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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| --- | --- | --- | --- |
| **Course Code** | **24WI3005** | **Duration** | **3hrs** |
| **Course Title** | **COMPUTATIONAL METHODS AND APPLICATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Differentiate between discrete and continuous probability distribution function. Explain any two PDFs highlighting their statistical parameters. | CO1 | U | 6 |
|  | b. | Interpret Type I and Type II error in hypothesis testing. | CO1 | U | 2 |
|  | c. | For the given data, fit a linear regression line  X: 50, 100, 150  Y: 5,12,20 | CO1 | A | 8 |
|  |  |  |  |  |  |
| 2. | a. | Compare and classify the nature of hyperbolic, parabolic and elliptic Differential Equations (PDEs) based on the discriminant B2 -4AC. | CO2 | A | 4 |
|  | b. | List the assumptions in Darcy’s law for porous media flow. | CO2 | U | 3 |
|  | c. | Illustrate the transport mechanism of contaminant in the subsurface flow with a neat sketch. | CO2 | A | 9 |
|  |  |  |  |  |  |
| 3. | a. | Examine the key components in the structure of an SPSS data file and their functions. | CO3 | A | 4 |
|  | b. | “Factor Analysis (FA) is a data reduction technique which can be applied in water quality assessment to identify the sources of pollution”. Justify. Illustrate with an example. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 4. | a. | Develop the governing finite difference equation using the Crank-Nicolson scheme for simulating one-dimensional advective-dispersive transport of a contaminant transport in a saturated porous medium (given set of parameters - flow velocity, dispersion coefficient, time step, and spatial grid size). | CO2 | A | 10 |
|  | b. | List any four methods of curve fitting. Explain the principle of any one of the methods in detail. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 5. | a. | Illustrate the following with an example in developing fuzzy model for prediction of water quality   1. Fuzzification 2. Membership functions 3. Evaluation of rules 4. Defuzzification. | CO4 | A | 10 |
|  | b. | Discuss in detail any one of the goodness of fit tests in hypothesis testing (with an example in the field of hydrology). | CO1 | An | 6 |
|  |  |  |  |  |  |
| 6. | a. | Classify the components /modules of SWAT model with relevant input parameters, equations, processes and output with a schematic diagram. | CO5 | An | 8 |
|  | b. | Analyze the chloride transport problem in a shallow aquifer system using MODFLOW. List the input data and layers to be created along with the boundary conditions while creating the model using Visual MODFLOW. | CO5 | An | 8 |
|  |  |  |  |  |  |
| 7. | a. | Evaluate a case-study of rainfall runoff prediction in a watershed using a suitable hydrological model. | CO6 | E | 8 |
|  | b. | Assess the functionality of WEAP model in integrating water demand, supply and allocation? Illustrate with a case study. | CO6 | E | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Consider the simple network below:    Assume the activation function as Sigmoid function,   1. Perform a forward pass on the network for the target/output=0.5 2. Compute the new weights for the output layer using backpropagation algorithm. | CO4 | An | 15 |
|  | b. | Differentiate between supervised and unsupervised algorithm with an example. | CO4 | A | 5 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Apply the concepts of probability distributions, hypothesis testing, and regression techniques to analyze environmental datasets. |
| CO2 | Solve one dimensional flow and transport models using finite difference method based on the nature of partial differential equations. |
| CO3 | Perform factor and principal component analysis on environmental data using SPSS. |
| CO4 | Apply the principles of AI and ML techniques, and Fuzzy logic concepts for prediction and forecasting. |
| CO5 | Apply the concepts of application software such as SWAT, Visual MODFLOW, and WEAP in hydrological modelling. |
| CO6 | Evaluate the case studies of the application of hydrological models. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **24WI3006** | **Duration** | **3hrs** |
| **Course Title** | **WATER RESOURCES SYSTEMS ANALYSIS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Enumerate the characteristics of a linear programming problem. | CO2 | U | 3 |
|  | b. | Examine the necessary and sufficiency conditions for a function of a single variable and multiple variables to be convex. | CO1 | Ap | 4 |
|  | c | Analyse the following function for convexity/ concavity and determine their values at the extreme points.  f(x)=x12 + x22 -4x1 -2x2 + 5 | CO1 | An | 9 |
|  |  |  |  |  |  |
| 2. | a. | Define a system in the context of water resources management. Discuss in detail any five types of systems with an example. | CO1 | U | 8 |
|  | b. | 1. Solve the following LP problem by graphical method:  Maximize z = 5x1 + 7x2  subject to 3x1 + 4x2 <=15  2x1 + 3x2 >= 12  x1, x2 >= 0  2. In the graphical method of solving LP problem, what does an unbounded feasible solution imply? | CO2 | Ap | 8 |
|  |  |  |  |  |  |
| 3. | a. | Discuss Bellman’s principle of optimality. Give an example for a sequential decision problem. | CO3 | U | 4 |
|  | b. | A total of 4 units of water is to be allocated optimally to three users. The allocation is made in discrete steps of one unit ranging from 0 to 4. With the three users denoted as User 1, User 2 and User 3 respectively, the returns obtained from the users for a given allocation are given in the following table.   |  |  |  |  | | --- | --- | --- | --- | | Amount of Water Allocated (x) | Return from User 1 (R₁(x)) | Return from User 2 (R₂(x)) | Return from User 3 (R₃(x)) | | 0 | 0 | 0 | 0 | | 1 | 5 | 5 | 7 | | 2 | 10 | 6 | 12 | | 3 | 9 | 3 | 17 | | 4 | 8 | 7 | 8 | | CO5 | An | 12 |
|  |  |  |  |  |  |
| 4. | a. | A city water supply project envisages expansion of the storage system from the existing capacity of 100 units to 160 units in the next 15years. The additional capacity required at the end of each of the 5 years and the discounted present worth for additional capacities are as given below:   |  |  | | --- | --- | | Time | Required Additional Capacity | | End of 5ᵗʰ year | 20 | | End of 10ᵗʰ year | 40 | | End of 15ᵗʰ year | 60 |  |  |  |  |  |  | | --- | --- | --- | --- | --- | | Period (Years) | 0 | 20 | 40 | 60 | | 1–5 | 0 | 120 | 150 | 200 | | 6–10 | 0 | 80 | 110 |  | | 11–15 | 0 | 6 |  |  | | CO3 | An | 12 |
|  | b. | Examine the different components of a simulation model. | CO4 | Ap | 4 |
|  |  |  |  |  |  |
| 5. | a. | Illustrate the multi-objective framework in handling conflicting objectives between irrigation and hydropower in a water resources system project. | CO6 | An | 8 |
|  | b. | Determine the required capacity of a reservoir whose inflows and demands over a 6-period sequence are as given below: (release = demand)  Period (t): 1 2 3 4 5  Inflow (Qt): 4 10 7 5 3  Demand (Dt): 5 1 4 6 2 | CO6 | Ap | 8 |
|  |  |  |  |  |  |
| 6. | a. | Explain the mass diagram approach in determining the reservoir capacity. | CO5 | Ap | 6 |
|  | b. | Formulate the Chance Constrained Linear Program for reservoir design and operation, when the inflow to a reservoir is a random variable. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | A random variable, X is described by a probability density function  f(x) = 5x2  0>=x<=1  =0. Otherwise  Find   1. Cumulative Distribution Function 2. E(X) 3. Var (X) | CO4 | Ap | 6 |
|  | b. | Assess a case study of linear programming model in maximizing the crop yield, considering the response of the crop to the amount of irrigation applied. | CO6 | E | 10 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Solve the following LP problem using simplex method  Maximize Z = 5x1 + 8x2  subject to  2x1 + 3x2 >=15  3x1 + 5x2 <=60  x1 + x2 = 18  x1, x2>= 0 | CO2 | Ap | 16 |
|  | b. | Distinguish between optimization and simulation. List any two techniques of optimization. | CO1 | U | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Explain system analysis in water resources planning and formulate the objective functions and constraints for linear optimization problems. |
| CO2 | Formulate and solve the linear programming model for reservoir operation using graphical and simplex method. |
| CO3 | Solve dynamic programming problems using forward and backward recursive methods for optimizing resource allocation and reservoir capacity. |
| CO4 | Apply Monte Carlo techniques to simulate water resources management scenarios and reliability analysis . |
| CO5 | Design the optimal water resources management strategies including operation policy for optimal allocation for efficient use of resources. |
| CO6 | Evaluate the successful case studies of optimization models in water resources management. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **24WI3009** | **Duration** | **3hrs** |
| **Course Title** | **FUNDAMENTALS OF ENVIRONMENTAL ISOTOPE HYDROLOGY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Give an account of the physio-chemical reactions that occur during equilibrium and non-equilibrium conditions of stable isotope fractionation during the hydrological cycle. | CO1 | U | 8 |
|  | b. | List any four stable and radioactive isotopes of natural origin used for the hydrological investigations. Write their significance in the field of hydrology. | CO1 | A | 4 |
|  | c. | Explain the basic principle behind the application of stable isotopes of water to identify the source of leakage in dam seepage/leakage studies. | CO1 | A | 4 |
|  |  |  |  |  |  |
| 2. | a. | Outline any two merits of tracer dilution method over the conventional methods of discharge measurements in mountainous streams. | CO3 | U | 4 |
|  | b. | Examine the limitations of chemical tracers and the advantages of radioactive tracers when used for the measurement of discharge in mountainous streams. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 3. | a. | Mention two favourable conditions generally exist in the mountainous streams which help to apply the tracer dilution technique for discharge measurement. | CO3 | U | 4 |
|  | b. | List potential applications of stable and radioactive isotopes for groundwater studies. | CO1 | U | 4 |
|  | c. | Analyze the factors influencing the rate of sedimentation in lakes/ reservoirs | CO4 | An | 4 |
|  | d. | Examine the significant role of any two isotopes and their half-life employed in sedimentation rate determination. | CO4 | An | 4 |
|  |  |  |  |  |  |
| 4. | a. | Write the limitations in using environmental tritium in age determination of groundwater. | CO4 | U | 4 |
|  | b. | Discuss the advantages of 210Pb method compared to 137Cs isotope method in sedimentation rate determination. | CO4 | A | 3 |
|  | c. | Explain the principle employed in applying Injected tritium for groundwater recharge studies. | CO4 | A | 4 |
|  | d. | Enumerate the adverse impacts of sedimentation in lakes/ reservoirs. | CO4 | U | 5 |
|  |  |  |  |  |  |
| 5. | a. | Define nuclear fission. Outline its significance in isotope hydrology. | CO5 | A | 3 |
|  | b. | What is Partial Test Ban Treaty? List any two nuclear accidents which took place after 1963. | CO2 | U | 4 |
|  | c. | Explain the term ‘quenching’ and various types of quenching in Liquid Scintillation Counting. | CO2 | A | 4 |
|  | d. | Explain the principle of Liquid scintillation counting system for the measurement of tritium in water samples. | CO2 | A | 5 |
|  |  |  |  |  |  |
| 6. | a. | Discuss the importance of Global Meteoric Water Line and Local Meteoric Water Line in the context of D and 18O data interpretation for the hydrological investigations. | CO3 | An | 6 |
|  | b. | Write the equation for dexcess (Deuterium excess) and describe its significance in the hydrological studies using stable isotopes of water (D and 18O). | CO3 | U | 6 |
|  | c. | List the stable isotopes used to identify the source of pollutants due to nitrates and sulphates in water. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 7. | a. | Illustrate the methods of sample preparation followed to convert stable isotopes of water into gaseous forms for the measurement of δ2H and δ18O in water using Isotope Ratio Mass Spectrometer. | CO2 | An | 10 |
|  | b. | Explain the principle employed in applying Injected tritium for groundwater recharge studies. | CO5 | A | 3 |
|  | c. | Mention the limitations/disadvantages of 137Cs in determination of sedimentation rate in lakes. | CO5 | U | 3 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Determine the stream discharge, Q (flow rate) in a mountainous stream using the following mass balance equation. Simplify the equation and attend the problem.  QC0+ qC1 = (Q + q) C2  Where, Q is the discharge rate of the stream, C0 is the natural background concentration of the tracer in the stream, C1 is the initial concentration of the tracer being injected into stream (at the upstream), C2 is the final concentration of the tracer after complete mixing of the tracer in the downstream and q is the constant rate of the injection of the tracer into the stream. | CO6 | E | 8 |
|  | b. | A chemical tracer with initial concentration of 520mg/L is injected at a constant rate of 240ml/s for about 45minutes in a mountainous stream. The natural background concentration of the tracer in the stream is 0.0002mg/L. The final observed concentration of the tracer is 0.4mg/L after complete mixing of the tracer at about 200meters downstream of the river. Determine the discharge rate (Q) of the stream and report it in cum/s. | CO6 | E | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Apply the concept of isotope fractionation in distribution of isotopes in various environmental samples. |
| CO2 | Analyse the samples using mass spectrometric techniques and interpret the stable isotope footprints in the hydrological research. |
| CO3 | Utilize isotopic data to identify the source and trace the hydrological processes in water cycle and groundwater systems. |
| CO4 | Estimate the age of lake, investigate water balance and measure the stream flow using environmental isotope hydrologic principles. |
| CO5 | Apply isotopic foot prints to study groundwater surface water interactions and track the migration of pollutants. |
| CO6 | Evaluate the case studies pertaining to the use of stable isotopes in hydrology, climate and environmental management |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **24WI3018** | **Duration** | **3hrs** |
| **Course Title** | **FOREST, URBAN AND AGRICULTURAL WATERSHED MANAGEMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Define watershed. What are the objectives of watershed development? | CO1 | U | 5 |
|  | b. | Explain the watershed processes and functions with an illustrative diagram. | CO1 | R | 11 |
|  |  |  |  |  |  |
| 2. | a. | Write short note on channel characteristics in a watershed. | CO3 | A | 5 |
|  | b. | How the watersheds are classified? Explain in detail. | CO3 | An | 11 |
|  |  |  |  |  |  |
| 3. | a. | What is the concept of topographic or contour map? Explain with neat sketches. | CO2 | A | 8 |
|  | b. | What is the role of Geographic Information System (GIS) for Watershed Delineation? Explain the steps for delineation of watershed by using GIS. | CO2 | An | 8 |
|  |  |  |  |  |  |
| 4. | a. | Write short note on causes and adverse effects of deterioration of forest watershed. | CO4 | R | 6 |
|  | b. | Explain the hydrological cycle of a forested ecosystem with a neat sketch. | CO4 | E | 10 |
|  |  |  |  |  |  |
| 5. | a. | Compare between global north and global south on agriculture output with illustrative graphical representation | CO2 | U | 8 |
|  | b. | What do you mean by drought? How it is classified. Explain. | CO2 | C | 8 |
|  |  |  |  |  |  |
| 6. | a. | Explain the Indicators and Stages for Watershed Program Evaluation. | CO2 | A | 7 |
|  | b. | List the pollutant categories to water quality degradation. Explain with indicators/examples. | CO3 | E | 9 |
|  |  |  |  |  |  |
| 7. | a. | Discuss in detail about drivers of Urbanisation and Urban Land Use Change. | CO5 | U | 9 |
|  | b. | Describe how to mitigate groundwater pollution caused by the agricultural  pollutants? | CO2 | A | 7 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Application of GIS tool and use of Satellite Imageries in watershed management. Discuss. | CO6 | E | 10 |
|  | b. | Briefly discuss the case studies of forest hydrology conducted in Western Ghats (MoEF). | CO6 | C | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Explain key watershed management concepts in integrated management of water resources in diverse landscapes. |
| CO2 | Describe the relationship between forest cover, hydrologic processes, soil erosion, and assess its impacts on watershed degradation. |
| CO3 | Assess the impact of agricultural practices on watershed health and develop indicators for soil and water conservation |
| CO4 | Analyze urban watershed challenges, including stormwater management, urban flooding and land-use planning on water resources. |
| CO5 | Examine case studies, applying watershed management concepts to solve real-world water resource issues in forest, agricultural, and urban settings |
| CO6 | Delineate the watershed using GIS tool and application software. |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **24WI3021** | **Duration** | **3hrs** |
| **Course Title** | **WATER HARVESTING AND SOIL CONSERVATION STRUCTURES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Discuss about flood water harvesting and routing with neat sketches. | CO1 | U | 8 |
|  | b. | Explain the long term water harvesting techniques with neat sketches. | CO1 | R | 8 |
|  |  |  |  |  |  |
| 2. | a. | Briefly explain agronomical measures in controlling soil erosion. | CO4 | A | 6 |
|  | b. | Discuss in detail about mechanics of water erosion. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the different factors affecting wind erosion. | CO2 | U | 8 |
|  | b. | How to control seepage and percolation losses in the case of farm pond? Explain the types and properties of lining materials. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 4. | a. | i. What is a terrace? How it is classified? Write short note on different types of bench terrace with neat sketches. | CO3 | R | 8 |
|  | b. | ii. Calculate the length and earthwork of the contour bund per hectare, vertical interval and cross sectional area of contour bund which is constructed on 5% land slope. The bund’s spacing (H.I) between consecutive bunds was maintained as 30 m. the other details are given as under:Top width = 50 cm; Bottom width = 125 cm; Soil is sandy loam; Height = 100 cm; Low rainfall zone and cost of construction = Rs.50/m3 | CO3 | An | 8 |
|  |  |  |  |  |  |
| 5. | a. | Explain the temporary gully control structures with neat sketches. | CO4 | E | 6 |
|  | b. | Discuss in detail for the site selection, design and construction of a percolation pond. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 6. | a. | Explain the components of drop spillway and their functions with a neat sketch | CO5 | A | 8 |
|  | b. | Explain the stepwise procedure for the design of bench terraces. | CO5 | An | 8 |
|  |  |  |  |  |  |
| 7. | a. | i. Explain the components of chute spillway and their functions with a neat sketch | CO6 | U | 8 |
|  | b. | ii. Determine the size of concrete pipe needed in a drop-inlet spillway for a peak flow of 2 m3/s and a total head of 3 m. Determine the slope to be given to the pipe for the pipe to flow full. Length of pipe = 12 m, entrance loss coefficient Ke = 0.5 and friction loss coefficient Kc = 0.03. | CO6 | A | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Explain the stepwise procedure for the design of drop-inlet spillway with a neat sketch | CO5 | R | 10 |
|  | b. | What are the factors responsible for different types of failure of hydraulic structure? Explain how to check against those failures. | CO6 | E | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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|  | **COURSE OUTCOMES** |
| CO1 | Apply the principles of water harvesting, identifying appropriate techniques for different environmental conditions and resource requirements. |
| CO2 | Design farm ponds and percolation ponds based on site selection and structural criteria. |
| CO3 | Identify the agents and causes of soil erosion and assess its impact on soil and water conservation. |
| CO4 | Examine temporary soil erosion control structures ensuring they meet functional and safety requirements. |
| CO5 | Design the structural components of drop spillway considering the safety against sliding and overturning. |
| CO6 | Apply the design principles of chute spillways and drop inlet spillways, ensuring effective energy dissipation under various hydraulic conditions |

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**END SEMESTER EXAMINATION – MAY / JUNE 2025**

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| **Course Code** | **24WI3032** | **Duration** | **3hrs** |
| **Course Title** | **APPLICATION OF ELECTROCHEMISTRY IN WATER AND WASTEWATER TREATMENT** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Design an electrochemical cell for the redox couple Ag+ / Ag and Cu2+ / Cu and write the cell representation, anode, cathode and overall reactions and calculate the cell voltage.  Given: Standard electrode potential of Ag: + 0.8 V and Cu: + 0.34 V | CO1 | A | 08 |
|  | b. | Analyze the process of e.m.f. measurement of an unknown electrochemical cell using potentiometric measurement method. | CO1 | An | 08 |
|  |  |  |  |  |  |
| 2. |  | Analyze the various parameters involved in the costing of an electrolytic process to identify an economically efficient process. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 3. | a. | Analyze the performance characteristics and general characteristics of electro-dialysis systems. How do these factors influence the efficiency of a desalination system. | CO3 | An | 08 |
|  | b. | Evaluate the advantages of electro-dialysis over other demineralization techniques. In what situations is ED the preferred method, and why? | CO3 | E | 08 |
|  |  |  |  |  |  |
| 4. | a. | Explain the purpose of an electro-dialysis unit and how it contributes to the desalination process. | CO3 | R | 08 |
|  | b. | Describe how electro-dialysis units are applied in specialized applications, such as in the food or pharmaceutical industries. Provide specific examples. | CO3 | R | 08 |
|  |  |  |  |  |  |
| 5. |  | Explain the key operational and design parameters influencing the performance of an electrocoagulation system. | CO4 | An | 16 |
|  |  |  |  |  |  |
| 6. | a. | Describe the principle of electrocoagulation, detailing the electrochemical reactions that occur at the anode and cathode. | CO4 | U | 08 |
|  | b. | Explain the phenomena of electrode passivation and activation in the context of electrocoagulation. How do these affect the performance of the process? | CO4 | U | 08 |
|  |  |  |  |  |  |
| 7. | a. | Illustrate with a diagram how ions are adsorbed and released in the electrodes for brackish water desalination using CDI. | CO5 | A | 08 |
|  | b. | Compare and contrast the ion adsorption behavior of activated carbon and biochar electrodes in CDI. Explain the role of ionic radii and hydrated radius in the removal efficiency of CDI. | CO5 | An | 08 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Apply various electrochemical techniques to treat liquors containing dissolved chromium. | CO6 | A | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL **M** – MARKS ALLOTTED

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| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Explain core electrochemical concepts such as Faraday’s laws of electrolysis and the role of electrochemical cells in charge transport. |
| CO2 | Apply the principles of electrochemistry in the design of electrochemical cells |
| CO3 | Assess the performance characteristics of electrodialysis in desalination, and compare ED with other water treatment methods. |
| CO4 | Analyze and compare electrocoagulation with chemical coagulation, assess its design and operational parameters |
| CO5 | Examine the working mechanism of CDI systems and types of carbon materials in removal of salts. |
| CO6 | Apply electrochemical processes to remove and recover metals from industrial effluents, particularly focusing on chromium and iron |