concepts in Graph theory.
- To learn more about the random process.
- To equip the students with Queuing models.

Outcome:

- Students will have the knowledge of applying the concepts of graphs and trees in their engineering fields.
- Students will be able to able to understand the advanced concepts in random process.
- Students are able to apply queuing theory concepts in their subjects.

Course Description:
Graph Theory : Graphs, Euler graph, Hamiltonian graph, Transportation network, coloring, Trees, Minimal Spanning Trees. **Random processes**: Special classes, Stationary, Analytical representations, Weiner Process function, Auto correlation, cross Correlation, Properties, Ergodicity, Mean Ergodic theorem, Correlation Ergodic process, Power spectral density and its properties. **Introduction of Queuing theory**: Queuing model involving M/M/I: ∞/FIFO, M/M/C: ∞/FCFS, M/M/I: N/FCFS, M/M/C: N/FCFS (Derivations are not included – simple problems to be asked).

Reference Books:

1. Discrete Mathematical Structures, Bernard Kolman, Robert C.busby, Sharo Cutler Ross, Prentice Hall of India, 2004, 5th edition.
2. Probability, Statistics and Random processes, T.Veerarajan, Tata McGraw Hill Publishing company lt, 2006, 2nd edition.
3. Hamdy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.
4. Applied Discrete Structures For Computer Science, Alan Doerr, Kenneth Levasseur, Galgotia Publishers Pvt.Ltd, 1st Edition, 1998.
5. Discrete Mathematics and Its Applications, Kenneth H. Rosen, Mcgraw Hill, 3rd Edition, 2005.
6. Probability Theory and Random Processes, Murugesan K, Anuradha Agencies, 1st Edition, 1998.
7. Probability and Random Processes with Applications to Signal Processing, Henry Stark, John W. Woods, Pearson Education Asia, 3rd Edition, 2012.

14MA3007 APPLIED STATISTICS

Credits: 3:0:0

Objective:
- To develop skills of the students in the area of probability and statistics.
- To know more about descriptive and inferential statistics.
- To understand the various application of Time Series and Design of experiments.

Outcome:
- Knowledge in the technique, methodology and Application of statistics.
- A basic understanding in Forecasting.
- Students are able to apply regression analysis to their engineering problems.

Course Description:
Statistics:Probability, Binomial, Poisson and Normal Distributions, Concepts of reliability, Serial and parallel systems Method of least squares, fitting a straight line, fitting exponential and power curve. **Time Series:** Components of Time Series, Measurement of Trend, Method of Semi averages, Method of Moving Average, Method of Simple Averages , Ratio to Moving Average Method. **Statistical Analysis**:Multiple Regression of X_1 on X_2 and $X_{3,}$ Tests based on large samples, Small samples. The Mann Whitney U test. **Design of Experiments:** Randomized block design, Latin square design, comparison of RBD and LSD.

Reference Books:

1. Gupta S.P., "Statistical Methods", New Delhi, S.Chand & Co., 37th Edition 2009.
2. Veerarajan T, "Probability, Statistics and Random Processes", Second Edition, Tata McGraw Hill publishing company, 2003.
3. Kandasamy P., Thilagavathi K and Gunavathy K., "Numerical Methods", S.Chand & Co., 2009
4. Richard A. Johnson, "Probability and Statistics For Engineers", Prentice Hall of India, 2005.
5. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Co., 2007.
6. Kapoor J.N. & Saxena H.C. "Mathematical Statistics", S.Chand & Company, 2006.
7. David P.Doane, Lori E.Seward, "Applied Statistics in Business and Economics", Tata McGraw Hill Publishing Company, 2007.

14MA3008 COMPUTATIONAL MATHEMATICS

Credits: 3:0:0

Objective:

- To provide the students with the understanding of basic concepts in Variations.
- To learn the applications of Partial Differential Equations.
- To equip the students with the knowledge in Numerical Methods for analysis and modeling.

Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during the course of study.
- Students are able to understand the application of differential equations.
- Students apply differential equations and numerical methods for modeling.

Course Description:

Calculus of variations: Euler's equation, Functional dependant on its first and second order derivatives. **Classification of partial differential equation of second order**: Solution of Laplace equation by Liebmann method, Solution of Poisson equation by Liebmann method, differential Equation by Bender Schmidt method, Crank Nicholson method. **Initial value problems**: Picard's method – Euler, Improved Euler and modified Euler methods. **Eigen value problems**: Power & Inverse power methods – Jacobi methods. **Boundary value problems**: Raleigh-Ritz, collocation methods, Horner's, Muller's and Chebyshev's method, Graffe's root square method ,Gauss elimination, Gauss-Jordan, Relaxation methods, Newton Raphson methods, Newton-Cotes quadrature formula – Simpson's $1/3^{rd}$ and $3/8^{th}$ rules - Weddle's rule (Single & Double integral) – Gaussian quadrature formula, Natural cubic spline functions.

Reference Books:

1. Naveenkumar, "An Elementary course on Variational problems in calculus", Narosa Publishing House, 2003.
2. Veerarajan T., Ramachandran T., "Numerical Methods", Tata McGraw Hill, 2003.
3. Curtis F-Gerald, "Applied Numerical Analysis", 5th edition, Addison Wesley Publishing Company, 2001.
4. Venkataraman M.K., "Numerical methods in Science and Engineering", National Publishing Company, Revised Edition, 2005.
5. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Third edition, Brooks/Cole Publishing Company, California, 1994.
6. Grewal B S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
7. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical methods for scientific and Engineering Computation", 6th Edition, New Age International, 2005.

14MA3009 APPLIED GRAPH THEORY AND QUEUING THEORY

Credits: 3:0:0

Objective:

- To equip the students with the basic knowledge in number theory, graph theory and automata theory that have applications in software technology.
- To provide the students with soft computing techniques from random processes.
- To learn queuing theory models.

Outcome:

- Students will have ability to write efficient programs.
- Students are able to develop algorithms.
- Students apply queuing models in their engineering subjects.

Course Description:

Graph theory: Basic Terminology, Some special simple graphs, Representations of graphs, Connectivity, Shortest path algorithm and Trees. **Number theory:** Divisibility, primes, fundamental theorem of arithmetic, Division Algorithm, G.C.D & LCM. **Automata theory:** Languages& Grammars, Phrase Structure Grammars & Types, Derivation trees, backus-Naur Form, Finite-state machines with outputs & types, Finite-state machines with no outputs, Regular sets, Kleene's theorem, Regular grammars. **Random process:** Classification of random processes, Special Classes, Average values of Random processes, Stationary, Autocorrelation Function, Cross-correlation Function & their properties, Ergodicity, Mean Ergodic Theroem – Gaussian Process & its properties. **Queuing theory**: Characteristics of Queuing systems, Representation a queuing Model, Properties of the models (M/M/1): (∞/FIFO) and (M/M/k): (∞/FIFO) – simple problems

Reference Books:

1. Kenneth Rosen H., "Discrete mathematics and its Applications", Tata McGraw –Hill Edition, 2012.
2. Veerarajan T., "Probability, Statistics and Random Processes", Second edition, Tata McGraw-Hill, Sixth reprint 2009.
3. Bernard Kolman, Robert Busby C., Sharon Cutler Ross, "Discrete Mathematical Structures", Fifth Edition, Pearson Education, 2004.
4. Richard Williams H., "Probability, Statistics and Random Process for Engineers", CENGAGE Learning, 2009.
5. Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science", Prentice-Hall of India Private Ltd. 2004.
6. Handy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.
7. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.

14MA3010 GRAPH THEORY AND ALGORITHMS

Credits: 3:0:0

Objective:

- To provide the student with the understanding of basic concepts in Graph theory.
- To learn linear programming problems.
- To know more about data structures.

Outcome:

- Students will be able relate their subject knowledge with their engineering subjects during the course of study.
- Students apply optimization techniques in their engineering subjects.
- Understanding Graph network problems.

Course Description:

Basics of graph theory: Graphs – Data structures for graphs – Sub graphs – Operations on Graphs Connectivity – Networks and the maximum flow – Minimum cut theorem - Trees – Spanning trees – Rooted trees – Matrix representation of graphs. Eulerian graphs and Hamiltonian graphs – Standard theorems – Planar graphs – Euler's formula -Five colour theorem – Coloring of graphs – Chromatic number (vertex and edge) properties and examples – Directed graphs. Graph algorithm**:** Computer Representation of graphs – **Basic graph algorithms:** Minimal spanning tree algorithm – Kruskal and Prim's algorithm - Shortest path algorithms – Dijsktra's algorithm. **Linear Programming**: Graphical methods – Simplex method (Artificial variables not included).

Reference Books:

1. Gupta S.C., Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2002.
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India (p) Ltd. 2004.
3. Kenneth Rosen H., "Discrete mathematics and its Applications", Tata McGraw –Hill Edition, 2012.

4. Kanti Swarup, Man Mohan, Gupta P.K., “Operations Research”, Sultan Chand &Sons, 2000.
5. Walpole Myers, Myers, Ye, “Probability & Statistics for Engineers and Scientists”. Pearson Education, first Indian reprint, 2002.
6. Gupta S.C., Kapoor V.K., “Fundamentals of Applied Statistics”, Sultan Chand & Sons, 2002.
7. Veerarjan T., “Theory of Probability and Random Process”, Tata McGraw Hill Publishing Company Science, PHI, 2005.

14MA3011 BIOSTATISTICS AND QUALITY CONTROL

Credits: 3:0:0

Objective:

- To provide the student with the understanding of basic concepts in Statistics, Distributions.
- To learn Testing of Hypothesis for analysis, design of experiments.
- To equip the students with the knowledge in quality control.

Outcome:

- Students will be able to relate their subject knowledge with their engineering subjects during the course of study.
- Students are able to apply sampling techniques to biological data.
- Students apply the techniques in SQC to biological data.

Course Description:

Statistics: Measures of central tendency, Dispersion, Binomial, Poisson, Normal distributions. Population, sample, one tailed and two tailed tests, Tests based on large samples, proportion and mean. Tests based on t, F, chi square distributions. Design of experiments, completely randomized design, randomized block design, Latin square design –comparison of RBD and LSD. **Quality Control:** Types of variation , types of control charts X chart, R Chart, C Chart, Advantages and Limitations of SQC, Acceptance sampling, Single acceptance sampling plan, double sampling plan, construction of a OC curve, AQL and LTPD.

Reference Books:

1. S.P. Gupta, Statistical Methods, Sultan Chand and sons., New Delhi, 2009.
2. T.Veerarajan, Probability, Statistics and Random Processes, TataMcGraw Hill, second edition, 2009.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S.Chand & Company Ltd, 2007.
4. Kandasamy P., Thilagavathi K and Gunavathi K., “Engineering Mathematics” Volume II (First revised and enlarged edition), S. Chand & Co., New Delhi, 2000.
5. Gupta S.C., Kapoor V.K., “Fundamentals of Applied Statistics”, Sultan Chand & Sons, 2002.
6. Veerarjan T., “Theory of Probability and Random Process”, Tata McGraw Hill, 2005.
7. Walpole Myers, Myers, Ye, “Probability & Statistics for Engineers and Scientists” Pearson Education, first Indian reprint, 2002

14MA3012 NUMERICAL METHODS AND BIOSTATISTICS

Credits: 3:0:0

Objective:

- To provide the students with the knowledge in numerical problems.
- To learn the problems related with Eigen values and Eigen vectors.
- To equip the students with statistical techniques for biological data.

Outcome:

- At the end of the course, the students would be acquainted with the basic concepts in numerical methods and their uses.
- Upon completion of this course, students will understand and be able to apply basic techniques in descriptive statistics.
- Students will be able to solve different kinds of problems that occur in engineering.

Course Description:

Numerical Methods:Bisection method, Newton-Raphson method, Gauss-Seidel iteration method, Gauss-Jordan method,- Eigenvalues and Eigenvectors. Linear Interpolation, polynomial interpolation, Difference tables, Gregory-Newton interpolation, Trapezoidal rule, Simpson's rule, Newton's Three-eights rule. Solution of differential equations: Euler's Method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoring and Stability of solution. **Statistic**s: Sampling, frequency distribution, measure of central tendency-Mean median and mode, measure of dispersion, Probability Distribution, binomial, Poisson. **Curve fitting and correlation:** Linear least square fit, nonlinear fit, polynomial fit, coefficient of correlation, multiple correlation, partial correlation, rank correlation.

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Reference Books:

1. Balagurusamy E., "Computer Oriented Statistical and Numerical Methods", MacMillan series, Madurai, 2000.(Theory and problems only).
2. Rajaraman V., "Computer oriented numerical methods", Prentice-Hall publications, 2007.
3. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical methods for scientific and Engineering Computation", 6^{th} Edition, New Age International, 2012.
4. Thangaraj . P, "Computer Oriented Numerical Methods", Prentice hall of India Pvt. Ltd, New Delhi, 2008.
5. Grewal B.S, "Higher Engineering Mathematics", 42^{th} Edition, Khanna publishers, New Delhi 2012.
6. Kandasamy P., "Numerical Methods", S.Chand and Co, Reprint 2010.
7. Erwin Kreyszig, "Advanced Engineering Mathematics", 8^{th} Edition, John Wiley Publications, 2008.

14MA3013 GRAPH THEORY AND PROBABILITY

Credits: 3:0:0

Objective:

- To develop the skills of the students in the area of Graph theory.
- To know about Probability theory.
- To learn Sampling Distributions.

Outcome:

- Students will have knowledge in Graph Theory.
- Students have the basic understanding in Probability.
- Students have the skills in Sampling Distributions for modeling.

Course Description:

Graph Theory: Graph terminology – Representing Graphs and Graph Isomorphism-connectivity- Euler and Hamiltonian paths, Shortest path algorithm -Planar graphs – Graph Coloring– Chromatic number **–**Introduction to Trees – application of Trees- Tree traversal - Spanning trees – Rooted trees -Minimal spanning tree-– Kruskal and Prim's algorithms – DFS and BFS algorithms. **Probability:** Addition Law – Multiplication law – Conditional Probability. Distributions: Binomial, Poisson and Normal distributions. Sampling distributions**:** Tests based on large samples, Student's t, F and chi-square test for Goodness of fit, Independence of attributes.

Reference Books:

1. Gupta S.C and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 2008.
2. Kenneth Rosen H, "Discrete mathematics and its Applications", Tata McGraw –Hill Edition, Seventh Edition, Reprint 2012.
3. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall of India, 2011.
4. Bondy A and Moorthy U, "Graph Theory and Applications", McMillan, London, Reprint 2013
5. Grewal B S, "Higher Engineering Mathematics", 42^{nd} Edition, Khanna Publications, Delhi, 2012.
6. T.Veerarajan, Probability, Statistics and Random Processes, TataMcGraw Hill, second edition, 2009.
7. Kreyszig E., "Advanced Engineering Mathematics", (8th Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2000.

14MA3014 FUNDAMENTALS OF STATISTICS

Credits: 3:0:0

Objective:

- To provide the students with the basic concepts of statistics.
- To learn probability theory needed for analysis.
- To understand the basic concepts in ANOVA.

Outcome:

- Students will be able to make logical conclusions using statistical concepts.
- Students are able to apply statistical tools for modeling.
- Understanding the application of Baye's theorem in engineering fields.

Course Description:

Basic statistics: Measures of central tendency, Measures of Dispersion -Correlation and regression. **Probability and distributions:** Axioms of probability– Bayes' Theorem–Theoretical Distributions - Binomial, Poisson and Normal distributions. Tsting of hypothesis**:** Tests based on large samples –proportion and mean – Small samples – t, F, chi square distributions. **Design of experiments:** Analysis of Variance– One factor classification – completely randomized design- - two way classification – Randomised block design - Latin square design – analysis of design for three factor of classification.

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Reference Books:

1. S.P. Gupta, Statistical Methods, Sultan Chand and sons., New Delhi, 2009
2. T. Veerarajan, Probability, Statistics and Random Processes, Tata McGraw Hill, Second edition, 2009.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S.Chand & Company Ltd, 2007.
4. Grewal B S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
5. Gupta S.C., Kapoor V.K., "Fundamentals of Applied Statistics", Sultan Chand & Sons, 2002.
6. Veerarjan T., "Theory of Probability and Random Process", Tata McGraw Hill Publishing Company Science, PHI, 2005.
7. Mille I.R. and Freund J.E., "Probability and Statistics for Engineers", Prentice Hall, second edition. 2004,

14MA3015 OPERATIONS RESEARCH TECHNIQUES

Credits: 3:0:0

Objective:

- To provide the students with the understanding of basic concepts in Operations Research.
- To learn transportation and assignment problems.
- To develop the skills of students in Queuing models.

Outcome:

- Students are able to relate their subject knowledge with the engineering subjects.
- Students apply sequencing problems for modeling.
- Students are able to understand queuing model techniques.

Course Description:

Linear Programming Problem - formulation of Linear Programming problem, Graphical Method solution to L.P.P, Simplex Method, Artificial variable technique and two phase simplex method, Duality, Dual and simplex method, Dual Simplex Method. **Sequencing:** Job sequencing, n jobs through two machines, n jobs through m machines and two jobs through m machines. **Transportation Model**: Initial basic feasible solutions, moving towards optimality, Degeneracy. **Assignment problem**: Multiple Solution, Hungarian Algorithm, Maximization in Assignment Model, Impossible Assignment. **Queuing model**: problems involving (M\M\1): (∞\FIFO) , (M\M\c): (∞\FIFO) Models. **Network analysis**: PERT & CPM- network diagram-probability of achieving completion date-crash time- cost analysis. **Simulation models:** Elements of simulation model-Monte Carlo technique – applications.

Reference Books:

1. Handy Taha. A., "Operations Research" (Sixth Edition) Prentice – Hall of India Private Limited, New Delhi, 2010.
2. Natarajan A.M., Balasubramani P., Tamilarasi A., "Operations Research", Pearson Education, I Edn, 2003.
3. Srinivasan G., "Operations Research", Eastern Economy Edition, I Edn. 2007.
4. Winston, "Operations Research, Applications and Algorithms" , Cengage Learning, 4^{th} Edition, 2004.
5. Sharma J.K., "Operations Research: Theory and Applications" (3rd Edition) Macmillan Company of India Ltd., 2008.
6. Goel.B.S. Mittal.S.K, "Operations Research" (19th Edition), Pragati Prakashass, 2002.
7. Panneerselvam. R.,"Operations Research", (2nd Edition), Phi Learning Pvt., Ltd., 2010.

14MA3016 STATISTICS AND NUMERICAL METHODS

Credits: 3:0:0

Objective:

- To provide the student with the understanding of basic concepts in Statistics.
- To learn Probability theory.
- To equip the knowledge in Numerical Methods for Analysis.

Outcome:

- The students will be able to apply the concepts in Statistics and Numerical methods.
- Students are able to use numerical techniques for modeling.
- Students are able to apply correlation and regression analysis for decision making.

Course Description:

Statistics: Frequency distributions-Graphs of frequency Distribution – Measures of central Value –Measures of Dispersion–Correlation, Scatter diagram, rank correlation, regression lines, regression equations–Probability, Conditional probability, Baye's theorem, Expectations, Distributions: Binomial, Poisson and normal. **Numerical Mathematics**: The Solution of Numerical Algebraic and Transcendental Equations- Simultaneous linear algebraic equations- Numerical differentiation and Numerical Integration – Numerical Solution of ordinary differential equations.

Reference Books:

1. Gupta S.P., "Statistical Methods", 33rd edition, Sultan Chand & Co., 2004.
2. Venkataraman M.K., "Numerical Methods in Science and Engineering", Revised edition, The National Publishing Company, 2005.
3. Kandasamy P., Thilagavathy K., Gunavathy K., "Numerical Methods", S. Chand & Co. Ltd. Reprint 2009.
4. Veerarajan T., Ramachandran T., "Numerical Methods with Programs in C", Tata McGraw Hill Publishing Company Ltd, Second edition, 2006.
5. Gupta S.C., Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, XI edition, New Delhi, 2002.
6. Veerarajan T., "Probability Statistics and Random Variables", Tata McGraw-Hill, New Delhi 2004.
7. Thangaraj. P, "Computer Oriented Numerical Methods", Prentice hall of India pvt. Ltd, New Delhi, 2008.

14MA3017 DISCRETE MATHEMATICS

Credits: 3:0:0

Objective:

- To provide the student the understanding of basic concepts in discrete mathematics.
- To learn the basics of graphs and trees.
- To teach finite state machines, languages and grammars.

Outcome:

- The students will be able to handle problems logically.
- Students are to write computer programs.
- Students have the knowledge of compiler design.

Course Description:

Logic: Propositional Equivalences - Predicates and Quantifiers - Methods of Proof - Set operations - Functions. **Boolean Functions:** Logic Gates- Minimization of circuits-Mathematical Induction–Structural Induction-Relations and their Properties. **Graph Theory**: Graph Terminology –Connectivity – Euler and Hamiltonian Paths – Shortest Path Problems, Planar graphs, coloring graphs. Trees: – Tree Traversal – Spanning Trees – Minimum Spanning Trees. **Finite Automata**: Languages and Grammars – Finite-State Machines with Output –Finite State Machines with No Output.

Reference Books:

1. Kenneth Rosen H., “Discrete Mathematics and its Applications”, , Tata McGraw-Hill, Edition 2012.
2. Edgar Goodaire G., Michael Parmeter M., “Discrete Mathematics with Graph Theory”, Third Edition, 2003.
3. Lipschultz, “Discrete Mathematics”, Schaum’s Series, 2002.
4. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, “Discrete Mathematical Structures”, 6th Edition, Pearson Education, 2009.
5. Iyengar N.Ch.S.N., Chandrasekharan V., Venkatesh K.A. and Arunachalam P.S., “Discrete mathematics”, Vikas Publishing, 2003.
6. Swapan Kumar Sarkar, “A textbook of Discrete Mathematics”, S. Chand & Company, 2004.
7. LIU C.L; Mohapatra D.P, “Elements of discrete mathematics: A computer oriented approach”, TATA McGRAW-HILL publishing company limited, Third edition, 2009.
8. Girish Sharma, Manoj Singhal, “A text book of discrete mathematics”, A.K. publications, First edition 2010.

14MA3018 OPTIMIZATION TECHNIQUES

Credits: 3:0:0

Objective:

To impart knowledge on optimization techniques such as

- Linear and non linear programmings,
- Integer programming and Dynamic programming,
- Genetic algorithm and Network techniques.

Outcome:

Ability to :

- have a basic understanding of optimization algorithms,
- formulate engineering design problems as mathematical optimization problems,
- use computational tools to solve the optimization problems.

Course Description:

Engineering applications of optimization – classification of optimization problems- **Linear programming**: Formulation of LPP, Solution to LPP by simplex method, **Integer programming**: Cutting plane algorithm, Branch and bound technique, **Dynamic Programming**: Air Cargo model, Capital budgeting problem, **Non linear Programming**: Lagrangian method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Geometric programming - **Network Techniques**: Shortest Path Model – Minimal Spanning Tree Problem – Maximal flow problem – Introduction to Genetic algorithm.

Reference Books:

1. S. S. Rao, “Engineering Optimization – Theory and Practice”, NAI publishers, 2013.
2. R. Panneerselvam, “Operations Research”, Prentice Hall of India Private Limited, New Delhi, 2005

3. Kalymanoy Deb, “Optimization for Engineering Design”, Prentice Hall of India Private Ltd., New Delhi, 2003
4. P.K.Gupta and D.S.Hira, “Practical Problems in Operations Research” – Sultan Chand & Sons, New Delhi, 2008.
5. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, New Delhi, 2000.
6. J.K.Sharma, “Operations Research – Theory and Applications”, Macmillan India Ltd., 2007.
7. Hamdy A.Taha, “Operations Research – An Introduction”, Prentice Hall of India, 2012.