

**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19BT2018** | **Duration** | **3hrs** |
| **Course Name** | **ENZYME ENGINEERING AND TECHNOLOGY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the non-protein part of the enzyme. | | CO1 | U | 1 |
| 2. | Infer the best model that describes the interaction between active site and substrate. | | CO1 | R | 1 |
| 3. | For an enzyme-catalyzed reaction, Vmax is 5.7g/(Lmin) and Kp is 25 min-1. Calculate the initial Enzyme concentration E0. | | CO4 | An | 1 |
| 4. | In a reaction mixture containing 20 µmol of starch and amylase enzyme, it took 15 minutes for the complete conversion of starch. The protein content of the mixture was 30mg. Determine the specific activity. | | CO4 | An | 1 |
| 5. | Determine the Km of enzyme if the initial velocity is reduced to half of the maximum velocity. | | CO6 | An | 1 |
| 6. | Name any two cell disruption techniques. | | CO5 | R | 1 |
| 7. | Identify the type of inhibition observed with inhibitor that can bind to both active site of the enzyme and enzyme substrate complex. | | CO6 | U | 1 |
| 8. | Recall an enzyme used in the anti-blood clotting. | | CO2 | R | 1 |
| 9. | Name the immobilization technique that may be accomplished with sodium algenate. | | CO3 | U | 1 |
| 10. | List out the enzymes used in the laundry industry. | | CO2 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate the interaction between an enzyme and its substrate, according to the lock and key model. | | CO1 | U | 3 |
| 12. | For an enzyme-catalyzed reaction, with an initial enzyme concentration of 0.075g/L, constants were determined as Km= 9 g[S]/L and Vmax=1.7g/L min. Determine Kp. | | CO4 | An | 3 |
| 13. | Draw and label an immobilized enzyme packed bed reactor. | | CO3 | R | 3 |
| 14. | Construct a Lineweaver Burk plot for competitive and non-competitive inhibition. | | CO6 | A | 3 |
| 15. | For an enzyme catalyzed reaction, Vmax is 2.1 g/(Lmin) and K2 is 28 min-1. Calculate the initial Enzyme concentration E0. | | CO4 | An | 3 |
| 16. | Assess the importance of nanobiocatalyst in bioprocessing. | | CO2 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Elaborate a detailed note on the Enzyme Commission’s system of classification of enzymes with examples. | CO1 | R | 8 |
|  | b. | How are enzymes classified based on their specificity? Explain each specificity with an example. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | The following results were obtained for an enzyme- catalyzed reaction. Substrate concentration [S] and corresponding initial reaction rates (v) measured for an enzyme catalyzed reaction, for initial enzyme conc. of 5 µmol, are as follows.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | [S] (mM) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | v (µmol/min) | 2 | 3.5 | 4.8 | 5.6 | 6 | 6.2 | 6.3 | 6.4 | 6.5 |   Estimate (i) M-M parameters for this situation using Lineweaver-Burk plot and Hanes woolf plot. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Derive the expression for competitive and noncompetitive inhibition reactions and explain it with the help of a line-weaver Burk plot. | CO6 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Derive Michaelis Menten equation for single substrate reaction without inhibition. What are the methods available to estimate MM parameters explain in detail. | CO6 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Discuss in detail on various chromatographic techniques involved in purification of an intracellular enzyme. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | What is immobilization? Compare the physical and chemical methods of immobilization of enzymes with examples. | CO3 | U | 6 |
|  | b. | Elaborate on the construction and working of a fluidized bed bioreactor. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Describe with a neat sketch of calorimetric biosensor and piezo-electric biosensors used in industry. | CO2 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Examine the application of various enzymes in food and pharmaceutical industries. | CO2 | R | 8 |
|  | b. | Summarize on Biotransformation application of enzymes. | CO2 | U | 4 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand enzymes and enzymatic reactions |
| **CO2** | Relate the application of enzymes in various industries |
| **CO3** | Apply enzymes in free and immobilized form for various reaction |
| **CO4** | Analyze and solve problems related to enzymes and kinetics |
| **CO5** | Evaluate the processing and purification of enzymes |
| **CO6** | Hypothesize model for enzyme kinetics and inhibition types |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 9 | 8 | - | - | - | - | 17 |
| **CO2** | 9 | 20 | - | - | - | - | 29 |
| **CO3** | 3 | 13 | - | - | - | - | 16 |
| **CO4** | - | - | - | 20 | - | - | 20 |
| **CO5** | 1 | 12 | - | - | - | - | 13 |
| **CO6** | - | 1 | 3 | 25 | - | - | 29 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19BT2020** | **Duration** | **3hrs** |
| **Course Name** | **DOWNSTREAM PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | What is a key distinction between Gram-positive and Gram-negative bacteria regarding the recovery of intracellular products? | | CO1 | U | 1 |
| 2. | What is the common name of an anionic detergent frequently utilized in cell lysis protocols? | | CO1 | R | 1 |
| 3. | How does the specific cake resistance vary with pressure for compressible cake formation? | | CO2 | U | 1 |
| 4. | How would you explain the significance of the "separation factor" when choosing a solvent for extraction processes? | | CO2 | A | 1 |
| 5. | What are the contrasting characteristics of compressible and incompressible cakes in filtration? | | CO3 | U | 1 |
| 6. | What factors influence the drag force exerted on a spherical particle in a Newtonian fluid? | | CO3 | An | 1 |
| 7. | Can you identify an anionic resin and its associated functional group used in ion-exchange processes? | | CO4 | R | 1 |
| 8. | Which functionalized adsorbent is suitable for reverse-phase chromatography? | | CO4 | R | 1 |
| 9. | What chromatographic parameters are necessary to calculate the resolution between two peaks? | | CO5 | An | 1 |
| 10. | How would you define equilibrium moisture content in the context of the drying process? | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Categorize bioproducts according to volume, market value, and price index. | | CO1 | An | 3 |
| 12. | Elucidate the role of alkali treatment in cell lysis and discuss the accompanying challenges. | | CO2 | U | 3 |
| 13. | Recommend two pretreatment techniques capable of enhancing the filtration rate of fermentation broth substantially. | | CO3 | An | 3 |
| 14. | Identify the issue related to protein precipitation methods utilizing organic solvents. | | CO4 | U | 3 |
| 15. | Describe the mechanism underlying pH-based adjustments for optimizing extraction efficiency. | | CO5 | An | 3 |
| 16. | Determine the ionic strength of a 2 M solution of Al2(SO4)3. | | CO5 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Evaluate the efficacy and suitability of various physical and mechanical cell lysis methods through a comparative analysis. | CO1 | U | 8 |
|  | b. | Outline the factors and limitations to be addressed prior to implementing a thermal cell lysis protocol. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Formulate the mathematical correlation between the processed slurry volume and operational duration in batch filtration. | CO2 | A | 8 |
|  | b. | Compare and contrast compressible and incompressible cakes regarding their impact on filtration process efficiency. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Derive the expression for batch filtration rate as a function of pressure drop, liquid viscosity, resistance of filter medium, and cake. | CO3 | U | 3 |
|  | b. | Fermentation broth is filtered using a batch setup and the filtration time data is provided. If the surface area of membrane filter is 0.1 m2 against a pressure drop 10 kPa, viscosity 0.005 Nsm-2, and solid content of slurry 10 kg/m3, Calculate specific cake resistance of the solid deposited.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Time (s) | 5 | 10 | 20 | 30 | | Vol. filtrate (m3) | 0.040 | 0.055 | 0.080 | 0.095 | | CO3 | E | 9 |
|  |  |  |  |  |  |
| 20. | a. | Outline the procedural steps of ion exchange chromatography and elucidate the influence of pH and ion exchanger type on process efficacy. | CO4 | An | 6 |
|  | b. | Differentiate between distinct phases of the drying cycle by analyzing drying rate and moisture content variations, providing suitable explanations. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. | a. | Calculate the % recovery of steroid, if 100 ml of from culture broth containing 25 mg/ml is repeatedly (3 times) extracted with 50 ml of fresh methylene chloride. Given partition coefficient of steroid between organic and aqueous phase is 75. | CO5 | E | 9 |
|  | b. | Calculate extraction factor, if volume of aqueous to organic phase is 2:1 and partition coefficient is 130. | CO5 | E | 3 |
|  |  |  |  |  |  |
| 22. | a. | Classify the different membrane module configurations adopted in the separation process. | CO5 | U | 8 |
|  | b. | Explain the operating principle behind the reverse osmosis process. | CO5 | An | 4 |
|  |  |  |  |  |  |
| 23. | a. | The addition of 10 g charcoal to 100 L of fermentation broth containing 200 mg/L of antibiotic results in 30% drug recovery. The adsorption isotherm is given by the Freundlich model, . Estimate the recovery if 20 g of charcoal would have been added to the broth. | CO3 | E | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Derive the mathematical formula for crystal growth using diffusion and surface reaction theory. | CO6 | An | 6 |
|  | b. | Analyze and contrast the performance, mechanisms, and applications of hot-air drying and lyophilization. | CO6 | U | 6 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the fundamentals of product isolation and separation techniques |
| **CO2** | Distinguish various techniques for product recovery and isolation |
| **CO3** | Explain operating principles across different solid(liquid)-liquid separation process |
| **CO4** | Analyze product recovery in solid-liquid separation processes |
| **CO5** | Compare the performances of different extraction techniques |
| **CO6** | Apply separation techniques for bio product recovery |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 13 | 0 | 3 | 0 | 0 | 17 |
| **CO2** | 0 | 8 | 9 | 0 | 0 | 0 | 17 |
| **CO3** | 0 | 4 | 0 | 4 | 21 | 0 | 29 |
| **CO4** | 2 | 3 | 0 | 6 | 6 | 0 | 17 |
| **CO5** | 0 | 8 | 0 | 11 | 12 | 0 | 31 |
| **CO6** | 1 | 6 | 0 | 6 | 0 | 0 | 13 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19BT2024** | **Duration** | **3hrs** |
| **Course Name** | **CHEMICAL REACTION ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the reaction order where the concentration of reactant drops linearly with time. | | CO1 | U | 1 |
| 2. | Specify if the molecularity and order of chemical reactions could be different. | | CO1 | An | 1 |
| 3. | Select the type of linearized plot to find the rate constant for 2nd order reaction. | | CO2 | U | 1 |
| 4. | Identify a bio/chemical reaction of shifting order depending on the concentration | | CO2 | R | 1 |
| 5. | Explain the physical significance of space-time for flow reactor types. | | CO3 | U | 1 |
| 6. | Identify the condition when the conversion time in a batch reactor, and space-time in PFR would be the same. | | CO3 | An | 1 |
| 7. | Infer the total area under the E-curve for residence time distribution. | | CO4 | U | 1 |
| 8. | Distinguish between 1st order and pseudo-first order reaction. | | CO2 | R | 1 |
| 9. | Choose the reaction where fractional change in volume is always zero. | | CO5 | U | 1 |
| 10. | Identify the source of mass transfer resistance in fluidized bed reactor. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | A gas phase reaction A+2B🡪C starts 5 mol A, 5 mol of B. Calculate εA for the same reaction scheme. | | CO1 | An | 3 |
| 12. | Briefly explain the approach adopted in the “Differential Method” to identify the order of a chemical reaction. | | CO2 | U | 3 |
| 13. | Deduce the expression relating fractional volume change (εA), initial concentration (CA0), concentration (CA), and fractional conversion XA. | | CO3 | An | 3 |
| 14. | Develop a general equation showing the time required to achieve a conversion XA for either isothermal or non-isothermal conditions in batch reactor. | | CO4 | A | 3 |
| 15. | Explain the different regions of a vessel and the flow pattern considered in non-ideal reactor compartment models. | | CO5 | An | 3 |
| 16. | Explain if the use of 10 MFR (each 1L) in series is better in comparison to single 10 L MFR for 1st order kinetics. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | The first-order reversible liquid reaction takes place in a batch reactor. . After 8 minutes, the conversion of A is 33.3% while the equilibrium conversion is 66.7%. Estimate the rate equation for this reaction. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. | a. | Enzyme E catalyzes the transformation of reactant A to product R as follows:  assuming a fixed amount of enzyme loading, and reactant (CAo:10 mol/l) into a batch reactor. Estimate the time needed for the concentration of reactant to drop to 0.025 mol/l. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 19. | a. | Enzyme E catalyzes fermentation of substrate A (the reactant) to product R. Estimate the size of the mixed flow reactor needed for 95% conversion of reactant in a feed stream (25 L/min) of reactant (2 mol/L) and enzyme. The kinetics of the fermentation at this enzyme concentration are given by | CO3 | E | 6 |
|  | b. | Derive the operating equation for PFR under steady-state conditions, relating reaction rate with space-time, and degree of conversion | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | A liquid reactant stream (1 M) passes through two mixed flow reactors in a series. The concentration of A in the exit of the first reactor is 0.5 M. Estimate the concentration in the exit stream of the second reactor. The reaction is second-order for A and V2/V1 = 2. | CO4 | An | 8 |
|  | b. | Justify the reason for having a better performance of one 10 L PFR than a single 10 L MFR for chemical conversion with identical feed flow rate and composition. | CO4 | E | 4 |
|  |  |  |  |  |  |
| 21. | a. | Explain the procedure to formulate an E-curve from the concentration profile in a pulse-feeding experiment using a non-ideal reactor system. | CO5 | U | 4 |
|  | b. | Continuous response to a pulse input into a closed vessel which is to be used as a chemical reactor. Compute the mean residence time of fluid in vessel t, and tabulate and plot the exit age distribution E.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Time (min) | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | | Conc. (g/l) | 0 | 3 | 5 | 5 | 4 | 2 | 1 | 0 | | CO5 | A | 8 |
|  |  |  |  |  |  |
| 22. | a. | A mixed flow reactor with aqueous feed (10 mol/l of A) is used in a chemical reaction  with 70% conversion. The reactor is replaced with one having double the volume, with the same and the same feed rate. Estimate the new conversion. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | A mixed flow reactor (2 m3) processes an aqueous feed (100 L/min) containing reactant A (CA0 = 100 mM). The reversible reaction is represented as: . Estimate the equilibrium conversion and the actual conversion in the reactor. | CO3 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the resistance steps involved in Gas-liquid-solid mass transfer in aerobic fermentation system. | CO6 | U | 6 |
|  | b. | Describe the operation of a packed-bed bioreactor system in heterogeneous biochemical reactions. | CO6 | U | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the kinetics of reactions |
| **CO2** | Remember the design equations and the performance of ideal reactors |
| **CO3** | Create various models for describing non-ideal behaviour of reactors |
| **CO4** | Analyse performance of combined reactors |
| **CO5** | Explain adsorption and desorption phenomena in heterogeneous systems. |
| **CO6** | Design of various fermenter/bioreactors |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 0 | 1 | 0 | 4 | 12 | 0 | 17 |
| **CO2** | 2 | 4 | 0 | 0 | 12 | 0 | 18 |
| **CO3** | 0 | 1 | 0 | 10 | 30 | 0 | 41 |
| **CO4** | 0 | 1 | 3 | 8 | 4 | 0 | 16 |
| **CO5** | 0 | 5 | 8 | 3 | 0 | 0 | 16 |
| **CO6** | 0 | 16 | 0 | 0 | 0 | 0 | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19BT2027** | **Duration** | **3hrs** |
| **Course Name** | **BASICS OF BIOINFORMATICS** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define bioinformatics. | | CO1 | U | 1 |
| 2. | Define proteomics. | | CO1 | R | 1 |
| 3. | What is the role of bioinformatics in genetics? | | CO2 | R | 1 |
| 4. | What are the key components of a DNA sequence? | | CO2 | R | 1 |
| 5. | Define BLAST in bioinformatics. | | CO3 | U | 1 |
| 6. | Explain the term "sequence alignment." | | CO3 | R | 1 |
| 7. | Define homology in the context of bioinformatics. | | CO4 | U | 1 |
| 8. | What is a genome assembly? | | CO5 | R | 1 |
| 9. | Explain the term "lead compound" in drug design. | | CO6 | U | 1 |
| 10. | Define target-based virtual screening. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Define the central dogma of molecular biology and explain how it relates to bioinformatics. | | CO1 | R | 3 |
| 12. | Describe the significance of sequence alignment in bioinformatics and explain the difference between global and local sequence alignment. | | CO2 | U | 3 |
| 13. | Explain the concept of homology and its importance in evolutionary biology and bioinformatics. | | CO3 | R | 3 |
| 14. | Explain the concept of open reading frames (ORFs) and discuss their importance in genome annotation and gene prediction. | | CO4 | U | 3 |
| 15. | Define the role of molecular dynamics simulations in drug discovery and explain how it can be used to study protein-ligand interactions. | | CO5 | R | 3 |
| 16. | Describe the role of bioinformatics in drug discovery and development, highlighting the use of computational methods in virtual screening and molecular docking. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Briefly describe the importance and scope of bioinformatics. | CO1 | R | 6 |
|  | b. | Write a short note on elementary commands and protocols of internet. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the concept of bioinformatics and its significance in modern biological research. Discuss the interdisciplinary nature of bioinformatics and the key areas it encompasses. Provide examples of bioinformatics applications in genomics, proteomics, and systems biology. | CO2 | R | 10 |
|  | b. | What is Ref Seq? | CO2 | U | 2 |
|  |  |  |  |  |  |
| 19. | a. | Describe the role of the European Bioinformatics Institute (EBI) in providing access to biological databases and resources. | CO2 | R | 6 |
|  | b. | Describe the significance of the National Center for Biotechnology Information (NCBI) as a hub for biological databases and resources. | CO2 | R | 6 |
|  |  |  |  |  |  |
| 20. | a. | Describe the different databases and tools available on the NCBI website, such as PubMed, BLAST, and dbSNP, and explain how researchers can utilize these resources for various biological analyses. | CO3 | R | 6 |
|  | b. | Explain the significance of UniProt, a comprehensive database of protein sequences and functional information. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | What is scoring matrix | CO4 | R | 4 |
|  | b. | Outline the steps used to find values for a BLOSUM amino acid similarity matrix. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 22. | a. | Compute the dynamic programming table, alignments and associated sequence identities for the two strings WATER and WINE, where Symbol mis-match -5; gap insertion -1; match 5 | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Describe the process of de novo genome assembly in computational genomics. Explain the challenges associated with assembling genomes from short-read sequencing data and discuss different algorithms and tools used for de novo assembly. | CO5 | R | 6 |
|  | b. | Explain the concept of molecular mechanics in molecular modeling. Discuss how molecular mechanics force fields are used to calculate the energy and geometry of molecular systems. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the process of drug discovery, highlighting the key stages involved from target identification to clinical trials. Explain the role of computational methods in each stage of the drug discovery process | CO6 | R | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Gain knowledge on Biological databases and tools. |
| **CO2** | Understand the significance of biological databases and their utilization. |
| **CO3** | Apply the knowledge of Bioinformatics skill to solve the biological problems in Genomics and Proteomics |
| **CO4** | Analyze different types of biological databases and resources. |
| **CO5** | Evaluate the vital role drugs interacting to the target. |
| **CO6** | Create databases and tools of Drug like molecules. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 16 | 1 |  |  |  |  | 17 |
| **CO2** | 24 | 5 |  |  |  |  | 29 |
| **CO3** | 10 | 7 |  |  |  |  | 17 |
| **CO4** | 4 | 12 |  | 12 |  |  | 28 |
| **CO5** | 10 | 6 |  |  |  |  | 16 |
| **CO6** | 15 | 2 |  |  |  |  | 17 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **19BT2054** | **Duration** | **3hrs** |
| **Course Name** | **ENVIRONMENTAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **CO** | **BL** | **Marks** |
|  | **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | Define environmental pollution. | CO1 | R | 1 |
| 2. | Name the component of oil spill in oceans due to human activity. | CO1 | R | 1 |
| 3. | Give an example of point and nonpoint sources of water pollution. | CO1 | An | 1 |
| 4. | Tabulate different layers of atmosphere. | CO1 | R | 1 |
| 5. | Name the major hydrocarbon present in biogas. | CO2 | R | 1 |
| 6. | Define eutrophication. | CO3 | R | 1 |
| 7. | Name the microbe to clean radioactive substances. | CO4 | R | 1 |
| 8. | Define adsorption. | CO6 | C | 1 |
| 9. | Determine the number of bacterial strains present in Oil Zapper. | CO6 | A | 1 |
| 10. | Define mycorrhizae. | CO6 | R | 1 |

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|  | **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Categorize on the nature of different environmental pollutants. | CO1 | An | 3 |
| 12. | Write the technical solutions to prevent soil pollution. | CO2 | C | 3 |
| 13. | Summarize the environmental impact of solid wastes | CO3 | E | 3 |
| 14. | Illustrate the scientific understanding on acid rain. | CO4 | U | 3 |
| 15. | Identify the sources of xenobiotic compounds. | CO5 | R | 3 |
| 16. | Write the advantages of biofertilizers. | CO6 | A | 3 |

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|  | **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | |
| 17. | a. | Discuss the importance of microbes as bioadsorbent for the removal of heavy metal contaminated wastewater. | | CO1 | U | 6 |
|  | b. | Explain the atmospheric pollution increasing global warming, smog formation and acid rain | | CO1 | U | 6 |
|  |  |  | |  |  |  |
| 18. | a. | Describe the process involved for the removal of nitrate and phosphorus from wastewater with suitable types of bioreactor | | CO2 | An | 8 |
|  | b. | Summarize the treatment methods of waste water by lagoons | | CO2 | An | 4 |
|  |  |  | |  |  |  |
| 19. | a. | Recognize the principle and working mechanisms of settling chamber, cyclone separator and venturi scrubber with schematic diagrams. | | CO3 | R | 6 |
|  | b. | Explain the wastewater treatment process by upflow anaerobic sludge blanket reactor with spaghetti theory | | CO3 | R | 6 |
|  |  |  | |  |  |  |
| 20. |  | Impact on the harmful effects due to disposal of industrial wastes without adequate treatment and explain how to solve problem using 3 R’s. | | CO4 | C | 12 |
|  |  |  | |  |  |  |
| 21. |  | Summarize *In situ* and *Ex situ* bioremediation of soil pollutants with examples. | | CO5 | E | 12 |
|  |  |  | |  |  |  |
| 22. |  | Explain the production process of biogas for the generation of electricity with neat sketch. | | CO6 | U | 6 |
|  |  | Summarize on the applicability of biomining process to prevent the effect of metal pollution on environment. | | CO6 | U | 6 |
|  |  |  | |  |  |  |
| 23. |  | Write a note on metagenomics. Validate the bioremediation process through genomic tools for cleaner environment. | | CO3 | U | 12 |
|  |  |  | **Compulsory:** | | | |
| 24. | a. | Write a note on the biosensors employed for the monitoring of water quality. | | CO6 | A | 8 |
|  | b. | Comment on the production process of bioplastic. | | CO6 | A | 4 |

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|  | **COURSE OUTCOMES** |
| CO1 | Infer the biotechnological solutions to address environmental issues including pollution, mineral,  renewable energy and water recycling |
| CO2 | Appraise the opportunities for incorporating environmental quality into products, processes and  projects. |
| CO3 | Develop technologies for bioremediation and biodegradation |
| CO4 | Acquaint oneself with the pertinent legislation and methodology of pollutants |
| CO5 | Demonstrate the professional responsibility towards protecting the environment |
| CO6 | Apply scientific solutions for the development of environmental sustainable products |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 3 | 12 | - | 4 | - | - | 19 |
| CO2 | 1 | - | - | 12 | - | 3 | 16 |
| CO3 | 13 | 12 | - | - | 3 | - | 28 |
| CO4 | 1 | 3 | - | - | - | 12 | 16 |
| CO5 | 3 | - | - | - | 12 | - | 15 |
| CO6 | 1 | 12 | 16 | - | - | 1 | 30 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT1002** | **Duration** | **3hrs** |
| **Course Name** | **BASICS OF PYTHON PROGRAMMING** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the character set used in Python. | | CO1 | R | 1 |
| 2. | Identify a suitable datatype to store the accurate weight of a person. | | CO1 | R | 1 |
| 3. | Predict the output of the given snippet,  print(“cAMEL”.capitalize()) | | CO2 | R | 1 |
| 4. | State the purpose of split() function. | | CO2 | R | 1 |
| 5. | Name any one unordered collection in Python. | | CO3 | U | 1 |
| 6. | Predict the output of lst[7,4,2,9,1].pop(2) | | CO4 | U | 1 |
| 7. | Infer the use of count function. | | CO4 | An | 1 |
| 8. | Tabulate ‘and’ operation from logical operators. | | CO4 | R | 1 |
| 9. | Define the membership operator. | | CO5 | R | 1 |
| 10. | Compute the loop execution of the given code  i=3  while ( i < 7):  print(“good”) | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Define Module with example. | | CO1 | R | 3 |
| 12. | Give examples on any two approaches of formatted strings in python | | CO2 | U | 3 |
| 13. | Write a Python program to remove duplicate elements in a list. | | CO3 | R | 3 |
| 14. | List down the methods not supported by tuples. | | CO4 | U | 3 |
| 15. | Differentiate between break and continue statements. | | CO5 | An | 3 |
| 16. | State the use of Seq() in python. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Develop a menu-driven program using python to build a basic calculator. | CO1 | U | 6 |
|  | b. | Discuss about various datatypes supported by python with suitable code snippets. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Construct a python code on find and replace multiple words in the given sentence.  Mystr=”Good Morning Ria!!!. Hope you are doing great. Ria, tomorrow please bring text book. Ria, have a great sleep”.  In the above sentence change the name “Ria” into “Anu” using string functions | CO2 | A | 6 |
|  | b. | Enumerate six string functions along with their descriptions and provide a sample for each. | CO2 | R | 6 |
| 19. | a. | Develop a Python program to get name and regno of 5 students from the user and store it in to two lists. If a name is searched, then the corresponding regno must be printed as output. | CO3 | A | 8 |
|  | b. | Demonstrate the following slicing techniques,   * Positive indexing * Negative indexing * Reversing the content   Using step count | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. | a. | Develop a python code to extract each element from a tuple and append into a list. If the extracted element is a number then square it before appending it. Otherwise append it as given. | CO4 | U | 6 |
|  | b. | Construct a code to copy the content of a file into another file using Python. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain the control and looping statements supported by python with suitable examples. | CO5 | An | 8 |
|  | b. | Write a Python program to reverse a given number. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 22. | a. | Give a sample code for the nested if with appropriate description. | CO3 | U | 8 |
|  | b. | Enumerate the mode of operation used in the files. | CO4 | A | 4 |
|  |  |  |  |  |  |
| 23. |  | Discuss various operators in Python with example | CO1 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Discuss the basic sequence operations in biopython packages. | CO6 | U | 12 |

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

|  |  |
| --- | --- |
| **CO1** | Understand, write, compile, and run Python programs. |
| **CO2** | Analyze Python structures that implement decisions, loops, and store arrays and use these structures in a well-designed, OOP program. |
| **CO3** | Create Python programs that make use of various modules and packages |
| **CO4** | Understand regular expressions and extract required information from file and databases. |
| **CO5** | Relate and arrange information from multiple files |
| **CO6** | Apply the principles of object-oriented programming and well-documented programs in the Python language, including use of the Bio-python packages in big data analytics |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO/BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 5 | 24 | - | - | - | - | 29 |
| **CO2** | 8 | 3 | 6 | - | - | - | 17 |
| **CO3** | 3 | 9 | 12 | - | - | - | 24 |
| **CO4** | 1 | 10 | 10 | 1 | - | - | 22 |
| **CO5** | 1 | 4 | - | 11 | - | - | 16 |
| **CO6** | 3 | 13 | - | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2001** | **Duration** | **3hrs** |
| **Course Name** | **CHEMISTRY OF BIOMOLECULES** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Show the structure of fructose. | | CO1 | U | 1 |
| 2. | List the components of element. | | CO1 | R | 1 |
| 3. | Define vitamins. | | CO2 | R | 1 |
| 4. | Tell the functions of minerals. | | CO2 | R | 1 |
| 5. | Compare between denaturation and renaturation. | | CO3 | U | 1 |
| 6. | Recall the composition of sucrose. | | CO3 | R | 1 |
| 7. | Cite the sources for vitamin A. | | CO4 | U | 1 |
| 8. | Tell the nitrogenous bases present in RNA and DNA. | | CO4 | R | 1 |
| 9. | Group the various classes of water soluble vitamins. | | CO5 | U | 1 |
| 10. | Compare DNA and RNA. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Cite the role of buffers. | | CO1 | U | 3 |
| 12. | Define nucleic acids. | | CO2 | R | 3 |
| 13. | Give examples for triose sugar. | | CO3 | R | 3 |
| 14. | Recite the functions of nitrogen. | | CO4 | R | 3 |
| 15. | Indicate the functions of vitamin C. | | CO5 | U | 3 |
| 16. | Represent the types of disaccharide sugars. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. |  | Describe the buffering against pH changes in biological systems | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Enumerate on chemical properties of fatty acids with suitable reactions | CO1 | R | 12 |
|  |  |  |  |  |  |
| 19. |  | Show the structure and types of RNA with suitable diagrams. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 20. |  | Reproduce the structure of aliphatic and aromatic amino acids. | CO4 | R | 12 |
|  |  |  |  |  |  |
| 21. |  | Discuss the composition, structure and properties of nucleotides. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Generalize the structure, classification and properties of carbohydrates. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe the various classification and structure of lipids. | CO3 | R | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the structure, functions and deficiency diseases caused by vitamin D. | CO6 | U | 6 |
|  | b. | Tabulate the functions of micro minerals. | CO6 | R | 6 |

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|  | **COURSE OUTCOMES** |
| CO1 | Recall the chemical bonding properties of biomolecules. |
| CO2 | Understand biochemistry at the atomic level, and draw the basic structures of biomolecules. |
| CO3 | Recognize the significance of biomolecules in the proper functioning of living cells. |
| CO4 | Illustrate the structure and functions of conjugated biomolecules-proteoglycans, glycolipids and glycoproteins. |
| CO5 | Discuss the applications of biomolecules in biotechnology industries. |
| CO6 | Analyze the clinical and biological significance of biomolecules. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 13 | 16 |  |  |  |  | 29 |
| CO2 | 17 | - |  |  |  |  | 17 |
| CO3 | 10 | 13 |  |  |  |  | 23 |
| CO4 | 22 | 1 |  |  |  |  | 23 |
| CO5 | - | 16 |  |  |  |  | 16 |
| CO6 | 6 | 10 |  |  |  |  | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2003** | **Duration** | **3 hrs** |
| **Course Name** | **CELL BIOLOGY** | **Max. Marks** | **100** |

(For Senior Students Only)

(PTO)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Define Permeability. | | CO2 | | R | 1 |
| 2. | Comment on CAR T-Cell Therapy. | | CO5 | | A | 1 |
| 3. | Differentiate symport from cotransport. | | CO2 | | An | 1 |
| 4. | Cite the role of AUG and UAA codons of mRNA. | | CO2 | | A | 1 |
| 5. | List the proteins present in the intermediate filaments of Cytoskeleton. | | CO3 | | U | 1 |
| 6. | Recall the connective tissues that have abundant extracellular matrix. | | CO3 | | R | 1 |
| 7. | Define metastasis. | | CO5 | | U | 1 |
| 8. | Identify any THREE second messengers in a cell. | | CO4 | | An | 1 |
| 9. | Name any TWO notable diseases caused by pathogenic bacteria. | | CO1 | | U | 1 |
| 10. | Mention the imaging technique that uses lasers to scan objects. | | CO6 | | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Illustrate Wherever Necessary)** | | | | | | |
| 11. | Draw and label the Unit Membrane model of Plasma Membrane. | | CO1 | | An | 3 |
| 12. | Write a short note on protein glycosylation in Endoplasmic Reticulum. | | CO2 | | U | 3 |
| 13. | Illustrate the cart-wheel organization of microtubules in a motile organelle. | | CO3 | | U | 3 |
| 14. | Highlight the differences between prokaryotic and eukaryotic mRNA. | | CO2 | | An | 3 |
| 15. | Categorize the types of Cancer cells. | | CO5 | | An | 3 |
| 16. | State any THREE significant discoveries in Cell Biology. | | CO6 | | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any FIVE Questions from Q.No. 17 to 23; Q.No. 24 is Compulsory)**  **(Illustrate Wherever Necessary)** | | | | | | |
| 17. | a. | Enumerate any SIX unique features of Lysosomes. | CO1 | An | | 6 |
|  | b. | Illustrate the organization and functions of mitochondria with a neat diagram. | CO1 | A | | 6 |
|  |  |  |  |  | |  |
| 18. | a. | Illustrate the different phases of Cell cycle and its regulations. | CO2 | An | | 6 |
|  | b. | Draw the structure of sarcomere and explain the molecular mechanism of muscle contraction. | CO3 | An | | 6 |
|  |  |  |  |  | |  |
| 19. | a. | Describe the macromolecular organization of cell matrix. | CO3 | An | | 6 |
|  | b. | Explain cell adhesion molecules and cell junctions. | CO3 | U | | 6 |
|  |  |  |  |  | |  |
| 20. | a. | Illustrate the binding of any THREE ligands to cell surface receptors. | CO6 | A | | 6 |
|  | b. | Define signal transduction. Highlight the process in rod cells with a neat diagram. | CO5 | U | | 6 |
| 21. | a. | Explain the steps involved in the mechanism of Na+ and K+ transport with diagrams. | CO2 | An | | 6 |
|  | b. | 1. Name the Process. 2. Mark the labels (A, B, C & D). 3. Explain the Process. | CO2 | An | | 6 |
|  |  |  |  |  | |  |
| 22. | a. | Illustrate how G-proteins activate cAMP dependent protein kinase and highlight its functions with a neat sketch. | CO4 | A | | 6 |
|  | b. | Enumerate the types of signaling molecules. Comment on its mode of action. | CO4 | An | | 6 |
|  |  |  |  |  | |  |
| 23. | a. | Explain the role of inositol triphosphate (IP3) in signal transduction. | CO3 | A | | 6 |
|  | b. | Stem cell therapy has revolutionized the management of diseases in man - Justify. | CO5 | E | | 6 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Draw neat sketches of cell imaging techniques and enumerate their applications in cell sorting. | CO6 | A | | 7 |
|  | b. | Create the sequence of events leading to programmed cell death. | CO2 | C | | 5 |

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

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **COURSE OUTCOMES** | | | | | | | | | |
| **CO1** | Exhibit a knowledge base in cells, structure, organelles and their functions. | | | | | | | | | |
| **CO2** | Outline the process involved in synthesis, transport, cell cycle regulation and cell death. | | | | | | | | | |
| **CO3** | Relate cell movement to cytoskeleton, and cell-cell and cell-matrix interactions to communication. | | | | | | | | | |
| **CO4** | Infer the role of ligands and receptors in cell signaling and signal transduction. | | | | | | | | | |
| **CO5** | Categorize the different types of cancer and stem cell therapies. | | | | | | | | | |
| **CO6** | Apply the imaging techniques in cell biology to analyze the characterization of cell organelles. | | | | | | | | | |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** |  | 1 | 6 | 9 |  |  | 16 |
| **CO2** | 1 | 3 | 1 | 22 |  | 5 | 32 |
| **CO3** | 1 | 10 | 6 | 12 |  |  | 29 |
| **CO4** |  |  | 6 | 7 |  |  | 13 |
| **CO5** |  | 7 | 1 | 3 | 6 |  | 17 |
| **CO6** | 4 |  | 13 |  |  |  | 17 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
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| **Course Code** | **20BT2003** | **Duration** | **3hrs** |
| **Course Name** | **CELL BIOLOGY** | **Max. Marks** | **100** |

**(For First Years only)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Differentiate between Gram positive and Gram negative bacterial cell wall. | | CO1 | U | 1 |
| 2. | Mention anyone function of free ribosomes. | | CO1 | R | 1 |
| 3. | Name the site where the photosynthesis takes place in plant cells. | | CO2 | R | 1 |
| 4. | In which organelle the oxidative phosphorylation takes place in eukaryotes? | | CO2 | R | 1 |
| 5. | Name any one motor protein associated with microtubules. | | CO3 | U | 1 |
| 6. | Give an example for intermediate filaments. | | CO3 | R | 1 |
| 7. | Identify the type of virus, which enters host cells via membrane fusion. | | CO4 | U | 1 |
| 8. | State the type of receptor, which is used by the steroid hormones for binding. | | CO4 | R | 1 |
| 9. | What is apoptosis? | | CO5 | U | 1 |
| 10. | Cite a research application of confocal laser scanning microscopy. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Lysosomes are regarded as suicidal bag of cell. Justify. | | CO1 | An | 3 |
| 12. | Compare the functions of SER and RER. | | CO2 | U | 3 |
| 13. | Illustrate the structure of microtubules in flagella. | | CO3 | An | 3 |
| 14. | List the properties of cell surface receptors. | | CO4 | U | 3 |
| 15. | Categorize the types of cancer based on the origin. | | CO5 | An | 3 |
| 16. | Summarize the advantages of FACS analysis. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Write a detailed account on the any TWO molecular models of plasma membrane. | CO1 | A | 6 |
|  | b. | Compare the different roles of plasma membrane and nuclear membrane. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the process of nerve impulse transmission in neurons. | CO2 | An | 6 |
|  | b. | Classify the membrane transport systems. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Relate the sliding filament theory with muscle contractions. | CO3 | U | 6 |
|  | b. | Write a short note on the functions of microtubules. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the different modes of chemical signaling with an example. | CO4 | U | 6 |
|  | b. | Describe how G-proteins activates cAMP dependent protein kinases with an example and highlight its functions with a neat sketch. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | List the unique features of stem cells and highlight their potential. | CO5 | R | 6 |
|  | b. | Give a detailed note on transformation of cells in culture. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Classify the signaling receptors and brief the mechanism of insulin receptor signaling. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Illustrate the process of protein N-glycosylation that happens in ER. | CO2 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the working principle of fluorescence microscopy with illustrations and add a note on its applications as cell imaging technique. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | To develop a sound knowledge base in the molecular organization of cell organelles and analyze their functions. |
| **CO2** | To outline the process that regulates membrane transport, controls cell cycle and cell death. |
| **CO3** | To correlate cell movement to cytoskeleton, and cell-cell and cell-matrix interactions to communication. |
| **CO4** | To apply the role of ligands and receptors in cell signaling and signal transduction. |
| **CO5** | To categorize the different types of cancer and apply the principles of stem cell therapy. |
| **CO6** | To apply the imaging techniques in cell biology and design characterization of cell organelles. |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 7 | 6 | 3 | - | - | 17 |
| **CO2** | 2 | 21 | - | 6 | - | - | 29 |
| **CO3** | 1 | 13 | - | 15 | - | - | 29 |
| **CO4** | 1 | 16 | - | - | - | - | 17 |
| **CO5** | 6 | 7 | - | 3 | - | - | 16 |
| **CO6** | - | 4 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2005** | **Duration** | **3hrs** |
| **Course Name** | **BASICS OF INDUSTRIAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name the accessory used in a stirred tank bioreactor to enable fluid mixing. | | CO1 | R | 1 |
| 2. | Recognize the microbial growth phase in industrial production process. | | CO1 | R | 1 |
| 3. | What is the average carbon requirement of bacteria in production media? | | CO2 | R | 1 |
| 4. | Name any one fungus used in industrial bioprocess of secondary metabolite. | | CO4 | A | 1 |
| 5. | Recall saccharification. | | CO6 | R | 1 |
| 6. | Name any one steroid of industrial importance. | | CO3 | R | 1 |
| 7. | Quote the significance of lysozyme. | | CO6 | R | 1 |
| 8. | Name any one product derived from plant of pharmaceutical importance. | | CO4 | R | 1 |
| 9. | State the significance of biofertilizer. | | CO5 | R | 1 |
| 10. | Name the organism used in microbial enhanced oil recovery. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Analyze the nutritional composition of media used in industrial bioprocess. | | CO1 | An | 3 |
| 12. | Illustrate fermentation conditions for wine production. | | CO2 | U | 3 |
| 13. | Describe the process flow chart of steroid. | | CO3 | An | 3 |
| 14. | Review the significance of glutathione. | | CO4 | U | 3 |
| 15. | List the products derived from animal cells and its industrial applications. | | CO5 | An | 3 |
| 16. | Describe the principle of biogas production. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Summarize the basic concepts of upstream and downstream process in industrial production of metabolites with suitable examples. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the industrial production process of ethanol and its applications. | CO3 | R | 8 |
|  | b. | Describe the significance of process flow sheet in industrial bioprocess. | CO1 | R | 4 |
|  |  |  |  |  |  |
| 19. | a. | Evaluate the global demand and industrial bioprocess of ethanol with a neat diagram. | CO4 | E | 8 |
|  | b. | List the microorganisms used in vitamin B12 production. | CO2 | R | 4 |
|  |  |  |  |  |  |
| 20. |  | “India is the largest consumer of antibiotics globally”, Analyze the bioprocess involved in production of antibiotic Streptomycin in India with necessary diagram. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Describe the industrial production process of xanthan gum with a neat diagram. | CO2 | U | 8 |
|  | b. | Name the microorganisms used in production of luciferin. | CO4 | R | 4 |
|  |  |  |  |  |  |
| 22. | a. | Define bioremediation. | CO1 | R | 2 |
|  | b. | Explain the upstream, fermentation and downstream process involved in production of carotene. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 23. |  | Summarize the industrial production of vaccines and its significance in pharmaceutical biotechnology. | CO5 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate the industrial production of various animal derived compounds of pharmaceutical importance in modern biotechnology. | CO6 | A | 12 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Remember the use of microbes for developing industrial products and processes. |
| CO2 | Understand the techniques for genetic improvement of micro-organisms to improve yield of bioproducts. |
| CO3 | Explain the technical issues related with microorganisms in the production of bio products. |
| CO4 | Analyze industrial-market value of these bio products and relate them with the scope of biotechnology |
| CO5 | Relate the clinical and biological significance of these bio products for sustainable bioprocess engineering |
| CO6 | Evaluate the difference in manufacturing commercial bio products and all the ethical issues involved in it. |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 8 | 12 | - | 3 | - | - | 23 |
| CO2 | 5 | 11 | - | - | - | - | 16 |
| CO3 | 9 |  | 10 | 3 | - | - | 22 |
| CO4 | 5 | 3 | 1 | 12 | 8 | - | 29 |
| CO5 | 1 |  |  | 3 | 12 | - | 16 |
| CO6 | 3 | 3 | 12 | - | - | - | 18 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2007** | **Duration** | **3hrs** |
| **Course Name** | **BIO-ANALYTICAL TECHNIQUES** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | What is meant by calibration of an instrument? | | CO1 | R | 1 |
| 2. | Recall the concept of precision in analytical techniques. | | CO1 | R | 1 |
| 3. | State the principle of fluorimeter. | | CO2 | R | 1 |
| 4. | Give any two applications of conductivity meter. | | CO2 | A | 1 |
| 5. | Define centrifugal force. | | CO3 | R | 1 |
| 6. | Name the chemical matrix used as stationary phase in TLC. | | CO3 | R | 1 |
| 7. | Give any one mobile phase used in HPLC. | | CO3 | R | 1 |
| 8. | Name the scientist who developed chromatography technique. | | CO4 | R | 1 |
| 9. | Write the principle of scintillation counter. | | CO6 | R | 1 |
| 10. | Write an application of radioactive isotopes in medicine. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Outline the concept of accuracy in instrumental methods. | | CO1 | U | 3 |
| 12. | Illustrate any three applications of spectrofluorometer. | | CO2 | U | 3 |
| 13. | State the principle of zonal centrifugation. | | CO3 | R | 3 |
| 14. | Outline the various stationary phase materials used in gel permeation chromatography. | | CO4 | R | 3 |
| 15. | Mention the specific role of SDS in SDS-PAGE. | | CO5 | U | 3 |
| 16. | Illustrate the types of radioactive isotopes with examples. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the concept of Good’s buffer and other buffers used in extraction of various biological molecules with suitable examples. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. |  | Describe the principle and different methods of solvent extraction used to drive secondary metabolites from medicinal plants with a suitable example. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Define Beer - Lambert’s law. | CO2 | R | 2 |
|  | b. | Outline the principle, instrumentation and applications of Raman Spectroscopy. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 20. | a. | List two safety rules that should be followed in working with centrifuge. | CO3 | R | 2 |
|  | b. | Illustrate the instrumentation and working principle in isopycnic centrifugation with neat diagram. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 21. | a. | Mention the principle of Ion exchange chromatography. | CO3 | R | 2 |
|  | b. | Explain the molecule separation process and purification of compounds using Gas chromatography method. | CO3 | E | 10 |
|  |  |  |  |  |  |
| 22. | a. | Define electrophoresis. | CO4 | R | 2 |
|  | b. | Illustrate the process of separation and size determination of DNA using agarose gel electrophoresis. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 23. | a. | Explain the working procedure in determination of thermogravimetry analysis of a polymer. | CO4 | E | 6 |
|  | b. | Describe the principle and detection of radioactive isotopes using scintillation counter with some applications. | CO6 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the structural elucidation of compounds using mass spectrometry analysis with data. | CO5 | E | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the concepts of calibration and testing |
| **CO2** | Illustrate the different methods of analytical techniques for quantitative analysis |
| **CO3** | Explain importance of centrifugation and chromatography as analytical techniques |
| **CO4** | Demonstrate the gel electrophoresis and thermal analytical techniques |
| **CO5** | Analyze the methods of structural elucidation of different compounds |
| **CO6** | Illustrate importance of radioactive isotopes in modern research |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 2 | 15 | - | - | 12 | - | 29 |
| **CO2** | 3 | 13 | - | 1 | - | - | 17 |
| **CO3** | 13 | 10 | - | - | 10 | - | 33 |
| **CO4** | 3 | 13 | - | - | 6 | - | 22 |
| **CO5** | 1 | - | - | - | 12 | - | 13 |
| **CO6** | 4 | 6 | - | - | - | - | 10 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2009** | **Duration** | **3hrs** |
| **Course Name** | **BIOCHEMISTRY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Q. No.** | | | **Questions** | | **CO** | **BL** | | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | | | | |
| 1. | | Name the enzyme responsible for interconversion of pyruvate to acetyl CoA. | | | CO1 | R | | 1 |
| 2. | | Determine the number of ATP synthesized in aerobic conditions. | | | CO1 | A | | 1 |
| 3. | | Identify the pyrrolidine containing aromatic amino acid. | | | CO2 | R | | 1 |
| 4. | | Write the structure of tyrosine. | | | CO2 | A | | 1 |
| 5. | | Name the final electron acceptor in ETC cycle. | | | CO3 | R | | 1 |
| 6. | | State the source of electrons for complex II in ETC cycle. | | | CO3 | R | | 1 |
| 7. | | Differentiate between nucleoside and nucleotide. | | | CO4 | R | | 1 |
| 8. | | Name the source of N1 in the structure of pyrimidine nucleus. | | | CO4 | R | | 1 |
| 9. | | Identify the enzyme responsible for Tarui’s disease. | | | CO5 | R | | 1 |
| 10. | | Mention three mechanisms in the regulation for glycogenesis and glycogenolysis. | | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | | | | |
| 11. | Write the importance of substrate level phosphorylation in glycolysis. | | | CO1 | | | A | 3 |
| 12. | Differentiate between glycine and alanine. | | | CO2 | | | An | 3 |
| 13. | Mention three different sources of phosphorus in energy conservation process. | | | CO3 | | | An | 3 |
| 14. | Construct a roadmap for the synthesis of uric acid from hypoxanthine and GMP. | | | CO$ | | | A | 3 |
| 15. | Name the enzymes responsible for phenylketonuria, alkaptonuria and albinism diseases. | | | CO5 | | | An | 3 |
| 16. | Explain the structure of steroid nucleus. | | | CO6 | | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | | | | |
| 17. | Explain the metabolic pathways for glycolysis in aerobic and anaerobic conditions. | | | CO1 | | | An | 12 |
|  |  | | |  | | |  |  |
| 18. | Write a detailed note on the degradation of alanine and leucine. | | | CO2 | | | C | 12 |
|  |  | | |  | | |  |  |
| 19. | Discuss the metabolic events for electron transport chain. | | | CO3 | | | U | 12 |
|  |  | | |  | | |  |  |
| 20. | Describe the De-novo and salvage pathways in purine biosynthesis. | | | CO4 | | | U | 12 |
|  |  | | |  | | |  |  |
| 21. | Enlist the inborn errors mentioning the name of defective enzymes and symptoms of amino acids and nucleotide metabolisms. | | | CO5 | | | R | 12 |
|  |  | | |  | | |  |  |
| 22. | Explain the metabolic pathways involved in glycogenesis and glycogenolysis. | | | CO1 | | | U | 12 |
|  |  | | |  | | |  |  |
| 23. | Summarize in detail on the β-oxidation of fatty acids. | | | CO6 | | | E | 12 |
| **Compulsory:** | | | | | | | | |
| 24. | Write a detailed note on the metabolic regulation of glycogen synthesis and degradation. | | | CO6 | | | U | 12 |

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| **COURSE OUTCOMES** | |
| CO1 | Acquire knowledge on the metabolic pathways. |
| CO2 | Summarize the biosynthesis and degradation pathways of amino acids. |
| CO3 | Explain the importance of bioenergetics and energy rich compounds. |
| CO4 | Understand the metabolic reactions of nucleotides. |
| CO5 | Learn the various inborn errors of metabolism. |
| CO6 | Analyze the anabolic and catabolic reactions of lipids. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 12 | 4 | 12 | - | - | 29 |
| CO2 | 1 | - | 1 | 3 | - | 12 | 17 |
| CO3 | 2 | 12 | 19 | 3 | - | - | 17 |
| CO4 | 2 | 12 | 3 |  | - | - | 17 |
| CO5 | 13 | - | - | 3 | - | - | 16 |
| CO6 | 1 | 15 | - | - | 12 | - | 28 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20BT2011** | **Duration** | **3hrs** |
| **Course Name** | **MICROBIOLOGY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | State the works of Joseph Lister in the field of microbiology. | | CO1 | R | 1 |
| 2. | Write the importance of agar-agar. | | CO1 | A | 1 |
| 3. | Define the functions of pili. | | CO2 | R | 1 |
| 4. | Give an example for a capsulated microorganism. | | CO2 | U | 1 |
| 5. | Define diauxic growth. | | CO5 | R | 1 |
| 6. | Give example for an acid fast bacteria. | | CO3 | U | 1 |
| 7. | State the properties of antimicrobial drug. | | CO4 | R | 1 |
| 8. | Name the causative agent for Gonorrheal disease. | | CO6 | R | 1 |
| 9. | Write the importance of Mycorrhizae in agriculture. | | CO6 | A | 1 |
| 10. | Name the common bacteria found in contaminated water. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain the contributions of Edward Jenner. | | CO1 | U | 3 |
| 12. | Describe the structure of prokaryotic cell and label its parts. | | CO2 | U | 3 |
| 13. | Classify bacteria based on morphology, arrangement and staining reactions. | | CO3 | An | 3 |
| 14. | Illustrate the importance of ethylene oxide gas in sterilization. | | CO4 | U | 3 |
| 15. | Compare auxotroph and prototroph. | | CO5 | An | 3 |
| 16. | Illustrate the structure of Coronavirus with their symptoms. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Discuss the impact of 16S rRNA gene sequence analysis for identification of bacteria with suitable examples. | CO1 | U | 8 |
|  | b. | Discuss Germ theory of disease with a suitable experiment. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Describe the salient features of Gram positive cell wall with a neat diagram. | CO2 | U | 8 |
|  | b. | Summarize the biological importance of lichens with suitable examples. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate the working principle of bright field microscope with their use. | CO3 | A | 8 |
|  | b. | Explain the principle of phase contrast microscopy with a neat diagram. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 20. | a. | Assess the mechanism of action of any THREE antibacterial agents. | CO4 | E | 6 |
|  | b. | Explain the mode of action of phenol and alcohol on microorganisms. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Analyze the factors that affect the growth of microorganisms with examples. | CO5 | An | 8 |
|  | b. | Explain how will you obtain a synchronous culture and mention its uses with a neat diagram | CO5 | An | 4 |
|  |  |  |  |  |  |
| 22. | a. | Discuss the causative agent and pathogenicity of tuberculosis. | CO6 | U | 8 |
|  | b. | Summarize the significance of symbiotic nitrogen fixing bacteria in soil with suitable examples. | CO6 | E | 4 |
|  |  |  |  |  |  |
| 23. | a. | Critically analyze the clinical features of rabies with neat illustrations. | CO6 | An | 6 |
|  | b. | Explain the clinical manifestations of *Candida albicans*. | CO6 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | In the absence of a source of drinking water supply in an area, the resident has to use groundwater for drinking. As a microbiologist, how will you determine the potability of this water? | CO6 | E | 8 |
|  | b. | Assess the health benefits of consuming probiotics with suitable examples. | CO6 | E | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recall the basic knowledge on the development of microbiology |
| CO2 | Recognize the fundamental concepts pertaining to the structure and functions of microbes |
| CO3 | Appraise the importance of microscopy, staining techniques and classify the microorganisms |
| CO4 | Apply appropriate physical and chemical methods to control the growth of microbes |
| CO5 | Formulate the nutritional requirements for microbial growth and their metabolism |
| CO6 | Compare and categorize the interactions of microorganisms with humans and animals |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 15 | 1 | - | - | - | 17 |
| CO2 | 1 | 16 | - | - | - | - | 17 |
| CO3 | - | 1 | 12 | 3 | - | - | 16 |
| CO4 | 1 | 9 | - | - | 6 | - | 16 |
| CO5 | 1 | - | - | 15 | - | - | 16 |
| CO6 | 2 | 17 | 1 | 6 | 16 | - | 42 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20BT2013** | **Duration** | **3hrs** |
| **Course Name** | **FLUID MECHANICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | How would you differentiate a Newtonian fluid from ideal fluid? | | | CO1 | R | 1 |
| 2. | Given that the pressure inside a soap bubble and a water droplet are equivalent. If the diameter of the droplet is 50 mm, what would it be for soap bubble? | | | CO1 | U | 1 |
| 3. | What is the different kind of manometers generally used to measure pressure inside a fluid? | | | CO2 | R | 1 |
| 4. | Explain the relationship between gauge pressure and absolute pressure. | | | CO2 | U | 1 |
| 5. | What is the physical interpretation of “head” in a fluid flow? | | | CO2 | R | 1 |
| 6. | Analyze the scenarios when continuity equation will not hold true. | | | CO2 | An | 1 |
| 7. | Why would one prefer orifice meter over venturimeter? | | | CO3 | U | 1 |
| 8. | If the flow is doubled in a venturimeter, how the differential mercury manometer reading would change? | | | CO4 | An | 1 |
| 9. | What is the different kind of minor energy losses a flow can experience in pipe? | | | CO5 | An | 1 |
| 10. | Loss of head due to sudden contraction is “actually due to sudden expansion”. Explain this observation. | | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | | Calculate the total energy-head for fluid flow, considering the meaning of “head” in context. | | CO1 | E | 3 |
| 12. | | The capillary rise in a glass tube immersed in water is 5 cm. If the diameter of the tube is doubled, what would be new value of capillary rise? | | CO3 | An | 3 |
| 13. | | A mercury manometer is connected to a vertical pipe at two points 2 m apart. If differential reading is 50 cm Hg, calculate the pressure difference between the two points. | | CO3 | An | 3 |
| 14. | | Explain the flow regime conditions for calculation of “coefficient of friction”. | | CO2 | E | 3 |
| 15. | | Find the velocity of the flow of an oil through a pipe, when the difference of mercury level in a differential U-tube manometer connected to the two tapings of the pilot-tube is 100 mm. Take co-efficient of pilot-tube and sp. gr. of oil are 0.98 and 0.8, repectively. | | CO5 | An | 3 |
| 16. | | Estimate the change in discharge rate through a syphon if pipe diameter is doubled. Hint: or | | CO6 | E | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | | |
| 17. | | a. | An oil of viscosity 5 poise is used to lubricate between a shaft and sleeve. The shaft diameter is 10 cm and rotates at 120 rpm. Calculate the power loss if the sleeve length is 40 cm and thickness of oil film is 1 cm.  40 cm  10 cm  1 cm | CO1 | E | 12 |
|  | |  |  |  |  |  |
| 18. | | a. | A horizontal pipe of 30 m long is connected to a water tank at one end and discharges to atmosphere. The first 20 m length the diameter of the pipe is 15 cm which suddenly enlarges to 30 cm diameter. The water level in tank is 25 m above the center of pipe. Determine rate of flow considering entrance loss, and pipe frictions. Further assume *f*= 0.01. | CO4 | C | 12 |
|  | |  |  |  |  |  |
| 19. | | a. | An oil of specific gravity 0.9 is flowing through a venturimeter having an inlet diameter of 20 cm and throat diameter of 10 cm. If the discharge rate of oil is 60 L/s, estimate the reading in oil mercury differential manometer, given Cd = 0.98. | CO3 | E | 12 |
|  | |  |  |  |  |  |
| 20. | | a. | A syphon of 15 cm diameter connects two reservoirs having difference in water level elevation of 15 m. The length of syphon is 400 m and summit are 4 m above water level in upper reservoir. The length of pipe from upper reservoir to summit is 80 m. Calculate discharge rate through syphon and pressure at summit. Assume *f*=0.005 and no minor losses in flow. | CO4 | E | 12 |
|  | |  |  |  |  |  |
| 21. | | a. | An orifice-meter with orifice dimeter 10 cm is inserted in a pipe of 20 cm diameter. The pressure gauges fitted up- and down- stream of orifice-meter gives readings of 19.62 N/cm2 and 9.81 N/cm2, respectively. Find the discharge of water through pipe, if coefficient of discharge for the orifice meter is 0.6. | CO5 | E | 12 |
|  | |  |  |  |  |  |
| 22. | | a. | Water is flowing through a 5 m long vertical tapered pipe as shown here. The cross section at the lower and upper ends are 0.2 m2 and 0.1 m2, respectively. Estimate the pressure at the upper end of the pipe, if flow rate is 0.3 m3/s and pressure at lower end is 11.22 N/cm2. Assume no head loss due to friction. | CO3 | C | 12 |
|  | |  |  |  |  |  |
| 23. | | a. | A differential U-tube mercury manometer is connected between two pipes as shown in figure. Water is flowing through pipe “A”, whereas alcohol (specific gravity 0.8) is flowing through pipe “B”. What is the pressure difference between two pipes? | CO2 | C | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | | a. | Explain the principle of Buckingham’s π-Theorem in dimensional analysis, elucidating each steps taking a relevant example. | CO6 | E | 12 |

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

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **COURSE OUTCOMES** | | | | | | | |
| **CO1** | Understand the nature of fluids, statics and dynamics of fluid flow. | | | | | | | |
| **CO2** | Summarize the principles for flow in transportation of fluids in the problems related to the process engineering. | | | | | | | |
| **CO3** | Relate flow through pipe and flow past immersed object. | | | | | | | |
| **CO4** | Analyze the equations of fluid flow. | | | | | | | |
| **CO5** | Evaluate principles of fluid flow phenomena in scale up. | | | | | | | |
| **CO6** | Create empirical relations using dimensional analysis to understand fluid flow phenomena. | | | | | | | |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | | |
| CO / BL | | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | | 1 | 1 | - | - | 15 | - | 17 |
| CO2 | | 2 | 1 | - | 1 | 3 | 12 | 19 |
| CO3 | | - | 1 | - | 6 | 12 | 12 | 31 |
| CO4 | | - | - | - | 1 | 12 | 12 | 25 |
| CO5 | | - | 1 | - | 4 | 12 | - | 17 |
| CO6 | | - | - | - | - | 15 | - | 15 |
|  | | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20BT2015** | **Duration** | **3hrs** |
| **Course Name** | **BIOPROCESS PRINCIPLES** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State an example of ancillary equipment used alongside fermenters. | | CO1 | U | 1 |
| 2. | Name one process used to ensure containment of microorganisms during fermentation. | | CO1 | R | 1 |
| 3. | Identify one method used for measuring the rate of stirring in a fermenter. | | CO2 | U | 1 |
| 4. | List the factors to be considered during designing of a commercial medium for industrial-scale fermentations. | | CO2 | R | 1 |
| 5. | Differentiate between a simple and a complex medium in terms of nutrient composition. | | CO2 | U | 1 |
| 6. | State the factors considered in determining the sterilization time for batch heat sterilization. | | CO3 | R | 1 |
| 7. | Identify the significance of filter sterilization in fermentation. | | CO3 | U | 1 |
| 8. | Define crowded plate technique. | | CO4 | R | 1 |
| 9. | Identify one desired characteristic that is often screened for in industrial microorganisms | | CO5 | U | 1 |
| 10. | Categorize the parameter that is checked during quality control of microbial cultures. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare and contrast the design features of batch and continuous fermenters, highlighting their advantages and limitations. | | CO2 | A | 3 |
| 12. | Evaluate the role of ancillary equipment sensors in optimizing fermentation performance and process control. | | CO1 | An | 3 |
| 13. | Explain the concept of oxygen transfer rate (OTR). | | CO3 | U | 3 |
| 14. | Compare the design features of batch and continuous sterilization equipment. | | CO4 | A | 3 |
| 15. | List the advantages of lyophilization in microbial isolate preservation. | | CO5 | U | 3 |
| 16. | List the different molecular techniques in identifying and selecting microbial strains with specific traits for industrial applications. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Evaluate the role of containment systems in preventing microbial contamination and ensuring product quality in fermentation processes. | CO1 | E | 6 |
|  | b. | Analyze the significance of sampling frequency and techniques in monitoring key parameters during fermentation. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. |  | Analyze the critical aspects of fermenter design. How are the main parameters to be monitored during controlled fermentation processes? | CO4 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Outline the statistical approach for optimizing a fermentation medium to enhance microbial growth and productivity. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 20. |  | Evaluate the key factors influencing the design of fermentation media for industrial bioprocesses. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | Design a batch sterilization process to carry out medium sterilization in order to calculate sterilization time. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Design a depth filter system to achieve a flow rate of 500 L/hr while ensuring a microbial reduction level of at least 99.9%. The filter media has a pore size of 0.2 microns. Calculate the required filter area or depth to meet these criteria and justify your findings. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the principle of enrichment culture combined with indicator dyes for screening microbial populations. | CO5 | U | 6 |
|  | b. | Describe the different culture preservation techniques. | CO5 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the approaches in isolation of industrially important microorganisms. | CO6 | U | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the process of fermentation and its requirements |
| **CO2** | Remember the process of media formulation and medium optimization for fermentation process |
| **CO3** | Analyze the kinetics of sterilization process |
| **CO4** | Apply knowledge on isolation and storage of industrially important microbes |
| **CO5** | Analyze parameters to control during fermentation process |
| **CO6** | Evaluate the process of sterilization by filtration |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 |  | 9 | 6 |  | 17 |
| **CO2** | 13 | 2 | 3 |  | 12 |  | 30 |
| **CO3** | 1 | 4 | 24 |  |  |  | 29 |
| **CO4** | 1 |  | 3 | 12 |  |  | 16 |
| **CO5** |  | 10 | 6 |  |  |  | 16 |
| **CO6** | 3 |  | 13 |  |  |  | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20BT2017** | **Duration** | **3hrs** |
| **Course Name** | **MOLECULAR BIOLOGY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Write the chemical method for artificial induction of competence. | | CO1 | A | 1 |
| 2. | Name the cell cycle phase in which the DNA replication takes place. | | CO2 | R | 1 |
| 3. | **image.jpg**  Identify the type of mutation illustrated in the image above. | | CO3 | U | 1 |
| 4. | Analyze whether the mRNA is a copy of sense strand or not. | | CO4 | An | 1 |
| 5. | Which is the universal start codon? | | CO5 | R | 1 |
| 6. | Define operon. | | CO6 | U | 1 |
| 7. | Relate the term gene with genome. | | CO1 | A | 1 |
| 8. | Name the enzyme that unwinds DNA at the origin of replication. | | CO2 | R | 1 |
| 9. | List the biologically significant differences between DNA and RNA. | | CO3 | R | 1 |
| 10. | State the enzyme that carry out transcription. | | CO4 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Illustrate the central dogma of protein synthesis. | | CO1 | A | 3 |
| 12. | Explain the role of different DNA polymerases in eukaryotic DNA replication. | | CO2 | An | 3 |
| 13. | State the importance of SOS repair system. | | CO3 | R | 3 |
| 14. | Tabulate the differences between prokaryotic and eukaryotic transcription. | | CO4 | R | 3 |
| 15. | Write the significance of post translational modifications. | | CO5 | A | 3 |
| 16. | Relate the terms nucleotide, codon and amino acids. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Describe the mechanism of DNA packaging in eukaryotes. | CO1 | U | 6 |
|  | b. | Illustrate the experiment conducted to prove bacterial transformation. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Discuss various enzymes involved in prokaryotic DNA replication. | CO2 | U | 8 |
|  | b. | Evaluate the importance of replicase and reverse transcriptase in viral replication. | CO2 | E | 4 |
|  |  |  |  |  |  |
| 19. | a. | Write a detailed note on gene mutation and its types. | CO3 | A | 6 |
|  | b. | Explain the methylation dependent mismatch DNA repair mechanism. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the synthesis of mRNA in prokaryotes with a neat sketch. | CO4 | An | 8 |
|  | b. | Illustrate the mechanism of transcription pre-initiation complex formation in eukaryotes. | CO4 | An | 4 |
|  |  |  |  |  |  |
| 21. | a. | Discuss the process of amino acid activation and formation of initiation complex during prokaryotic translation with neat diagram. | CO5 | U | 6 |
|  | b. | Evaluate the importance of post transcriptional modifications in eukaryotes. | CO5 | E | 6 |
|  |  |  |  |  |  |
| 22. | a. | What are the structural genes controlled by lac operon? Explain the catabolic repression effects of this operon. | CO6 | U | 8 |
|  | b. | Justify the statement “The genetic code is redundant”. | CO6 | E | 4 |
|  |  |  |  |  |  |
| 23. | a. | Describe the initiation and elongation events happen during eukaryotic translation. | CO2 | U | 8 |
|  | b. | Distinguish between prokaryotic and eukaryotic translation. | CO4 | A | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the structure and function of RNA polymerase. | CO2 | A | 6 |
|  | b. | Discuss the photo reactivation repair mechanism with neat sketch. | CO3 | U | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recall the fundamental concepts of the prokaryotic and eukaryotic genome organization, its replication and gene expression |
| CO2 | Understand the process of replication, transcription and translation |
| CO3 | Recognize common mutations, their natural repair systems and inhibitors of gene expression |
| CO4 | Distinguish the process of replication, transcription and translation of prokaryotes and eukaryotes |
| CO5 | Appraise the post-synthesis modifications for transcription and translation |
| CO6 | Comprehend the role of genetic code, chromatin, operons and cis/trans elements in gene regulation |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 6 | 11 | - | - | - | 17 |
| CO2 | 2 | 16 | 6 | 3 | 4 | - | 31 |
| CO3 | 4 | 7 | 12 | - | - | - | 23 |
| CO4 | 4 | - | 4 | 13 | - | - | 21 |
| CO5 | 1 | 6 | 3 | - | 6 | - | 16 |
| CO6 | 1 | 11 | - | - | 4 | - | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2018** | **Duration** | **3hrs** |
| **Course Name** | **GENETIC ENGINEERING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Select whether *E. coli* is a naturally competent bacterium or not. | | CO1 | U | 1 |
| 2. | Name the enzyme that can catalyze the joining of two molecules by forming a new chemical bond. | | CO1 | R | 1 |
| 3. | State the molecular technique in which DNA sequences between two oligonucleotide primers can be amplified. | | CO2 | R | 1 |
| 4. | Recognize the restriction enzyme which has an optimal reaction temperature of 25oC. | | CO2 | R | 1 |
| 5. | Give an example for the vector that can propagate in two different host species. | | CO3 | U | 1 |
| 6. | What is the importance of “cos sites” in cosmid vector. | | CO3 | R | 1 |
| 7. | Estimate how many dsDNA is obtained from one dsDNA after 6 cycles of PCR. | | CO4 | U | 1 |
| 8. | Recognize the thermostable enzyme that lacks proof reading activity. | | CO4 | R | 1 |
| 9. | Identify the chemical used to prepare competent cells for heat-shock method of bacterial transformation. | | CO5 | U | 1 |
| 10. | Give an example for genetically modified plant. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | How the restriction-modification (R-M) system in bacteria act as defense mechanism? | | CO1 | An | 3 |
| 12. | Illustrate “Ecostar activity”. | | CO2 | U | 3 |
| 13. | Distinguish between cosmid and phagemid vector. | | CO3 | An | 3 |
| 14. | Compare the PCR components of RAPD and conventional PCR. | | CO4 | U | 3 |
| 15. | Differentiate transformation from transfection. | | CO5 | An | 3 |
| 16. | Discuss the role of IBSC. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | What are restriction endonucleases? List the efficiencies and deficiencies of restriction endonucleases. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the working mechanism of Ligases. | CO2 | A | 6 |
|  | b. | Write a note on role of polynucleotide kinase in genetic engineering. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Give a detailed notes on construction, nomenclature and applications of pBR322 vector. | CO3 | U | 6 |
|  | b. | Explain the process of insertional inactivation with suitable example. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the principle, procedure and application of PCR. Add a note on hot start PCR. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Write a detailed note on electroporation and liposome mediated gene transfer. | CO5 | A | 8 |
|  | b. | Tabulate the disadvantages of electroporation. | CO5 | R | 4 |
|  |  |  |  |  |  |
| 22. | a. | “VNTR Markers: An excellent tool for DNA fingerprinting”. Justify the given statement. | CO4 | An | 6 |
|  | b. | Write a note on the role of polynucleotide kinase in genetic engineering. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | What are genomic & CDNA libraries? Explain the construction of CDNA library in detail. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | List the major ethical issues related with genetically modified crops and genetic engineering. | CO6 | U | 6 |
|  | b. | Discuss various methods employed in the production of transgenic plants. | CO6 | U | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe the basics of genetic engineering |
| **CO2** | Understand the basic tools employed in genetic engineering. |
| **CO3** | Relate and evaluate the use of cloning vectors in genetic engineering. |
| **CO4** | Comprehend the concept of polymerase chain reaction and its applications. |
| **CO5** | Discuss and appraise the strategy and applications of gene cloning. |
| **CO6** | Analyze the importance of transgenesis in biotechnological research |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 13 | 1 | - | 3 | - | - | 17 |
| **CO2** | 2 | 3 | 18 | - | - | - | 23 |
| **CO3** | 1 | 7 | 6 | 3 | - | - | 17 |
| **CO4** | 1 | 4 | 12 | 6 | - | - | 23 |
| **CO5** | 4 | 1 | 20 | 3 | - | - | 28 |
| **CO6** | - | 16 | - | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2020** | **Duration** | **3hrs** |
| **Course Name** | **BIOPROCESS ENGINEERING** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name a parameter monitored online in a fermenter as indicators of inoculum quality | | CO1 | U | 1 |
| 2. | Name any one microbial product that does not give a selective advantage to producers during screening. | | CO1 | R | 1 |
| 3. | Define specific growth rate. | | CO3 | U | 1 |
| 4. | Give an example of a mixed-growth associated product. | | CO3 | U | 1 |
| 5. | Determine the degrees of reduction of lactic acid (C3H6O3). | | CO2 | A | 1 |
| 6. | State the significance of respiratory quotient. | | CO2 | U | 1 |
| 7. | State the unit of KLa. | | CO4 | R | 1 |
| 8. | Examine the change in specific oxygen uptake rate with dissolved oxygen concentration. | | CO4 | A | 1 |
| 9. | Explain the significance of the dilution rate in CSTR operation. | | CO5 | U | 1 |
| 10. | Identify the constant parameter in fed-batch operation: volume, biomass concentration, biomass content. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Describe the procedure for the development of inoculum for bacterial fermentations. | | CO1 | U | 3 |
| 12. | Explain the approaches to minimize the length of the lag phase. | | CO3 | A | 3 |
| 13. | Consider the ethanol fermentation by *Saccharomyces cerevisiae* as described by the following overall reaction. Estimate maximum yield for ethanol. | | CO2 | A | 3 |
| 14. | Describe the advantages of an airlift reactor over a bubble column reactor. | | CO6 | U | 3 |
| 15. | Deduce the mathematical expression adopted in the Fed-batch system for biomass and substrate concentration under pseudo-steady-state conditions. | | CO5 | U | 3 |
| 16. | Differentiate between OTR and OUR | | CO4 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the methods of screening industrially important microbes. | CO1 | A | 6 |
|  | b. | Explain the approaches in preservation of microbial culture. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | *Escherichia coli* produce recombinant porcine growth hormone in an aerobically grown batch culture with glucose as a growth-limiting substrate. Cell and substrate concentrations as a function of culture time are as follows.   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Time,h | 0 | 0.33 | 0.5 | 0.75 | 1.0 | 1.5 | 2.0 | 2.5 | 2.8 | 3.0 | 3.1 | 3.2 | 3.5 | 3.7 | | Cell concentration (X), g/L | 0.20 | 0.21 | 0.22 | 0.32 | 0.47 | 1.00 | 2.10 | 4.42 | 6.9 | 9.4 | 10.9 | 11.6 | 11.7 | 11.6 | | Substrate concentration (S), g/L | 25.0 | 24.8 | 24.8 | 24.6 | 24.3 | 23.3 | 20.7 | 15.7 | 10.2 | 5.2 | 1.65 | 0.2 | 0.0 | 0.0 |   a)Plot µ as a function of time  b)Determine µ max  c) Estimate the observed yield from substrate. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 19. | a. | The following overall reaction describes aerobic growth of *Saccharomyces cerevisiae* on ethanol.  (a) Determine the stoichiometric coefficients where RQ=0.66.  (b) Determine the biomass yield coefficient YX/S and oxygen yield coefficient YX/O2 | CO2 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | KLa determination of the stirred tank bioreactor operating at 500rpm, 1 atm and 370C by the dynamic response method obtained the following data. The oxygen source was air, and a millivolt meter read the dissolved oxygen level. Estimate KLa of the bioreactor.   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | t(s) | 0 | 40 | 51 | 56 | 62 | 67 | 72 | 78 | 88 | 135 | 220 | | DO (mV) | 0 | 0.01 | 0.16 | 0.32 | 0.51 | 0.70 | 0.84 | 1.0 | 1.10 | 1.10 | 1.10 | | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Derive the design equation for the batch fermentor which converts the substrate from S0 in Volume=V, following Monod Kinetics. | CO5 | An | 6 |
|  | b. | A chemostat cultivates an organism that obeys the Monod equation. The system operates under glucose limitation. F=100ml/h, S0=10g glucose/l, YX/S=0.5 g dwcells/g substare, µm=0.8h-1, Ks=1g/L. It achieves a substrate conversion of 98%.  Calculate the size of CSTR required and cell concentration at the exit.  Estimate the biomass productivity. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate the microbial growth, product formation, and substrate consumption kinetics in a batch reactor using appropriate mathematical expressions. Explain each term with appropriate units. | CO3 | A | 8 |
|  | b. | Explain a strategy that you may adopt to estimate the maintenance requirement of microbial culture. | CO3 | An | 4 |
|  |  |  |  |  |  |
| 23. | a. | A batch operation using aerobic bacteria produces an industrially important enzyme. About 20 g of cells seeded in 80 L of media. The lag phase was 30 min. The specific growth rate of the organism is 0.1 h-1 under the conditions maintained.  (a) Estimate the cell concentration after 3 hours of growth.  (b) At the same conditions as above, estimate the time required to yield a cell concentration of 1.5 g/l. | CO5 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Compare the different enzyme immobilization techniques adopted in the immobilized reaction system | CO6 | A | 6 |
|  | b. | Examine the mass transfer process of a substrate from the bulk fluid to surface of biocatalyst using the “effectiveness” factor | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand various methods of isolation and preservation of Industrially important microbes. |
| CO2 | Remember principles of stoichiometry and concepts of bioreactor engineering. |
| CO3 | Understand kinetic models of growth and product formation. |
| CO4 | Apply methods to calculate volumetric mass transfer coefficients in bioreactors. |
| CO5 | Analyze various bioreactors for fermentation process. |
| CO6 | Evaluate application of various reactors in fermentation processes. |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 10 | 6 |  |  |  | 17 |
| CO2 |  | 1 | 16 |  |  |  | 17 |
| CO3 |  | 2 | 11 | 4 | 12 |  | 29 |
| CO4 | 1 |  | 4 |  | 12 |  | 17 |
| CO5 |  | 4 |  |  | 24 |  | 28 |
| CO6 |  | 3 | 13 |  |  |  | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2021** | **Duration** | **3hrs** |
| **Course Name** | **ENZYME ENGINEERING AND TECHNOLOGY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | How many Zn+are present in one molecule of carbonic anhydrase? | | CO1 | An | 1 |
| 2. | Name the hydrolase enzyme involved in the formation of urea. | | CO1 | R | 1 |
| 3. | What is absolute substrate specificity? | | CO3 | U | 1 |
| 4. | Mention an irreversible inhibitor used for therapeutic applications. | | CO4 | R | 1 |
| 5. | Define Ki. | | CO6 | R | 1 |
| 6. | Write down a protease-inhibitor. | | CO5 | R | 1 |
| 7. | Which was the first enzyme to be immobilsed by adsorption method? | | CO3 | R | 1 |
| 8. | Give the function of laccase biosensors. | | CO2 | U | 1 |
| 9. | What is the role of glucose oxidase in the food industry. | | CO2 | U | 1 |
| 10. | What is enzyme immunoassay? | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | 50mg of an enzyme with a molecular weight of 72000 shows a Vmax of 6.4 mmol substrate per minute. Calculate the turnover number of the enzyme. | | CO1 | An | 3 |
| 12. | Write the salient features of the active site of enzymes. | | CO2 | U | 3 |
| 13. | How are different types of inhibitions diagnosed? | | CO3 | An | 3 |
| 14. | Give a short note on nanoenzyme biosensors. | | CO4 | U | 3 |
| 15. | Write the criteria of purity of enzymes. | | CO5 | A | 3 |
| 16. | Explain covalent catalysis with examples. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Elaborate on the six types of classification of enzymes with examples. | CO1 | R | 6 |
|  | b. | Describe the various factors influencing the enzyme activity. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | What happens to Km and Vmax in the presence of a competitive inhibitor for an enzyme catalysed reaction? Explain the kinetics. | CO4 | An | 6 |
|  | b. | How is the activity of allosteric enzymes regulated? Explain. | CO6 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Lactate dehydrogenase of crude liver homogenate exhibited an activity of 5.6 units per gram tissue and a protein concentration of 200mg per gram. After several purification steps, the enzyme preparation showed an activity of 2.8 units per ml and a protein concentration of 10 mg/ml. How many times was the enzyme purified? | CO5 | An | 6 |
|  | b. | Describe a method for the determination of enzyme-protein concentration. | CO5 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the different techniques of immobilization of enzymes. | CO3 | R | 6 |
|  | b. | Discuss the following immobilized enzyme reactors with respect to their design, mode of operation, and applications: i) Packed bed reactors ii) Membrane reactors. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Give a detailed account on different types of mechanism of enzyme action. | CO1 | R | 6 |
|  | b. | Describe the kinetics of noncompetitive inhibition with examples. | CO6 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | A biochemist purifies an enzyme and submits the data as below:   |  |  |  |  | | --- | --- | --- | --- | | S.No. | Procedure | Protein (mg) | Activity (units/min) | | 1 | Crude Extract | 16,000 | 3,600 | | 2 | Ammonium Sulphate Precipitation | 6000 | 2700 | | 3 | Organic Solvent Extraction | 5000 | 2100 | | 4 | Ion Exchange Chromatography | 800 | 1200 | | 5 | Gel Permeation Chromatography | 500 | 1100 | | 6 | Affinity Chromatography | 100 | 980 |   Using the above data,   1. Calculate the specific activity after each purification procedure. 2. Which of the purification methods used is most effective and least effective? | CO6 | An | 6 |
|  | b. | How does biocatalyst play significant role in organic synthesis? Explain. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Describe the different types of enzyme based biosensors. | CO3 | R | 6 |
|  | b. | Write a detailed account on the application of nanobiocatalyst. | CO2 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Give a detailed account on the kinetics of single substrate-enzyme catalysed reactions. | CO6 | An | 6 |
|  | b. | Elaborate on the industrial application of enzymes. | CO2 | A | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand enzymes and enzymatic reactions |
| **CO2** | Relate the application of enzymes in various industries |
| **CO3** | Apply enzymes in free and immobilized form for various reaction |
| **CO4** | Analyze the enzyme kinetics |
| **CO5** | Evaluate the processing and purification of enzymes |
| **CO6** | Hypothesize model for enzyme kinetics and inhibition types |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **A7n** | **E** | **C** | **Total** |
| **CO1** | 13 | - | - | 4 | - | - | 17 |
| **CO2** | - | 11 | 6 | - | - | - | 17 |
| **CO3** | 13 | 13 | 6 | 3 | - | - | 35 |
| **CO4** | 1 | 3 | - | 6 | - | - | 10 |
| **CO5** | 1 | 1 | 3 | 12 | 6 | - | 23 |
| **CO6** | 1 | 3 | 12 | 6 | - | - | 22 |
|  | | | | | | | **124** | |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20BT2023** | **Duration** | **3hrs** |
| **Course Name** | **DOWNSTREAM PROCESSING** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name a low-value high-volume fermentation product. | | CO1 | R | 1 |
| 2. | Identify the structural component unique to the Gram-negative cell wall. | | CO1 | U | 1 |
| 3. | Infer the role of NaOH in alkaline cell lysis protocol. | | CO1 | U | 1 |
| 4. | Select an isotherm model that holds for monolayer adsorption theory | | CO3 | R | 1 |
| 5. | Recognise the mechanism involved in protein precipitation by chaotropic agents. | | CO5 | R | 1 |
| 6. | Relate to different types of intra-molecular forces assisting the solubilization of globular protein. | | CO5 | U | 1 |
| 7. | Name an anionic resin and the functional group for the ion-exchange process. | | CO4 | R | 1 |
| 8. | Select a functionalized adsorbent appropriate for reverse-phase chromatography. | | CO4 | R | 1 |
| 9. | Name a chemical/additive used to regenerate the hydrophobic interaction chromatography column. | | CO4 | R | 1 |
| 10. | Define equilibrium moisture content in the context of the drying process. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Illustrate the mechanism of cell lysis mediated through ultrasonication. | | CO1 | An | 3 |
| 12. | Justify the need for cake washing step in a continuous rotary filter. | | CO2 | E | 3 |
| 13. | Deduce the mathematical relationship between residual aqueous phase concentration after a repeated cycle of extraction using a fresh organic solvent. | | CO2 | An | 3 |
| 14. | Calculate the ionic strength of 2 M of Al2(SO4)3 solution. | | CO5 | An | 3 |
| 15. | Explain the operating principle of the cross-flow filtration unit in the membrane separation process. | | CO4 | U | 3 |
| 16. | Justify the need to incorporate a spacer arm in affinity chromatography. | | CO4 | E | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Review the influence of different process conditions on the success of chemical and enzymatic cell lysis protocols. | CO1 | U | 8 |
|  | b. | Illustrate the working principle of high-pressure homogenizer. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Develop the mathematical relationship between the volume of slurry processed and operating time in batch filtration. | CO2 | A | 8 |
|  | b. | Distinguish between the compressible and incompressible cake based on their influence on filtration process performance. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | It takes 10 min to pellet down the cell suspension in a Swing-bucket centrifuge, operating at 5000 rpm. The distance of the rotation axis from the liquid surface and bottom of the centrifuge tube are 5 cm and 15 cm, respectively. Estimate the centrifugation time if the tubes are half-filled and operated at 2000 rpm. | CO3 | E | 6 |
|  | b. | *E. coli* suspension (particle density 1.1 g/cm3, size 200 µm) is allowed to settle down under gravity in a 50 cm height beaker. The density and viscosity of the cell-free medium are 1.0 g/cm3 and 1.2 cP. Calculate the sedimentation time required under the given conditions. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | The addition of 10 g charcoal to 100 L of fermentation broth containing 200 mg/L of antibiotic results in 30% drug recovery. The adsorption isotherm is given by the Freundlich model, . Estimate the recovery if 20 g of charcoal would have been added to the broth. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Fermentation broth containing antibiotic (10 mg/L) is being extracted with chloroform in a counter-current extraction system. Estimate the number of stages required for 99% recovery of the drug, if the flow rate of heavy and lighter phases are 2 L/min and 0.1 L/min, and the partition coefficient of antibiotic between the two phases is 150. | CO3 | E | 8 |
|  | b. | Administer different strategies to improve liquid-liquid extraction efficiency of ionizable organic acids present in fermentation broth. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 22. | a. | Classify the different membrane module configurations adopted in the separation process. | CO5 | U | 8 |
|  | b. | Explain the operating principle behind the reverse osmosis process. | CO5 | An | 4 |
|  |  |  |  |  |  |
| 23. | a. | Illustrate the steps involved in the operation of ion exchange chromatography. Explain the role of pH and type of ion-exchanger on process performance. | CO4 | An | 6 |
|  | b. | Distinguish between different stages of the drying cycle based on drying rate and moisture content, with an appropriate explanation. | CO4 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Select appropriate strategies to maintain required degree of supersaturation in the crystallization process. | CO6 | An | 6 |
|  | b. | Differentiate between nucleation and crystal growth phases for bioproduct polishing. | CO6 | U | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the fundamentals of product isolation and separation techniques |
| CO2 | Distinguish various techniques for product recovery and isolation |
| CO3 | Explain operating principles across different solid(liquid)-liquid separation process |
| CO4 | Analyze product recovery in solid-liquid separation processes |
| CO5 | Compare the performances of different extraction techniques |
| CO6 | Apply separation techniques for bio product recovery |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 14 | 0 | 3 | 0 | 0 | 18 |
| CO2 | 0 | 4 | 8 | 3 | 3 | 0 | 18 |
| CO3 | 1 | 0 | 4 | 0 | 32 | 0 | 37 |
| CO4 | 3 | 3 | 0 | 6 | 9 | 0 | 21 |
| CO5 | 1 | 9 | 0 | 7 | 0 | 0 | 17 |
| CO6 | 1 | 6 | 0 | 6 | 0 | 0 | 13 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20BT2025** | **Duration** | **3hrs** |
| **Course Name** | **IMMUNOLOGY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name the person who is known as “Father of Immunology”. | | CO1 | U | 1 |
| 2. | Name the microorganism which causes anthrax disease in poultry. | | CO1 | R | 1 |
| 3. | What is the role of adaptive immune system? | | CO2 | An | 1 |
| 4. | Name the anatomical barriers involved in innate immunity. | | CO2 | A | 1 |
| 5. | List the types of leucocytes involved in the first line immune system. | | CO3 | R | 1 |
| 6. | Define epitope. | | CO3 | U | 1 |
| 7. | State the role of T helper cells in recognizing the antigen. | | CO4 | U | 1 |
| 8. | Name the antimicrobial substance present in serum, saliva and tears | | CO4 | R | 1 |
| 9. | What is meant by heterokaryans? | | CO5 | U | 1 |
| 10. | Define abzymes. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Define extravasation process with diagrammatic representation. | | CO1 | U | 3 |
| 12. | Name the common allergens associated with type I hypersensitivity. | | CO2 | R | 3 |
| 13. | Write the importance of neutrophil in immune system. | | CO3 | U | 3 |
| 14. | Write any three causes of allergy in humans. | | CO4 | An | 3 |
| 15. | Discuss the process of anaphylaxis. | | CO5 | An | 3 |
| 16. | Define chimeric antibodies? | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Distinguish between innate and adaptive immune system. | CO1 | U | 6 |
|  | b. | Discuss the importance of secondary Lymphoid organs. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the role of B and T cells in immune mechanism. | CO2 | U | 6 |
|  | b. | Write the mechanism of phagocytosis. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate the formation of blood cellular components. | CO3 | U | 6 |
|  | b. | Explain the lineage and the functions of eosinophils in human immunity. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the structure of antibody with neat illustration. | CO4 | R | 6 |
|  | b. | Describe the antigen processing and presentation of Class I MHC molecule. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | Discuss about the types of hypersensitivity reactions when human body encounters with infections. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain immunosuppression mechanism with suitable examples. | CO5 | An | 6 |
|  | b. | Analyze glucocorticoids suppression in cell-mediated immunity. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 23. |  | Explain the process and steps involved in immunohistochemistry analysis with illustrations. | CO5 | An | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the process of monoclonal antibody production with illustrations. | CO6 | An | 6 |
|  | b. | Illustrate on mRNA, live attenuated, inactivated vaccines with examples. | CO6 | An | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Learn the history and development and controversies of the field of immunology. |
| CO2 | Recognizes the types of immunity, the basic plan of the immune of the immune system and the organs of the immune system. |
| CO3 | Identify the cells of the immune system and their functions. |
| CO4 | Understand the functioning of the innate and adaptive immune system |
| CO5 | Interpret the cellular & molecular interactions, physiology and the pathology of the immune system. |
| CO6 | Infer of the applications of immunology in diagnosis and treatment of diseases |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 16 |  |  |  |  | 17 |
| CO2 | 3 | 15 | 1 | 1 |  |  | 20 |
| CO3 | 1 | 10 |  |  |  |  | 11 |
| CO4 | 7 | 7 |  | 3 |  |  | 17 |
| CO5 |  | 13 |  | 27 |  |  | 40 |
| CO6 | 6 | 1 |  | 12 |  |  | 19 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20BT2029** | **Duration** | **3hrs** |
| **Course Name** | **BIOCHEMICAL THERMODYNAMICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
|  | **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Define adiabatic process in thermodynamics. | | CO1 | R | 1 |
| 2. | If the enthalpy change for a reaction is zero, then what does G equal to? | | CO1 | U | 1 |
| 3. | Explain the first law of thermodynamics. | | CO2 | R | 1 |
| 4. | Name the process, in which the temperature of the working substance remains constant during its expansion or compression. | | CO2 | U | 1 |
| 5. | Define open system. | | CO2 | R | 1 |
| 6. | Enumerate the compressibility factor of an ideal gas. | | CO2 | An | 1 |
| 7. | Determine the value for γ, if Cp= 8.58 cal/mol/degree and R is 2 cal/degree-mol. | | CO3 | U | 1 |
| 8. | Determine the unit for characteristics constant “B” in Virial equation. | | CO4 | An | 1 |
| 9. | If, F=C-P+2; then determine the value of F for the system, Ice-Water-Vapor. | | CO5 | An | 1 |
| 10. | Define sublimation. | | CO5 | U | 1 |
|  | **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Differentiate between intensive and extensive property of a system. | | CO1 | E | 3 |
| 12. | Determine the molar volume of a gas at 37 ⸰C and pressure of 2 bar. Assume the gas behaves ideally and R= 8.314 J/mol-K. | | CO3 | An | 3 |
| 13. | The coefficient of compressibility (k) and coefficient of volume expansion (β) of mercury at 273 K and 1 bar are 3.9×10–6 (bar)–1 and 1.8×10–4 K–1, respectively. Calculate CV in J/kg K for mercury given that CP = 0.14 kJ/kg K and density = 13.596×103 kg/m3. Given that, CP-CV = (β2VT/k). | | CO3 | An | 3 |
| 14. | A gas is enclosed by a frictionless piston in a 0.3 m diameter cylinder, and a metal block is placed on the piston. The weight of the piston and the block rested on it together equal to 100 kg. The atmospheric pressure and the acceleration due to gravity g are 1.013 bar and 9.792 m/s², respectively. Calculate the force exerted by the atmosphere in N. | | CO2 | E | 3 |
| 15. | A liquid of benzene and tolune form an Azeotrope containing 46.1 mole% benzene at 101.3 kPa and 345 K. Determine the mole fractions of benzene and tolune in the liquid and vapour phases. | | CO5 | An | 3 |
| 16. | A gas mixture containing 2 moles of N2, 7 mol of H2 and 1 mol of NH3 initially, undergoing reaction; N2+3H2 →2NH3. After some time ε = 0.5. Evaluate the estimated mole fraction of NH3 in the mixture. | | CO6 | E | 3 |
|  | **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23, Q. No. 24 is Compulsory)** | | | | |
| 17. |  | The total energy of a typical closed system is given by E= 50+25T+0.05T2 in joules. The amount of heat adsorbed by the system can be expressed as Q= 4000+10T in joules. Estimate the work done during the process in which temperature rises from 400 k to 800 k. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. |  | Determine the second virial coefficient B` in terms of B and third virial coefficient C` in terms of C. | CO4 | C | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain in detail on five different phase change processes of pure substances. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | From the plot of α vs P for CO, the area under the curve between 0 to 100 atm is observed as 0.0875 atm dm-3 mol-1. Calculate the fugacity at 100 atm and 0 ⸰C. Consider R as 0.0821 atm dm-3 K-1 mol-1. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain VLE diagram of Temperature vs composition (T-x-y) for a two-phase system. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 22. |  | Derive the following maxwell equation.  ( )S = - ( )V | CO3 | C | 12 |
|  |  |  |  |  |  |
| 23. |  | Prove that, specific heat capacity at constant pressure - specific heat capacity at constant volume is equal to the universal gas constant. | CO2 | C | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | A binary mixture consists of 60 mole% ethylene and 40 mole% propylene. At 423 K, the vapour pressures of ethylene and propylene are 15.2 atm and 9.8 atm, respectively. Calculate the total pressure and mole fraction of ethylene and propylene in the vapour phase. Assume the mixture behaves like an ideal solution. | CO6 | E | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Recognize relevant thermodynamic properties of ideal and real fluids |
| **CO2** | Explain concept of entropy, enthalpy, partial molar property, fugacity, activity of thermodynamic system |
| **CO3** | Solve mathematical problem involving volumetric, thermodynamic properties of real fluids |
| **CO4** | Infer dependency of biochemical reaction equilibrium on pressure and temperature |
| **CO5** | Design solution of VLE problem with real fluid for improved recovery in bioprocess system |
| **CO6** | Create problems dealing with multi-phase biochemical systems |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 1 | - | - | 15 | - | 17 |
| CO2 | 2 | 1 | - | 1 | 3 | 12 | 19 |
| CO3 | - | 1 | - | 6 | 12 | 12 | 31 |
| CO4 | - | - | - | 1 | 12 | 12 | 25 |
| CO5 | - | 1 | - | 4 | 12 | - | 17 |
| CO6 | - | - | - | - | 15 | - | 15 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20BT2030** | **Duration** | **3hrs** |
| **Course Name** | **CONCEPTS OF BIOINFORMATICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | What is bioinformatics? | | CO1 | U | 1 |
| 2. | Define genomics. | | CO1 | R | 1 |
| 3. | What is the role of bioinformatics in drug discovery? | | CO2 | R | 1 |
| 4. | What does BLAST stand for? | | CO2 | R | 1 |
| 5. | Define sequence alignment. | | CO3 | U | 1 |
| 6. | Explain the term "homology" in bioinformatics. | | CO3 | R | 1 |
| 7. | What is a phylogenetic tree? | | CO4 | U | 1 |
| 8. | What is the significance of protein structure prediction? | | CO4 | R | 1 |
| 9. | Define metagenomics. | | CO5 | U | 1 |
| 10. | What is the significance of bioinformatics in understanding evolutionary relationships? | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the significance of the RefSeq database hosted by NCBI. | | CO1 | R | 3 |
| 12. | Compare and contrast the data content and features of NCBI, DDBJ, and EMBL databases. | | CO2 | U | 3 |
| 13. | Describe the role of the Basic Local Alignment Search Tool (BLAST) in bioinformatics, highlighting its applications and functionalities. | | CO3 | U | 3 |
| 14. | Compare and contrast structural bioinformatics and functional genomics, highlighting their respective methodologies and applications. | | CO4 | U | 3 |
| 15. | Explain the significance of sequence alignment in bioinformatics. Provide examples of its applications in biological research. | | CO5 | R | 3 |
| 16. | Describe the process of homology modeling in molecular modeling. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Define and describe the type of biological databases are used in bioinformatics? | CO1 | R | 6 |
|  | b. | What are the different types of sequences entered into the databases? | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | You have a scoring scheme where  A match gives you +1  a mismatch gives you −1  opening a gap costs you −1  Write down the best Local alignment for the same two DNA sequences. S1= AATTCGCGTA & S2 = TATCGCTACA | CO2 | An | 10 |
|  | b. | Write the file format of EMBL Nucleotide Sequence Database. | CO1 | R | 2 |
|  |  |  |  |  |  |
| 19. | a. | You have a scoring scheme where  A match gives you +1  a mismatch gives you −1  opening a gap costs you −1  Write down the best Global alignment for the same two DNA sequences. S1= TTGCACGGA & S2 = TCGCACGGTA | CO2 | An | 10 |
|  | b. | Describe in detail the protein secondary structural databases and application. | CO2 | U | 2 |
|  |  |  |  |  |  |
| 20. | a. | Describe the sequence analysis technique available for biological functional prediction. | CO3 | U | 6 |
|  | b. | Enumerate the various types of multiple sequence alignment. Give the programs under each category, and mention the drawbacks of progressive alignment | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | What was the contribution of Margaret Dayhoff in the field of molecular evolution? | CO4 | R | 4 |
|  | b. | Outline the steps used to find values for a BLOSUM amino acid similarity matrix. | CO4 | R | 8 |
|  |  |  |  |  |  |
| 22. | a. | What is the advantage of a seeded method like BLAST compared to a Needleman -Wunsch alignment? | CO4 | U | 6 |
|  | b. | What is the difference between an iterated blast (psi-blast) search and a simple blast search? | CO5 | R | 6 |
|  |  |  |  |  |  |
| 23. | a. | Define phylogenetics. | CO5 | R | 2 |
|  | b. | Briefly describe the molecular phylogenetic algorithms in bioinformatics analysis. | CO5 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Briefly describe the importance and scope of bioinformatics on Molecular modelling. | CO6 | R | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Gain knowledge on biological databases and tools. |
| **CO2** | Understand the significance of biological databases and their utilization. |
| **CO3** | Apply the knowledge of Bioinformatics skill to solve the biological problems in Genomics and Proteomics |
| **CO4** | Analyze different types of biological databases and resources. |
| **CO5** | Evaluate the vital role drugs interacting to the target. |
| **CO6** | Construct phylogenetic tree based on Molecular data. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 18 | 1 |  |  |  |  | 19 |
| **CO2** | 2 | 5 |  | 20 |  |  | 27 |
| **CO3** | 1 | 16 |  |  |  |  | 17 |
| **CO4** | 13 | 10 |  |  |  |  | 23 |
| **CO5** | 16 | 10 |  |  |  |  | 26 |
| **CO6** | 12 | 4 |  |  |  |  | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **20BT2032** | **Duration** | **3hrs** |
| **Course Name** | **INDUSTRIAL SAFETY AND HAZARD ANALYSIS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define mishap probability factor. | | CO1 | U | 1 |
| 2. | Illustrate hazard triangle. | | CO2 | R | 1 |
| 3. | Identify the possible initiating mechanism and threat for the hazard element-’ high pressure tank’. | | CO2 | A | 1 |
| 4. | List any two technique attributes of hazard analysis. | | CO3 | R | 1 |
| 5. | Name a physical hazard in the workplace. | | CO1 | U | 1 |
| 6. | Name a disease for which occupation is one of the causal factors. | | CO3 | U | 1 |
| 7. | List the elements in cognitive ergonomics. | | CO4 | U | 1 |
| 8. | Cite an example of the COSHH symbol and its meaning. | | CO5 | R | 1 |
| 9. | Interpret the significance of HAZOP study. | | CO5 | U | 1 |
| 10. | Identify a deductive method for identifying ways in which hazards can lead to accidents. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Identify the basic components of hazard. | | CO1 | U | 3 |
| 12. | Categorize the hazard analysis approaches. | | CO2 | U | 3 |
| 13. | Suggest measures for prevention and control of occupational disease due to chemicals. | | CO3 | U | 3 |
| 14. | List the main Ergonomic Principles. | | CO4 | R | 3 |
| 15. | Examine the significance of safety committees in the workplace. | | CO5 | A | 3 |
| 16. | Distinguish between QRA and LOPA. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the transition of actualized hazard to mishap. | CO1 | A | 6 |
|  | b. | Discuss the various approaches in hazard recognition. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Compare the different hazard analysis types in the system safety discipline. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Describe the elements of safety & health programs in industry. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 20. | a. | Analyze the special considerations in storage of hazardous substances: | CO3 | An | 6 |
|  | b. | Explain the hierarchical strategy in preventing/controlling workplace hazards. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Elaborate the hazards identification and risk assessment procedure. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Evaluate the event tree analysis in risk assessment. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | Discuss the main ways to control a hazard. | CO4 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Examine the general biosafety recommendations for Good Large Scale Practices. | CO6 | E | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand plant safety in selection and layout of process plants and the usage of safety codes. |
| **CO2** | Distinguish different types of hazards |
| **CO3** | Relate the occupational diseases |
| **CO4** | Analyze the bio medical and engineering response to health hazards |
| **CO5** | Evaluate the effective process control and instrumentation methods |
| **CO6** | Create awareness the usage of safety measures |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** |  | 11 | 6 |  |  |  | 17 |
| **CO2** | 13 | 15 | 1 |  |  |  | 29 |
| **CO3** | 1 | 10 |  | 6 |  |  | 17 |
| **CO4** | 3 | 13 |  | 12 |  |  | 28 |
| **CO5** | 1 | 1 | 3 |  | 12 |  | 17 |
| **CO6** |  |  | 4 |  | 12 |  | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **20BT2033** | **Duration** | **3hrs** |
| **Course Name** | **ENVIRONMENTAL POLLUTION CONTROL ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Eutrophication. | | CO1 | R | 1 |
| 2. | What is meant by the term “stream”? | | CO1 | R | 1 |
| 3. | Define ‘*cess’* in the water act of 1974. | | CO2 | U | 1 |
| 4. | State the importance of national green tribunal? | | CO2 | R | 1 |
| 5. | List any two powers of central Government mentioned in EPA. | | CO3 | U | 1 |
| 6. | Define the term ‘baseline situation’ in EIA. | | CO3 | R | 1 |
| 7. | Identify the importance of 3R technology. | | CO4 | R | 1 |
| 8. | Recognize the difference between incineration and shredding. | | CO5 | U | 1 |
| 9. | Recall the function of the department of environment, forests and wildlife. | | CO6 | R | 1 |
| 10. | State the role of Review Committee on Genetic Manipulation. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | What is the role of material reuse in waste reduction | | CO1 | U | 3 |
| 12. | Identify the role of IBSC in an institution or organization. | | CO2 | R | 3 |
| 13. | Describe the role of mitigation in EIA. | | CO3 | U | 3 |
| 14. | Compare the efficiency of clean up technologies with three examples. | | CO4 | R | 3 |
| 15. | List the color-codes used on bins for biomedical waste disposal. | | CO5 | R | 3 |
| 16. | Distinguish between GMOs and GEOs. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the prevention and control with respect to air pollution act of 1981. | CO1 | A | 06 |
| b. | Categorize the importance of air quality standards with its ambient levels. | CO1 | An | 06 |
|  |  |  |  |  |  |
| 18. | a. | Discuss the purpose of the water act of 1974. | CO2 | A | 06 |
| b. | Describe the significant milestones of the Air act from inception. | CO2 | R | 06 |
|  |  |  |  |  |  |
| 19. |  | Describe the constitution, function and funding of central and state boards mentioned in EPA and add a note on penalties, procedure, standards of emission or discharge of environmental pollutants. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Categorize the types, objectives and key components involved in the conduct of an environmental audit. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Assess the measures taken for management and handling of Biomedical waste 1998. | CO5 | E | 06 |
| b. | Describe the importance of waste management facilities available in an industry. | CO5 | U | 06 |
|  |  |  |  |  |  |
| 22. | a. | Categorize the various clean technologies that can be implemented and its need for controlling pollution. | CO4 | A | 06 |
| b. | Explain the methods of 3R technology the generated waste with examples. | CO4 | U | 06 |
|  |  |  |  |  |  |
| 23. | a. | Assess the various stages in transport and standards for treatment and disposal of biomedical wastes as per schedule IV and V. | CO5 | An | 06 |
|  | b. | Describe the disadvantages in treating and management of biomedical wastes. | CO5 | U | 06 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Summarize the rules in manufacture, use, import, export and storage of hazardous microorganisms genetically engineered organisms or cells rules, 1989. | CO6 | E | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand basics of environmental pollution. |
| **CO2** | Remember Pollution control acts and regulations. |
| **CO3** | Apply bio safety principles in pollution control. |
| **CO4** | Evaluate cleaner technology on pollution control |
| **CO5** | Evaluate various approaches for biomedical waste treatment and disposal. |
| **CO6** | Analyze various biosafety measures. |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 02 | 03 | 06 | 06 | - | - | **17** |
| **CO2** | 10 | 01 | 06 | - | - | - | **17** |
| **CO3** | 01 | 16 | - | - | - | - | **17** |
| **CO4** | 04 | 06 | 06 | 12 | - | - | **28** |
| **CO5** | 03 | 13 | - | 06 | 06 | - | **28** |
| **CO6** | 02 | 03 | - | - | 12 | - | **17** |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **20BT2039** | **Duration** | **3hrs** |
| **Course Name** | **CANCER BIOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Write any one differentiating characteristic of a cancer cell. | | CO1 | R | 1 |
| 2. | Acidosis is one of the hallmarks of cancer metabolism. State the reason. | | CO1 | U | 1 |
| 3. | Name the bacteria associated with gastric cancer. | | CO2 | R | 1 |
| 4. | Analyze the endogenous carcinogens and mention any one of it. | | CO2 | An | 1 |
| 5. | What is meant by BRCA paradigm in carcinogenesis? | | CO3 | R | 1 |
| 6. | Name one anti-apoptotic protein molecule. | | CO3 | R | 1 |
| 7. | Which cells have the receptor for VEGF for angiogenesis? | | CO5 | U | 1 |
| 8. | State one immune detection method used for testing tumor marker. | | CO5 | R | 1 |
| 9. | Expand and infer CIS stage of cancer. | | CO4 | U | 1 |
| 10. | Neoadjuvant therapy is given before surgery or after surgery? | | CO6 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Contrast the cell proliferation from normal cell division. | | CO4 | An | 3 |
| 12. | List the non-radiation materials causing cancer and analyze the mechanism. | | CO1 | An | 3 |
| 13. | Sketch the VEGF signaling pathway for angiogenesis. | | CO3 | U | 3 |
| 14. | Write the clinical significance of invasion. | | CO5 | R | 3 |
| 15. | Infer on oncogene identification and detection. | | CO4 | U | 3 |
| 16. | Criticize on emerging gene therapy methods for cancer. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Classify the cancer based on site of origin, tissue type, grade and stage. | CO4 | U | 8 |
|  | b. | Draw the cell cycle and explain the modulations that happens in cancer. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Compare the intrinsic and extrinsic pathways of apoptosis with neat illustration. | CO4 | U | 8 |
|  | b. | Compare apoptosis and necrosis. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Recall all the modern theories of carcinogenesis. | CO1 | R | 8 |
|  | b. | What is meant by complete carcinogen? Give one example. | CO1 | R | 4 |
|  |  |  |  |  |  |
| 20. | a. | Outline the chemical carcinogenesis with suitable examples. | CO2 | U | 12 |
|  | b. | Illustrate the molecular mechanism of carcinogenesis by HPV. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 21. | a. | Define invasion. Explain three step theory of invasion with diagram. | CO5 | R | 8 |
|  | b. | Write the role of various proteases in metastasis events. | CO5 | R | 4 |
|  |  |  |  |  |  |
| 22. | a. | Explain the EGF induced oncogenic signaling pathway and highlight all the signal switches of carcinogenesis. | CO3 | R | 8 |
|  | b. | Write role of bcl-2 family as oncogenes. | CO3 | R | 4 |
|  |  |  |  |  |  |
| 23. | a. | Summarize the biopsy examination and clinical grading of cancer | CO6 | U | 8 |
|  | b. | Infer on breast cancer early detection screening methods. | CO6 | U | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Analyze the available molecular therapies and their advantages. | CO6 | An | 8 |
|  | b. | Criticize on cancer preventive and palliative care. | CO6 | An | 4 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Remember the epidemiology of cancer and principles of carcinogenesis |
| CO2 | Outline the different forms of cancer and the principles of their development |
| CO3 | Understand the complex pathways and molecular switches involved in the transformation of a normal cell to a cancer cell. |
| CO4 | Relate the cell biology with the regulatory imbalance in carcinogenesis, detection and therapy |
| CO5 | Recognize the molecular mechanism of cancer spread, its markers and therapy. |
| CO6 | Evaluate the current strategies of cancer diagnosis, prevention and treatment to develop new drugs. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 13 | 1 |  | 3 |  |  | 17 |
| CO2 | 1 | 12 |  | 1 |  |  | 14 |
| CO3 | 14 | 3 |  |  |  |  | 17 |
| CO4 |  | 28 |  | 3 |  |  | 31 |
| CO5 | 16 | 1 |  |  |  |  | 17 |
| CO6 |  | 12 |  | 16 |  |  | 28 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **20BT2043** | **Duration** | **3hrs** |
| **Course Name** | **STEM CELL TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | What are stem cells? | | CO1 | U | 1 |
| 2. | Define cryopreservation. | | CO1 | R | 1 |
| 3. | How will you protect the cell culture working environment from dust and other air born contaminants? | | CO2 | R | 1 |
| 4. | How 70% ethanol disinfects the cell culture environment? | | CO2 | R | 1 |
| 5. | Mention any one marker of embryonic stem cells. | | CO3 | U | 1 |
| 6. | List the sources of stem cells. | | CO3 | R | 1 |
| 7. | What is epigenetic reprogramming? | | CO4 | U | 1 |
| 8. | Mention any two growth factors essential for stem cell differentiation. | | CO4 | R | 1 |
| 9. | Mention any one risk in using stem cells for therapy. | | CO5 | U | 1 |
| 10. | What is called as cellular senescence? | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain any two applications of stem cell technology. | | CO1 | An | 3 |
| 12. | Give a brief account on the four ascending levels of containment as per Biosafety level. | | CO2 | U | 3 |
| 13. | Distinguish between Totipotency and Pluripotency. | | CO3 | An | 3 |
| 14. | Outline the principle of FACS. | | CO4 | U | 3 |
| 15. | What unique characteristics of stem cells make them an ideal candidate for organ regeneration? | | CO5 | An | 3 |
| 16. | Distinguish mortal and immortal cells. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | Elaborate an essay on the different types of media used in cell culture with a note on the conditions to be maintained. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Describe the aseptic techniques to be adopted in cell culture lab. | CO2 | U | 6 |
|  | b. | Explain in detail about the laboratory equipment essential for cell culture with their role. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Schematically illustrate the generation of iPSC and its application. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Discuss the differentiation of hematopoietic pluripotent stem cells into multipotent progenitor cells. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe the application of stem cell as a gene delivery vehicle. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Elaborate an essay on the isolation and application of umbilical cord blood. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe unique properties of stem cells. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Discuss the ethical issues one encounters in the application of stem cell therapy. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Explore the technique and the pros and cons of animal cell culture |
| **CO2** | Understand the definition of stem cell and the features that distinguish it from other cells |
| **CO3** | Recognize the different types of stem cells and their properties |
| **CO4** | Analyze the residence of the stem cells and the factors that affect its function. |
| **CO5** | Learn the isolation and application of stem cells. |
| **CO6** | Explores the ethical aspects of stem cell technology |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 13 | - | 3 | - | - | 17 |
| **CO2** | 2 | 15 | - | - | - | - | 17 |
| **CO3** | 1 | 13 | 12 | 3 | - | - | 29 |
| **CO4** | 1 | 28 | - | - | - | - | 29 |
| **CO5** | - | 1 | 12 | 3 | - | - | 16 |
| **CO6** | - | 4 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **20BT2045** | **Duration** | **3hrs** |
| **Course Name** | **AGRICULTURAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the importance of Apomixis. | | CO1 | R | 1 |
| 2. | Define Rhizogenesis. | | CO1 | R | 1 |
| 3. | Differentiate between interspecific from intergeneric hybridization. | | CO2 | U | 1 |
| 4. | List the objectives of population improvement programme. | | CO2 | R | 1 |
| 5. | State the importance of Isoschizomers in genetic engineering. | | CO3 | R | 1 |
| 6. | An extra-chromosomal segment of circular DNA of a bacterium is used to carry the gene of interest into the host cell. What is the name given to it? | | CO3 | R | 1 |
| 7. | Distinguish Biome from Ecosystems. | | CO4 | U | 1 |
| 8. | **State the difference between endemic and exotic species.** | | CO4 | R | 1 |
| 9. | Explain bioprospecting with examples. | | CO5 | U | 1 |
| 10. | Define the terms Contig and Scaffold in sequencing | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the significance of homozygous lines in plant breeding. | | CO1 | An | 3 |
| 12. | Explain the main features of interspecific hybridization. | | CO2 | U | 3 |
| 13. | Examine the functions of DNA polymerase in plant. | | CO3 | A | 3 |
| 14. | Summarize the objectives of Red Data Book. | | CO4 | U | 3 |
| 15. | Compare invention and inventive step in a patent. | | CO5 | An | 3 |
| 16. | Explain the role of genomics in crop improvement. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. | a. | Summarize the challenges associated in plant breeding with regard to climate change. | CO1 | U | 4 |
|  | b. | Discuss the significance of plant breeding in crop development. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 18. | a. | Critically analyze the nutritional requirement of *in vitro* cultures. | CO2 | An | 4 |
|  | b. | Explain the genetic basis of heterosis and their significance in plant breeding. | CO2 | An | 8 |
|  |  |  |  |  |  |
| 19. | a. | Compare the functions of Alkaline phosphatase and Polynucleotide kinase. | CO3 | An | 6 |
|  | b. | Analyze the mechanism and function of DNA ligase with a neat diagram. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the importance of biodiversity hotspots. | CO4 | A | 4 |
|  | b. | Illustrate the principles of conservation biology with strategies leading to successful studies. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 21. | a. | Discuss the reasons why the patent on Basmati should not have gone to an American Company. | CO5 | U | 4 |
|  | b. | Describe the basic principles underlying the plant variety protection laws in India. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 22. | a. | Explain the different factors that controls cellular totipotency. | CO2 | A | 4 |
|  | b. | Illustrate the different methods of breeding self-pollinated crops. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 23. | a. | Explain the various steps involved in somatic hybridization. | CO2 | U | 6 |
|  | b. | Describe the methods employed for protoplast isolation and fusion. | CO2 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss the importance of biological databases with suitable examples. | CO6 | U | 6 |
|  | b. | Summarize the genome project on *Arabidopsis thaliana* genome. | CO6 | U | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Acquire knowledge on plant breeding |
| CO2 | Outline the principles of plant breeding and its techniques |
| CO3 | Demonstrate various tools involved in genetic engineering |
| CO4 | Illustrate the different strategies for biodiversity conservation |
| CO5 | Acquire knowledge on IPR and its importance in patent rights |
| CO6 | Demonstrate different tools of plant genome analysis |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 12 | - | 3 | - | - | 17 |
| CO2 | 1 | 16 | 12 | 12 | - | - | 41 |
| CO3 | 2 | - | 3 | 12 | - | - | 17 |
| CO4 | 4 | 1 | 12 | - | - | - | 17 |
| CO5 | - | 13 | - | 3 | - | - | 16 |
| CO6 | 1 | 15 | - | - | - | - | 16 |
|  | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **20BT2047** | **Duration** | **3hrs** |
| **Course Name** | **RESEARCH METHODOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define omnibus panel. | | CO1 | U | 1 |
| 2. | Describe one example of an intervening variable. | | CO1 | R | 1 |
| 3. | Define research hypothesis. | | CO2 | R | 1 |
| 4. | Name the research design that seeks to explain the phenomenon behind specific behaviour. | | CO2 | R | 1 |
| 5. | Define population. | | CO3 | U | 1 |
| 6. | Describe construct. | | CO3 | U | 1 |
| 7. | Name the two types of construct validity. | | CO4 | R | 1 |
| 8. | Explain the types of cluster sampling. | | CO5 | R | 1 |
| 9. | Define plagiarism. | | CO6 | U | 1 |
| 10. | Name two software that aids in paper formatting. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Describe the concept to indicator flow with an example. | | CO1 | R | 3 |
| 12. | Explain the types of cross-sectional research design. | | CO2 | U | 3 |
| 13. | Describe the formula to calculate the sample size. | | CO3 | R | 3 |
| 14. | Explain the difference between cluster and stratified sampling. | | CO4 | U | 3 |
| 15. | Describe the Boolean operators with examples. | | CO5 | U | 3 |
| 16. | Explain the types of peer review process. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain any 2 types of hypothesis with suitable examples | CO1 | A | 3 |
|  | b. | Explain the types and characteristics of exploratory research design. | CO1 | An | 9 |
|  |  |  |  |  |  |
| 18. | a. | Explain the stages of the research process with neat diagram. | CO2 | A | 9 |
|  | b. | Explain the principles in designing good questionnaire. | CO2 | R | 3 |
|  |  |  |  |  |  |
| 19. | a. | Explain the steps to conduct stratified random and cluster sampling. | CO3 | A | 10 |
|  | b. | Explain the types of stratified random sampling. | CO3 | U | 2 |
|  |  |  |  |  |  |
| 20. | a. | Explain the univariate analysis. | CO4 | U | 2 |
|  | b. | Explain the steps involved in frequency distribution table with example. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 21. | a. | Explain the layout of a research paper. | CO5 | R | 10 |
|  | b. | Describe digital object identifier. | CO5 | R | 2 |
|  |  |  |  |  |  |
| 22. | a. | Define plagiarism. | CO6 | R | 2 |
|  | b. | Differentiate variuos types of plagiarism. | CO6 | E | 3 |
|  | c. | Explain the most common forms of plagiarism involved in writings. | CO6 | U | 7 |
|  |  |  |  |  |  |
| 23. | a. | Define Variable. | CO2 | R | 1 |
|  | b. | Explain the difference between dependent and independent Variable. | CO2 | A | 3 |
|  | c. | Describe different types of research variables with suitable examples. | CO2 | U | 8 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the steps involved in research paper submission to publication. | CO6 | R | 6 |
|  | b. | Explain the quality assurance steps involved in publication process. | CO6 | An | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the basic principles of research and its formulation |
| **CO2** | Illustrate the different methods of research designs and its specific applications |
| **CO3** | Classify the various techniques of data collection and statistical analysis |
| **CO4** | Elaborate the steps involved in preparation of different technical report and articles |
| **CO5** | Comprehend the bioethical and biosafety procedures in research |
| **CO6** | Gain knowledge on formulation, execution and evaluation of application oriented research |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 5 | 1 | 3 | 8 | - | - | 17 |
| CO2 | 6 | 11 | 12 | - | - | - | 29 |
| CO3 | 3 | 4 | 10 | - | - | - | 17 |
| CO4 | 1 | 5 | - | 10 | - | - | 16 |
| CO5 | 13 | 3 | - | - | - | - | 16 |
| CO6 | 11 | 9 | - | 6 | 3 | - | 29 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2054** | **Duration** | **3hrs** |
| **Course Name** | **ENVIRONMENTAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name the disease caused by excess accumulation of nitrates in infants. | | CO1 | R | 1 |
| 2. | List any two impacts of photochemical smog formation. | | CO2 | R | 1 |
| 3. | Define xenobiotics. | | CO3 | R | 1 |
| 4. | Give an example for secondary air pollutant. | | CO4 | U | 1 |
| 5. | Write any two examples of wet scrubbers. | | CO5 | A | 1 |
| 6. | Distinguish between Azotobacter and Acetobacter. | | CO6 | E | 1 |
| 7. | Define eutrophication. | | CO1 | R | 1 |
| 8. | Write the significance of primary waste water treatment. | | CO2 | A | 1 |
| 9. | State the importance of “filter cake” in fabric filters. | | CO4 | R | 1 |
| 10. | Differentiate between the effect of nitrogen dioxide on health and plants. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Illustrate how pH and color of the sewage water act as indicators? | | CO1 | A | 3 |
| 12. | Differentiate between BOD and COD. | | CO2 | A | 3 |
| 13. | Explain the importance of land-filling in solid waste management. | | CO3 | U | 3 |
| 14. | Categorize the types of air pollutant based on origin. | | CO4 | An | 3 |
| 15. | Compare slope leaching with heap leaching. | | CO5 | E | 3 |
| 16. | Write a short note on biomining. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Define bioadsorption. Explain the role of bacteria as a biosorbent for removal of heavy metal. | CO1 | R | 6 |
|  | b. | Describe any three environmental sampling procedures for evaluating the contaminants. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the process of adsorption in the removal of waste water contaminants. | CO2 | U | 6 |
|  | b. | Explain the working principle of trickling filter. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Write a detailed note on vermicomposting in solid waste management. | CO3 | A | 5 |
|  | b. | Explain i*n situ* bioremediation of soil pollutants with suitable examples. | CO3 | A | 7 |
|  |  |  |  |  |  |
| 20. | a. | Distinguish between dynamic precipitators and electrostatic precipitators. | CO4 | E | 5 |
|  | b. | List the control devices for gaseous pollutants and explain their working principle with suitable diagram. | CO4 | R | 7 |
|  |  |  |  |  |  |
| 21. | a. | Discuss various genomic tools for bioremediation. | CO5 | U | 6 |
|  | b. | List the harmful effects of air pollutants on human health. | CO5 | R | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the mechanism of quorum sensing in Gram negative bacteria. | CO6 | A | 6 |
|  | b. | Describe the production process of bioplastics and its degradation ability. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the degradation mechanism of xenobiotic compounds by microbial populations. | CO3 | An | 6 |
|  | b. | Discuss the role of “oil zapper” in oil sludge treatment. | CO6 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | What is RBC? Explain the working principle and importance of RBC in waste water treatment. | CO1 | R | 6 |
|  | b. | Write a note on BT toxin as biopesticide. | CO6 | A | 6 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Infer the biotechnological solutions to address environmental issues including pollution, mineral, renewable energy and water recycling. |
| CO2 | Appraise the opportunities for incorporating environmental quality into products, processes and projects. |
| CO3 | Develop technologies for bioremediation and biodegradation. |
| CO4 | Acquaint oneself with the pertinent legislation and methodology of pollutants. |
| CO5 | Demonstrate the professional responsibility towards protecting the environment. |
| CO6 | Apply scientific solutions for the development of environmentally sustainable products. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 14 | 6 | 3 | - | - | - | 23 |
| CO2 | 1 | 6 | 10 | - | - | - | 17 |
| CO3 | 1 | 3 | 12 | 6 | - | - | 22 |
| CO4 | 8 | 1 | - | 3 | 5 | - | 17 |
| CO5 | 7 | 6 | 1 | - | 3 | - | 17 |
| CO6 | - | 6 | 15 | 6 | 1 | - | 28 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2057** | **Duration** | **3hrs** |
| **Course Name** | **BIOETHICS, IPR AND BIOSAFETY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Recall the type of cabinet used for decontaminating materials at entry and exit to the cabinet. | | CO1 | R | 1 |
| 2. | Name the protocol that was adopted by the convention on Biological Diversity that aims to reduce greenhouse gas emissions. | | CO1 | R | 1 |
| 3. | Identify the number of ratifications done on the “Cartagena Protocol” on Biosafety. | | CO2 | R | 1 |
| 4. | Name the agreement needed to process transboundary movement of LMO’s. | | CO2 | R | 1 |
| 5. | State the Madrid Agreement. | | CO3 | R | 1 |
| 6. | Recall the person who designed the Indian Patent Act 1970. | | CO3 | R | 1 |
| 7. | Infer the significance of eugenics. | | CO4 | R | 1 |
| 8. | Cite the importance of Greenpeace India. | | CO4 | R | 1 |
| 9. | Restate the ethical concerns of designer babies research. | | CO5 | U | 1 |
| 10. | State the strategy behind rDNA technology. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Infer any two ways by which you can understand “Capacity Building” to implement a protocol. | | CO1 | R | 3 |
| 12. | Interpret the role of liability involved in risk management. | | CO2 | A | 3 |
| 13. | State the significance of Patent Cooperation Treaty (PCT). | | CO3 | R | 3 |
| 14. | Recall the ethical and political controversy of Embryonic Stem Cells. | | CO4 | R | 3 |
| 15. | Paraphrase the ethical implications of genetic engineering. | | CO5 | U | 3 |
| 16. | Recognize the disadvantages of using Pig as an organ donor. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. |  | Categorize the role of Regulatory committees in Rules 1989. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Summarize the various classes of Biosafety Cabinets with suitable clinical and research applications. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 19. |  | Appraise the different types of IPR with suitable examples and write why they are important. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | *Traditional knowledge was compromised due to lack of patent awareness* –Assess the statement with a suitable case study. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Interpret the advantages and disadvantages of bioethics in animal research. | CO5 | A | 06 |
|  | b. | Discuss about Human Cloning project and the ethical issues related to it. | CO5 | U | 06 |
|  |  |  |  |  |  |
| 22. |  | Examine the various Treaties formulated for Intellectual Property Rights. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Appraise the Ethical, Legal and Social Implications of Human Genome Project. | CO5 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Summarize the ethical principles in tissue and organ transplantation procedures. | CO6 | E | 08 |
|  | b. | List the steps involved in the production of monoclonal antibodies. | CO6 | R | 04 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Recall different rDNA technology of transgenic in animals, humans and microorganisms. |
| **CO2** | Understand the various biosafety regulations in transgenics. |
| **CO3** | Illustrate IPR and patent procedures. |
| **CO4** | Comprehend on various techniques of genome, stem cells and organ research in humans. |
| **CO5** | Aware of modern rDNA research and its ethical procedures. |
| **CO6** | Comprehend on recent ethical, legal and social economic impacts of rDNA research in biotechnology and its applications |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 5 | - | 12 | - | - | - | 17 |
| CO2 | 2 | - | 3 | - | 12 | - | 17 |
| CO3 | 5 | - | 12 | 12 | 12 | - | 41 |
| CO4 | 5 | - | - | - | - | - | 05 |
| CO5 | - | 10 | 6 | - | 12 | - | 28 |
| CO6 | 8 | - | - | - | 8 | - | 16 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2059** | **Duration** | **3hrs** |
| **Course Name** | **IOT IN BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | State the definition of IoT as per IoT European Research Cluster. | | CO1 | U | 1 |
| 2. | Explain the nomenclature of Internet of ‘Things’. | | CO1 | U | 1 |
| 3. | Draw the components of an IoT device in a temperature sensor. | | CO2 | R | 1 |
| 4. | What is a transducer? | | CO2 | R | 1 |
| 5. | Define VRI Technology. | | CO3 | R | 1 |
| 6. | What is the former name of Bayer Crop Science, one of the largest agricultural companies in the world? | | CO3 | U | 1 |
| 7. | Give the other name of digital footprint. | | CO4 | U | 1 |
| 8. | Name the first 2D barcode created by Intermec Corporation. | | CO4 | R | 1 |
| 9. | Signify the use of cloud server in IoT. | | CO5 | U | 1 |
| 10. | What is the Zigbee Technology otherwise called? | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List the significant projects by EU on IOT. | | CO1 | R | 3 |
| 12. | Differentiate between a Sensor and Transducer. | | CO2 | U | 3 |
| 13. | Explain the use of LoRa WAN as a WSN protocol. | | CO3 | U | 3 |
| 14. | Describe the need for good distribution practices certification and its importance for pharmaceutical industry. | | CO4 | U | 3 |
| 15. | Identify the importance of cloud server technology. | | CO5 | E | 3 |
| 16. | Relate the ground rules of IoT configuration management. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the six overlaps of the Internet of Things with other fields of Research. | CO1 | U | 06 |
|  | b. | Explore the Healthcare Cloud Computing Market Size in the Global Industry Forecasts until 2027 with respect to IoT. | CO1 | An | 06 |
| 18. | a. | Assess the different types of Actuators in IoT. | CO2 | A | 06 |
|  | b. | Categorize the various devices & equipment and products used by end users and their uses in modern day technology. | CO2 | An | 06 |
|  |  |  |  |  |  |
| 19. |  | Explain the types of sensors as an IoT model in Agriculture. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Classify the concept of Smart Robotic Warehouse Management System for Industry 4.0 using an example. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Debate the IoT-ization of the Healthcare leader, Bayer Inc. | CO5 | E | 06 |
|  | b. | Justify that “Bayer Global” is an Internationally operating company with respect ‘Superplum’ a Start-up in India. | CO5 | A | 06 |
|  |  |  |  |  |  |
| 22. |  | Discuss various Robotic control system. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Assess the various ways you can protect your digital footprint. | CO4 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Appraise the extent of ease extended by Automation in laboratories because of IoT. | CO6 | E | 12 |

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand the history and basic concepts of IOT. |
| **CO2** | Identify the various components of IOT. |
| **CO3** | Use IoT for different biotechnological applications. |
| **CO4** | Categorize IoT to different pharmaceutical applications. |
| **CO5** | Justify significance of IoT in research and development. |
| **CO6** | Plan IoT with future trends in biotechnology. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 03 | 08 | - | 06 | - | - | 17 |
| **CO2** | 02 | 03 | 06 | 06 | - | - | 17 |
| **CO3** | 01 | 16 | - | 12 | - | - | 29 |
| **CO4** | 01 | 04 | 12 | 12 | - | - | 29 |
| **CO5** | - | 01 | 06 | - | 09 | - | 16 |
| **CO6** | - | 04 | - | - | 12 | - | 16 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2061** | **Duration** | **3hrs** |
| **Course Name** | **BIOLOGY FOR ENGINEERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Biogenesis. | | CO1 | R | 1 |
| 2. | Discuss the modern cell theory. | | CO1 | U | 1 |
| 3. | Recall the role of Golgi apparatus. | | CO2 | R | 1 |
| 4. | List out some examples for macro nutrients. | | CO2 | R | 1 |
| 5. | Cite examples for Polysaccharides. | | CO3 | U | 1 |
| 6. | Explain the function of carbohydrates. | | CO3 | U | 1 |
| 7. | Define **differential media.** | | CO4 | R | 1 |
| 8. | Differentiate alleles and chromosome. | | CO5 | U | 1 |
| 9. | Recall the role of RNA polymerase I. | | CO6 | R | 1 |
| 10. | Name three binding sites on rRNA and their roles. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain Hardy-Weinberg theory. | | CO1 | U | 3 |
| 12. | Discuss cell cycle. | | CO2 | U | 3 |
| 13. | Define epimerism with an example. | | CO3 | R | 3 |
| 14. | Explain 3 applications of Microbiology, Immunology and Immunity, Cancer Biology, Stem Cell. | | CO4 | U | 3 |
| 15. | Recall the definition of multiple alleles with an examples. | | CO5 | R | 3 |
| 16. | State the seven subunits of RNA polymerase and their roles. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. | a. | Explain any three theories related to origin of life. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Describe any two theories of evolution with an example. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Discuss mitosis with illustration. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Define Depression, its Symptoms, Types, Causes and Treatment. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 21. | a. | Classify the biomolecules- Carbohydrates. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain different types of culture media. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Define genetic disorder with any two examples. | CO5 | R | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe Transcription and Translation | CO6 | U | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Define Life and Life forms. |
| CO2 | Recognize the importance of Human health, disease, and Comorbidities. |
| CO3 | Analyze biomolecules and enzymes in biological processes. |
| CO4 | Appraise the Significance of entrepreneurship and industry. |
| CO5 | Design a sustainable idea that is a trend for drug resistance. |
| CO6 | Evaluate ethics and honors for research in Biology. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 28 |  |  |  |  | 29 |
| CO2 | 14 | 15 |  |  |  |  | 29 |
| CO3 | 3 | 14 |  |  |  |  | 17 |
| CO4 | 1 | 15 |  |  |  |  | 16 |
| CO5 | 15 | 1 |  |  |  |  | 16 |
| CO6 | 5 | 12 |  |  |  |  | 17 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT2068** | **Duration** | **3hrs** |
| **Course Name** | **PRINCIPLES OF PLANT BIOTECHNOLOGY AND APPLICATIONS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the characteristics of a suitable explant. | | CO1 | R | 1 |
| 2. | Mention the significance of haploids. | | CO1 | R | 1 |
| 3. | What is gene gun? | | CO2 | R | 1 |
| 4. | Mention the site directed integration of transgene. | | CO2 | U | 1 |
| 5. | What is a Ri plasmid? | | CO3 | R | 1 |
| 6. | List the genes responsible for Nitrogen fixation in legumes. | | CO3 | R | 1 |
| 7. | Cite one example of a drug produced through plant cell suspension culture. | | CO4 | U | 1 |
| 8. | Define immobilization. | | CO4 | R | 1 |
| 9. | Recall and write two abiotic stress factor in plants. | | CO5 | R | 1 |
| 10. | Define the advantage of reusable bioreactors in plant cell suspension. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Analyze the process involved in development of haploids. | | CO1 | An | 3 |
| 12. | Apply the significance selectable markers in plant transformation. | | CO2 | A | 3 |
| 13. | Discuss co-integrative vector in plant genetic transformation. | | CO3 | R | 3 |
| 14. | Discuss the role of elicitors used for *in vitro* drug production through plant cell suspension culture. | | CO4 | R | 3 |
| 15. | Illustrate the steps involved in commercial seed production. | | CO5 | U | 3 |
| 16. | Describe the role of various control modules in bioreactors. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. |  | Explain the process of micro propagation and its significance with diagram. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the process for genetic transformation done using biolistic method for gene delivery in plants. | CO2 | U | 6 |
|  | b. | Analyze *Agrobacterium* mediated gene transfer focusing on the genes responsible for transformation. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Analyze in details the molecular mechanism involved in biological nitrogen fixation. | CO3 | An | 7 |
|  | b. | Analyze gene transfer in plants using a binary vector | CO3 | An | 5 |
|  |  |  |  |  |  |
| 20. |  | Evaluate the process of *in vitro* production of secondary metabolites using hairy root culture. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe the resistance mechanism exhibited by plants against biotic stress. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 22. |  | Analyze the seed multiplication model for successful production of superior class of different seeds. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Elaborative the methods involved in various Marker Assisted Selection (MAS) process. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Elaborate on the different types of bioreactors for *in vitro* production of pharmaceutical drugs through root culture. | CO6 | E | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Summarize cell and tissue culture techniques. |
| CO2 | Illustrate the knowledge on plant genetic engineering tools. |
| CO3 | Enumerate the different vectors used in plant transformation |
| CO4 | Employ different methods of in vitro drug production techniques |
| CO5 | Examine the principles of plant breeding and protection |
| CO6 | Assess the different bioreactors and its applications in plant biotechnology |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 12 |  | 3 |  |  | 17 |
| CO2 | 1 | 7 | 3 | 6 |  |  | 17 |
| CO3 | 5 |  |  | 12 |  |  | 17 |
| CO4 | 4 | 1 |  |  | 12 |  | 17 |
| CO5 | 1 | 15 |  | 12 |  |  | 28 |
| CO6 |  | 4 | 12 |  | 12 |  | 28 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20BT2069** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCES IN ANIMAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | What is the principle of flow cytometry? | | CO1 | U | 1 |
| 2. | How to do Cell Culture? | | CO1 | R | 1 |
| 3. | Name any two substrates used for monolayer scale up. | | CO2 | R | 1 |
| 4. | Define the term Vaccines. | | CO2 | R | 1 |
| 5. | Give examples of any two natural biomaterial used in tissue engineering. | | CO3 | U | 1 |
| 6. | Define Scaffold. | | CO3 | R | 1 |
| 7. | Identify any two fibrolytic bacteria of rumen. | | CO4 | U | 1 |
| 8. | Name the antifungal compounds produced by *L. casei* AST18 in milk fermentation. | | CO4 | R | 1 |
| 9. | Explain Micromanipulation technique. | | CO5 | U | 1 |
| 10. | Indicate any one ethical issue associated with transgenic animals. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the effectiveness of a cell bank management system. | | CO1 | An | 3 |
| 12. | List the factors optimized in a scaled-up suspension cell culture system. | | CO2 | U | 3 |
| 13. | Describe chitosan scaffold. | | CO3 | An | 3 |
| 14. | Infer on sour cream preparation. | | CO4 | U | 3 |
| 15. | How the micromanipulation techniques are used to perform ICSI? | | CO5 | An | 3 |
| 16. | Describe the process of genotyping transgenic animals using molecular markers for Marker Assisted Selection. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Demonstrate the interpretation of banding patterns on a karyotype to identify specific chromosome regions. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. | a. | Explain the protocol of cell culture in propagating viruses for Japanese Encephalitis and Poliovirus vaccine production. | CO2 | U | 6 |
|  | b. | Analyze the role of scaling up of monolayer cell culture. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Describe the protocol for initiation and cultivation of tumor spheroids in spinner flasks with illustrations. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Analyze the process of meat fermentation and fermented products with suitable examples. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Criticize on sexing of X and Y bearing sperms from semen samples of animals. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | Evaluate the impact of rapid molecular diagnostics on early detection and control of infectious diseases in animal populations. | CO6 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | Articulate the use of AI in animal monitoring with examples. | CO6 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Summarize the homologous recombination method in the development of transgenic animals. | CO6 | E | 6 |
|  | b. | Explain in detail on Cre/lox P system for gene knock out in animals. | CO6 | An | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Demonstrate the cell culture techniques for maintenance of cell lines |
| **CO2** | Recognize the importance of scaling up of cell culture for development of cell culture products |
| **CO3** | Interpret the applications of tissue engineering and 3D cell culture techniques |
| **CO4** | Relate the need of genetic screening for In vitro fertilization |
| **CO5** | Apply the knowledge of livestock improvement using transgenesis |
| **CO6** | Assess the scope, applications and ethical issues in animal biotechnology |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 | 12 | 3 | - | - | 17 |
| **CO2** | 2 | 9 | - | 6 | - | - | 17 |
| **CO3** | 1 | 13 | - | 3 | - | - | 17 |
| **CO4** | 1 | 4 | - | 12 | - | - | 17 |
| **CO5** | - | 1 | - | 3 | 12 | - | 16 |
| **CO6** | - | 4 | 12 | 6 | 18 | - | 40 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3002** | **Duration** | **3hrs** |
| **Course Name** | **GENETIC ENGINEERING AND RECOMBINANT PRODUCTS** | **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. | Represent the different transgenic plants developed using rDNA technology. | CO1 | U | 8 |
|  | b. | Express the concerns of genetically modified agricultural products. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Distinguish the vectors based on the aim of inserted gene and host cell with examples. | CO2 | An | 8 |
|  | b. | Compare the double antibiotic screening with the blue white colony screening method. | CO2 | An | 8 |
|  |  |  |  |  |  |
| 3. | a. | Create a flow chart for the rDNA microbial production of insulin in industry. | CO3 | C | 8 |
|  | b. | Integrate the rDNA microbial production of Chymosin with chees production. | CO3 | C | 8 |
|  |  |  |  |  |  |
| 4. | a. | State the genetic engineering approaches used for developing draught resistant crops. | CO4 | R | 8 |
|  | b. | Enumerate on the genome editing tools used for developing virus resistant crops. | CO4 | R | 8 |
|  |  |  |  |  |  |
| 5. | a. | Write the commercial applications of genetically modified animals with examples. | CO5 | A | 8 |
|  | b. | Examine the condition of cow milk protein allergy and describe the development of hypoallergenic cows for commercial purpose. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 6. | a. | Illustrate the construction of genomic library using cloning vector. | CO2 | U | 8 |
|  | b. | Describe the hybridization techniques used for screening genomic library. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 7. | a. | Compare and contrast the reverse transcriptase PCR and qPCR. | CO1 | E | 8 |
|  | b. | Appraise the use of pyrosequencing in NGS and describe the method. | CO1 | E | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Illustrate the production of hGH by genetic engineering and give its therapeutic uses. | CO6 | An | 10 |
|  | b. | Explain the therapeutic applications of recombinant enzymes with examples. | CO6 | An | 10 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the basic concepts in Genetic engineering. |
| CO2 | Recognize the usage of the tools of genetic engineering. |
| CO3 | Choose the techniques employed in genetic manipulation of microbes. |
| CO4 | Analyze the techniques employed in the genetic manipulation of plants for crop improvement |
| CO5 | Illustrate the techniques employed in the genetic manipulation animals for commercial purposes. |
| CO6 | Discuss the genetic manipulation techniques employed in the production of therapeutics. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 16 |  |  | 16 |  | 32 |
| CO2 |  | 16 |  | 16 |  |  | 32 |
| CO3 |  |  |  |  |  | 16 | 16 |
| CO4 | 16 |  |  |  |  |  | 16 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  |  |  | 20 |  |  | 20 |
|  | | | | | | | **132** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20BT3003** | **Duration** | **3hrs** |
| **Course Name** | **BIOPROCESS MODELLING AND SIMULATION** | **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. | Justify the need for mathematical model development for a given bioprocess system. | CO1 | E | 8 |
|  | b. | Explain the fundamental principles in dynamic bioprocess model development, with appropriate examples. | CO1 | A | 8 |
|  |  |  |  |  |  |
| 2. | a. | Microbial culture is growing on C- and N- sources and producing VFA as the product. It is known that a high concentration of VFA is inhibitory to microbial growth. Develop a bioprocess model for the system considering all relevant state variables. | CO2 | A | 8 |
|  | b. | Discuss the challenges inherent to solving the differential equations representing growth or product formation kinetics. Explain how a numerical approach can resolve the issue. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 3. | a. | Single substrate limited microbial growth is given by the following equations.  Assume initial, S, X, and P as 30, 1, and 0 g/L, respectively. If parameter values are known, i.e., µm – 0.3 h-1, Xmax – 10 g/L, Ks – 40 g/L, α – 0.1 g/g, β – 0.05 h-1, YX/S – 0.7 g/g, YP/S – 0.4 g/g. Calculate biomass, substrate, and product on the 1st and 2nd hour using Euler’s method. | CO3 | E | 10 |
|  | b. | Explain the reason for improved accuracy in the RK4 algorithm over Euler’s method in numerical integration. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 4. | a. | Develop a pseudocode or scheme to estimate unknown model parameters and model fitness from experimental data. | CO4 | A | 10 |
|  | b. | Infer the fitness indices and their calculation used as objective in the optimization algorithm for parameter estimation exercise. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 5. | a. | Explain the steps used in confidence interval estimation of parameters through boot-strapping, using the appropriate flowchart/scheme or diagram | CO5 | E | 8 |
|  | b. | Justify the need for bioprocess model cross-validation and outline the scheme to perform it. | CO5 | E | 8 |
|  |  |  |  |  |  |
| 6. | a. | Differentiate between modelling and simulation exercises for a bioprocess model. | CO1 | U | 6 |
|  | b. | Acetobacter culture growing on glucose produces Acetic acid and CO2. Develop a bioprocess model for the same considering changes in pH, carbonate chemistry, and dissociation of acetic acid | CO2 | C | 10 |
|  |  |  |  |  |  |
| 7. | a. | Formulate growth kinetics of a microorganism growing on two carbon sources. Further assume, that both carbon substrates are equivalent without any preferential uptake. | CO4 | C | 8 |
|  | b. | Explain the terms involved in logistic growth kinetics and their significance. Highlight the difficulty in using the logistic growth kinetics while simulating bioprocess | CO4 | An | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Develop a mathematical model of the anaerobic digestion process, assuming hydrolysis of the insoluble substrate into soluble sugar and further into acetic acid. Methanogen converts acetic acid to methane. | CO6 | A | 12 |
|  | b. | Design an ethanol fermentation model using glucose as substrate. Assume biomass growth can be retarded in high alcohol concentration. | CO6 | A | 8 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recognize the different stages and their inter-relationship in bioprocess modelling |
| CO2 | Relate modelling, simulation and parameter estimation |
| CO3 | Develop bioprocess system models from experimental data using Matlab tool |
| CO4 | Examine the suitability of developed models in a quantitative manner |
| CO5 | Interpret the bioprocess modelling outcome for refinement of model structure |
| CO6 | Formulate simplification strategies and simulate bioprocess models with relevant examples |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 0 | 6 | 8 | 0 | 8 | 0 | 22 |
| CO2 | 0 | 8 | 8 | 0 | 0 | 10 | 26 |
| CO3 | 0 | 6 | 0 | 0 | 10 | 0 | 16 |
| CO4 | 0 | 0 | 10 | 14 | 0 | 8 | 32 |
| CO5 | 0 | 0 | 0 | 0 | 16 | 0 | 16 |
| CO6 | 0 | 0 | 20 | 0 | 0 | 0 | 20 |
|  | | | | | | | **132** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3009** | **Duration** | **3hrs** |
| **Course Name** | **MICROBIAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

**ANSWER ALL QUESTIONS (5 X 20 = 100 Marks)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Q. No.** | **Sub Div.** | **Questions** | **CO / BL** | **Marks** |
| 1. | a. | Describe the microbial production of penicillin acylase followed by the method of purification. | CO6 / U | 10 |
| b. | Explain the various reactions involved in biotransformation of antibiotics. | CO3 / U | 10 |
| **(OR)** | | | | |
| 2. | a. | Appraise the production of Biodiesel from algae to overcome the energy crisis. | CO6 / E | 10 |
| b. | Outline the preparation, mechanism of action, advantages and disadvantages of recombinant vaccines presently used in animals. | CO6 / An | 10 |
|  |  |  |  |  |
| 3. | a. | Enumerate the objectives of metagenomics and their diversified applications. | CO2 / C | 10 |
| b. | Outline the genomic approaches employed to screen for novel drugs. | CO2 / An | 10 |
| **(OR)** | | | | |
| 4. | a. | Discuss the production of bacteriocin and their application in food industry. | CO5 / U | 10 |
| b. | Describe the methods to construct phylogenetic tree to understand the relationship between various genera of microbes. | CO3 / U | 10 |
|  |  |  |  |  |
| 5. | a. | Appraise the working of MALDI instrument and their applications in biology. | CO2 / E | 10 |
| b. | Describe the working principle of 2D gel electrophoresis and their application. | CO2 / E | 10 |
| **(OR)** | | | | |
| 6. | a. | Analyze bacterial pathogenesis at the level of proteome with suitable illustrations. | CO2 / An | 10 |
| b. | Create a workflow for high throughput proteomic approaches to screen for novel microbial enzymes. | CO2 / C | 10 |
|  |  |  |  |  |
| 7. | a. | Examine the relationship between gut microflora and human health with examples. | CO4 / An | 10 |
| b. | Explain the role of bacteriophage in control of antimicrobial resistance bacteria. | CO4 / E | 10 |
| **(OR)** | | | | |
| 8. | a. | Demonstrate the significance of mycorrhizae in agriculture with suitable examples. Add a note on their types. | CO4 / A | 10 |
| b. | Illustrate the attractive features of food preservation through use of irradiation. | CO5 / A | 10 |
|  | | **Compulsory** |  |  |
| 9. | a. | Discuss the screening techniques employed for the detection and isolation of industrially important microbes high yielding microorganisms. | CO1 / U | 10 |
| b. | Describe strain improvement using Recombinant DNA technology to enhance the yield of microbial products with suitable examples. | CO3 / U | 10 |

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Gain knowledge about recent advances in microbial biotechnology |
| CO2 | Apply the concept of genomics and proteomics in biotechnology with regard to microorganisms |
| CO3 | Acquire practical exposure to recombinant DNA technology in microbes to enhance animal health and production |
| CO4 | Demonstrate and evaluate the interactions between microbes, hosts and environment. |
| CO5 | Give an account of important microbial/enzymatic industrial processes in food and fuel industry. |
| CO6 | Critically analyze any microbial products from an economics/market point of view |

|  |  |  |  |  |  |  |  |
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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | 10 | - | - | - | - | 10 |
| CO2 | - | - | - | 20 | 20 | 20 | 60 |
| CO3 | - | 30 | - | - | - | - | 30 |
| CO4 | - | - | 10 | 10 | 10 | - | 30 |
| CO5 | - | 10 | 10 | - | - | - | 20 |
| CO6 | - | 10 | - | 10 | 10 | - | 30 |
|  | | | | | | | **180** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3010** | **Duration** | **3hrs** |
| **Course Name** | **AGRICULTURE AND FOOD BIOTECHNOLOGY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Evaluate the sustainability and long-term impacts of Integrated Pest and Nutrient Management practices on soil health and ecosystem resilience. | CO1 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Describe in detail the importance of phosphate solubilizing microorganisms as biofertilizer. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Explain the various types of bioreactors used in the fermentation technology with a neat diagram. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Analyze the advantages and limitations of single-cell proteins for human consumption compared to traditional protein sources. | CO4 | An | 10 |
|  | b. | Discuss emerging trends in immobilized enzyme research and their potential to revolutionize the food industry. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. |  | Assess the regulatory requirements and labeling considerations related to using food additives and preservatives for shelf-life extension. | CO5 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Analyze the potential impact of bio-preservation and natural preservation on food industry practices and their contribution to a more sustainable food supply chain. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Evaluate the principles and advantages of aseptic packaging in food preservation. | CO4 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Evaluate the effectiveness of WTO mechanisms in resolving trade disputes and promoting fair agricultural trade practices. | CO6 | An | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Describe how the bacteria, fungi or mold, parasites, and their toxins can contaminate food and cause foodborne illnesses. | CO6 | U | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Acquire knowledge on basics of biotechnology in Agriculture. |
| CO2 | Outline the applications of microbes in Agriculture. |
| CO3 | Understand the concept of industrial Biotechnology processes. |
| CO4 | Relate the technological applications in food processing. |
| CO5 | Evaluate the advances in Food processing and Packaging. |
| CO6 | Analyze Marketing and Export of Food Products. |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | - | - | 20 | - | 20 |
| CO2 | - | 20 | - | - | - | - | 20 |
| CO3 | - | - | - | 20 | - | - | 20 |
| CO4 | - | 10 | - | 30 | 20 | - | 60 |
| CO5 | - | - | - | - | 20 | - | 20 |
| CO6 | - | 20 | - | 20 | - | - | 40 |
|  | | | | | | | **180** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **20BT3012** | **Duration** | **3hrs** |
| **Course Name** | **BIOETHICS AND BIOSAFETY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Illustrate the National and International level of biosafety regulations in recombinant DNA research with suitable examples. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Discuss on handling and disposal of hazardous materials used in Biotechnology. | CO5 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Write the importance of patent and procedure of patent submission with mention of five patents in Biotechnology field. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Define IPR. Summarize the different types of intellectual property rights with suitable examples. | CO3 | U | 20 |
|  |  |  |  |  |  |
| 5. |  | Explain plant breeder’s rights and its legal implications with suitable examples. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Explain the biosafety assessment procedures of GM foods with case studies of relevance. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 7. |  | Describe transgenesis and its methods of producing transgenic animals. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Justify the use of animals for research in biotechnology and ethics in animal cloning with suitable case studies. | CO1 | E | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Analyze the rDNA guidelines of department of biotechnology for microorganisms with suitable examples. | CO6 | An | 20 |

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|  | **COURSE OUTCOMES** |
| CO1 | Recall different rDNA technology of transgenic in animals, humans and plants. |
| CO2 | Understand the various biosafety regulations in transgenics. |
| CO3 | Illustrate IPR and patent procedures. |
| CO4 | Comprehend on various techniques of genome, stem cells and organ research in humans. |
| CO5 | Aware of modern rDNA research and its ethical procedures. |
| CO6 | Comprehend on recent ethical, legal and social economic impacts of rDNA research in biotechnology and its applications. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 20 |  |  | 20 |  | 40 |
| CO2 |  | 20 |  |  |  |  | 20 |
| CO3 |  | 20 | 20 |  |  |  | 40 |
| CO4 |  |  | 20 |  |  |  | 20 |
| CO5 |  | 20 |  | 20 |  |  | 40 |
| CO6 |  |  |  | 20 |  |  | 20 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3015** | **Duration** | **3hrs** |
| **Course Name** | **COMPUTATIONAL BIOLOGY** | **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. | Explain briefly about the Morse Potential and Harmonic Oscillator Model in classical molecular mechanics. | CO1 | R | 10 |
|  | b. | Briefly Describe the techniques of DNA computing methods and characterization. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 2. | a. | Explain the principle and methodology involved in detail study of molecular mechanics. | CO1 | U | 9 |
|  | b. | What is force field? Describe briefly about the classical mechanics in force field. | CO2 | R | 7 |
|  |  |  |  |  |  |
| 3. | a. | Explain the working principle of next generation sequencing techniques and application. | CO2 | R | 8 |
|  | b. | Compare and categorize the NGS platform available for sequencing technology. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 4. | a. | Describe the detail note on different types of sequencing in NGS with application. | CO3 | A | 9 |
|  | b. | Explain the issues identified in data mining with example. | CO4 | R | 7 |
|  |  |  |  |  |  |
| 5. | a. | Explain the processes taken place in the backend of a data warehouse. | CO4 | U | 8 |
|  | b. | What is data mining? Explain the steps in data mining process. | CO4 | R | 8 |
|  |  |  |  |  |  |
| 6. | a. | Describe the role of systems biology in biological application and explain the basics of computer networks. | CO4 | R | 9 |
|  | b. | Define and differentiate the types of Networks in graph theory and list out the role of networks in metabolic construction and reconstruction. | CO5 | A | 7 |
|  |  |  |  |  |  |
| 7. | a. | Define Systems biology, Interpret the technology used in computer networks. | CO6 | U | 8 |
|  | b. | Explain the importance of biological networks and application of protein network analysis. | CO6 | R | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Briefly describe the MD models of Newtonian dynamics, Integrators Leapfrog and Varlet algorithm, Potential truncation and shifted-force potentials. | CO6 | R | 10 |
|  | b. | Justify the importance of Implicit and explicit Solvation models, Periodic boundary conditions, Temperature and pressure control model in molecular dynamics simulations. | CO6 | U | 10 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the principles of, biological data and interpretation. |
| CO2 | Demonstrate high throughput biological data and perform statistical analysis. |
| CO3 | Make use of advanced data mining and machine learning techniques. |
| CO4 | Create skills on molecular modeling and simulation, whole cell modeling, drug discovery, and Systems Biology |
| CO5 | Clarify the implementation of algorithms which may help them design their own. |
| CO6 | Explain the theory and practical aspects of important computational experimental techniques. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 16 | 9 |  |  |  |  | 25 |
| CO2 | 15 |  |  |  |  |  | 15 |
| CO3 |  | 8 |  | 9 |  |  | 17 |
| CO4 | 24 | 8 |  |  |  |  | 32 |
| CO5 |  |  |  | 7 |  |  | 7 |
| CO6 | 18 | 18 |  |  |  |  | 36 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3018** | **Duration** | **3hrs** |
| **Course Name** | **SUSTAINABLE BIOPROCESS DEVELOPMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Describe the major microbial products of biological processing. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Evaluate the concepts of upstream and downstream processing. | CO2 | E | 20 |
|  |  |  |  |  |  |
| 3. |  | Apply the bioreactor configurations citing one example. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Sketch the details of a membrane bioreactor with its applications. | CO5 | U | 20 |
|  |  |  |  |  |  |
| 5. |  | Describe the steps by which engineers optimize the volumetric mass transfer coefficient to enhance mass transfer efficiency. | CO4 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Outline the challenges associated with implementing models with growth inhibitors in sustainable bioprocess design. | CO4 | R | 20 |
|  |  |  |  |  |  |
| 7. |  | Discuss the methodologies commonly used to conduct economic assessments within sustainability evaluations. | CO6 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Discuss the significance of incorporating long-term environmental impacts into sustainability assessments. | CO6 | U | 20 |
|  | | | | | |
| 9. |  | Illustrate the bioprocess considerations in plant cell cultures with examples. | CO2 | A | 20 |
|  |  |  |  |  |  |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Develop growth model based on the microbial characteristics |
| CO2 | Understand working procedure of bioprocess industries |
| CO3 | Analyze the diversity and nature of bio-products |
| CO4 | Evaluate enzyme reaction and its kinetics |
| CO5 | Understand different configurations of bioreactors |
| CO6 | Understand the sustainability assessment methods |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 20 |  |  |  |  | 20 |
| CO2 |  |  | 20 |  | 20 |  | 40 |
| CO3 |  |  | 20 |  |  |  | 20 |
| CO4 | 20 | 20 |  |  |  |  | 40 |
| CO5 |  | 20 |  |  |  |  | 20 |
| CO6 |  | 40 |  |  |  |  | 40 |
|  | | | | | | | **180** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3019** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED ANIMAL BIOTECHNOLOGY & TISSUE CULTURE** | **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. | Write a detailed note on culturing of animal embryos. | CO1 | E | 8 |
|  | b. | Explain the methods of super ovulation, embryo transfer, and sexing in animal biotechnology. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. |  | Discuss the methods of cryopreservation in livestock animal breeding. | CO2 | U | 16 |
|  |  |  |  |  |  |
| 3. | a. | Justify how animals can be used as model for human genetic disorders with various examples. | CO3 | E | 8 |
|  | b. | Recall on how the cloning can be used for conservation of endangered species with suitable examples. | CO3 | R | 8 |
|  |  |  |  |  |  |
| 4. | a. | Write a detailed account on genetic characterization of livestock breeds of animals. | CO3 | E | 8 |
|  | b. | Describe how marker assisted breeding of livestock helps in enhancing the precision of breeding programs. | CO4 | R | 8 |
|  |  |  |  |  |  |
| 5. |  | Summarize on gene knock out technology used to inactivate specific genes. | CO4 | U | 16 |
|  |  |  |  |  |  |
| 6. |  | Recall facts and basic concepts about scaffold fabrication and biomaterials in tissue engineering. | CO5 | R | 16 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the various approaches to cell culture for industrial scaling up. | CO5 | U | 10 |
|  | b. | What is cell line preservation and authentication in terms of animal biotechnology? | CO5 | R | 6 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Elaborate on transgenic animals’ production methods and its ethical concerns. | CO6 | R | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Define concepts in Animal Biotechnology |
| CO2 | Describe the importance of Cryopreservation of embryos and embryo sexing in animals |
| CO3 | Relate and evaluate the genetic defects in animal embryos through molecular diagnosis |
| CO4 | Experiment the technology used for animal breeding |
| CO5 | Comprehend the fundamental concepts of mammalian cell and generation of cell line and to demonstrate tissue engineering applications for implantable materials. |
| CO6 | Design the strategies for livestock improvement through transgenesis with ethical concern. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 8 |  |  | 8 |  | 16 |
| CO2 |  | 16 |  |  |  |  | 16 |
| CO3 | 8 |  |  |  | 16 |  | 24 |
| CO4 | 8 | 16 |  |  |  |  | 24 |
| CO5 | 22 | 10 |  |  |  |  | 32 |
| CO6 | 20 |  |  |  |  |  | 20 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3021** | **Duration** | **3hrs** |
| **Course Name** | **DRUG DESIGN AND DISCOVERY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Describe the various dosage forms of drug. | CO1 | U | 8 |
|  | b. | Explain Lipinski’s rule and list the factors that affect drug distribution. | CO1 | R | 8 |
|  |  |  |  |  |  |
| 2. | a. | Describe the tools for target identification and validation. | CO3 | U | 12 |
|  | b. | Draw the flowchart of drug design process. | CO1 | R | 4 |
|  |  |  |  |  |  |
| 3. |  | Explain the concept of occupancy theory, rate theory and induced fit theory of pharmacokinetics. | CO2 | U | 16 |
|  |  |  |  |  |  |
| 4. | a. | Examine the various steps involved in carrying out a clinical trial. | CO6 | R | 8 |
|  | b. | Describe the current principles of Good Clinical Practices guidelines. | CO6 | U | 8 |
|  |  |  |  |  |  |
| 5. | a. | Discuss in detail the US FDA regulatory agency. | CO4 | U | 8 |
|  | b. | Describe the regulatory action of Central Drugs Standard Control Organization – CDSCO. | CO5 | R | 8 |
|  |  |  |  |  |  |
| 6. | a. | Classify the different forms of IPR and its implications in drug discovery and development. | CO4 | U | 12 |
|  | b. | Give one example for World Intellectual Property organization (WIPO). | CO5 | U | 4 |
|  |  |  |  |  |  |
| 7. | a. | Explain various routes of administration with their advantages and disadvantages. Add a note on novel drug delivery system. | CO2 | U | 10 |
|  | b. | Illustrate about acute toxicity studies. | CO6 | U | 6 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. |  | Describe the CADD on account of structure and ligand. | CO3 | R | 20 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the process of drug discovery and development. |
| CO2 | Discuss the challenges faced in each step of the drug discovery process. |
| CO3 | Classify the computational methods used in drug discovery. |
| CO4 | Organize information into a clear report. |
| CO5 | Demonstrate their ability to work in teams and communicate scientific information effectively. |
| CO6 | Construct, review and evaluate preclinical and clinical pharmaceutical studies. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 12 | 8 | - | - | - | - | 20 |
| CO2 | 10 | 16 | - | - | - | - | 26 |
| CO3 | 20 | 12 | - | - | - | - | 32 |
| CO4 | - | 20 | - | - | - | - | 20 |
| CO5 | 8 | 4 | - | - | - | - | 12 |
| CO6 | 8 | 14 | - | - | - | - | 22 |
|  | | | | | | | **132** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **20BT3026** | **Duration** | **3hrs** |
| **Course Name** | **STEM CELL THERAPEUTICS** | **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. |  | Discuss in detail about the principle and use of laminar flow hood and autoclave in animal cell culture laboratory. | CO1 | U | 16 |
|  |  |  |  |  |  |
| 2. |  | Classify stem cells based on their origin and explain their properties. | CO2 | U | 16 |
|  |  |  |  |  |  |
| 3. |  | Describe the procedure for the isolation of stem cells. | CO3 | U | 16 |
|  |  |  |  |  |  |
| 4. |  | Elaborate wound healing and the application of stem cell in skin regeneration. | CO4 | A | 16 |
|  |  |  |  |  |  |
| 5. |  | Elucidate on the design and engineering of organ in chip. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Discuss the various strategies developed for cancer therapy using stem cells. | CO4 | A | 16 |
|  |  |  |  |  |  |
| 7. |  | Elaborate the application of stem cells in treating infertility. | CO6 | A | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Describe Cell Nuclear Transfer and cloning. | CO6 | A | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the basic concepts in culturing animal and mammalian cells |
| CO2 | Understand the aspects of cellular ageing |
| CO3 | Understand the types of Stem cells, their development and function |
| CO4 | Learn the various methods to isolate and culture Stem cells |
| CO5 | Learn the various therapeutic applications of stem cells |
| CO6 | Appreciate the bigger picture of Stem Cell Technology and their impact of society and civilization |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 16 |  |  |  |  | 16 |
| CO2 |  | 16 |  |  |  |  | 16 |
| CO3 |  | 16 |  |  |  |  | 16 |
| CO4 |  |  | 32 |  |  |  | 32 |
| CO5 |  |  | 16 |  |  |  | 16 |
| CO6 |  |  | 36 |  |  |  | 36 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | **20BT3027** | **Duration** | **3hrs** |
| **Course Name** | **NANOBIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Discuss the top down approach in nanofabrication. | CO1 | U | 10 |
|  | b. | Explain the biological synthesis of nanoparticles. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Examine the different methods in characterization of nanomaterials by spectroscopy. | CO2 | An | 10 |
|  | b. | Evaluate the biomedical application of biomimicry with Diatoms as an example for silicon biomineralization. | CO1 | E | 10 |
|  |  |  |  |  |  |
| 3. | a. | Classify the nanocarriers in targeted drug delivery. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the principle and components in microfluidic devices. | CO5 | U | 10 |
|  | b. | Analyze the application of microfluidic devices as a lab on chip platform with suitable examples. | CO5 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Evaluate the role of nanotechnology in diagnosis and treatment of diseases. | CO3 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain nanobiosensor and classify them based on the transducer. | CO4 | A | 10 |
|  | b. | Describe the principle and application of Cantilever Nanosensors. | CO4 | R | 10 |
|  |  |  |  |  |  |
| 7. | a. | Examine the microneedles and nanoparticles for targeted and highly controlled drug delivery. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the role of nanotechnology in tissue engineering. | CO3 | U | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss nanotoxicology and effects of nanoparticles on living organisms. | CO6 | U | 10 |
|  | b. | Analyze the risks and toxicity of nanoparticles and nanostructured materials. | CO6 | An | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the basic principles of nanotechnology |
| CO2 | Understanding the application of various techniques characterization and interpreting the  properties of nanomaterials as per required application. |
| CO3 | Understand and apply the knowledge of nanomaterials and nanobiomaterials to enable health  sector advancements. |
| CO4 | Design devices and systems for various biological applications. |
| CO5 | Conceptualize the design and development aspects in the domains like NEMS/BIOMEMS |
| CO6 | Enlighten with comprehensive knowledge of toxicity associated with nanomaterials and Optimize  the synthesis for better biocompatibility of Nanomaterials |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 10 | 10 |  | 10 |  | 30 |
| CO2 |  |  |  | 10 |  |  | 10 |
| CO3 |  | 20 | 20 | 20 | 20 |  | 80 |
| CO4 | 10 |  | 10 |  |  |  | 20 |
| CO5 |  | 10 |  | 10 |  |  | 20 |
| CO6 |  | 10 |  | 10 |  |  | 20 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| **Course Code** | | **20BT3029** | **Duration** | | | | **3hrs** | |
| **Course Name** | | **CANCER MANAGEMENT TECHNIQUES** | **Max. Marks** | | | | **100** | |
|  | |  |  | | | |  | |
| **Sl. No.** | **Questions** | | | | **CO** | **BL** | **M** | |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | | | | |
| 1. | a. | Describe the pathology, the types of cancer and the various stages of cancer invasion and metastasis. | | | CO1 | R | 20 | |
|  |  | **(OR)** | | |  |  |  | |
| 2. | a. | Analyze the alterations in growth factors and cell signaling leading to cancer. | | | CO2 | An | 10 | |
|  | b. | Illustrate the angiogenesis promoters involved in the proliferation of cancer. | | | CO2 | An | 10 | |
|  |  |  | | |  |  |  | |
| 3. | a. | Justify the metabolic activity of proteins and enzymes involved as markers for cancer cells. | | | CO3 | E | 20 | |
|  |  | **(OR)** | | |  |  |  | |
| 4. | a. | Discuss on Ultra sound and Endoscopic examination with figures used as imaging techniques to detect cancer. | | | CO4 | U | 20 | |
|  |  |  | | |  |  |  | |
| 5. | a. | Criticize on the various immunodiagnostic techniques used for cancer marker detection. | | | CO4 | E | 20 | |
|  |  | **(OR)** | | |  |  |  | |
| 6. | a. | Evaluate the common types of adjuvant therapy given for cancer patients and comment on their challenges. | | | CO5 | E | 20 | |
|  |  |  | | |  |  |  | |
| 7. | a. | Analyze the challenges of Radiotherapy and Hormone therapy to treat cancer. | | | CO5 | An | 20 | |
|  |  | **(OR)** | | |  |  |  | |
| 8. | a. | Evaluate the various risk factors of cancer and criticize the role of food and lifestyle in cancer prevention. | | | CO6 | E | 20 | |
| **COMPULSORY QUESTION** | | | | | | | | |
| 9. | a. | Analyze the measures of post treatment recurrence prevention and add a note on the IoT technique to manage cancer. | | | CO6 | An | 20 | |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the pathology and metabolism of cancers and their reporting systems. |
| CO2 | Recall the molecular pathways and relate them in cancer development, progression, detection and therapy. |
| CO3 | Identify the potential molecular and cellular targets for diagnosis and therapy. |
| CO4 | Evaluate the technologies available for early diagnosis-prevention, targeted therapy and for effective management of post therapy – palliative care. |
| CO5 | Analyze the challenges in the present cancer management methods. |
| CO6 | Apply the knowledge and discuss new means of cancer management, prevention strategies and modes of palliative care to prolong the life of cancer cases. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 20 |  |  |  |  |  | 20 |
| CO2 |  |  |  | 20 |  |  | 20 |
| CO3 |  |  |  |  | 20 |  | 20 |
| CO4 |  | 20 |  |  | 20 |  | 40 |
| CO5 |  |  |  | 20 | 20 |  | 40 |
| CO6 |  |  |  | 20 | 20 |  | 40 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3030** | **Duration** | **3hrs** |
| **Course Name** | **GENOMICS AND PROTEOMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the experimental method of resolving proteins using two-dimensional sodium dodecyl sulfate–polyacrylamide gel electrophoresis. | CO3 | U | 10 |
|  | b. | Explain the significance of human genome project. | CO6 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the stereoisomerism in amino acid residues of a protein molecule. | CO3 | An | 10 |
|  | b. | How can individual genes be inactivated by homologous recombination in *Saccharomyces cerevisiae?* | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the experimental method of DNA sequencing developed by Frederick Sanger. | CO2 | U | 10 |
|  | b. | How is protein identification performed using peptide mass fingerprinting? | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Describe, with suitable examples and results, the significance of the classical experiments performed by Gregor Mendel for understanding the field of genomics. | CO1 | U | 10 |
|  | b. | Explain the classification of amino acid residues based on their properties. | CO3 | R | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the single nucleotide polymorphism observed in eukaryotic genomes. | CO2 | U | 10 |
|  | b. | Explain any five post-translational modifications observed in eukaryotic organisms. | CO5 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Write, with suitable examples, the genetic features of prokaryotic genomes. | CO1 | U | 10 |
|  | b. | Describe the behavior of chromosomes during nuclear division that explains the partial genetic linkage observed in eukaryotic genomes? | CO4 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain, with a suitable example, a) the chain termination method devised by Fred Sanger for sequencing a DNA molecule, and b) how the results of the sequencing experiment are analyzed. | CO3 | R | 10 |
|  | b. | Describe the experimental method of separation of DNA molecules using agarose gel electrophoresis. | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe the genetic features of eukaryotic genomes. | CO1 | U | 10 |
|  | b. | Explain a) how the nuclease protection experiment is performed on chromatin from human nuclei, and b) how the results of this experiment are analyzed. | CO1 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe in detail the steps involved in amplifying a DNA molecule using the polymerase chain reaction. | CO3 | U | 10 |
|  | b. | Explain how peptide sequence analysis is performed using tandem mass spectroscopy. | CO3 | R | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Relate and comprehend the concepts in genome organization, genomics and proteomics. |
| CO2 | Explain some of the current genomics technologies and illustrate how these can be used to study  gene function. |
| CO3 | Apply interdisciplinary knowledge (e.g. chemistry, biophysics) to solve problems in proteomics  and genomics. |
| CO4 | Analyze and infer genomes and proteomes by employing database search, algorithms and tools. |
| CO5 | Appraise the applications of genomics and proteomics in medicine. |
| CO6 | Compile, discuss and critically review the recent updates / progress in genomics and proteomics  research. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 0 | 40 | 0 | 0 | 0 | 0 | 40 |
| CO2 | 0 | 30 | 20 | 0 | 0 | 0 | 50 |
| CO3 | 30 | 20 | 0 | 10 | 0 | 0 | 60 |
| CO4 | 0 | 0 | 10 | 0 | 0 | 0 | 10 |
| CO5 | 10 | 0 | 0 | 0 | 0 | 0 | 10 |
| CO6 | 10 | 0 | 0 | 0 | 0 | 0 | 10 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3031** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED ENVIRONMENTAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Critically analyze the various sources of hazardous wastes. Add a note on the characteristics of hazardous waste and explain any one. | CO1 | An | 10 |
|  | b. | Classify the major causes of air pollution leads to global warming and greenhouse gas effects. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe the working and application of Fluidized bed biological reactor with a neat diagram. | CO2 | U | 10 |
|  | b. | Explain the working principle and application of Sequential batch reactor with a neat diagram. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Describe the process of activated sludge system employed in waste treatment. Add a note on its merits and demerits. | CO2 | U | 12 |
|  | b. | Discuss the working principle of Trickling filter which acts as attached growth biological reactor. | CO2 | U | 08 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Illustrate the biodegradation process of Chromium, Arsenic and Selenium with suitable illustrations. | CO5 | An | 10 |
|  | b. | Explain the recalcitrant compound degradation pattern and how the hydrocarbon products are degraded. | CO5 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the biological treatment of leather tanning industry. | CO3 | U | 10 |
|  | b. | Critically analyze the impact of environmental pollutants caused by petrochemical industries and suggest a suitable detoxification methods using microorganisms. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Describe cleaner technologies with respect to food and dairy industries. | CO3 | U | 10 |
|  | b. | Assess the different methods to manage medical waste and solid waste. | CO4 | E | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain *In situ* and *Ex situ* bioremediation with their merits and demerits. | CO5 | A | 10 |
|  | b. | Phytoremediation is useful in reducing heavy metal pollution in water and soil-Discuss | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Illustrate the different process steps involved in bioleaching of heavy metals. | CO3 | An | 10 |
|  | b. | Explain biogas production with a neat flow chart. Add a note on any four common problems in biogas plant. | CO6 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain about vermiculture techniques with its required materials. | CO4 | U | 10 |
|  | b. | Nanotechnology has enormous potential for providing innovative solutions to a wide range of environmental issues- Discuss with suitable examples. | CO6 | U | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Create an awareness of professional responsibility towards protecting the environment |
| CO2 | Learn environmental issues involved engineering and resources projects |
| CO3 | Study the natural and engineered bio-treatment methods to remediate the pollutants |
| CO4 | Develop treatment methods and create awareness about opportunities in environmental management |
| CO5 | Future challenges for bioremediation and biodegradation process |
| CO6 | Investigate the opportunities for incorporating environmental quality into products, processes and projects |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | - | 20 | - | - | 20 |
| CO2 | - | 30 | 10 | - | - | - | 40 |
| CO3 | - | 20 | - | 10 | - | - | 30 |
| CO4 | - | 10 | - | 10 | 10 | - | 30 |
| CO5 | - | 10 | 10 | 20 | - | - | 40 |
| CO6 | - | 20 | - | - | - | - | 20 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3051** | **Duration** | **3hrs** |
| **Course Name** | **BIOCHEMISTRY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Classify carbohydrates in details based on the number of carbon atoms. | CO1 | An | 10 |
|  | b. | Write the metabolic pathways involved in the formation of uric acid as a result of purine degradation. | CO2 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Classify different types of lipids based on the structural compositions. | CO1 | An | 10 |
|  | b. | Explain the structure of DNA with a diagram. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Write a detailed note on the chemical name, structure, dietary sources and deficiency syndromes of vitamin A, D, E and K. | CO3 | C | 10 |
|  | b. | Describe the basic understanding on urea cycle. | CO4 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Write a detailed note on the dietary sources and deficiency syndromes of macro elements. | CO3 | C | 10 |
|  | b. | Discuss the importance of oxidative and non-oxidative phases for pentose phosphate pathway. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Write the importance of complex I to complex V in ETC cycle. | CO4 | U | 10 |
|  | b. | Write a detailed note on the properties and classifications of different amino acids with structures. | CO5 | C | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the metabolic pathways of TCA cycle. | CO4 | U | 10 |
|  | b. | Describe the metabolic steps involved in fatty acids biosynthesis. | CO5 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the metabolic pathways of glycolysis in aerobic and anaerobic conditions. | CO5 | U | 10 |
|  | b. | Mention the metabolic pathways for β-oxidation of fatty acids. | CO6 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe the properties of triacylglycerols and different tests to check the purity of fat. | CO6 | R | 10 |
|  | b. | Explain the tertiary and quaternary structures of protein molecule. | CO5 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Write a detailed note on different types of phospholipids and its functions. | CO6 | C | 10 |
|  | b. | Memorize the structures and functions of cholesterol and ergosterol. | CO6 | R | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Acquire knowledge on structure, properties and biological functions of carbohydrates, lipids and proteins. |
| CO2 | Assess the significance of nucleic acid structure, properties and functions. |
| CO3 | To impart knowledge on the significance of vitamins and mineral functions. |
| CO4 | Integrate the metabolic pathways of synthesis and degradation of biomolecules. |
| CO5 | Justify the clinical and biological significance of biomolecules. |
| CO6 | Classify the biomolecules and understand their specific roles in biological system. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | - | 20 | - | - | 20 |
| CO2 | 10 | 10 | - | - | - | - | 20 |
| CO3 | - | - | - | - | - | 20 | 20 |
| CO4 | 10 | 30 | - | - | - | - | 40 |
| CO5 | - | 30 | - | - | - | 10 | 40 |
| CO6 | 30 | - | - | - | - | 10 | 40 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3052** | **Duration** | **3hrs** |
| **Course Name** | **PLANT SECONDARY METABOLITES AND PHARMACEUTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Shikimic acid pathway is more appropriately called chorismic acid pathway – strengthen the statement by explaining its biosynthesis. | CO2 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Analyze the major types of plant secondary metabolites and their specific functions. | CO1 | An | 20 |
|  |  |  |  |  |  |
| 3. |  | Evaluate the concept of Compartmentalization to show how Secondary metabolism is an integral part of cellular metabolism. | CO3 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Classify the process of detection of microbial pathogens in plants using chemical defense mechanism with examples. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | Describe the details of various excipients and pharmaceutical ingredients with examples. | CO5 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Evaluate the selection criteria for excipients used in pharmaceutical dosage forms. | CO6 | E | 20 |
|  |  |  |  |  |  |
| 7. |  | Analyze the production of pharmaceutically important secondary metabolites – Taxol. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Illustrate various subclasses of flavonoids with suitable examples and list their functions. | CO1 | U | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Narrate the inhalation therapy and the delivery of drug for demulcents and expectorants | CO6 | R | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Enumerate major plant secondary metabolites and its uses |
| CO2 | Illustrate the biosynthesis and regulation of plant secondary metabolites |
| CO3 | Infer the different methods of production of secondary metabolites |
| CO4 | Interpret the biochemical pathways for improved secondary metabolite production |
| CO5 | Enumerate the pharmaceutical procedures for preformulation studies |
| CO6 | Examine the development of formulation and dosage forms |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 20 |  | 20 |  |  | 40 |
| CO2 |  |  | 20 |  |  |  | 20 |
| CO3 |  |  |  |  | 20 |  | 20 |
| CO4 |  |  | 20 |  |  |  | 20 |
| CO5 | 20 |  |  | 20 |  |  | 40 |
| CO6 | 20 |  |  |  | 20 |  | 40 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3053** | **Duration** | **3hrs** |
| **Course Name** | **MOLECULAR BIOLOGY AND CELL SIGNALING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the rolling circle model of replication. | CO1 | U | 10 |
|  | b. | Explain the importance of DNA repair mechanism. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain in detail about the eukaryotic replication with a neat diagram. | CO1 | An | 15 |
|  | b. | Justify the enzymes that contribute for excision repair mechanisms in DNA. | CO1 | E | 5 |
|  |  |  |  |  |  |
| 3. | a. | Discuss the steps involved in initiation, elongation and termination of transcription in prokaryotes. | CO2 | U | 15 |
|  | b. | Define Genetic codon. | CO2 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Write in detail about the post-translational modification in eukaryotes. | CO3 | A | 12 |
|  | b. | State the functions of RNA polymerase in prokaryotic transcription. | CO2 | R | 8 |
|  |  |  |  |  |  |
| 5. | a. | Explain the properties and function of lac operon with a schematic diagram. | CO4 | An | 15 |
|  | b. | Define epigenetic modification. | CO3 | R | 5 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Illustrate how G-proteins activate cAMP dependent protein kinase and highlight its functions with a neat sketch. | CO4 | A | 15 |
|  | b. | Differentiate between intracellular signaling and intercellular signaling. | CO4 | U | 5 |
|  |  |  |  |  |  |
| 7. | a. | Define oncogenes. Evaluate the pathological symptoms and treatment for Human Papilloma Virus and Epstein Barr Virus. | CO5 | E | 15 |
|  | b. | Write a detailed note on siRNA. | CO6 | C | 5 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe the function of JAK/STAT pathway involved in cell signalling with a neat diagram. | CO4 | R | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Define bacteriophage. Enumerate the regulation of lytic cycle in bacteriophage with a neat sketch. | CO6 | R | 10 |
|  | b. | Illustrate the regulation of lysogeny cycle in bacteriophage. | CO6 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Exhibit a knowledge base in DNA replication, transcription, translation and Cell signaling. |
| CO2 | Summarize the process of gene expression and its regulation in prokaryotes and eukaryotes. |
| CO3 | Experiment with model organisms in gene expression studies and cancer research. |
| CO4 | Compare and contrast the different molecular processes in gene expression, signalling processes and cancer mechanism. |
| CO5 | Engage in review of scientific literature in the areas of biomedical sciences. |
| CO6 | Critique and professionally present primary literature articles in the general biomedical sciences field. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 10 | 10 | 15 | 5 | - | 40 |
| CO2 | 13 | 15 | - | - | - | - | 28 |
| CO3 | 5 | - | 12 | - | - | - | 17 |
| CO4 | 20 | 5 | 15 | 15 | - | - | 55 |
| CO5 | - | - | - | - | 15 | - | 15 |
| CO6 | 10 | - | 10 | - | - | 5 | 25 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3054** | **Duration** | **3hrs** |
| **Course Name** | **MICROBIOLOGY AND MOLECULAR GENETICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain Illumina NGS method of sequencing. Add a note on their application. | CO1 | U | 10 |
|  | b. | Explain Bergey’s manual of bacterial classification with suitable examples. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Illustrate the principle of autoclave, hot air oven and filtration in microbial growth with a neat diagram. | CO2 | A | 10 |
|  | b. | Explain the working principle of lyophilization and their application in preservation of industrially important microorganisms. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Discuss the causative agent, symptoms, pathogenicity and prevention of *Mycobacterium tuberculosis*. | CO3 | An | 10 |
|  | b. | Assess the mode of action of any THREE major antibacterial agents. | CO2 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the following experiments with suitable illustration:  (a) Transformation (b) Interrupted and Uninterrupted mating. | CO4 | U | 10 |
|  | b. | Describe the usefulness of tetrad analysis in gene mapping with suitable diagram. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Illustrate the impact of retrotransposons on human evolution with examples. | CO5 | An | 10 |
|  | b. | Explain the mechanism and applications of RNA silencing. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Describe *In situ* and *Ex situ* bioremediation with their merits and demerits. | CO3 | U | 10 |
|  | b. | Compare the morphological structure and functions of prokaryotic cell and eukaryotic cell. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Illustrate the life cycle, mode of transmission and clinical features of malaria. | CO3 | An | 12 |
|  | b. | Explain the clinical manifestations of *Candida albicans*. | CO3 | U | 08 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the mode of action of mutagens: (a) Hydroxylamine (b) Nitrous acid. | CO6 | U | 08 |
|  | b. | Explain the mechanism of Ultraviolet Radiation induced DNA damage. | CO6 | U | 06 |
|  | c. | List any three harmful and beneficial effects of mutation with examples. | CO6 | R | 06 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Develop a suitable protocol for the isolation of mutants using any TWO chemical mutagens. | CO6 | C | 10 |
|  | b. | With suitable diagrams, explain Missense, Nonsense and Frame shift mutations. | CO6 | U | 10 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Analyze the classification, diversity, and ubiquity of major categories of microorganisms |
| CO2 | Demonstrate the structural, physiological differences of microorganisms and their growth control |
| CO3 | Evaluate the interactions between microbes, hosts and environment. |
| CO4 | Acquire knowledge on prokaryotic, eukaryotic genome organization and the process of replication |
| CO5 | Interpret the epigenetic effects on transposons in genes of interest |
| CO6 | Describe the causes and consequences of mutations on microbial evolution and the generation of diversity |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 20 | - | - | - | - | 20 |
| CO2 | - | 10 | 20 | - | - | - | 30 |
| CO3 | - | 20 | - | 20 | 10 | - | 50 |
| CO4 | - | 20 | - | - | - | - | 20 |
| CO5 | - | - | 10 | 10 | - | - | 20 |
| CO6 | 6 | 24 | - | - | - | 10 | 40 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3055** | **Duration** | **3hrs** |
| **Course Name** | **ANIMAL BIOTECHNOLOGY AND IMMUNOLOGY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Define Immunology. Describe its importance in the proliferation of tumour. | CO1 | R | 10 |
|  | b. | Elaborate on the tissues and organs involved in the Immunosystem. | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the physiological process involved in acute inflammation. | CO2 | U | 20 |
| 3. | a. | Illustrate the advances in using animal models to treat diseases. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Analyze the importance of immunotolerance and its implications. | CO4 | An | 20 |
| 5. | a. | What is an antibody? Analyze the importance and production of monoclonal antibodies. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Articulate the importance of rDNA technology employed in animal biotechnology. | CO6 | U | 20 |
| 7. | a. | Sketch the principle, importance and applications of flow cytometry. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Highlight the importance of Antifertility vaccines and their applications. | CO6 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Illustrate with neat diagrams the technique of Immunoflorescence. | CO6 | An | 10 |
|  | b. | Sketch the importance behind immunosupression and the process involved. | CO6 | A | 10 |

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|  | **COURSE OUTCOMES** |
| CO1 | Explain the role of cryopreservation of embryos and embryo sexing. |
| CO2 | Describe the basic concepts in animal biotechnology and its importance in livestock improvement. |
| CO3 | Relate and identify the genetic defects in animal embryos through molecular techniques. |
| CO4 | Identify the cellular and molecular basis of immune responsiveness through antigen and antibody interactions. |
| CO5 | Describe the roles of the immune system in both maintaining health and contributing to disease. |
| CO6 | Demonstrate a capacity for problem-solving about immune responsiveness. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 20 | - | - | - | - | - | 20 |
| CO2 | - | 20 | - | - | - | - | 20 |
| CO3 | - | - | 20 | - | - | - | 20 |
| CO4 | - | - | - | 20 | - | - | 20 |
| CO5 | - | - | 40 | 20 | - | - | 40 |
| CO6 | - | 20 | 30 | 10 | - | - | 60 |
|  | | | | | | | **180** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3056** | **Duration** | **3hrs** |
| **Course Name** | **RESEARCH METHODOLOGY AND APPLIED STATISTICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the different types of review in scientific literature based on their scope and purpose. | CO1 | U | 10 |
|  | b. | Identify the significance of performing literature review on a topic. Illustrate the strategies to get relevant information from scientific database(s). | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the different steps in conducting scientific research with flowchart. Justify the need of mapping the “research gap” and formulating research “hypothesis”. | CO2 | An | 10 |
|  | b. | Design a hypothetical experiment to investigate the impact of an “inducer” on microbial growth and metabolites production. Describe the key components of the experimental design, including the independent and dependent variables, control groups, and any potential confounding variables. Justify your choices. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Summarize the structural components in a typical research paper, briefly explain the purpose of each section, and syntax, formatting guidelines to be followed. | CO3 | E | 10 |
|  | b. | Explain the strategies to effectively write the “Results and discussion” section of research article. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Evaluate the ethical considerations surrounding authorship in academic publications. Describe the criteria for authorship, the responsibilities of co-authors and corresponding author | CO4 | E | 10 |
|  | b. | Examine the ethical and practical implications of plagiarism in scientific writing. Describe different types of plagiarism and ways to avoid it. | CO4 | E | 10 |
|  |  |  |  |  |  |
| 5. | a. | Differentiate between data fabrication and data falsification in research. Discuss the potential consequences of these unethical practices on the scientific community and society. | CO4 | U | 10 |
|  | b. | Organize the different steps in Editorial process in publication life-cycle of a manuscript to version-of-record. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | The average height of a population is 170 cm with a standard deviation of 10 cm. Estimate the probability that a randomly selected individual is shorter than 160 cm. | CO5 | E | 10 |
|  | b. | A researcher measures the blood pressure of 100 individuals and finds an average of 120 mm Hg with a standard deviation of 15 mm Hg. Estimate a 95% confidence interval for the population mean blood pressure. | CO5 | E | 10 |
|  |  |  |  |  |  |
| 7. | a. | A hospital claims that the average waiting time in the emergency room is less than 20 minutes. A random sample of 25 patients yields an average waiting time of 18 minutes with a standard deviation of 4 minutes. Test the hospital's claim at a 1% significance level. | CO5 | E | 10 |
|  | b. | A clinical trial to test the effectiveness of a new drug in reducing cholesterol levels in patients is undertaken. Describe the step-by-step process of setting up a hypothesis test for this study, state the null hypothesis (H0) and the alternative hypothesis (H1). | CO5 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Effectiveness of a new drug in reducing blood pressure before and after treatment is measured. Test whether the drug is effective in reducing pressure or not.   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Individual | A | B | C | D | E | F | G | H | I | J | | Before | 140 | 145 | 150 | 136 | 155 | 138 | 142 | 147 | 148 | 155 | | After | 130 | 137 | 140 | 129 | 150 | 132 | 136 | 143 | 142 | 152 | | CO5 | E | 10 |
|  | b. | The mean response time of a species of pigs to a stimulus is 0.8 s. Twenty-eight pigs were given 2 oz of alcohol and then tested. The average response time was 1.0 s with a standard deviation of 0.3 s. Justify the conclusion that alcohol affects the mean response time at 5 percent level of significance. | CO5 | E | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the steps involved in calculation of regression coefficient from experimental and modelled data, with appropriate example. | CO6 | An | 10 |
|  | b. | Glucose measurement in DNSA method is likely to have a linear regression model. Illustrate the steps involved in parameter estimation, (*i.e.,* slope and intercept) using the least square approach | CO6 | A | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Design their experiment keeping in mind the appropriate statistical test to be adopted in support of  research hypothesis |
| CO2 | Understand key steps to transform a wobbly idea into a convincing research proposal report -  connecting the small objectives to big-picture |
| CO3 | Perform hypothesis testing based on parametric and non-parametric approach in statistical package,  office tools |
| CO4 | Analyze the need of literature, experimental data, and supporting information in realm of research  publication |
| CO5 | Practice good-research and publication ethics |
| CO6 | Understand the need of statistical analysis pertinent to their experimental data |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 10 | 10 | 0 | 0 | 0 | 0 | 20 |
| CO2 | 0 | 0 | 10 | 10 | 0 | 0 | 20 |
| CO3 | 0 | 0 | 0 | 10 | 10 | 0 | 20 |
| CO4 | 0 | 10 | 0 | 10 | 20 | 0 | 40 |
| CO5 | 0 | 0 | 0 | 0 | 60 | 0 | 60 |
| CO6 | 0 | 0 | 10 | 10 | 0 | 0 | 20 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3057** | **Duration** | **3hrs** |
| **Course Name** | **BIOPROCESS AND DOWNSTREAM PROCESSING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain in detail with a neat sketch the overview of the fermentation process. | CO1 | U | 10 |
|  | b. | Elaborate on any five parameters to be monitored and controlled during the fermentation process. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Illustrate in detail with a neat sketch the basic configuration of the fermenter. | CO1 | U | 10 |
|  | b. | Classify the sensors based on their application to process control with examples | CO1 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | For the following data calculate the difference, average difference, mean square, experimental error and factors showing a larger effect Where, D-1 and D-2 are dummy variables.   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **Factor** | **Car** | **Vit** | **Min** | **Nit** | **AF** | **D-1** | **D-2** | | **Σ(H)** | 10.9 | 22.1 | 1.5 | 7.6 | 5.6 | 1.2 | 9.8 | | **Σ(L)** | 15.6 | 11.7 | 5.1 | 4.6 | 2.3 | 1.3 | 9.6 | | CO2 | An | 10 |
|  | b. | Explain in detail various types of sterilization methods followed in the bioprocess industry. | CO2 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain the utility of different ingredients used to formulate fermentation medium. Also add a note on non-nutritional media supplements. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 5. |  | How the industrially important microbes are isolated from the environment? Explain various primary screening methods involved in the isolation of microbes. | CO3 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | List out various preservation techniques followed to store isolated industrially important microbes and explain in detail. | CO3 | U | 20 |
|  |  |  |  |  |  |
| 7. | a. | Derive the expressions for various types of product inhibition. | CO4 | An | 15 |
|  | b. | Explain the specialty of Leude King Piret's equation with equations. | CO4 | An | 5 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Elaborate on the various methods of cell disruption carried out to extract intracellular products with examples. | CO5 | U | 10 |
|  | b. | With a neat diagram, explain the process of precipitation of proteins. | CO5 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the working principle of gel filtration chromatography and write a note on the determination of the molecular weight of purified enzymes. | CO6 | A | 10 |
|  | b. | Elaborate on the steps involved in the production of citric acid with a neat flow sheet. | CO6 | U | 10 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the process of fermentation and its requirements |
| CO2 | Recall the media formulation, medium optimization and sterilization process |
| CO3 | Illustrate the importance of microbial screening and preservation in bioprocessing |
| CO4 | Discuss the cell growth and product formation |
| CO5 | Apply knowledge on various unit operations in downstream processing |
| CO6 | Analyze industrial product development in the fermentation process |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 40 | - | - | - | - | 40 |
| CO2 | - | 20 | - | 20 | - | - | 40 |
| CO3 | 20 | 20 | - | - | - | - | 40 |
| CO4 | - | - | - | 20 | - | - | 20 |
| CO5 | - | 20 | - | - | - | - | 20 |
| CO6 | - | 10 | 10 | - | - | - | 20 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3058** | **Duration** | **3hrs** |
| **Course Name** | **MOLECULAR MEDICINE AND DIAGNOSTICS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the following intra cellular signaling pathways:   1. G-protein coupled receptor. 2. receptor tyrosine kinase | CO1 | R | 10 |
|  | b. | Describe the process of DNA microarray and its applications. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the following techniques used for the identification of pathogens.  i) 16srRNA sequencing  ii) Whole genome sequencing | CO2 | A | 10 |
|  | b. | Analyze the steps involved in primer and probe designing using biological tools. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the attributes and classification of biobanks. | CO3 | U | 10 |
|  | b. | Describe the ethical aspects involved in human biobank. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the procedure for the biological sample collection for disease diagnosis. | CO4 | An | 10 |
|  | b. | Evaluate the processing of samples and interpretation of results to identify the disease. | CO4 | E | 10 |
|  |  |  |  |  |  |
| 5. | a. | Express the impact genetical disorder of sickle cell anemia and represent its diagnostic approach. | CO5 | U | 10 |
|  | b. | Describe about amino acid deficiency –Phenylketonuria a metabolic error in humans. | CO5 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Describe chemiluminesent immuno assay for the detection of enzymes in the cells. | CO6 | R | 10 |
|  | b. | Discuss fluorescent immuno assay for the detection of antigen and antibody reaction. | CO6 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the factors involved in microbial pathogenicity in humans. | CO5 | R | 10 |
|  | b. | Illustrate on the types of fungal diseases in humans. | CO5 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Discuss the importance of PCR in tuberculosis disease diagnosis. | CO2 | U | 10 |
|  | b. | Illustrate with example about containment and future trends of immunodiagnostics. | CO2 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Express the processing of class I MHC molecule in antigen processing and presentation. | CO6 | U | 10 |
|  | b. | Describe the process of monoclonal antibody production with illustrations. | CO6 | An | 10 |

**CO** – COURSE OUTCOME **BL** – BLOOM’S LEVEL

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recognize molecular mechanisms in development of disease |
| CO2 | Predict the use of molecular genetic methods in the detection, identification and quantification of different microorganisms. |
| CO3 | Apply the principles of molecular diagnostics and advantages/limitations of its applications |
| CO4 | Develop technological integration of chemistry, physics and molecular biology for use in bioanalysis relevant for biomedical research and diagnostics. |
| CO5 | Design advanced study in the theoretical and practical aspects of the genetic basis and diagnosis of disease from both human and pathogen perspectives. |
| CO6 | Appraise the knowledge of molecular testing to the most commonly performed applications in the clinical laboratory such as: nucleic acid extraction, resolution and detection, analysis and characterization of nucleic acids and proteins, nucleic acid amplification and DNA sequencing. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 10 | 10 |  |  |  |  | 20 |
| CO2 |  | 10 | 10 | 10 |  |  | 30 |
| CO3 |  | 20 |  |  |  |  | 20 |
| CO4 |  |  |  | 10 | 10 |  | 20 |
| CO5 | 30 | 10 |  |  |  |  | 40 |
| CO6 | 40 | 10 |  |  |  |  | 50 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3062** | **Duration** | **3hrs** |
| **Course Name** | **INDUSTRIAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Discuss the importance of upstream processing in industrial biotechnology. | CO1 | U | 6 |
|  | b. | Write a detailed note on the different types of downstream processing with the merits and demerits. | CO1 | U | 14 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Illustrate the industrial production of L-Lysine with the process flow diagram. | CO1 | A | 20 |
|  |  |  |  |  |  |
| 3. | a. | Explain the role of microbes in the formation of biofertilizers. | CO3 | U | 10 |
|  | b. | Write the industrial production of succinic acid. | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Classify different microorganisms and discuss their industrial applications. | CO3 | R | 20 |
|  |  |  |  |  |  |
| 5. | a. | Write the bioprocessing involved in the production and applications of cellulase enzyme. | CO4 | U | 10 |
|  | b. | Describe the role of solid-state fermentation in the synthesis of α- amylase enzyme. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss the production of bioethanol from biomass and its commercial prospects in Indian market. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Examine the clinical significance and the production process of monoclonal antibodies. | CO5 | A | 8 |
|  | b. | Write the differences in the commercial scale production of beer and wine. | CO5 | An | 12 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe isolation, fermentation, harvesting and post-harvesting processes for SCP. | CO6 | U | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the function of the accessories with pictorial representation of a batch bioreactor. | CO2 | U | 12 |
|  | b. | Discuss on the working principles of continuous and fed-batch bioreactors for the industrial production of carbohydrate based bioproduct. | CO2 | U | 8 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Acquire knowledge on industrial bioprocess and process flow diagrams. |
| CO2 | Remember various types of bioproducts and steps in fermentation technology. |
| CO3 | Understand the problems related to handling microorganisms and selection of microbial culture for specific kind of bioproducts. |
| CO4 | Analyze industrial-market value of the bio products and relate them with the scope of biotechnology. |
| CO5 | Justify the clinical and biological significance of these bio products for sustainable bioprocess engineering. |
| CO6 | Illustrate the difference in manufacturing commercial bioproducts and the ethical issues related to entrepreneurial aptitude. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 20 | 20 | - | - | - | 40 |
| CO2 | - | 30 | - | - | - | - | 30 |
| CO3 | 30 | - | - | - | - | - | 30 |
| CO4 | - | 20 | - | 20 | - | - | 40 |
| CO5 | - | - | 10 | 10 | - | - | 20 |
| CO6 | - | 20 | - | - | - | - | 20 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3063** | **Duration** | **3hrs** |
| **Course Name** | **PHARMACEUTICAL TECHNOLOGY AND CLINICAL TRIAL** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Define Drug. Briefly describe the natural source of lead to discover drugs. | CO1 | R | 10 |
|  | b. | Interpret the routes of drug administration in animal body with few examples. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe the mechanisms of action of agonists and antagonists, including the differences between competitive and non-competitive antagonism. Provide examples of drugs acting as agonists and antagonists. | CO2 | U | 10 |
|  | b. | Illustrate the ADME properties of drugs and factors influencing ADME process. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Summaries the important unit process applied on the drugs manufacturing pharmaceutical chemical technology. | CO2 | U | 10 |
|  | b. | Describe the process of fermentation, highlighting its significance in pharmaceutical production. | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the tablet manufacturing process, including the steps involved from formulation development to tablet compression and coating. | CO3 | U | 10 |
|  | b. | Infer the formulation and manufacturing of hard gelatin capsule .Explain various methods of evaluation of capsule. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Enumerate and describe the evaluation of various drug formulation by analytical methods. | CO4 | R | 10 |
|  | b. | Classify liquid dosage forms. Describe in brief the formulation components of clear liquids with the role of each component in the formula. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Define and differentiate the functional difference of Antibiotics and biological hormones. | CO5 | R | 10 |
|  | b. | Briefly describe GMP implies on pharmaceutical industries. | CO5 | R | 10 |
|  |  |  |  |  |  |
| 7. | a. | Interpret the various materials used for pharmaceutical product to store and packaging. | CO5 | A | 10 |
|  | b. | Describe the Recent advances in the manufacture of drugs using  r-DNA technology. | CO6 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Define biomaterials. Explain the role of controlled and sustained delivery of drugs through materials. | CO6 | R | 10 |
|  | b. | Classify the Biomaterial used for drug delivery systems for therapeutic application. | CO6 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Define clinical trial? Explain briefly about various clinical trial phases used to define pharmacological activity of drugs. | CO5 | R | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Distinguish to excel in research and to succeed in Biopharmaceutical technology profession through global, rigorous post graduate education. |
| CO2 | Contrast students with a solid foundation in pharmacology, scientific and engineering fundamentals required to solve biopharmaceutical related problems. |
| CO3 | Understand students with good scientific and technical knowledge so as to comprehend novel products and solutions for the health care issues. |
| CO4 | Articulate in scientific & professional ethics on biological product manufacturing process. |
| CO5 | Discover scientific methods and SOPs in clinical trials and fundamentals in new drug discovery process. |
| CO6 | Develop academic environment aware of excellence in new drug discovery and patenting professional career. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 10 | 10 |  |  |  |  | 20 |
| CO2 |  | 30 |  |  |  |  | 30 |
| CO3 | 10 | 20 |  |  |  |  | 30 |
| CO4 | 10 | 10 |  |  |  |  | 20 |
| CO5 | 40 |  | 10 |  |  |  | 50 |
| CO6 | 10 | 20 |  |  |  |  | 30 |
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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3066** | **Duration** | **3hrs** |
| **Course Name** | **ALGAE BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the scope and application of algal biotechnology with suitable examples. | CO1 | U | 10 |
|  | b. | Illustrate the different techniques used for the isolation of algae from marine sources. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Modification of media is necessary for enhancing the growth and yield of products from algae-Justify with suitable examples. | CO2 | E | 10 |
|  | b. | Summarize the value added products obtained from algae with their applications. Add a note on their merits and demerits. | CO2 | E | 10 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the importance of algal species in food supplement industry with appropriate examples. | CO3 | An | 10 |
|  | b. | Algae as potential source of protein – Justify the statement based on their protein quality, amino acid composition, and digestibility. | CO3 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | GC-MS based metabolite profiling would be a useful tool to uncover the primary metabolic network in algae- Explain with suitable examples. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 5. | a. | Explain the production of biofuel using suitable algal species which overcome the energy crisis. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Algae as a green technology for heavy metals removal from various wastewater- Critically analyze with suitable examples. | CO3 | An | 10 |
|  | b. | Develop an effective and eco-friendly algal technology for the removal of dye from industrial waste water. | CO3 | C | 10 |
|  |  |  |  |  |  |
| 7. | a. | Examine the importance of temperature, pH, light and salt in culturing algal cells. | CO1 | A | 08 |
|  | b. | Explain the types of algal culture. Add a note on the initiation and maintenance of any one type of algal culture. | CO1 | U | 12 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Fatty acid composition as biomarkers of freshwater microalgae-Substantiate with suitable examples. | CO6 | E | 10 |
|  | b. | Explain how phylogenetic tree aid to understand the relationship between various genera of algae. | CO6 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the molecular techniques used for the identification of algal species having economic importance. | CO6 | U | 12 |
|  | b. | Summarize the challenges and applications of algal genomics. | CO6 | U | 08 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the importance of algae and their culture techniques |
| CO2 | Summarize the value added products of algae |
| CO3 | Outline the application of algae in Industry and environment |
| CO4 | Elaborate the cell characteristics of microalgae |
| CO5 | Investigate different products from algal sources through technological interventions |
| CO6 | Infer algal characterization using molecular tools |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 32 | 08 |  |  |  | 40 |
| CO2 |  |  |  |  | 20 |  | 20 |
| CO3 |  | 10 |  | 10 | 10 | 10 | 40 |
| CO4 |  |  | 20 |  |  |  | 20 |
| CO5 |  |  |  | 20 |  |  | 20 |
| CO6 |  | 30 |  |  | 10 |  | 40 |
|  | | | | | | | **180** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **20BT3067** | **Duration** | **3hrs** |
| **Course Name** | **TISSUE ENGINEERING AND STEM CELL TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Elaborate the importance of Cell line preservation and its authentication. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Discuss the concepts involved in 3D cell culturing and the protocols involving the same. | CO2 | U | 10 |
|  | b. | Classify the role of tissue engineering its significance and possible applications. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Discuss the recent developments in cell seeding of implantable materials. | CO2 | U | 10 |
|  | b. | Interpret the disadvantages of *in vivo* cell culturing. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Debate on the various cell viability and cell cytotoxicity assays to access cell lines. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Discuss the various methods to grow multicellular tumor spheroids and assess its stability. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Write the concept of stem cell differentiation and the significance of its cell types. | CO4 | R | 20 |
|  |  |  |  |  |  |
| 7. |  | Interpret the various sources, types, classification, lineage, and properties of immune cells. | CO4 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Appraise the isolation of cord blood cell and brief its advantages and its applications. | CO6 | E | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Outline the significance of stem cells in treating autoimmune disorders. | CO6 | An | 10 |
|  | b. | What are the significances of Haemocytometer in validating the cell number along with the calculation? | CO6 | An | 10 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Explain the concepts in cell culture techniques |
| CO2 | Understand the importance of 3D cell culture and its applications |
| CO3 | Analyse tissue engineering process and applications in the field of medicine |
| CO4 | Categorize different types of stem cells and its functions |
| CO5 | Examine the methods involved in the isolation of stem cells. |
| CO6 | Justify the clinical potential, significance and ethics of stem cells |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 40 | - | - | - | - | 40 |
| CO2 | - | 20 | - | 20 | - | - | 40 |
| CO3 | - | - | 20 | - | - | - | 20 |
| CO4 | 40 | - | - | - | - | - | 40 |
| CO5 | - | - | - | - | 20 | - | 20 |
| CO6 | - | - | - | 20 | - | - | 20 |
|  | | | | | | | **180** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **HUMAN ANATOMY, PHYSIOLOGY AND HEALTH EDUCATION** | **Duration** | **3hrs** |
| **Course Name** | **20BT3069** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Define Anatomy and describe the structural organization of human body. | CO1 | R | 10 |
|  | b. | Explore the composition and organization of the cellular membrane. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | What is the skeletal system, and what are its types and functions? | CO2 | R | 20 |
|  |  |  |  |  |  |
| 3. | a. | Describe the mechanism involved in muscle contraction and generation of nerve impulse. | CO3 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Define active transport and discuss in detail about uniport, antiport and symport process. | CO4 | U | 10 |
|  | b. | Discuss the composition and functions of blood and body fluids. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Distinguish the functions of Sympathetic and Parasympathetic nervous system. | CO5 | E | 10 |
|  | b. | Describe the functional mechanism of lymphatic organs and tissues. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss the types, causes and symptoms associated with Anemia | CO4 | U | 20 |
|  |  |  |  |  |  |
| 7. | a. | Illustrate and label the structure of heart and explain various events during each cardiac cycle. | CO5 | A | 10 |
|  | b. | Categorize the regulation of blood pressure, pulse, and disorders of heart. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain different measures of family planning in male and female. | CO6 | U | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Validate the various treatments involved in First Aid for snake bite, burns, poisoning and fractures. | CO6 | C | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Recall the anatomical terminology to identify and describe locations of major organs of each system covered. |
| CO2 | Explain interrelationships among molecular, cellular, tissue and organ functions in each system. |
| CO3 | Summaries the interdependency and interactions of the systems |
| CO4 | Enumerate contributions of organs and systems to the maintenance of homeostasis. |
| CO5 | Describe the physiological role of CVS system on human body. |
| CO6 | Infer to aware of excellence in health education and first aid and to describe modern technology and tools used to study for excellent education carrier and well beings. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 10 |  |  | 10 |  |  | 20 |
| CO2 | 20 |  |  |  |  |  | 20 |
| CO3 | 20 |  |  |  |  |  | 20 |
| CO4 |  | 40 |  |  |  |  | 40 |
| CO5 |  | 10 | 10 | 10 | 10 |  | 40 |
| CO6 | 20 |  |  |  |  | 20 | 40 |
|  | | | | | | | **180** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **22BT2071** | **Duration** | **3hrs** |
| **Course Name** | **GOOD MANUFACTURING AND LABORATORY PRACTICES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Good Clinical Practices. | | CO1 | R | 1 |
| 2. | What is SOP? | | CO1 | R | 1 |
| 3. | Name the ISO standard for environment management. | | CO2 | R | 1 |
| 4. | Define Quality Control. | | CO2 | R | 1 |
| 5. | State one validation in pharma industry. | | CO3 | R | 1 |
| 6. | Write one example for design of experiment in biotech product development. | | CO3 | A | 1 |
| 7. | Define Quality Assurance. | | CO4 | R | 1 |
| 8. | State the role of IBSC. | | CO5 | U | 1 |
| 9. | Name one microorganism which can be considered under biosafety level 3. | | CO5 | R | 1 |
| 10. | Write the function of Animal ethical committee. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate the principle of standard operating protocol for pH meter in biochemistry laboratory. | | CO1 | A | 3 |
| 12. | Explain the difficulty in adaptation of quality standards in food industry. | | CO2 | U | 3 |
| 13. | Write the different methods of sanitation followed in industrial production unit. | | CO3 | U | 3 |
| 14. | State the function of ISO 9000. | | CO4 | R | 3 |
| 15. | Write the different containment facilities used for control of infectious agents in biosafety level 4 laboratory. | | CO5 | An | 3 |
| 16. | Explain the steps involved in production of pharma drug for commercialization as per the Government of India guidelines. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the WHO guidelines on Good Manufacturing Practices for drug production in pharma industry. | CO1 | U | 10 |
|  | b. | State the significance of Good Clinical Practices. | CO1 | R | 2 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the different International and National quality systems and standards in product development. | CO2 | A | 10 |
|  | b. | Name the ISO standard for food safety. | CO2 | R | 2 |
|  |  |  |  |  |  |
| 19. | a. | Explain the steps involved in design of experiments in development of products in food industry. | CO3 | An | 8 |
|  | b. | Summarize the application of DOE in development of herbal product. | CO3 | E | 4 |
|  |  |  |  |  |  |
| 20. |  | Discuss the steps in identification of Critical Control Points in product development in food industry. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the principle and guidelines of NABL accreditation of food Laboratory with necessary example. | CO4 | An | 8 |
|  | b. | Summarize the significance of ISO standards in industrial quality assurance. | CO4 | E | 4 |
|  |  |  |  |  |  |
| 22. | a. | Discuss the DBT guidelines of Government of India on Biosafety levels with suitable examples. | CO5 | U | 10 |
|  | b. | Define biosafety. | CO5 | R | 2 |
|  |  |  |  |  |  |
| 23. |  | Explain laboratory associated infections and other hazards in biotechnology labs with suitable examples. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Categorize the guidelines involved in animal studies in drug development. | CO6 | An | 10 |
|  | b. | Explain the steps involved in development of drugs for commercialization. | CO6 | A | 2 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Understand the key regulatory and compliance elements with respect to Good Manufacturing Practices, Good Laboratory Practices and Good Clinical Practices. |
| **CO2** | Formulate check lists and SOPs for various assessment and accreditation process. |
| **CO3** | Implement Good laboratory and manufacturing practices in Food and Pharma Industries. |
| **CO4** | Organize readiness in conduct of audits and trials. |
| **CO5** | Assess biological safety and hazards. |
| **CO6** | Gain knowledge on regulatory affairs. |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 4 | 10 | 3 | - | - | - | **17** |
| **CO2** | 4 | 3 | 10 | - | - | - | **17** |
| **CO3** | 1 | 3 | 1 | 8 | 4 | - | **17** |
| **CO4** | 4 | 12 | - | 8 | 4 | - | **28** |
| **CO5** | 3 | 23 | - | 3 | - | - | **29** |
| **CO6** | 4 | - | 2 | 10 | - | - | **16** |
| **TOTAL** | | | | | | | **124** |

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**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **22BT2072** | **Duration** | **3hrs** |
| **Course Name** | **METABOLIC ENGINEERING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the metabolic fuel of cells. | | CO1 | R | 1 |
| 2. | What do you mean by amphibolic pathway? | | CO1 | R | 1 |
| 3. | Differentiate feedback inhibition from feedback repression. | | CO2 | U | 1 |
| 4. | Define the term catabolite repression. | | CO2 | R | 1 |
| 5. | State the importance of isotopomers. | | CO3 | R | 1 |
| 6. | Write the role of NMR in isotope based experiment. | | CO3 | A | 1 |
| 7. | Explain elasticity coefficient of an enzyme. | | CO4 | U | 1 |
| 8. | List the advantages of bioconversion. | | CO4 | R | 1 |
| 9. | Name the protease producing bacteria. | | CO5 | R | 1 |
| 10. | Write the role of calcium oxide in citric acid recovery. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish between substrate and metabolic product with suitable examples. | | CO1 | An | 3 |
| 12. | Explain allosteric enzyme with a neat diagram. | | CO2 | U | 3 |
| 13. | Compare steady state and pseudo steady state assumptions in metabolic flux analysis. | | CO3 | U | 3 |
| 14. | Evaluate the relationship between substrate concentration, enzyme activity and flux regulation. | | CO4 | E | 3 |
| 15. | Explain the factors that can influence bioconversion in biotechnological processes. | | CO5 | U | 3 |
| 16. | Critically analyze the impact of product inhibition on bioconversion reactions. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. | a. | Give an overview of integration of anabolism and catabolism in a biosynthetic pathway. | CO1 | U | 8 |
|  | b. | Explain the usefulness of genome and proteome methods in characterization of metabolites. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Distinguish between concerted feedback regulation and cumulative feedback regulation with examples. | CO2 | An | 6 |
|  | b. | Explain gene regulation by Jacob and Monad model citing lac operon as example. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the rationale of choice of labeled substrate in 13C metabolic flux analysis. | CO3 | An | 6 |
|  | b. | Distinguish between an “over-determined” and “under-determined” in metabolic flux analysis system? How would you measure unknown flux from such kind of system? | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the linearized kinetic relation with elasticity parameters for Metabolic Control Analysis with appropriate example. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Define bioconversion. Illustrate the biotransformation process of steroids with suitable example. | CO5 | A | 6 |
|  | b. | Explain mixed or sequential bioconversions in product formation with suitable examples. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Apply the concept of mutants resistant to repression in isolation of lysine producing novel strains. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Discuss the strategies to enhance the product yield and productivity of ethanol. | CO6 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the possible strategies to increase lysine production in bacterial system. | CO6 | U | 6 |
|  | b. | Explain how metabolic engineering strategies can improve the protease production. | CO6 | U | 6 |

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|  | **COURSE OUTCOMES** |
| CO1 | Comprehend modern biology with engineering principles |
| CO2 | Recall the principles and regulation of metabolic pathways |
| CO3 | Construct suitable metabolic flux models using available metabolic engineering tools |
| CO4 | Familiarize with the conceptual framework involved in metabolic control analysis |
| CO5 | Appreciate the process of bioconversion to produce commercial product |
| CO6 | Describe the industrial applications of metabolic engineering in the field of medicine, energy, and environment |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / BL | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 12 | - | 3 | - | - | 17 |
| CO2 | 1 | 4 | 12 | 12 | - | - | 29 |
| CO3 | 1 | 3 | 1 | 12 | - | - | 17 |
| CO4 | 1 | 13 | - | - | 3 | - | 17 |
| CO5 | 1 | 3 | 12 | - | - | - | 16 |
| CO6 | - | 24 | 1 | 3 | - | - | 28 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

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| --- | --- | --- | --- |
| **Course Code** | **22BT2074** | **Duration** | **3hrs** |
| **Course Name** | **BIOPROCESS ENGINEERING** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Respiratory Quotient. | | CO1 | R | 1 |
| 2. | Find the apparent growth yield coefficient of biomass for a substrate using the following observation, X0 = 50 g/l, Xf = 100 g/l, S0 = 100 g/l; and Sf =25 g/l. | | CO2 | An | 1 |
| 3. | For an enzyme-catalyzed reaction, with an initial enzyme concentration of 0.09 g/l, constants were determined as Km= 3 g/l and Vmax=2.7 g/l min. Determine Kp. | | CO2 | E | 1 |
| 4. | If the specific growth rate (µ) of a culture in the logarithmic phase is 1.5 min.1  , Calculate the doubling time. | | CO2 | E | 1 |
| 5. | Recall any one alternative to the Monod growth model. | | CO2 | R | 1 |
| 6. | Define an unstructured and segregated model. | | CO2 | R | 1 |
| 7. | State the importance of critical oxygen concentration in aerobic fermentation. | | CO4 | An | 1 |
| 8. | Differentiate between batch and fed-batch modes of operation. | | CO5 | An | 1 |
| 9. | Name any two continuous reactors. | | CO5 | R | 1 |
| 10. | Write the expression for the power requirement of a bioreactor under aerated conditions. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Estimate the biomass yield coefficient for the biochemical reaction: | | CO1 | An | 3 |
| 12. | Differentiate between the log phase and the deceleration phase. | | CO2 | U | 3 |
| 13. | List out the factors that influence KLa. | | CO4 | An | 3 |
| 14. | Derive the speciality of the Leudeking Piret model. | | CO2 | A | 3 |
| 15. | Differentiate between HRT and SRT. | | CO5 | An | 3 |
| 16. | State the strategies for scale-down experiments. | | CO3 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | The following results were obtained for an enzyme-catalyzed reaction. Estimate Km and Vmax using Lineweaver-Burk plot. Estimate the initial velocity at substrate concentration of 30 mmol L-1, if enzyme concentration is doubled.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Substrate concentration (mmol L-1) | 5.0 | 6.67 | 10.0 | 20.0 | 40.0 | | Initial velocity (mmol L-1 min-1) | 0.14 | 0.18 | 0.23 | 0.32 | 0.40 | | CO2 | An | 12 |
|  |  |  |  |  |  |
| 18. | a. | Derive the expression for competitive and non-competitive inhibition toxic compound reactions and explain it with the help of a line-weaver Burk plot. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Aerobic degradation of an organic compound by a mixed culture in wastewater is represented by the following reaction.  **C3H6O3+ aO2 + b NH3 🡪 cC5H7NO2+dH2O+eCO2**  If Yx/s= 0.4 g /g, calculate**,**   1. Stoichiometric coefficients a, b, c, d, and e. 2. yield coefficients Yx/O2 and Yx/NH3. 3. respiratory quotient. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 20. | a. | Microbial growth on glucose is assumed to follow Monod’s kinetics, and the following data is obtained from a batch study. Estimate µmax, and Ks   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Time (h) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | | X (g/l) | 1.00 | 1.46 | 2.12 | 3.03 | 4.20 | 5.50 | 6.51 | | S (g/l) | 20.00 | 18.45 | 16.26 | 13.23 | 9.33 | 5.00 | 1.63 | | CO6 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | The production of ethanol was carried out in a batch reactor and the following data were obtained.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Time (h)** | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | | **Glucose (g/l)** | 100 | 94 | 83 | 76 | 62 | 50 | 40 | 22 | | ***Penicillin (g/l)*** | 0.5 | 2.5 | 3.2 | 6.7 | 12.1 | 16.8 | 25.7 | 29 | | **Biomass (g/l)** | 0 | 2 | 3.5 | 6.1 | 8.4 | 10.7 | 11.9 | 16 |   Determine (a) max-specific growth rate, (b) specific growth rate at 40 h, (c) biomass yield coefficient, (d) product yield coefficient, and (e) doubling time. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | Elaborate on static and dynamic gassing out methods used to estimate the volumetric mass transfer coefficient in microbial reactors. | CO4 | An | 8 |
|  | b. | A strain of *E. coli* is cultured in a fermenter under operating conditions kLa is 612 h- 1. Oxygen solubility in broth is approximately 8 mg/l. Calculate maximum biomass conc., if the specific oxygen uptake rate is 400 mg g-1 h - 1. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 23. | a. | Formulate biomass and substrate balance equations in CSTR under steady-state conditions. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate with a neat sketch the design and working of an air lift bioreactor. | CO3 | U | 6 |
|  | b. | Describe the process of scale-up of bioreactors. | CO3 | U | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Gain knowledge on principles of stoichiometry and concepts of bioreactor engineering |
| **CO2** | Understand the growth kinetics and enzyme kinetics in the fermentation process |
| **CO3** | Apply bioreactor design fundamentals in scale up process |
| **CO4** | Evaluate the oxygen requirement in aerobic culture and oxygen-limited growth |
| **CO5** | Analyze various bioreactors for the fermentation process. |
| **CO6** | Evaluate the application of enzymes and the techniques of immobilization |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | - | - | 3 | 12 | - | 16 |
| **CO2** | 2 | 3 | 15 | 13 | 14 | - | 47 |
| **CO3** | - | 15 | - | - | - | - | 15 |
| **CO4** | - | 4 | - | 12 | - | - | 16 |
| **CO5** | 1 | 12 | - | 4 | - | - | 17 |
| **CO6** | - | 12 | 1 | - | - | - | 13 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **22BT2079** | **Duration** | **3hrs** |
| **Course Name** | **WASTE MANAGEMENT AND UPCYCLING** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the atomic bomb that was dropped on Nagasaki. | | CO1 | R | 1 |
| 2. | Which toxic compound is not found in e-waste? | | CO1 | U | 1 |
| 3. | Which cities produce the highest e-waste in India? | | CO2 | U | 1 |
| 4. | **List the gases produced in open dumps from the decomposition of biodegradable wastes.** | | CO2 | R | 1 |
| 5. | Give examples for biomedical wastes. | | CO3 | U | 1 |
| 6. | Define biofuels. | | CO3 | R | 1 |
| 7. | Name the earthworm known as red wiggler. | | CO4 | R | 1 |
| 8. | Give examples for toxic wastes. | | CO4 | U | 1 |
| 9. | Define leaching. | | CO5 | R | 1 |
| 10. | Name the toxic material present in the newspaper. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | State the role of MSDS in hazard storage. | | CO1 | R | 3 |
| 12. | Differentiate between composting and vermicomposting. | | CO2 | U | 3 |
| 13. | List the applications of biohydrogen. | | CO3 | R | 3 |
| 14. | Compare between bioreactor and secure landfill. | | CO4 | U | 3 |
| 15. | Cite the characteristics of sludge. | | CO5 | U | 3 |
| 16. | Write the role of civic amenity site in collection of solid waste. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the effect of plastics on environment. | CO2 | A | 6 |
|  | b. | Describe the degradation of organic waste by vermicomposting. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the various disposal methods for solid waste. | CO1 | A | 6 |
|  | b. | Enumerate the causes and effects of nuclear holocaust. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 19. | a. | Describe the storage methods for hazardous waste. | CO4 | U | 6 |
|  | b. | Explain the types of bioreactor landfill. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Generalize the physical and biological properties of solid waste. | CO2 | U | 6 |
|  | b. | Explain the various types of landfill with suitable diagrams. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | Illustrate with diagram the effluent treatment plant for waste water. | CO5 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Sketch the process for Bioethanol production and explain them. | CO6 | A | 12 |
|  |  |  |  |  |  |
| 23. |  | Discuss the types and effects of biomedical wastes. | CO4 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Elaborate the steps involved in upcycling of textile waste. | CO6 | A | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Categorize different types of wastes and develop concepts in the field of waste management. |
| **CO2** | Relate the characteristics features of different wastes and influencing factors. |
| **CO3** | Analyze suitable techniques to transport and disposal of wastes. |
| **CO4** | Compare among various waste processing technologies |
| **CO5** | Formulate treatment process of wastewater and sludge disposal. |
| **CO6** | Develop sustainable technologies for waste conversion into value-added products. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 16 | 1 | 6 |  |  |  | 23 |
| **CO2** | 1 | 10 | 6 |  |  |  | 17 |
| **CO3** | 4 | 7 | 6 |  |  |  | 17 |
| **CO4** | 1 | 22 | - |  |  |  | 23 |
| **CO5** | 1 | 3 | 12 |  |  |  | 16 |
| **CO6** | 1 | - | 27 |  |  |  | 28 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **22BT2087** | **Duration** | **3hrs** |
| **Course Name** | **COMPUTER AIDED DRUG DESIGN** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | What role does molecular modeling play in CADD? | | CO1 | U | 1 |
| 2. | What is the purpose of QSAR in CADD? | | CO1 | R | 1 |
| 3. | Which molecular descriptor measures molecular size in CADD? | | CO2 | U | 1 |
| 4. | Define the pharmacophore modeling. | | CO2 | R | 1 |
| 5. | What is the significance of model interpretation in QSAR studies? | | CO3 | U | 1 |
| 6. | Which property measures a molecule's resistance to deformation under stress? | | CO3 | R | 1 |
| 7. | State the significance of the term "polarity" in molecular properties. | | CO4 | U | 1 |
| 8. | Which property describes the three-dimensional arrangement of atoms in a molecule? | | CO5 | R | 1 |
| 9. | What is the primary objective of employing Molecular Mechanics in drug design? | | CO5 | U | 1 |
| 10. | Write the significance of energy minimization in molecular modeling. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the concept of molecular docking in Computer-Aided Drug Design (CADD) and discuss its significance in the process of drug discovery. | | CO1 | U | 3 |
| 12. | Describe the steps involved in ligand-based virtual screening in Computer-Aided Drug Design (CADD), and discuss its role in identifying potential drug candidates | | CO2 | R | 3 |
| 13. | Infer the significance of pharmacophore modeling in Computer-Aided Drug Design (CADD) and explain how it aids in the design of new drugs. | | CO3 | U | 3 |
| 14. | State the concept of quantitative structure-activity relationship (QSAR) modeling in Computer-Aided Drug Design (CADD), and discuss its applications in drug discovery. | | CO4 | R | 3 |
| 15. | Explain the concept of structure-based drug design in Computer-Aided Drug Design (CADD) and discuss its advantages in the drug discovery process | | CO5 | U | 3 |
| 16. | Write the significance of virtual screening in Computer-Aided Drug Design (CADD). | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | What is Computer-Aided Drug Design (CADD), and what are its primary objectives? Explain how CADD integrates computational techniques with experimental methods in the drug discovery process. | CO1 | R | 6 |
|  | b. | Describe the role of methods used to calculate the physiochemical parameters. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the role of electronic parameters in QSAR modeling, including electronegativity, ionization potential, and electron affinity. Explain how these parameters reflect compound reactivity and affinity for biological targets. Provide examples of QSAR models incorporating electronic descriptors to predict activity. | CO2 | U | 6 |
|  | b. | Describe the physicochemical parameters were determined by various experimental and theoretical approaches | CO2 | R | 6 |
|  |  |  |  |  |  |
| 19. | a. | Describe the stages involved in the modern drug discovery process, from target identification to clinical trials. Discuss the key challenges and considerations at each stage, and explain how integration of computational and experimental approaches enhances the efficiency of the process. | CO3 | U | 8 |
|  | b. | Briefly describe the role of genomics, proteomics and bioinformatics in new drug discovery | CO3 | U | 4 |
|  |  |  |  |  |  |
| 20. | a. | Explain the principles and application of Hansch and Free Wilson analysis and relationship. | CO3 | U | 6 |
|  | b. | Describe the difference between 2D and 3D QSAR modeling approaches. Discuss the advantages and limitations of each approach and provide examples of their applications in drug discovery. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Interpret the role of Molecular and Quantum Mechanics in drug design. | CO4 | A | 6 |
|  | b. | State the principles of molecular docking and its applications in Computer-Aided Drug Design (CADD). Explain how molecular docking predicts the binding conformation and affinity of small molecules to target proteins. | CO4 | R | 6 |
|  |  |  |  |  |  |
| 22. | a. | Define energy minimization. Describe the methods used to confirm the bioactive confirmation of biomolecule. | CO4 | R | 6 |
|  | b. | Explain the importance of molecular properties in drug design. Discuss how physicochemical properties influence the pharmacokinetic and pharmacodynamic profiles of drug candidates**.** | CO4 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Describe the importance of hydrogen bonding capacity in drug design. Explain how De novo drug design methodology helps in drug discovery. | CO5 | A | 6 |
|  | b. | Infer the process of homology modeling in molecular modeling. Discuss how homology modeling constructs three-dimensional models of protein structures based on known homologous structures. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Compare and contrast ligand-based and structure-based pharmacophore modeling approaches in Computer-Aided Drug Design (CADD). Discuss their respective advantages, limitations, and applications in drug discovery. Provide examples to illustrate their utility. | CO6 | U | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Explain the various stages of drug discovery |
| **CO2** | Demonstrate the concept modern drug discovery process and validation |
| **CO3** | Describe physicochemical Properties and the techniques involved in QSAR |
| **CO4** | Learn introduction to Bioinformatics and Cheminformatics role in molecular docking studies |
| **CO5** | Contrast the methods in molecular and quantum mechanics in molecular properties |
| **CO6** | Explain various structure-based drug design methods in de nova virtual ligands screening |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 7 | 10 |  |  |  |  | 17 |
| **CO2** | 10 | 13 |  |  |  |  | 23 |
| **CO3** | 1 | 25 |  |  |  |  | 26 |
| **CO4** | 15 | 7 | 6 |  |  |  | 28 |
| **CO5** | 1 | 7 | 6 |  |  |  | 14 |
| **CO6** | 0 | 16 |  |  |  |  | 16 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION – APRIL / MAY 2024**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **22BT2090** | **Duration** | **3hrs** |
| **Course Name** | **GENOME EDITING FOR THERAPY** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Give one example for autosomal recessive disorder. | | CO1 | U | 1 |
| 2. | What are alleles? | | CO1 | R | 1 |
| 3. | Name the type of PCR used for detection of multiple pathogens by using multiple primer sets where each one targets a particular pathogen. | | CO2 | R | 1 |
| 4. | Write any two advantages of real time PCR. | | CO2 | R | 1 |
| 5. | Name the nuclease enzyme of ZF domain. | | CO3 | U | 1 |
| 6. | Expand TALEN. | | CO3 | R | 1 |
| 7. | Define protospacer adjacent motif. | | CO4 | U | 1 |
| 8. | Write the role of miRNA in genome editing. | | CO4 | An | 1 |
| 9. | Name the vector-based therapy used for the treatment of Hemophilia A. | | CO5 | An | 1 |
| 10. | Write any two limitations of genome editing tools. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the steps involved in reverse transcriptase PCR. | | CO1 | An | 3 |
| 12. | Write the role of Phi3 1 Integrase in genome editing. | | CO2 | R | 3 |
| 13. | Illustrate on the design of sgRNA. | | CO3 | An | 3 |
| 14. | Write about the types of coding and non-coding RNAs. | | CO4 | R | 3 |
| 15. | Explain X chromosome inactivation give example. | | CO5 | An | 3 |
| 16. | Explain the fitness of edited cells. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Analyze RFLP technique used in the detection of Sickle cell Anemia. | CO1 | An | 6 |
|  | b. | Describe Sangers method of gene sequencing with illustrations. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the mechanism and applications of ZFNs in genome editing. | CO2 | U | 6 |
|  | b. | Explain DNA microarray technology and its applications. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Appraise on gene knockout in mice using CRISPR/CAS9. | CO4 | An | 6 |
|  | b. | Analyze the natural defense mechanism in bacteria and the development CRISPR editing system. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain gene silencing mechanism through siRNA in eukaryotic cells. | CO3 | U | 6 |
|  | b. | Describe how miRNA regulate the expression of multiple mRNAs. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Analyze the process involved in *in vivo* editing therapy for HIV. | CO5 | AN | 12 |
|  |  |  |  |  |  |
| 22. | a. | Discuss the applications TALEN in genome editing. | CO5 | U | 6 |
|  | b. | Explain the challenges in gene editing clinical translation. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain homologous recombination method with suitable example. | CO5 | U | 6 |
|  | b. | Describe the process of Cre/Lox P system in genome editing. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss the applications and limitations of gene editing tools with examples. | CO6 | R | 6 |
|  | b. | Describe about WHO recommendations on genome editing for the advancement of public health, | CO6 | R | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe the basic concepts in human genome organization and genetic diseases. |
| **CO2** | Understand the tools used in genome editing. |
| **CO3** | Identify various strategies in genome editing for therapy. |
| **CO4** | Understand thoroughly the technique of CRISPR in therapeutics. |
| **CO5** | Demonstrate a capacity for understanding the social impact of genome engineering. |
| **CO6** | Perceive the ethical implications of genome editing. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / BL** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 1 | 1 |  | 15 |  |  | 17 |
| **CO2** | 5 | 12 |  |  |  |  | 17 |
| **CO3** | 1 | 13 |  | 3 |  |  | 17 |
| **CO4** | 3 | 1 |  | 13 |  |  | 17 |
| **CO5** |  | 18 |  | 16 |  |  | 34 |
| **CO6** | 12 | 10 |  |  |  |  | 22 |
|  | | | | | | | **124** |