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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Compare mono and disaccharides. | | CO1 | U | 1 |
| 2. | Quote any TWO examples for phospholipids. | | CO1 | R | 1 |
| 3. | Define zwitterion. | | CO2 | R | 1 |
| 4. | State the clinical significance of ketosis. | | CO2 | R | 1 |
| 5. | Distinguish saturated fatty acids from unsaturated fatty acids. | | CO3 | U | 1 |
| 6. | State the industrial applications of proteins. | | CO3 | R | 1 |
| 7. | Cite any TWO sources of fat. | | CO4 | U | 1 |
| 8. | Sketch the structure of tRNA. | | CO4 | R | 1 |
| 9. | Group the various classes of fatty acids. | | CO5 | U | 1 |
| 10. | Distinguish any one benefit of PUFA from MUFA. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the sources of vitamin B1. | | CO1 | U | 3 |
| 12. | Name few nutraceuticals. | | CO2 | R | 3 |
| 13. | Give examples for homo and hetero polysaccharides. | | CO3 | R | 3 |
| 14. | Write short motes on the components of simple lipids. | | CO4 | R | 3 |
| 15. | Identify the basic functions of vasopressin. | | CO5 | U | 3 |
| 16. | State the industrial applications of carbohydrates. | | 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 various theories related to concept of matter, atom and molecule. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Classify the peptide bond, natural and artificial peptides. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 19. |  | Draw the structure of mRNA, rRNA and tRNA with basic functions | CO2 | R | 12 |
|  |  |  |  |  |  |
| 20. |  | Recall the types and properties of amino acids . | CO4 | R | 12 |
|  |  |  |  |  |  |
| 21. |  | Discuss the composition, structure and properties of DNA. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the structure and properties of oligo and polysaccharides. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe the structure and functional properties of fatty acids. | CO3 | R | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | State the benefits of vitamin B6. And also cite how vitamin B6  can prevent or mitigate the deficiency disease. | CO6 | U | 6 |
|  | b. | Tabulate the functions of antioxidants. | CO6 | R | 6 |

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

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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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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define anabolism. | | CO1 | U | 1 |
| 2. | Where does the glycolysis take place in a cell? | | CO1 | R | 1 |
| 3. | Write the fate of amino group of amino acids after transamination. | | CO2 | R | 1 |
| 4. | Name the common metabolic intermediate of aromatic amino acids synthesis. | | CO2 | R | 1 |
| 5. | Write the first compound, synthesized in the process of fatty acid synthesis. | | CO6 | U | 1 |
| 6. | Cite any ONE clinically significant derivative of cholesterol. | | CO6 | R | 1 |
| 7. | State ONE disorder of purine metabolism along with the defective enzyme. | | CO5 | U | 1 |
| 8. | Write the end product of purine catabolism in human. | | CO4 | R | 1 |
| 9. | How much Gibb’s free energy (Δ*G'*⸰) is released in ATP hydrolysis to ADP and Pi? | | CO3 | U | 1 |
| 10. | State the shunt pathway, which interlinks the TCA cycle and urea cycle. | | CO1 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List any THREE characteristics of a biocatalyst. | | CO1 | An | 3 |
| 12. | Define transamination and give the reaction. | | CO2 | U | 3 |
| 13. | State the clinical implications and applications of ketogenesis. | | CO6 | An | 3 |
| 14. | Define *de novo* synthesis of purine and pyrimidine. State the precursors used. | | CO4 | U | 3 |
| 15. | Criticize on the uncouplers of ETC and oxidative phosphorylation with an example. | | CO3 | An | 3 |
| 16. | Relate the primary metabolites with the synthesis of secondary metabolites. | | CO1 | 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. | Appraise the amphibolic role of TCA cycle with a neat sketch. | CO1 | A | 6 |
|  | b. | Depict the biochemical reaction pathway of TCA cycle. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. |  | Describe the catabolic reactions of phenylalanine and tyrosine along with the clinical implications of inborn errors of their catabolism. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain the reaction steps involved in the β-oxidation of fatty acids and calculate the bioenergy generated in oxidation of palmitic acid. | CO6 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Illustrate the metabolic degradation pathway of thymine and comment on the disorders associated with pyrimidine metabolism. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Examine the metabolic pathways of glycogenesis and glycogenolysis with their coordinated regulation. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | Integrate the ETC with oxidative phosphorylation for bioenergy generation with a diagrammatic illustration. | CO3 | An | 6 |
|  | b. | Give the redox reactions of glycolysis and photosynthesis. | CO3 | R | 6 |
|  |  |  |  |  |  |
| 23. |  | Explain how the CO2 is assimilated in plants via Calvin cycle. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain how the metabolic pathways of glycolysis and gluconeogenesis are coordinately regulated. State the reason for it. | CO1 | U | 12 |
|  | b. |  |  |  |  |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Apply knowledge of metabolic pathways |
| **CO2** | Distinguish between the biosynthesis and degradation pathways of amino acids |
| **CO3** | Illustrate the importance of bioenergetics and energy-rich compounds. |
| **CO4** | Illustrate the metabolic reactions of nucleotides |
| **CO5** | Examine the correlation between various inborn errors of metabolism and clinical outcomes |
| **CO6** | Analyse the anabolic and catabolic reactions of lipids |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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

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| **Q. No.** | **Questions** | | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Mention the biological importance of restriction and modification system in bacteria. | | | CO1 | U | 1 |
| 2. | “A recombinant DNA molecule was created by ligating a gene to a plasmid vector. By mistake, an exonuclease enzyme was mixed with the recombinant DNA”, state how will this affect the transformation of the plasmid? | | | CO1 | R | 1 |
| 3. | Name any one selectable and scorable marker. | | | CO2 | R | 1 |
| 4. | “A low level of expression of lac operon occurs at all the time in a bacterial cell”. Comment on the above statement | | | CO2 | R | 1 |
| 5. | What are phagemids? | | | CO3 | U | 1 |
| 6. | Name any one strategy to increase the copy number of plasmid. | | | CO3 | R | 1 |
| 7. | What are random primers? | | | CO4 | U | 1 |
| 8. | Comment on PCR as an alternate to genomic cloning. | | | CO4 | R | 1 |
| 9. | Report ‘Red white screening’. | | | CO5 | U | 1 |
| 10. | List any two commercially available transgenic plant in the market. | | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Differentiate linkers and adaptors. List the advantage of using linkers in gene cloning. | | | CO1 | An | 3 |
| 12. | How to prevent self-ligation of plasmids? | | | CO2 | U | 3 |
| 13. | State what is TA cloning and its application in gene cloning. | | | CO3 | An | 3 |
| 14. | Write the PCR programme for the following set of primers after calculating annealing temperature  **Forward Primer : 5’ ATATCTGCATGCTATGC 3’**  **Reverse Primer : 3’ CATGCGTACGTCGATGC 3’** | | | CO4 | U | 3 |
| 15. | How will you calculate the numbers of clones to be screened to identify a single positive clone with 99% confidence in a genomic library constructed for human (30 billion bp) in a λ library of insert size 20 kbp to identify a single copy gene. | | | CO5 | An | 3 |
| 16. | List the process of production of Dolly. | | | CO6 | U | R |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | | |
| 17. |  | Write a detailed note on the different types of Restriction Endonucleases and its application in rDNA technology. | CO1 | | An | 12 |
|  |  |  |  | |  |  |
| 18. |  | Give a detailed account on various modifying enzymes used in creating recombinant DNA molecules. | CO2 | | U | 12 |
|  |  |  |  | |  |  |
| 19. | a. | Give an account on pBR322 and pUC18 cloning vectors. | CO3 | | U | 08 |
|  | b. | Write short notes on tac and λPL promoters used in *E.coli* expression system | CO3 | | U | 04 |
|  |  |  |  | |  |  |
| 20. |  | Describe the working principle and the process of RACE PCR and Real Time PCR. | CO4 | | U | 12 |
|  |  |  |  | |  |  |
| 21. |  | Explain the two different methods involved in the construction of full –length cDNA library. | CO5 | | An | 12 |
|  |  |  |  | |  |  |
| 22. |  | Explain how will you clone and express eukaryotic gene using Baculaovirus expression system. | CO3 | | An | 12 |
|  |  |  |  | |  |  |
| 23. |  | Explain gene complementation and gain of function strategy to screen the libraries. | CO3 | | A | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | How genetic engineering is useful in improving the agronomic traits in plants? Explain with a suitable examples | CO6 | | E | 12 |

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

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|  | **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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**END SEMESTER EXAMINATION – NOV/ DEC 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Monoclonal antibodies are ­­­­­­­­­­­­­­­­­­­­­­­­­­­­­sector ----------------- products. | | CO1 | U | 1 |
| 2. | In a 5 step process , if the overall yield is expected to be 50% , then the step yield is ------------ | | CO1 | R | 1 |
| 3. | The specific cake resistance for a Incompressible cake is ------------ | | CO2 | R | 1 |
| 4. | Buoyant force is caused due to -------------- difference between particle and the fluid | | CO2 | R | 1 |
| 5. | Reverse phase adsorption used for adsorption of -----------------molecules | | CO3 | U | 1 |
| 6. | Pre-dispersed solvent extraction involves the use of micron or sub-micron particle called as------------ | | CO3 | R | 1 |
| 7. | Time taken for a particular analyte to pass through the system is called----------time | | CO4 | U | 1 |
| 8. | Hexane is an example of ---------------solvent | | CO4 | R | 1 |
| 9. | In a spray dryer, the heat transfer to the dryer for drying is by------------and---------- | | CO5 | U | 1 |
| 10. | ---------------filtration step is used before chromatography in mAb purification. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Assume that Streptomycin is being recovered by ultrasonication from 5 litres of bacterial cell suspension having a cell concentration of 12.5 g/L. Past experiences have shown that 40% of the antibiotic can be recovered in 30 minutes. Predict the time required for 80% recovery of the antibiotic. | | CO1 | An | 3 |
| 12. | Write about Plate and frame filter press | | CO2 | U | 3 |
| 13. | Enlist the methods for precipitation using principle of solvent modification | | CO3 | An | 3 |
| 14. | Which type of chromatography separates mixtures due to interactions between the ligand and target molecule? | | CO4 | U | 3 |
| 15. | Differentiate between Adiabatic and Conductive drying | | CO5 | An | 3 |
| 16. | Discuss the key steps involved in Downstream processing of lactic acid purification | | 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. |  | *Penicillium chrysogenum* cells are cultivated to produce amino acids. The cell suspension you are working with has a concentration of 1.5 x 107 cells/mL. The secreted product in the cytoplasm is being recovered by the phenomenon of cavitation in a yeast cell suspension The shear forces cleave a complex network of structure and promotes the isolation of intracellular compounds. The amount of released product per 5ml was measured during the process. At 60 sec the concentration of the released product is 3.49 mg/L and the process is continued for 120 seconds and the amount of the released product is 4.56 mg/L. To achieve maximum recovery further the process is repeated upto 240 sec. Predict the concentration of desired product released. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. | a. | Derive an expression for time taken in Batch filtration. | CO2 | A | 6 |
|  | b. | It is desired to achieve complete recovery of bacterial cells from a fermentation broth with a pilot plant scale tubular centrifuge. It has been already determined that the cells are approximately spherical with a radius of 0.5 µm and have a density of 1.10 g/cm3. The speed of the centrifuge is 5000 rpm, the bowl diameter is 10 cm, the bowl length is 100 cm, and the outlet opening of the bowl has a diameter of 4 cm. Estimate the maximum flow rate of the fermentation broth that can be attained |  | E | 6 |
|  |  |  |  |  |  |
| 19. | a. | Quinine molecules partitioned between kerosene and water is given by x2= (0.004mol/l) y. We plan to contact 8 l of kerosene containing 0.009 M quinine with 4 l of water. What fraction of quinine is extracted? | CO3 | E | 8 |
|  | b. | How extraction of Thermolabile compounds are carried out? |  | U | 4 |
|  |  |  |  |  |  |
| 20. | a. | Write Short notes on Hydrophobic Interaction Chromatography | CO4 | A | 6 |
|  | b. | Give a brief note on Ion exchange Chromatography |  | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Crystallization is carried out for 150 l of Sodium Citrate Slurry, operated at 60l/hr. Assume same withdrawal rate , Density of crystals as 1.8 g/cm3, G is 0.064 mm/hr and B is 6.38x 107 nuclei/hr. Find the Dominant crystal size, No. of crystals smaller or equal to this crystal size. The fraction in this range and its area | CO5 | E | 8 |
|  | b. | Discuss the stages of Crystal formation |  | A | 4 |
|  |  |  |  |  |  |
| 22. |  | You are filtering a beer containing two species A and B with dia 7x10-4 and 0.3x10-4 You have measured the specific cake resistance of each species , µαρo(A)=1.3X109 and µαρo(B)=2.6X109Kg/sec m3 . For combined cultures it is seen that µαρo=(⅀øi√µαiρi)2. Where øi is the fraction of solute I in all solutes. Your present beer contains half the concentration of A as B. How long will it take to filter 850 lts of combined beer in a filter of negligible medium resistance, a pressure drop of 105 N/m2 and 4 m2 area. Which will get filtered quickly A or B? | CO2 | E | 12 |
|  |  |  |  |  |  |
| 23. |  | Give the principle behind Gel permeation chromatography. A chromatography column packed with Bio Gel P resin is used to separate Estrogen and progesterone. The column is 7.5 cm in diameter and 25 cm in height. What is the retention time for Estrogen and progesterone? The Specifications are as follows: a) The partition coefficients are 0.38 and 0.18 b) Void volume = 1.9 × 10−4 m3 c) ωr = 3 × 10−3 m3/kg dry resin d) ρg = 1.25 × 103 kg/m3 e) Eluting flow rate is 0.7 l/h | CO4 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Discuss the rationale behind each step including cell disruption, inclusion body solubilization, refolding, proteolytic cleavage, and chromatographic purification for recombinant Insulin Production. | CO6 | C | 8 |
|  | b. | Explain how purity and biological activity are maintained throughout the process. |  | A | 4 |

**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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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Expand PAMPs and PRR with two examples in each. | | CO1 | U | 1 |
| 2. | List the granulocytes and agranulocytes. | | CO1 | A | 1 |
| 3. | Distinguish serum and plasma. | | CO1 | A | 1 |
| 4. | List any two NOS utilized by the immune system. | | CO2 | R | 1 |
| 5. | Give the name of the immunoglobulin that is first produced in response to infection. | | CO3 | U | 1 |
| 6. | Name the component that enables IgA to pass through membranes and be secreted. | | CO3 | R | 1 |
| 7. | Give the name of the condition caused by HIV. | | CO4 | An | 1 |
| 8. | List the professional Antigen Presenting Cells (APCs). | | CO5 | R | 1 |
| 9. | Expand ELISA. | | CO5 | E | 1 |
| 10. | Give the name of the technology for which Kholer and Milstien were awarded the Nobel prize. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Brief upon commensals/normal flora now known as microbiota. | | CO1 | An | 3 |
| 12. | Outline the design of the human immune system. | | CO2 | U | 3 |
| 13. | Write about neutralization, opsonization and complement activation. | | CO3 | R | 3 |
| 14. | Differentiate Affinity from Avidity. | | CO4 | U | 3 |
| 15. | Distinguish between epitope and paratope and mention the molecular interactions between them. | | CO5 | E | 3 |
| 16. | Write short notes on hypersensitivity reactions. | | 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 in detail the structure and function of primary lymphoid organs. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain Hematopoiesis cycle to produce immune cells and blood cells with a neat diagram. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Describe the basic structure of Immunoglobulins also classify different types of antibodies | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain in detail the processing and presentation of antigen by MHC-I. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. | a | Write sort notes on complement system | CO5 | U | 6 |
|  | a | Write sort notes on Lectin pathway |  | U | 6 |
|  |  |  |  |  |  |
| 22. |  | Elucidate the types, properties and the role of cytokines in regulating the immune system | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Illustrate how the process of leukocyte extravasation happens during skin cut or wound | CO6 | E | 6 |
|  | b. | Distinguish between T-dependent and T-independent B-cell activation. | CO6 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain different types of vaccines against COVID-19. | CO6 | An | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Exhibit a. knowledge on the history, development and controversies in 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** | Relate the cells of the immune system and their functions. |
| **CO4** | Categories the functions of the innate and adaptive immune system. |
| **CO5** | Analyze the cellular and molecular interactions, physiology and the pathology of the immune system. |
| **CO6** | Infer of the applications of immunology in diagnosis and treatment of diseases. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State ONE key feature of the Protein Data Bank (PDB) file format. | | CO1 | U | 1 |
| 2. | Name the uses of Bioinformatics in medicine. | | CO1 | R | 1 |
| 3. | Mention ONE feature of SwissProt database. | | CO2 | U | 1 |
| 4. | List any ONE secondary protein database. | | CO2 | A | 1 |
| 5. | What is the purpose of using substitution matrices in sequence alignment? | | CO3 | U | 1 |
| 6. | Identify the algorithm used for local sequence alignment. | | CO3 | R | 1 |
| 7. | List any one EMBL-EBI tool used for sequence alignment. | | CO4 | U | 1 |
| 8. | Which bioinformatics resource provides access to gene expression data. | | CO4 | R | 1 |
| 9. | What type of data is used to construct phylogenetic trees? | | CO5 | U | 1 |
| 10. | Suggest ONE reason why energy minimization is essential in structural refinement. | | CO6 | C | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the role of Protein Data Bank (PDB) in structural biology and molecular modeling. | | CO1 | An | 3 |
| 12. | Illustrate how protein sequence databases can be used in functional annotation of unknown proteins. | | CO2 | A | 3 |
| 13. | Compare PAM and BLOSUM substitution matrices. | | CO3 | An | 3 |
| 14. | Evaluate the effectiveness of gene expression databases in studying disease-related transcriptomics. | | CO4 | E | 3 |
| 15. | Compare distance-based and character-based tree reconstruction methods with suitable examples. | | CO5 | An | 3 |
| 16. | Illustrate the steps involved in ab-initio protein structure prediction. | | 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. | Describe the importance of Bioinformatics in modern biological research and healthcare. | CO1 | U | 6 |
|  | b. | Illustrate how PDB files represent 3D protein structures and support molecular visualization. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Justify the integration of multiple biological databases for comprehensive molecular analysis. | CO1 | E | 6 |
|  | b. | Explain the data fields and annotation features found in a GenBank flat file. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Discuss the structure and content of primary sequence databases with suitable examples. | CO2 | U | 6 |
|  | b. | Illustrate the difference between primary and secondary databases in terms of data origin and annotation. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the concept of sequence alignment and its significance in bioinformatics. | CO3 | U | 6 |
|  | b. | Illustrate the steps involved in pairwise sequence alignment using dynamic programming. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | Evaluate the role of energy minimization and molecular simulation techniques in refining protein structures and studying biomolecular interactions. | CO6 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | Describe the features and applications of ExPASy tools in protein sequence analysis. | CO4 | U | 6 |
|  | b. | Compare different primer design tools in terms of algorithm, specificity, and user interface | CO4 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Analyze the difference between distance-based and character-based phylogenetic tree reconstruction methods with examples. | CO5 | An | 6 |
|  | b. | Explain the structure, function, and significance of genomics and proteomics databases in biological research. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Compute the dynamic programming table, alignments and associated sequence identities for the two strings You have a scoring scheme were  A match gives you +5  a mismatch gives you -3  opening a gap costs you −1  Write down the best Global alignment for the same two DNA sequences.  S1= AATTCGCGTA & S2 = TATCGCTACA | CO3 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Gain knowledge on biological databases and tools. |
| **CO2** | Illustrate 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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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Give an example of a **physical parameter** analyzed in water quality testing. | | CO1 | U | 1 |
| 2. | Write the factors that affect the efficiency of bio- adsorption. | | CO1 | An | 1 |
| 3. | Define activated sludge. | | CO2 | R | 1 |
| 4. | State the main byproduct of anaerobic digestion. | | CO2 | R | 1 |
| 5. | Identify a suitable control device for removing fine dust particles from flue gas. | | CO3 | A | 1 |
| 6. | State the impact of primary pollutants. | | CO3 | R | 1 |
| 7. | Write the main constituents of solid waste. | | CO4 | U | 1 |
| 8. | Give an example of recyclable solid waste. | | CO4 | R | 1 |
| 9. | Define recalcitrance in the context of biodegradation. | | CO5 | U | 1 |
| 10. | What is the main output of an integrated bio-digester? | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate the process of adsorption in the removal of wastewater contaminants. | | CO1 | An | 3 |
| 12. | Write the working principle of trickling filter. | | CO2 | U | 3 |
| 13. | Infer the major effects of air pollution on humans, animals, vegetation, and materials. | | CO3 | An | 3 |
| 14. | Give TWO examples of converting solid waste into useful bioproducts with their benefits in greener environment. | | CO4 | C | 3 |
| 15. | Write the role of “oil zapper” in oil sludge treatment. | | CO5 | An | 3 |
| 16. | List any TWO types of bio-fertilizers used in agriculture. Highlight their advantages, | | 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. | Explain the impact of greenhouse gases in environmental pollution. | CO1 | U | 6 |
|  | b. | Describe the importance of microbes as bioadsorbent for the removal of heavy metal contaminated wastewater. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Outline the process involved in the treatment of commercial sewage during primary, secondary and tertiary stages. | CO2 | R | 4 |
|  | b. | Illustrate the process of trickling filter and anaerobic sludge blanket reactor for wastewater treatment with their advantages. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 19. |  | Define eutrophication. Elucidate the importance to remove nutrients from wastewater with suitable treatment process. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain with neat sketches of the working principle and add notes on advantages, and disadvantages of air pollution control devices. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Define metagenomics. Elaborate the bioremediation process through genomic tools for cleaner environment. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 22. |  | Evaluate the methods and challenges of converting solid waste into useful products focusing on both environmental and economic perspectives. | CO5 | C | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the microbes induced leaching process with suitable examples. | CO6 | A | 6 |
|  | b. | Illustrate the types of biosensors employed for the monitoring of environmental pollution. | CO5 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the operational principle of an integrated bio-digester and how it produces both biogas and electricity. | CO6 | C | 6 |
|  | b. | Describe TWO types of bio-fertilizers used in agriculture and their benefits. | CO6 | A | 6 |

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

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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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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **20BT2058** | **Duration** | **3hrs** |
| **Course Title** | **TISSUE ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | **Interpret** the purpose of using antibiotics in culture media. | | CO1 | U | 1 |
| 2. | **List** any TWO essential equipment used in a cell culture laboratory. | | CO1 | R | 1 |
| 3. | **Name** the method used for chromosome analysis. | | CO2 | R | 1 |
| 4. | **Identify** ONE enzyme used to study cell characterization. | | CO2 | R | 1 |
| 5. | **Cite** the role of scaffold porosity in tissue regeneration. | | CO3 | U | 1 |
| 6. | **Define** biomaterial. | | CO3 | R | 1 |
| 7. | State the primary role of hematopoietic cells in the human body. | | CO4 | U | 1 |
| 8. | **List** TWO types of mesenchymal cells. | | CO4 | R | 1 |
| 9. | **Cite** how tissue-engineered constructs are evaluated through in-vitro testing before clinical application. | | CO5 | R | 1 |
| 10. | State the role of FDA regulations in tissue engineered product development. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | **Differentiate** between contamination caused by bacteria and mycoplasma. | | CO1 | An | 3 |
| 12. | **Cite** the role of enzyme activity assays in characterizing specific cell types. | | CO2 | U | 3 |
| 13. | **Compare** the advantages and limitations of natural and synthetic biomaterials in tissue engineering applications. | | CO3 | An | 3 |
| 14. | **Write** the structural and functional differences between 2D and 3D cell culture systems. | | CO4 | A | 3 |
| 15. | **Compare** artificial blood vessels with natural ones. | | CO5 | An | 3 |
| 16. | List the ethical concerns associated with the use of stem cells in tissue engineering. | | 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. |  | **Describe** the **methods used for quantification of cells**. Compare the accuracy and applicability of manual vs. automated techniques. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | **Explain** different methods used to characterize cultured cells based on morphology, chromosome analysis, and enzyme activity. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Evaluate the uses of different stem cells in tissue engineering applications. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | Analyze the functional differences among epithelial, mesenchymal, neuroectodermal, and hematopoietic cells in relation to their applications in tissue engineering. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | **Evaluate** the therapeutic potential and limitations of artificial liver tissue engineering for treating liver failure. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 22. |  | **Differentiate** between bacterial, fungal, and mycoplasma contamination based on their characteristics and effects on cultured cells. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | **Describe** how tissue engineering strategies differ for hard tissues and soft tissues. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | **Examine** how FDA guidelines influence the design and testing of new tissue-engineered products. | CO6 | An | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Exhibit the fundamental concepts about types of cells and culturing procedures |
| **CO2** | Analyze the cellular interaction and molecular aspects of cell differentiation. |
| **CO3** | Design scaffolds, tissue implants and its use in tissue engineering |
| **CO4** | Apprise about 3D culture mechanism and cell interactions |
| **CO5** | Evaluate the tissue engineering applications in the field of medicine |
| **CO6** | Adapt the regulatory and ethical issues in tissue Engineering |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **20BT2059** | **Duration** | **3hrs** |
| **Course Title** | **IoT IN BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the person who introduced the Auto-ID Center concept related to IoT at MIT. | | CO1 | R | 1 |
| 2. | Define interoperability in IoT ecosystems. | | CO1 | U | 1 |
| 3. | Name two hardware components essential for IoT system connectivity. | | CO2 | R | 1 |
| 4. | State the function of a gateway in IoT architecture? | | CO2 | U | 1 |
| 5. | Mention one IoT-based application used in precision aquaculture. | | CO3 | R | 1 |
| 6. | Name one IoT-based system used for soil moisture monitoring. | | CO3 | U | 1 |
| 7. | State the function of data matrix codes in pharmaceutical serialization? | | CO4 | U | 1 |
| 8. | Define the term ‘network latency’ in IoT communications. | | CO4 | R | 1 |
| 9. | List two companies that have implemented IoT in vaccine cold-chain logistics. | | CO5 | U | 1 |
| 10. | Mention one major limitation of IoT device scalability in healthcare applications. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Summarize the key events leading to global IoT standardization initiatives. | | CO1 | U | 3 |
| 12. | Explain the working of biosensors used in IoT health-monitoring systems. | | CO2 | U | 3 |
| 13. | Differentiate between edge devices and cloud servers with examples. | | CO3 | An | 3 |
| 14. | Interpret how IoT-based packaging helps ensure pharmaceutical authenticity. | | CO4 | A | 3 |
| 15. | List three competitive advantages achieved by IoT-enabled biotech industries. | | CO5 | An | 3 |
| 16. | Explain how blockchain technology enhances IoT data integrity. | | 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 how IoT convergence with AI and ML has advanced biotechnology innovation. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Analyze the impact of IoT communication protocols on data reliability in biotechnology applications. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Describe the impact of IoT-driven smart-irrigation systems on sustainability. | CO3 | U | 6 |
| b. | Evaluate IoT adoption barriers in small-scale farming. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | Examine the ethical implications of IoT data tracking in pharmaceuticals. | CO4 | An | 6 |
| b. | Assess the regulatory challenges associated with IoT compliance in drug manufacturing. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. | a. | Evaluate the contributions of IoT-based lab-automation systems like Hamilton STAR in improving experiment reproducibility. | CO5 | E | 6 |
| b. | Analyze the business transformation of Biocon through IoT integration. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. |  | Discuss IoT-driven cybersecurity frameworks for protecting medical-device data. | CO6 | An | 12 |
| 23. |  | Explain the importance of predictive maintenance in IoT-connected bioprocess systems. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Evaluate how IoT and robotics together transform workflow efficiency in biotechnology laboratories. | CO6 | E | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Relate the history and basic concepts of IOT. |
| **CO2** | Analyse the various components of IOT. |
| **CO3** | Apply IOT for different biotechnological applications. |
| **CO4** | Distinguish IOT to different pharmaceutical applications. |
| **CO5** | Justify significance of IOT in research and development. |
| **CO6** | Design IOT based devices for future trends in biotechnology. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **20BT3018** | **Duration** | **3hrs** |
| **Course Title** | **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. |  | Analyze the key components of the fermentation process, with particular emphasis on upstream processing. | CO1 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Evaluate the role of microbial diversity in development of major products of biological processing | CO2 | E | 20 |
|  |  |  |  |  |  |
| 3. |  | Illustrate the mixing mechanism in a bioreactor and discuss the associated power requirements | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Describe the working principle and structural components of a membrane bioreactor (MBR) with its key applications | CO5 | U | 20 |
|  |  |  |  |  |  |
| 5. |  | Analyze the steps involved in optimizing the volumetric mass transfer coefficient to enhance mass transfer efficiency | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Outline the leudeking-piret mode models in estimating the growth inhibitors in a sustainable bioprocess design | CO4 | R | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain the mechanism and process flow of batch operation in a continuously stirred tank reactor (CSTR). | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Analyze the impact of incorporating long-term environmental impacts into sustainability assessments | CO6 | An | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Analyze the bioprocess considerations in animal cell cultures with examples | CO6 | An | 20 |

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

|  |  |
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|  | **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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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **20BT3019** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED ANIMAL BIOTECHNOLOGY AND 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. |  | Describe the processes involved in artificial insemination and in vitro fertilization in livestock. | CO1 | U | 16 |
|  |  |  |  |  |  |
| 2. |  | Explain the techniques used in the genetic diagnosis of embryos and foetuses, including gene knockout technology and diagnostic kits. | CO2 | An | 16 |
|  |  |  |  |  |  |
| 3. |  | Evaluate animal cloning from embryonic cells and adult cells, and its advantages and limitations in livestock breeding. | CO3 | E | 16 |
|  |  |  |  |  |  |
| 4. |  | Describe the molecular and genetic approaches for livestock improvement through marker-assisted selection and transgenic technology. | CO4 | U | 16 |
|  |  |  |  |  |  |
| 5. |  | Explain the importance of cytotoxicity and cell viability assays in tissue engineering. | CO5 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Analyze the mechanism, efficacy, and application of immune contraceptive Vaccines in controlling the populations of free-ranging wildlife and feral animals. | CO3 | An | 16 |
|  |  |  |  |  |  |
| 7. |  | Explain the procedure involved in embryo transfer, embryo sexing and embryo splitting. | CO1 | A | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Evaluate the procedure involved in the design and development of the artificial pancreas and blood vessels in tissue engineering. | CO6 | E | 20 |

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

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|  | **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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**END SEMESTER EXAMINATION – NOV/DEC 2025**

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| **Course Code** | **20BT3021** | **Duration** | **3hrs** |
| **Course Title** | **DRUG DESIGN AND DISCOVERY** | **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. | 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. | Describe the various steps involved in carrying out a clinical trial. | CO6 | R | 8 |
|  | b. | Explain 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 the steps involved in 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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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **20BT3052** | **Duration** | **3hrs** |
| **Course Title** | **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. | a. | Explain the structure, function and commercial significance of secondary metabolite flavonoids with suitable examples. | CO1 | A | 10 |
|  | b. | Analyze the ecological functions and biological activities of plant secondary metabolite with examples. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Illustrate the MEP pathway of biosynthesis and functions of terpenoids in plants with a neat diagram. | CO2 | U | 15 |
|  | b. | Write the mechanism of exchange of intermediates between biochemical pathways in plants. | CO2 | A | 5 |
|  |  |  |  |  |  |
| 3. |  | Evaluate the concept of genetic regulation of key enzymes in plants with suitable examples. | CO3 | E | 20 |
|  |  |  |  |  |  |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the process of commercial production of plant secondary metabolite Taxol. | CO4 | U | 15 |
|  | b. | Write the role of endophytes in plant secondary metabolite production. | CO4 | A | 5 |
|  |  |  |  |  |  |
| 5. |  | Write the method of cloning and characterization of enzymes in Shikimate pathway in a neat diagram. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Explain the process of metabolic engineering of Yeast for production alkaloids and its significance in commercial production. | CO2 | A | 20 |
|  |  |  |  |  |  |
| 7. | a. | Write the parameters of solubility in preformulation of drugs. | CO3 | U | 5 |
|  | b. | Illustrate the properties and selection criteria of various excipients in preformulation studies. | CO3 | U | 15 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Evaluate the various excipients used in pharmaceutical dosage forms. | CO6 | E | 10 |
|  | b. | Explain the process of formulation development in inhalation dosage form. | CO6 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Illustrate the process of formulation, production and evaluation of dry syrups. | CO6 | E | 20 |

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

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|  | **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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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **22BT2070** | **Duration** | **3hrs** |
| **Course Title** | **TOTAL QUALITY MANAGEMENT AND PROCESS ECONOMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the QC tool used for prioritizing issues. | | CO1 | U | 1 |
| 2. | Give an example of a company in the biotech manufacturing industry. | | CO1 | R | 1 |
| 3. | Name the quality guru associated with the "Zero Defects" philosophy | | CO2 | R | 1 |
| 4. | Define quality. | | CO2 | R | 1 |
| 5. | Identify one situation in a biotechnology process where the PDSA cycle can be applied. | | CO3 | U | 1 |
| 6. | Define supplier partnership in quality management. | | CO3 | R | 1 |
| 7. | State the purpose of a quality management system audit. | | CO4 | R | 1 |
| 8. | Define Environmental Management System (EMS). | | CO4 | R | 1 |
| 9. | State the free-rider problem. | | CO5 | U | 1 |
| 10. | Cite how the return on investment contributein project economics. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between manufacturing and service organizations. | | CO1 | U | 3 |
| 12. | List any three characteristics of an effective leader that contribute to quality management in an organization. | | CO2 | U | 3 |
| 13. | State the three types of supplier sourcing with suitable examples. | | CO3 | R | 3 |
| 14. | Cite the purpose of the Affinity Diagram and give an example of its application. | | CO4 | A | 3 |
| 15. | Cite what are the factors that influence the structure of a market. | | CO5 | A | 3 |
| 16. | Describe the major components shown in a cost diagram. | | 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 components of the cost of quality. | CO1 | U | 6 |
|  | b. | Explain the impact of the shift from mass production to a service and knowledge-based economy on the 'customer focus' principle in TQM. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. |  | Describe the Deming’s 14 Principles of Quality Management and their impact on continuous improvement in the biotechnology industry. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. |  | Evaluate the significance of dimensions of quality in ensuring product consistency, safety, and customer satisfaction within the biotechnology industry. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the steps of the Kaizen approach and their role in achieving continuous improvement in a biotechnology organization. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. |  | Evaluate the role of non-statistical management tools in enhancing decision-making and process improvement, with examples from at least five tools. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | Write a detailed note on the six principles of a Quality Management System. | CO4 | R | 6 |
|  | b. | Classify the main components of an Environmental Management System and their role in promoting sustainable practices in an organization. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Compare perfect competition and monopoly market structures. | CO5 | A | 6 |
|  | b. | Explain the role of government intervention in correcting market failure related to environmental resources. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the steps involved in conducting an economic feasibility analysis for a new bioprocess project. | CO6 | U | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Apply quality management system in manufacturing and servicing organization. |
| **CO2** | Implement the Framework of TQM. |
| **CO3** | Appraise the implementation process for TQM. |
| **CO4** | Design the Process control tools for better quality management and control charts. |
| **CO5** | Analyse Process equipment economics and market structure. |
| **CO6** | Analyse the cost entities in estimation and costing of bioreactors. |



**END SEMESTER EXAMINATION – NOV / DEC 2025**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the inhibition model showing unchanged Km but reduced Vmax. | | CO1 | R | 1 |
| 2. | Find the yield coefficient of biomass with respect to a substrate using the following observation,  X0 = 50 Xf = 100; S0 = 100; and Sf =25. | | CO2 | E | 1 |
| 3. | Recall the formula used for calculating biomass yield. | | CO2 | R | 1 |
| 4. | Identify the relationship between yield coefficient and substrate utilization. | | CO2 | U | 1 |
| 5. | Define Monod model. | | CO3 | U | 1 |
| 6. | State the relation between substrate concentration and growth rate. | | CO3 | U | 1 |
| 7. | Find the role of agitation in oxygen transfer. | | CO4 | U | 1 |
| 8. | Identify one method used for oxygen transfer estimation. | | CO5 | U | 1 |
| 9. | List the physical methods of enzyme immobilization. | | CO5 | R | 1 |
| 10. | State the need for scaling down in fermentation processes. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Estimate the biomass yield coefficient for the biochemical reaction: | | CO1 | E | 3 |
| 12. | Find if , , . | | CO2 | E | 3 |
| 13. | For and , find . | | CO3 | E | 3 |
| 14. | If OTR=0.6 and concentration difference=0.003, find kLa. | | CO4 | A | 3 |
| 15. | Differentiate between free and immobilized reactors. | | CO5 | An | 3 |
| 16. | State the strategies for scale-down experiments. | | 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. |  | 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 HW plot  (ii) Initial reaction rate for 50 mM of substrate with 20 µmol of enzyme | CO2 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Derive the expression for all types of toxic compound inhibition reactions and explain it with the help of a line-weaver Burk plot. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Degradation of an organic compound by a mixed culture of organisms in waste water can be represented by the following reaction  **C6H5COOH+ 4.2O2 + 2.1 NH3 🡪 2.1C5H7NO3+6H2O+3.2CO2**   1. Determine the yield cefficients Y(X/S), Yx/O2 and Yx/NH3. 2. Determine the degree of reductions for the substrate, bacteria. 3. Respiratory quotient. | CO1 | E | 6 |
|  | b. | Baker's yeast production is described as the following equation. Calculate the yield coefficients YX/S, YX/O2, and degree of reduction for biomass and glucose. | CO1 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | Summarize the advantages and disadvantages of various methods of immobilization | CO6 | U | 6 |
|  | b. | Differentiate between the airlift bioreactor with a fluidized bed bioreactor. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | The production of ethanol was carried out in a batch reactor and the following data were obtained.   |  |  |  |  | | --- | --- | --- | --- | | **Time (hr)** | **Substrate conc. (g/l)** | **Biomass conc. (g/l)** | **Ethanol conc.**  **(g/l)** | | 0 | 150 | 0.5 | 0 | | 20 | 140 | 2.5 | 2 | | 30 | 125 | 3.2 | 3.5 | | 50 | 76 | 6.7 | 7.1 | | 70 | 62 | 12.1 | 8.4 | | 90 | 50 | 16.8 | 10.7 | | 120 | 40 | 25.7 | 11.9 | | 150 | 22 | 29.3 | 18.1 |  1. Determine net-specific growth rate. 2. Specific growth rate @70hrs. 3. Biomass yield coefficient. 4. Product yield coefficient. 5. Doubling time. 6. Max cell concentration if 15 g/l of biomass is used as inoculum. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | Elaborate on sulphite oxidation method and gassing out method used to estimate the volumetric mass transfer coefficient in microbial reactors | CO4 | An | 6 |
|  | b. | Classify different types of aerators with a neat sketch. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 23. |  | Explain in detail the construction, working, and types of an airlift bioreactor. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate with a neat sketch the design and working of a bubble column and fluidized bed bioreactor. | CO3 | U | 12 |

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

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|  | **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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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the 5-Rs relevant to the waste management program. | | CO1 | R | 1 |
| 2. | Identify the one waste category that is not part of MSW. | | CO1 | R | 1 |
| 3. | State the need for the TCLP test in waste characterization. | | CO2 | R | 1 |
| 4. | Define the COD of a waste sample collected for characterization. | | CO2 | R | 1 |
| 5. | Select the waste categories that should be dumped into the landfill. | | CO3 | R | 1 |
| 6. | Classify the different landfills based on operating conditions. | | CO3 | U | 1 |
| 7. | Name a stabilization process for heavy-metal-contaminated waste. | | CO4 | R | 1 |
| 8. | Select the biomedical waste that comes under blue-color coding. | | CO4 | R | 1 |
| 9. | Interpret the sludge-volume index of the activated sludge generated. | | CO5 | U | 1 |
| 10. | Select a biochemical property of sludge that dictates the sludge disposal route. | | CO5 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between Build-Transfer-operate (BTO) and Build-Operate-Transfer model for waste management program. | | CO1 | U | 3 |
| 12. | Infer the desirable properties for a waste storage container. | | CO2 | U | 3 |
| 13. | Identifye the use of Geotextile and Geomembrane in landfill structure. | | CO3 | A | 3 |
| 14. | Analyze the purpose of developing a common effluent treatment plant. | | CO4 | An | 3 |
| 15. | Appraise the characteristics that need to be considered when reusing wastewater. | | CO5 | An | 3 |
| 16. | Explain various pretreatment strategies employed before liquid biofuel production. | | 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. | Distinguish the six classes of waste, their origin, and suggested treatment referred to by Indian law. | CO1 | U | 6 |
|  | b. | Explain the different user charge policies for the waste collection and management system. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Distinguish between various MSW collection services offered, and discuss their advantages and limitations. | CO2 | An | 6 |
|  | b. | Analyse the merits and demerits associated with various waste sampling options for solid waste. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate the operational framework for the Hauled container and stationary container systems. | CO3 | A | 6 |
|  | b. | Discuss the strategy to calculate the number of trips per day in the conventional hauled container system. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Analyze the enabling technologies, main products, and limitations for different waste management systems. | CO4 | An | 6 |
|  | b. | Analyze the significance of different controlling factors involved in the composting process. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Give examples of the different technological interventions adopted to ensure ZLD technology in industrial operations. | CO5 | U | 6 |
|  | b. | Compare different salt concentrating technologies used in ZLD Operations. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the different stages in the solid waste incineration process, considering mechanistic insight. | CO4 | An | 6 |
|  | b. | Infer the strategies adopted to manipulate the pyrolysis conditions depending on the desired product, i.e., biochar, syngas, or biooil. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 23. |  | Examine the different pretreatment, processing steps, and advantages of vermicomposting. Analyze the critical factor dictating process performance. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the different possible routes, considering the viability of upcycling of textile waste. | CO6 | An | 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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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22BT2080** | **Duration** | **3hrs** |
| **Course Title** | **GENE EXPRESSION AND TRANSGENICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List two vectors with tags used in protein expression. | | CO1 | R | 1 |
| 2. | Name one expression system used for plant proteins. | | CO1 | R | 1 |
| 3. | Identify post-translational modifications that mammalian cells can perform but *E. coli* cannot. | | CO2 | U | 1 |
| 4. | Name one mammalian cell line commonly used in protein production. | | CO2 | R | 1 |
| 5. | List the insect cell lines used for baculovirus-mediated expression. | | CO3 | R | 1 |
| 6. | State one application of cell-free protein synthesis. | | CO3 | R | 1 |
| 7. | Define electroporation. | | CO4 | R | 1 |
| 8. | State the role of a selectable marker. | | CO4 | R | 1 |
| 9. | Give two examples of humanized animal models. | | CO5 | U | 1 |
| 10. | State what is functional genomics. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write the role of plasmid vectors in facilitating the stable integration of a gene into the plant genome. | | CO1 | U | 3 |
| 12. | Justify the use of *B. subtilis* as a safe host for the overexpression of enzymes. | | CO2 | E | 3 |
| 13. | Discuss the effects of the choice of extract in protein modifications. | | CO3 | An | 3 |
| 14. | State the importance of reporter genes. | | CO4 | R | 3 |
| 15. | List two applications of transgenic fish in research or industry. | | CO5 | An | 3 |
| 16. | Write the applications of TOGA. | | 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 strategies used to achieve overexpression of integral membrane proteins. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Evaluate the large-scale recombinant protein production processes using mammalian cell-based systems (CHO and HEK cells). | CO2 | E | 6 |
|  | b. | Explain the advantages of using *Pseudomonas fluorescens* as a host system. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the principle, components, and workflow of a cell-free protein expression system. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Evaluate the process involved in *Agrobacterium tumefaciens*-mediated gene transfer and its applications in plant biotechnology with a neat diagram. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe the significance of humanized animal models in studying therapeutic testing against human diseases. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the steps in the Retrovirus-mediated gene transfer method in the gene transfer process with a neat diagram. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Evaluate the steps involved in protein expression using insect cell-free extract and their significance. | CO3 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the principle and workflow of Total Gene Expression Analysis and SAGE. | CO6 | U | 12 |

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

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| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Define the concepts in gene expression system. |
| **CO2** | Relate and evaluate the use of cloning vectors and promoters in genetic engineering. |
| **CO3** | Understand and analyze the process of purification of proteins. |
| **CO4** | Discuss and appraise the strategy and applications of gene cloning. |
| **CO5** | Analyze the importance of transgenesis in biotechnological research. |
| **CO6** | Comprehend the current status of genome sequencing projects. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22BT2082** | **Duration** | **3hrs** |
| **Course Title** | **PRECISION MEDICINE AND WELLNESS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define metabolomics. | | CO1 | R | 1 |
| 2. | Name a technology used in transcriptomics. | | CO1 | U | 1 |
| 3. | State the primary function of T cells in immune defense. | | CO2 | R | 1 |
| 4. | Define autoimmunity. | | CO2 | R | 1 |
| 5. | State the role of pharmacogenomic testing in drug selection. | | CO3 | U | 1 |
| 6. | Define adverse drug reaction (ADR). | | CO3 | R | 1 |
| 7. | Define synthetic lethality in cancer therapy. | | CO4 | U | 1 |
| 8. | State the importance of BRCA1 and BRCA2 genes in hereditary cancers. | | CO4 | R | 1 |
| 9. | State the role of a training dataset in machine learning. | | CO5 | U | 1 |
| 10. | Define “Prakriti” in Ayurvedic medicine. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the significance of proteomics in disease diagnosis. | | CO1 | An | 3 |
| 12. | Explain the principle of CAR-T cell therapy. | | CO2 | U | 3 |
| 13. | Interpret the role of tumor profiling in cancer management. | | CO3 | An | 3 |
| 14. | Explain the concept of oncogene addiction in targeted cancer therapy. | | CO4 | U | 3 |
| 15. | Differentiate between supervised and unsupervised learning with suitable examples. | | CO5 | U | 3 |
| 16. | Explain the origin and evolution of Ayurveda as a traditional system of medicine. | | 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 process of transcriptomics in understanding gene expression under disease conditions. | CO1 | U | 6 |
|  | b. | Explain the role of proteomics in biomarker discovery for diseases. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the major components of the immune system. | CO2 | U | 6 |
|  | b. | Describe the influence of cytokines and transcription factors in immune cell differentiation. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the application of pharmacogenomic testing in predicting adverse drug reactions. | CO3 | An | 6 |
|  | b. | Explain the contribution of tumor profiling in predicting prognosis in cancer. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the objectives of precision oncology. | CO4 | U | 6 |
|  | b. | Evaluate the ethical issues related to genetic counseling in cancer patients. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain the importance of family history in genetic counseling. | CO5 | U | 6 |
|  | b. | Evaluate the benefits and limitations of genetic testing in personalized therapy. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Compare supervised, unsupervised, and reinforcement learning in healthcare applications. | CO5 | U | 6 |
|  | b. | Evaluate the challenges of AI/ML in healthcare and propose suitable mitigation strategies. | CO5 | E | 6 |
|  |  |  |  |  |  |
| 23. |  | Evaluate the application of pharmacogenomics in guiding personalized drug selection and dosage optimization. | CO3 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Assess the significance of the Ayurvedic concept of Prakriti in maintaining and monitoring individual health. | CO6 | E | 6 |
|  | b. | Explain the significance of Agni in maintaining health according to Ayurveda. | CO6 | An | 6 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Analyse how the HGP has advanced technology in biomedical research. |
| **CO2** | Assess the diversity of life evolves over time by processes (leading to) of genetic change, particularly the role of genetic and genomic variation throughout the genome in health and disease. |
| **CO3** | Examine recent advances in disease risk prediction, molecular diagnosis and progression of diseases, and targeted therapies for individuals. |
| **CO4** | Develop the translational research into healthcare delivery that benefits the general public. |
| **CO5** | Analyse the ethical, legal, and social implications of health privacy and policy laws for precision medicine. |
| **CO6** | Evaluate primary and secondary precision medicine research. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **22BT2085** | **Duration** | **3hrs** |
| **Course Title** | **SYNTHETIC AND SYSTEMS BIOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define a biological system. | | CO1 | R | 1 |
| 2. | Give an example of a genetic network. | | CO1 | R | 1 |
| 3. | Define probabilistic model in gene expression | | CO2 | R | 1 |
| 4. | State the role of promoter regions in gene regulation. | | CO2 | R | 1 |
| 5. | Name one neurotransmitter involved in synaptic transmission. | | CO3 | U | 1 |
| 6. | State the significance of calcium ions in synaptic interactions. | | CO3 | R | 1 |
| 7. | Give an example of a paracrine signaling molecule. | | CO4 | U | 1 |
| 8. | State the role of signal transduction pathways in cell communication. | | CO4 | R | 1 |
| 9. | Name the type of data used in functional genomic modeling. | | CO5 | U | 1 |
| 10. | State one application of the human erythrocyte model. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate the role of advanced measurement systems in capturing dynamic biological data. | | CO1 | A | 3 |
| 12. | Compare atomic-level simulation and coarse-grained modeling in terms of resolution and computational cost. | | CO2 | U | 3 |
| 13. | Justify the use of kinetic models for predicting synaptic transmission efficiency under varying physiological conditions. | | CO3 | E | 3 |
| 14. | Compare the roles of Wnt and Notch pathways in regulating cell fate decisions. | | CO4 | An | 3 |
| 15. | Explain the concept of cellular simulation and its role in systems biology. | | CO5 | U | 3 |
| 16. | Evaluate the differences in modeling capabilities between E-CELL and GROMOS. | | 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. | Evaluate the impact of integrating multi-omics data (genomics, transcriptomics, proteomics) in systems-level biological modeling. | CO1 | E | 6 |
|  | b. | Explain the concept of systems biology and its differences from traditional biological approaches. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Model a simple genetic network involved in stress response by applying systems-level thinking. | CO1 | A | 6 |
|  | b. | Illustrate the use of time-series data from high-throughput experiments to model gene regulatory networks. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the concept of probabilistic modeling in the context of prokaryotic gene regulation. | CO2 | U | 6 |
|  | b. | Simulate the transcriptional regulation of a prokaryotic operon by applying a probabilistic model. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Model ligand-receptor interactions in a cell-signaling pathway by applying stochastic simulation techniques. | CO3 | A | 6 |
|  | b. | Illustrate the use of kinetic models to simulate neurotransmitter release and postsynaptic response. | CO3 | R | 6 |
|  |  |  |  |  |  |
| 21. | a. | Evaluate the impact of noise and variability in stochastic simulations of signal transduction pathways. | CO3 | E | 6 |
|  | b. | Justify the use of mathematical modeling in predicting emergent behaviors in cell cycle regulation. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the concepts of induction and competence in cellular development and their coordination in tissue patterning. | CO4 | U | 6 |
|  | b. | Differentiate between paracrine and juxtacrine signaling in terms of range, specificity, and biological outcomes. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | Evaluate the potential of virtual biology laboratories in enhancing experimental reproducibility and hypothesis testing. | CO5 | E | 6 |
|  | b. | Explain the estimation of parameters from time-series gene expression data using computational techniques. | CO5 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the concept of whole-cell simulation and its significance in systems biology and personalized medicine | CO6 | U | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Describe how naturally system organisms regulate the expression of their genes |
| **CO2** | Understand the regulation of the genes and properties |
| **CO3** | Infer synthetic biology alters the properties of the cell or the organism |
| **CO4** | Apply a algorithm for sensitivity analysis and parameter fitting |
| **CO5** | recognize, exemplify and explain typical network motifs for signaling pathways |
| **CO6** | Develop synthetic cell model to recognize the cell-cell communications. |



**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT2003** | **Duration** | **3hrs** |
| **Course Title** | **ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define the term 'instrument calibration' | | CO1 | R | 1 |
| 2. | Define precision in measurements. | | CO1 | R | 1 |
| 3. | State the working principle of a fluorimeter. | | CO2 | R | 1 |
| 4. | Mention any two uses of a conductivity meter. | | CO2 | R | 1 |
| 5. | Define centrifugal force. | | CO3 | R | 1 |
| 6. | List the matrices used in TLC. | | CO3 | R | 1 |
| 7. | Name one mobile phase commonly used in HPLC. | | CO4 | R | 1 |
| 8. | Name the scientist who is credited with developing chromatography. | | CO4 | R | 1 |
| 9. | State the principle of scintillation counter | | CO6 | R | 1 |
| 10. | Give one medical use of radioactive isotopes. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain accuracy in the context of instrumental analytical techniques | | CO1 | U | 3 |
| 12. | List applications of a Spectrofluorometer. | | CO2 | U | 3 |
| 13. | Cite how the electron beam generated in Electron microscopy | | CO3 | R | 3 |
| 14. | Outline the process of reverse transcription | | CO3 | R | 3 |
| 15. | Cite the basic function of SDS in SDS-PAGE. | | CO4 | U | 3 |
| 16. | Describe different types of radioactive isotopes and provide suitable 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 used in extraction of various biological molecules with suitable examples. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. |  | Illustrate the principle and method of extraction using Soxhlet apparatus | CO1 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Define Beer - Lambert’s law | CO2 | R | 2 |
|  | b. | Summarize the principle, instrumentation, and applications of Raman spectroscopy. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 20. | a. | Describe the working principle of Scanning Electron Microscopy (SEM) highlighting two of its major applications in material analysis. | CO3 | R | 5 |
|  | b. | Explain the working principle and instrumentation of centrifugation, highlighting the different types of rotors used. | CO3 | E | 7 |
|  |  |  |  |  |  |
| 21. | a. | Explain the principle of ion exchange chromatography and its role in separating charged biomolecules | CO3 | U | 5 |
|  | b. | Describe the process of separation of compounds using Gas chromatography | CO3 | E | 7 |
|  |  |  |  |  |  |
| 22. | a. | Evaluate the role of electrophoresis in molecular biology, explaining its influence on resolution and interpretation of biomolecular separation. | CO4 | An | 5 |
|  | b. | Describe the process of size determination of DNA from an agarose gel electrophoresis | CO4 | E | 7 |
|  |  |  |  |  |  |
| 23. | a. | Explain the working procedure of thermogravimetric analysis (TGA) in polymer characterization | CO4 | An | 6 |
|  | b. | Explain the principle of detection of radioactivity in samples using scintillation counter | CO6 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Evaluate the role of mass spectrometry in determining molecular structure of metabolites using a schematic representation | CO5 | E | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Apply 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** | Analyse the methods of structural elucidation of different compounds |
| **CO6** | Illustrate importance of radioactive isotopes in modern research |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT2004** | **Duration** | **3hrs** |
| **Course Title** | **MICROBIOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List one contribution of Edward Jenner to the field of microbiology. | | CO1 | R | 1 |
| 2. | Give an example of an airborne disease. | | CO1 | R | 1 |
| 3. | Sketch the structure of *Chlamydomonas.* | | CO2 | U | 1 |
| 4. | Identify the symbiotic partners in a lichen. | | CO2 | A | 1 |
| 5. | State the principle of acid fast staining. | | CO3 | U | 1 |
| 6. | Give an example of a halophilic microorganism. | | CO3 | R | 1 |
| 7. | Differentiate between disinfectants and antiseptics with suitable examples. | | CO4 | U | 1 |
| 8. | Define multidrug resistance. | | CO4 | R | 1 |
| 9. | State one role of microbes in soil health. | | CO5 | R | 1 |
| 10. | Identify the most common bacteria that inhabit the respiratory tract. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | State the contributions made by Robert Koch with relevant examples. | | CO1 | An | 3 |
| 12. | How asexual reproduction initiate through binary fission in bacteria with a neat diagram. | | CO2 | U | 3 |
| 13. | Explain the working principle of phase contrast microscopy. | | CO3 | An | 3 |
| 14. | Define the role of filtration in microbial control. | | CO4 | An | 3 |
| 15. | Define diauxic growth with a suitable diagram. | | CO5 | U | 3 |
| 16. | Write the mode of transmission and prevention of HIV/AIDS. | | 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. | Evaluate the events that lead to the discrediting of the theory of spontaneous generation theory. | CO1 | An | 8 |
|  | b. | Differentiate between the systemic and numerical classification systems of bacteria. | CO1 | An | 4 |
|  |  |  |  |  |  |
| 18. | a. | Draw the structure of a Gram-positive bacterial cell wall with a diagram. | CO2 | U | 6 |
|  | b. | Sketch and explain the lytic and lysogenic cycles of a bacteriophage. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Explain the working principle and applications of Scanning Electron Microscopy (SEM) with a diagram. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Evaluate the impact of autoclaving and UV radiation in sterilization. | CO4 | E | 6 |
|  | b. | Explain the mode of action and therapeutic uses of Acyclovir and Azidothymidine in viral infections. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. | a. | Classify the nutritional requirements of microorganisms based on carbon, energy, and electron sources with examples. | CO5 | An | 6 |
|  | b. | Evaluate synchronous and asynchronous growth in bacterial cultures with their advantages. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Write the detailed account on the principle, mechanism and procedure of Gram staining | CO3 | U | 6 |
|  | b. | Explain the working principle and function of major components of light microscope. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Write the microbial fermentation step-by-step process involved in the production of sauerkraut. | CO5 | U | 6 |
|  | b. | Explain the principle, procedure and significance of MPN method in testing potable water. | CO6 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Correlate the symbiotic relationship between Rhizobium and leguminous plants with a diagram. | CO6 | An | 4 |
|  | b. | Examine the pathogenesis of malaria, its symptoms and transmission cycle. | CO6 | An | 8 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Evaluate the significant development in microbiology. |
| **CO2** | Illustrate the fundamental concepts pertaining to the structure and functions of microbes. |
| **CO3** | Assess the importance of microscopy, staining techniques and classify the microorganisms. |
| **CO4** | Assess the appropriate physical and chemical methods to control the growth of microbes |
| **CO5** | Evaluate the nutritional requirements for microbial growth and their products. |
| **CO6** | Analyze the interactions of microorganisms with humans and animals. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT2005** | **Duration** | **3hrs** |
| **Course Title** | **BASICS OF INDUSTRIAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Classify fermentation based on oxygen requirement. | | CO1 | U | 1 |
| 2. | Give one example of a product obtained by microbial fermentation. | | CO1 | R | 1 |
| 3. | Define strain improvement. | | CO2 | R | 1 |
| 4. | Give one example of a genetically modified microorganism used in industry. | | CO2 | R | 1 |
| 5. | List any two examples of primary metabolites. | | CO3 | U | 1 |
| 6. | Define downstream processing. | | CO3 | R | 1 |
| 7. | List two enzymes used in the food industry. | | CO4 | U | 1 |
| 8. | Name one microbial source for biopolymer production. | | CO4 | R | 1 |
| 9. | State the significance of Taxol in medicine. | | CO5 | U | 1 |
| 10. | Name one microorganism used for biofertilizer production. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Distinguish between batch, fed-batch, and continuous fermentation. | | CO1 | An | 3 |
| 12. | Identify any one method used for the genetic modification of microbes. | | CO2 | U | 3 |
| 13. | Illustrate the phases of microbial growth during fermentation. | | CO3 | An | 3 |
| 14. | Illustrate the role of microbial pigments in food and cosmetic industries. | | CO4 | U | 3 |
| 15. | State the advantages of recombinant vaccines. | | CO5 | An | 3 |
| 16. | Cite the role of microorganisms in waste degradation during bioremediation. | | 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 Fermentation and its types. | CO1 | A | 6 |
|  | b. | Explain the stages of a typical industrial bioprocess using a process flow diagram. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Evaluate the effectiveness of strain improvement strategies in production. | CO2 | E | 6 |
|  | b. | Explain the use of plasmids for gene transfer in industrial microorganisms. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain fermentation principles in producing amino acids at industrial scale. | CO3 | A | 6 |
|  | b. | Illustrate alcohol fermentation from molasses using process flow diagram. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Evaluate the role of Nisin as a biopreservative in the food industry. | CO4 | E | 6 |
|  | b. | Explain the production and extraction of carotene as a natural pigment. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. | a. | Differentiate between conventional and recombinant vaccine production. | CO5 | An | 6 |
|  | b. | Explain plant cell culture techniques in producing Taxol. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the role of media composition in enhancing microbial productivity. | CO1 | An | 6 |
|  | b. | Evaluate the industrial importance of steroid production using microbial systems. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the production of Single Cell Protein (SCP) with microbial culture. | CO6 | A | 6 |
|  | b. | Evaluate the industrial importance and advantages of using bio-flavours over synthetic flavouring agents. | CO4 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the process of microbial formulation and field application of biofertilizers. | CO6 | A | 6 |
|  | b. | Explain the advantages of microbial biofuel production over conventional fuel sources. | CO6 | An | 6 |

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

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|  | **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 applications. |
| **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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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT3001** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCES IN BIOPOLYMER AND APPLICATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Explain the structural diversity and biological significance of various glycoconjugates. | CO1 | U | 16 |
|  |  |  |  |  |  |
| 2. |  | Illustrate how protein or peptide-based biopolymers are applied in the food and packaging industry. Support your answer with suitable industrial examples. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 3. |  | Evaluate the pharmaceutical application of peptide hormones as drugs. | CO3 | E | 16 |
|  |  |  |  |  |  |
| 4. | a. | Apply your understanding of lipid chemistry to describe how lipids are utilized in pharmaceutical formulations. | CO4 | A | 8 |
|  | b. | Illustrate the design and function of liposome-based nanoformulations for targeted drug delivery. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 5. |  | Analyze the role of nucleic acid probes in clinical laboratories and molecular diagnostics. | CO5 | An | 16 |
|  |  |  |  |  |  |
| 6. |  | Analyze the use of enzyme markers in the diagnosis of hepatobiliary diseases, myocardial disorders, renal dysfunction, and cancer. | CO2 | An | 16 |
|  |  |  |  |  |  |
| 7. |  | **Analyze** the molecular basis of ABO blood group determination with respect to glycan structures on red blood cells. | CO1 | An | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Evaluate the use of biopolymers in bioremediation. Discuss how biopolymeric materials assist in pollutant removal, microbial immobilization, and environmental sustainability. | CO6 | E | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Outline the basic structure, composition and functions of biopolymers. |
| CO2 | Illustrate the applications of biopolymers in medical, pharma, food and agro industries. |
| CO3 | Apply technologies such as protein engineering, glysosylation engineering, enzyme engineering, antibody engineering to study the biomolecules. |
| CO4 | Compare and contrast the structure functional relationship of different biomolecules. |
| CO5 | Appraise the applications of biomolecules as biomarkers in diagnosis of diseases and as biosensors |
| CO6 | Evaluate the recent updates / progress in biopolymers research and their applications |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT3005** | **Duration** | **3hrs** |
| **Course Title** | **ENZYME TECHNOLOGY AND INDUSTRIAL APPLICATIONS** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the models that describes the mechanism of enzyme action with a neat diagram. | CO1 | U | 8 |
|  | b. | Classify enzymes based on their specificity and explain each specificity with an example. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. |  | Classify various types of enzyme inhibition kinetics and derive the expressions for all the types of toxic compound inhibition reactions and explain it with the help of a Line-weaver Burk plot. | CO2 | An | 16 |
|  |  |  |  |  |  |
| 3. |  | The kinetics of an enzyme-catalyzed reaction were analyzed in the absence of inhibitor. Determine MM parameters using double reciprocal plot and Michaelis Menten plot and compare the values.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Substrate concentration (mmol) | 0.2 | 0.5 | 1.0 | 2.5 | 5 | 10 | | Initial velocity (mmol min-1) | 0.35 | 0.8 | 1.4 | 2.3 | 2.8 | 3.1 | | CO2 | E | 16 |
|  |  |  |  |  |  |
| 4. | a. | Explain various methods of enzyme immobilization with suitable examples and write its advantages and disadvantages. | CO3 | An | 10 |
|  | b. | Differentiate between a packed bed and fluidized bed bioreactor. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 5. |  | Illustrate with a neat sketch the construction and working of potentiometric biosensor and amperometric biosensors used in industry with its industrial applications. | CO4 | A | 16 |
|  |  |  |  |  |  |
| 6. |  | Explain the process of production, extraction and purification of the enzyme alpha amylase with a neat flow diagram and mention their uses. | CO5 | U | 16 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the application of various enzymes in food and pharmaceutical industries with suitable examples. | CO5 | A | 8 |
|  | b. | Differentiate the industrial applications of pectinase with cellulose. | CO6 | An | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Explain the application of enzyme pyruvate aldolase in organic synthesis and summarize their uses in industries. | CO6 | A | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Analyze the mechanism of enzyme action for enhancing industrial production. |
| CO2 | Evaluate the kinetics of an enzyme-substrate reaction and enzyme inhibition for industrial scale-up. |
| CO3 | Assess the process of enzyme immobilization and its kinetics for efficient production. |
| CO4 | Design of enzyme-immobilized bioreactors and biosensors for diverse applications. |
| CO5 | Demonstrate extraction and purification of the enzymes for commercial production. |
| CO6 | Synthesize of organic compounds using enzymes. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT3010** | **Duration** | **3hrs** |
| **Course Title** | **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. | Describe the structural and functional processing characterization of DNA. | CO1 | R | 8 |
|  | b. | Summarize the computational operations and Step involve in DNA computing techniques | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Explain the technological concept of Adelman experiment for DNA biomolecular computing. | CO1 | U | 8 |
|  | b. | Describe the importance of RNA secondary structure, write a detailed note on covariance models and Application of RNA fold. | CO1 | R | 8 |
|  |  |  |  |  |  |
| 3. | a. | Outline the steps used to find RNA structure folding by Nussinov algorithms. | CO2 | R | 8 |
|  | b. | Describe the classical mechanics in force field. | CO2 | R | 8 |
|  |  |  |  |  |  |
| 4. | a. | Illustrate the force field mechanism models of Potentials. | CO3 | R | 9 |
|  | b. | Describe the principal mechanism of The Morse Potential and Harmonic Oscillator Model for Molecular simulations. | CO3 | U | 7 |
|  |  |  |  |  |  |
| 5. | a. | Explain the principal analysis of predicted dynamics simulation structure of molecule with various functions. | CO3 | R | 8 |
|  | b. | Describe briefly about the classical mechanics in force field. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 6. | a. | Explain the principle and methodology involved in detail study of molecular mechanics. | CO4 | R | 9 |
|  | b. | Classify the types of potential in molecular mechanics. | CO4 | U | 7 |
|  |  |  |  |  |  |
| 7. | a. | Explain in detail about the implementation and Importance of a data warehousing in datamining. | CO5 | U | 8 |
|  | b. | Define data warehouse. Draw the architecture of data warehouse and explain the three tiers in detail. | CO5 | A | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Explain briefly about the systems biology networks and basics of computer networks. | CO6 | An | 10 |
|  | b. | Analyze the various properties and types of Networks with respective functional characterization. | CO6 | An | 10 |

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

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

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT3011** | **Duration** | **3hrs** |
| **Course Title** | **PHARMACEUTICAL 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. |  | Illustrate the process of pre-clinical toxicity assessment and design of a clinical trial. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Discuss pharmacogenomic applications throughout preclinical testing and clinical trial phases in drug development. | CO1 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Discuss the importance of genetically engineered animals in pharmaceutical development highlighting their applications. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Analyze the principles of personalized medicine and its emerging role in transforming healthcare delivery and patient outcomes. | CO3 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Evaluate absorption, distribution and metabolism pathways and its significance in drug metabolism | CO4 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Analyze the design and operational mechanism of solid-phase immunodiagnostic assays and their role in clinical diagnostics | CO4 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Evaluate the synthesis of genetically engineered vaccines with reference to SARS-CoV-2 | CO5 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Analyze the steps followed in miniaturization of biopharmaceuticals and therapeutics for drug delivery | CO5 | An | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Analyze the critical parameters that contribute to improving the stability and shelf life of protein-based pharmaceutical products | CO6 | An | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Evaluate different pharmaceutical parameters for the current and future biotechnology related products on the market. |
| CO2 | Analyse Screening, isolation, characterization and scale-up of Biological products. |
| CO3 | Understand the legal steps involved in progressing a new drug to market and their science |
| CO4 | Develop skills in molecular immunotherapeutics and immunotherapy. |
| CO5 | Expertise in pharmaceutical drug delivery methods and analysis. |
| CO6 | Gain  knowledge in physicochemical properties, pharmacology and the formulation |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **24BT3014** | **Duration** | **3hrs** |
| **Course Title** | **ADVANCED ENVIRONMENTAL 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. | Illustrate the role of biotechnology in environmental protection for clean and green India | CO1 | E | 10 |
|  | b. | Define water pollution? Discuss in detail about the causes, effects and prevention of water pollution. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Define eutrophication. Elucidate the importance to remove nutrients from wastewater with suitable treatment process. | CO3 | An | 12 |
|  | b. | Outline the process involved in the treatment of commercial sewage during primary, secondary and tertiary stages. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 3. | a. | Explain the steps involved for the treatment of wastewater and sewage with suitable bioreactor design and operations. | CO2 | An | 12 |
|  | b. | Summarize the treatment methods of waste water by lagoons. | CO2 | R | 8 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Write the types of bioremediation? Mention the role of microorganisms for *in situ* bioremediation in detail? | CO5 | A | 12 |
|  | b. | Comment on super bug and elucidate the methods to degrade oil spills using genetically engineered microbes. | CO4 | An | 8 |
|  |  |  |  |  |  |
| 5. | a. | Explain the microbes induced leaching process with suitable examples. | CO5 | E | 10 |
|  | b. | Demonstrate the processes and mechanisms involved in the production of biogas. | CO4 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | List out the harmful effects due to disposal of industrial wastes without adequate treatment and how to solve problem using 3 R’s. | CO6 | C | 20 |
|  |  |  |  |  |  |
| 7. |  | Design the process of attached growth reactor for waste water treatment with suitable examples. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Design the process of upflow anaerobic sludge blanket reactor for waste water treatment. | CO3 | C | 8 |
|  | b. | Describe how microbial populations can be promoted to degrade xenobiotic hydrocarbon compounds. | CO3 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Define metagenomics. Elaborate in detail about bioremediation through genomic tools for cleaner environment. | CO6 | A | 20 |
|  |  |  |  |  |  |

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

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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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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT3015** | **Duration** | **3hrs** |
| **Course Title** | **BIOCHEMISTRY** | **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. |  | Sketch the reactions involved in the breakdown of glucose to pyruvate during aerobic conditions? | CO1 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Discuss the physical, chemical properties and functions of fatty acids with suitable examples. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. |  | Explain the anabolic reactions of any two aromatic amino acids. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Describe the double helical structure of DNA and the single stranded structure of ribose nucleotide linked by phosphodiester bond with suitable diagram. | CO2 | R | 20 |
|  |  |  |  |  |  |
| 5. |  | Interpret the structure and conformational levels of protein with suitable examples. | CO1 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Classify the structure of mono, oligo and polysaccharides with examples. | CO1 | U | 20 |
|  |  |  |  |  |  |
| 7. | a. | Sketch the reactions involved in the biosynthesis and degradation of fatty acids. | CO4 | A | 10 |
|  | b. | Summarize on the electron transport chain and chemiosmosis theory for ATP production by Oxidative phosphorylation. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Interpret the source, daily requirement, functions and deficiency symptoms of vitamin A, D and K | CO3 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Classify macro elements and their biochemical functions and deficiency disorders | CO6 | An | 20 |

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

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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 | Apply the knowledge on the significance of Vitamins and mineral functions |
| CO4 | Integrate the metabolic pathways of synthesis and degradation of biomolecules |
| CO5 | Differentiate the clinical and biological significance of biomolecules |
| CO6 | Compare the biomolecules and understand their specific roles in biological system |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT3017** | **Duration** | **3hrs** |
| **Course Title** | **MOLECULAR BIOLOGY AND CELL SIGNALING** | **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 process of θ replication in *E. coli*. Examine its regulation by signal. | CO1 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain how gene expression is regulation by *Lac* operon in *E. coli*. Add a note on the catabolite regulation in *Lac* operon. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Analyze the role of cell cycle regulation and oncogenes expression in the development of cancer. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Relate various types of viruses with cancer development. | CO4 | A | 10 |
|  | b. | Sketch the multistage theory of carcinogenesis. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 5. |  | Analyze and write the various molecular targeted therapy with examples. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Describe the process of transcription in prokaryotes. Add a note on the post Transcriptional Processing of Eukaryotic mRNA. | CO1 | R | 20 |
|  |  |  |  |  |  |
| 7. |  | Evaluate the role of *cis* and *trans* elements of eukaryotes in gene expression regulation. Appraise the gene editing with an example. | CO2 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Analyze the recent Nobel prize awarded works related to cell signaling and highlight any one research related to cancer. | CO6 | An | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Illustrate with suitable examples how the abnormal receptor tyrosine kinase mediated signaling pathways contribute in cancer development. | CO6 | A | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Associate the knowledge in DNA replication, transcription, translation and Cell signaling |
| CO2 | Summarize the process of gene expression and its regulation in prokaryotes and eukaryotes |
| CO3 | Understand the gene expressions in cancer |
| CO4 | Compare and contrast the different molecular processes in gene expression, signaling processes and cancer development mechanism |
| CO5 | Analyze the emerging molecular targeted therapies |
| CO6 | Integrate the knowledge of cell signaling with carcinogenesis |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT3018** | **Duration** | **3hrs** |
| **Course Title** | **MICROBIOLOGY AND MOLECULAR GENETICS** | **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. | Compare the determinative (phenetic) approach with the phylogenetic approach in bacterial taxonomy. | CO1 | R | 10 |
|  | b. | Describe the principles of chemotaxonomy and their role in the classification of microorganisms. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | A microbiologist observes a cell with ribosomes, a plasma membrane, and circular DNA but no nucleus under an electron microscope, justify the cell type based on structural features. | CO1 | An | 10 |
|  | b. | Compare the mechanisms of action and effectiveness of chemical compounds as disinfectants against various microorganisms. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Describe the causative agent, symptomatology, pathogenicity and diagnosis of *Mycobacterium tuberculosis..* | CO2 | U | 10 |
|  | b. | Examine the various roles of gut microbiota in human health, specifically their impacts on metabolism, immune function and disease prevention. | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Compare the mechanisms of transformation, transduction, and conjugation in terms of their biological significance and experimental applications. | CO3 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Write the methods used to map bacterial and phage genes using classical genetic crosses. How do interrupted mating and phage co-transduction experiments contribute to determining gene order and distance? | CO3 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Write a detailed account on the steps involved in performing a tetrad analysis in yeast to determine gene linkage and recombination frequency. | CO4 | An | 12 |
|  | b. | Write the types of bioremediation. Explain the role of microorganisms for *in situ* bioremediation in detail. | CO4 | A | 08 |
|  |  |  |  |  |  |
| 7. | a. | Propose a genetic engineering approach that uses a eukaryotic transposon system to introduce a target gene into a model organism. | CO4 | C | 10 |
|  | b. | Compare the mechanisms of action of THREE antibacterial agents. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Define RNA interference (RNAi). Describe the roles of siRNA, miRNA, Dicer, and RISC in gene silencing. | CO5 | U | 10 |
|  | b. | Explain the modes of action of different chemical mutagens. Compare direct and indirect mutagenesis with suitable examples. | CO6 | E | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe the molecular mechanisms underlying X-chromosome inactivation and its biological significance. | CO6 | A | 10 |
|  | b. | Analyze the effects on different classes of point mutations in gene expression and phenotype, using examples from human diseases. | CO6 | E | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Illustrate the classification, diversity, and ubiquity of major categories of microorganisms. |
| CO2 | Analyze the structural and physiological differences among microorganisms and their growth control. |
| CO3 | Compare the interactions between microbes, hosts and the environment. |
| CO4 | Examine the organization of prokaryotic and eukaryotic genomes and the processes involved in their replication. |
| CO5 | Analyze the epigenetic effects of transposons on specific genes of interest. |
| CO6 | Evaluate the causes and consequences of mutations in microbial evolution and their contributions to generating diversity. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT3019** | **Duration** | **3hrs** |
| **Course Title** | **ANIMAL BIOTECHNOLOGY AND IMMUNOLOGY** | **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 process involved in the cryopreservation of embryos. | CO1 | R | 10 |
|  | b. | Illustrate the steps in embryo transfer and embryo sexing. | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the process of artificial insemination in animal breeding. | CO2 | U | 10 |
|  | b. | Describe the importance in embryo splitting and its ethical issues. | CO2 | U | 10 |
|  | | | | | |
| 3. |  | Examine how marker assisted breeding in livestock improvement. | CO2 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Evaluate the importance and procedure of i*n uetro* testing of foetus for genetic defects | CO4 | E | 20 |
|  | | | | | |
| 5. | a. | Describe homologous recombination process for the development of transgenic animals. | CO3 | An | 10 |
|  | b. | Explain the mechanism of Cre LoXP system for gene knockout in animals. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Analyze how different animal models contribute to understanding the mechanisms of human diseases. | CO3 | E | 20 |
|  | | | | | |
| 7. | a. | Analyze the principles and mechanism immunofluorescence technique. | CO4 | U | 10 |
|  | b. | Outline the principle and procedure of flow cytometry. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Interpret on the production of monoclonal antibodies using hybridoma technology with the protocol and its applications. | CO5 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Analyze the mechanism of immunity towards bacterial and viral infections. | CO6 | An | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Examine the process of cryopreservation of embryos and embryo sexing |
| CO2 | Analyze concepts in animal biotechnology and its importance in livestock improvement. |
| CO3 | Assess the genetic defects in animal embryos through molecular techniques. |
| CO4 | Analyze cellular and molecular basis of immune responsiveness through antigen and antibody. |
| CO5 | Assess 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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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT3020** | **Duration** | **3hrs** |
| **Course Title** | **RESEARCH METHODOLOGY** | **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. |  | Illustrate different scientific search engines in accessing research literature, with suitable examples. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Describe the key steps in recognizing a research problem and outlining the associated gaps in existing literature. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Evaluate the essential elements involved in formulating a research problem | CO3 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Apply the significance of repeatability and reproducibility of a data in validation of laboratory studies | CO4 | A | 20 |
|  |  |  |  |  |  |
| 5. |  | Analyze the sequential steps involved in preparing a well-structured scientific report. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Evaluate the importance of author guidelines in scientific publications | CO4 | E | 20 |
|  |  |  |  |  |  |
| 7. |  | Evaluate the principles of scientific conduct and the various forms of scientific misconduct | CO5 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Classify plagiarism and self plagiarism in the context of publication | CO6 | U | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Evaluate the recent developments in generative AI and AI-assisted technologies in publication | CO6 | E | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Design their experiment keeping in mind the appropriate statistical test to be adopted in support of research hypothesis |
| CO2 | Apply 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 | Apply statistical analysis pertinent to the experimental data |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT3022** | **Duration** | **3hrs** |
| **Course Title** | **MOLECULAR MEDICINE AND DIAGNOSTICS** | **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. | Apply the principle of qPCR to quantify gene expression differences between tumour and normal tissues. | CO1 | A | 10 |
|  | b. | Compare DNA microarray and qPCR techniques with respect to diagnostic accuracy, scalability, and data interpretation. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Examine molecular genetic methods used for detecting and identifying pathogenic microorganisms in clinical blood samples. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. | a. | Discuss the contribution of microscopy and flow cytometry to the analysis of cellular morphology in disease diagnosis. | CO3 | U | 10 |
|  | b. | Evaluate the importance of biobanks in supporting translational research and outline the associated ethical and regulatory considerations. | CO3 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Apply karyotyping and FISH techniques to prenatal detection of chromosomal abnormalities, emphasizing their diagnostic scope and limitations. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 5. | a. | Evaluate the molecular defect and diagnostic approaches used for Phenylketonuria (PKU) with reference to disease detection and management. | CO5 | E | 10 |
|  | b. | Analyze the principles and diagnostic applications of immunoassays such as ELISA, CLIA, and FIA. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Evaluate an integrated diagnostic workflow for neonatal sepsis, correlating molecular assays, imaging, and sample-handling strategies to ensure accuracy and reliability. | CO4 | E | 20 |
|  |  |  |  |  |  |
| 7. | a. | Analyze a case of false-positive result in PCR-based microbial detection, identifying probable causes and corrective measures. | CO2 | An | 10 |
|  | b. | Assess the contribution of molecular epidemiology databases in tracking and controlling hospital-acquired infections. | CO2 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Evaluate nano-drug delivery systems in terms of mechanism, advantages, and clinical effectiveness in improving therapy. | CO6 | E | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe the role of recombinant DNA-derived therapeutic proteins (e.g., insulin, erythropoietin) in precision medicine. | CO6 | U | 10 |
|  | b. | Analyze the mechanism and therapeutic relevance of RNA interference–based therapies, emphasizing delivery and monitoring aspects. | CO6 | An | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand molecular mechanisms in development of disease |
| CO2 | Implement molecular genetic methods in the detection, identification and quantification of different microorganisms |
| CO3 | Analyze the applications of cell imaging and bio banking in diagnosis of diseases. |
| CO4 | Apply the principles of molecular diagnostics and advantages/limitations of its applications |
| CO5 | Design advanced study in the theoretical and practical aspects in diagnostics of genetic disorders |
| CO6 | Appraise the knowledge of drug targeting and molecular therapies in treatment for various diseases. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT3026** | **Duration** | **3hrs** |
| **Course Title** | **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. | Distinguish between drug development and discovery, focusing on target identification, target validation, lead compound identification and optimization. | CO1 | An | 10 |
|  | b. | Explain the compartmental models for pharmacokinetics and the interpretation of the “volume of distribution” of a drug. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Distinguish between different unit processes and operations in API manufacturing. | CO2 | U | 10 |
|  | b. | Analyze the steps involved in the complex fermentation process. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Justify the need for granulation and different granulation techniques in tablet manufacturing. | CO3 | E | 10 |
|  | b. | Examine the advantages of tablet preparation and the role of different ingredients combined in tablet formulation. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the different characterization and test specifications for tablet preparation. | CO4 | U | 10 |
|  | b. | Compare the protein therapeutics and small molecules based on production, composition, stability and delivery. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Illustrate the dissolution-controlled, diffusion-controlled drug delivery systems as a controlled release formulation. | CO5 | An | 10 |
|  | b. | Analyze the specific advantages and requirements for the nasopulmonary route of drug administration. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the different parameters that map the absolute and relative bioavailability of pharmaceutical preparations. | CO1 | U | 10 |
|  | b. | Elaborate on the experimental design relevant to bioequivalence studies. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Illustrate the estimation of Vd from the plasma concentration profile, and/or elimination rate data. | CO2 | A | 10 |
|  | b. | Deduce the relationship between clearance rate and urinary elimination profile of an orally administered drug. | CO2 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Analyze the use of emulsion in different pharmaceutical formulations and the considerations specific to the route of drug delivery. | CO3 | An | 10 |
|  | b. | Summarize the specific quality control tests specific to solution, suspension and emulsion formulations. | CO3 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Distinguish between different stages of clinical trials based on the primary objectives and analysis of outcomes in the drug development process. | CO6 | U | 10 |
|  | b. | Explain the significance of “randomization”, “stratification”, “control”, and “ethics” in clinical trial design. | CO6 | An | 10 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Demonstrate the mechanisms of drug action |
| CO2 | Apply principles in pharmacology, scientific and engineering fundamentals required to solve  biopharmaceutical-related problems |
| CO3 | Apply good scientific and technical knowledge to comprehend novel products and solutions for healthcare issues. |
| CO4 | Apply scientific & professional ethics to the biological product manufacturing process. |
| CO5 | Design scientific methods and SOPs in clinical trials and fundamentals in the new drug discovery process. |
| CO6 | Assess the academic environment, recognizing excellence in new drug discovery and patenting, as well as professional career opportunities. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course Code** | **24BT3032** | **Duration** | **3hrs** |
| **Course Title** | **HUMAN ANATOMY, PHYSIOLOGY, AND HEALTH EDUCATION** | **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 mechanisms of passive and active transport across the plasma membrane, emphasizing the role of concentration gradients. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Evaluate the clinical manifestations and management principles of osteoporosis and arthritis. | CO2 | E | 20 |
|  |  |  |  |  |  |
| 3. |  | Analyze the pathophysiological mechanisms and treatment of anemia, leukemia, and blood-borne pathogens. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Explain in detail the organization and components of the lymphatic system with a neat diagram | CO4 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Evaluate the diagnostic importance of electrocardiography in detecting cardiac abnormalities. | CO5 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Describe the levels of organization in the human body and their significance in maintaining structural integrity. | CO1 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Analyze the principles of ABO and Rh blood group systems and their role in blood transfusion compatibility. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Describe a balanced nutritional diet and its classification, and the prevention of nutritional deficiency disorders. | CO6 | U | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Analyze the epidemiology and control of communicable diseases such as measles, tuberculosis. | CO6 | An | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Apply anatomical terminology to identify and describe locations of major organs. |
| CO2 | Assess interrelationships among molecular, cellular, tissue and organ functions. |
| CO3 | Analyze the interdependency and interactions of the systems. |
| CO4 | Evaluate the role of organs and systems to the maintenance of homeostasis. |
| CO5 | Examine the physiological role of CVS system on human body. |
| CO6 | Assess the excellence in health education and frist aid. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **24BT3033** | **Duration** | **3hrs** |
| **Course Title** | **VACCINE 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. |  | Examine the historical developments in vaccination technologies | CO1 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Discuss the Capitalist model of healthcare and vaccination. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Describe significant steps involved in antigen processing and presentation for vaccine design. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Describe the different types of vaccines based on their biochemical identity and route of administration. | CO3 | E | 20 |
|  |  |  |  |  |  |
| 5. |  | Discuss the composition of Adjuvants, their types and functions in immunogenic responses. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Discuss the attenuation, inactivation steps in preparation of vaccines, and highlight the chemicals used in the process | CO4 | R | 20 |
|  |  |  |  |  |  |
| 7. |  | Elaborate on the various modes of vaccine delivery, explaining their advantages and disadvantages. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Discuss Passive immunization and post exposure prophylaxis. | CO6 | E | 20 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Analyze the different types of vaccines developed for COVID-19. | CO6 | An | 20 |
|  |  |  |  |  |  |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Describe the role of immune cells and their mechanism and concept of vaccination. |
| CO2 | Categorize the different types of vaccines available for diseases. |
| CO3 | Understand the modern strategies and routes of immunization. |
| CO4 | Apply the concept of vaccine technology for development of vaccines. |
| CO5 | Evaluate various delivery methods suitable for vaccines. |
| CO6 | Relate the quality control and regulatory guidelines involved in vaccine production. |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25BT201** | **Duration** | **3hrs** |
| **Course Title** | **MATHEMATICS AND NUMERICAL COMPUTING FOR BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | ***Construct***the rate reaction matrix R of the metabolites and enzyme reactions in the metabolic network. | 1a | U | 1 |
| 2. | *Find* the eigenvalues for the gene interaction matrix A and A-1, representing the regulation between mRNA (M), enzyme (E), and metabolite (C) concentrations in a cellular network.  . | 1c | R | 1 |
| 3. | *List* two types of correlation commonly observed in microbial growth studies. | 2e | R | 2 |
| 4. | *Calculate* the correlation coefficient between biomass (X) and substrate (Y) concentrations in a microbial study, where the regression coefficients of biomass on substrate and substrate on biomass are bXY = − 0.2 and  bYX = − 0.8 respectively. | 2i | U | 2 |
| 5. | *Identify* the order and degree of the differential equation  describing nutrient consumption in a continuous bioreactor. | 3c | R | 3 |
| 6. | *Determine* the complementary function of a regulatory protein y(x) in a cell culture, which is modelled by (D2 - 5D + 6) y = 0. | 3d | U | 3 |
| 7. | *List* any two techniques of integration used in modeling bioprocess systems. | 4a | R | 4 |
| 8. | *Evaluate* the integral  which represents the **rate of increase of biomass** in a bacterial culture. | 4b | U | 4 |
| 9. | *Describe* one application of finite differences in enzyme kinetics with example. | 5a | R | 5 |
| 10. | *Write* the formula of Simpson’s one-third and three-eighth rules. | 5d | R | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | ***Verify***the Cayley-Hamilton theorem and compute the inverse of the enzyme reaction matrix . | 1d | A | 1 |
| 12. | *Calculate* the Spearman’s rank correlation coefficient​ between enzyme activities in two different culture conditions A and B. Also interpret the result.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Microbial Strain | 1 | 2 | 3 | 4 | 5 | | Enzyme Activity (Condition A, µmol/min) | 15 | 20 | 28 | 12 | 40 | | Enzyme Activity (Condition B, µmol/min) | 40 | 30 | 50 | 35 | 20 | | 2g | An | 2 |
| 13. | *Determine* the instantaneous rate of change of product formation using the product rule for a fermentation process described by  and , with . Evaluate at t = 2 and t = 6 hours and interpret the results in terms of growth–substrate interaction. | 3b | An | 3 |
| 14. | *Calculate* the total substrate consumed by evaluating the integral  using Bernoulli’s formula. | 4g | A | 4 |
| 15. | *Determine* the rate of change of a metabolite concentration produced by a bacterial culture at x = 1 hour using Newton’s forward difference formula from the following data.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Time (x in hours) | 0 | 1 | 2 | 3 | | Metabolite concentration C (g/L) | 1 | 2.1 | 3.9 | 6.2 | | 5a | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | *Compute* the eigenvalues and eigenvectors of the metabolic flux matrix , which represents interactions between metabolites M1, M2, and M3. Also interpret the stability of the metabolic work. | 1b | A | 1 |
| **(OR)** | | | | |
| 17 | *Diagonalize*the matrix  representing the effect of a drug on metabolic enzymes, and identify which enzyme pathways are most strongly affected by the drug. | 1e | An | 1 |
|  |  |  |  |  |
| 18 | *Solve* for the concentrations of metabolites x, y, and z in a cellular reaction network using the Gauss elimination method, given the following steady-state equations: x + y + z = 6  2x + 3y + z = 11  x + 2y + 4z = 17​. | 2b | A | 2 |
| **(OR)** | | | | |
| 19 | *Determine* the relationship between different incubation temperatures and enzyme yield in a microbial fermentation process as observed in the following data.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Temperature (oC) | 25 | 30 | 35 | 40 | 45 | | Enzyme yield (U/mL) | 80 | 120 | 150 | 140 | 110 |   Also estimate the enzyme yield when the temperature is 38oC. | 2h | An | 2 |
|  |  |  |  |  |
| 20 | *Find* the complete solution of the differential equation , which describes the enzyme concentration over time E(t) under controlled reaction conditions. | 3d | A | 3 |
| **(OR)** | | | | |
| 21 | *Determine* the solution of the enzyme-driven oscillatory system  *y′′ + y = tan x*, using the method of variation of parameters. | 3f | A | 3 |
|  |  |  |  |  |
| 22 | 1. *Evaluate* the definite integral of B(t) = 2t – log(t) from t = 1 to t = 4 to assess the net increase of biomass in a bioprocess. 2. *Solve* the drug concentration model  using partial fractions. | 4b  4e | E | 4 |
| **(OR)** | | | | |
| 23 | 1. In an enzyme-catalyzed reaction, the reaction rate *v*(*x*) depends on substrate concentration as ​, where *x* is the substrate concentration (mm). Using the substitution rule, *compute* the total product formed, , over a given concentration range. 2. Compute  to obtain the total enzyme produced in a time-dependent reaction. | 4d  4f | A  A | 4 |
| **Compulsory Question:** | | | | |
| 24 | *Compute* the cumulative substrate consumption in a microbial culture from t = 0 to t = 6 hours for , using numerical integration methods:   1. Trapezoidal rule 2. Simpson’s 1/3rd rule 3. Simpson’s 3/8th rule. | 5d | E | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25BT202** | **Duration** | **3hrs** |
| **Course Title** | **PHYSICS FOR BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | Compare bright-field and dark-field microscopy in terms of their illumination method and the appearance of the specimen. | 1a | U | 1 |
| 2. | Explainthe principle of light propagation in optical fiber cable with a neat sketch. | 1e | U | 1 |
| 3. | **Name** the thermodynamic parameter that governs spontaneity in enzyme-catalyzed reactions and **recall** the condition for spontaneity. | 2a | R | 2 |
| 4. | Recall the energy exchange components in a biological calorimetry setup. | 2c | R | 2 |
| 5. | Comparethe X-ray attenuation patterns of soft tissue and bone in a diagnostic image. | 3b | U | 3 |
| 6. | Recall one medical scenario where CT imaging is preferred over MRI. | 3c | R | 3 |
| 7. | Interpret the relationship between Young’s modulus and biomaterial flexibility in implant design. | 4b | U | 4 |
| 8. | Compare crystalline and amorphous biomaterials used in tissue scaffolds. | 4d | U | 4 |
| 9. | Interpretthe relationship between nanoparticle size and optical bandgap in bioimaging. | 5c | U | 5 |
| 10. | A nanoparticle sample has an X-ray diffraction peak at 2θ = 30° with a full width at half maximum (FWHM) of 0.5°. Using the Scherrer equation, identify the crystallite size. Assume λ = 0.154 nm and K = 0.9. | 5b | A | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | A start-up is designing a handheld diagnostic microscope for blood-cell imaging using blue light (λ = 450 nm). The design uses a lens with numerical aperture (NA) = 0.65. Interpret the microscope’s resolution limit using the Rayleigh criterion, and evaluate whether it is sufficient to distinguish red blood cells (~6–8 µm) from smaller platelets (~2–3 µm). | 1b | E | 1 |
| 12. | Distinguish between an open system and a closed system as defined by the exchange of energy and matter. | 2c | An | 2 |
| 13. | Compareionizing and non-ionizing radiation with suitable examples. | 3a | U | 3 |
| 14. | During a viscosity test, two different spindles (large and small) gave slightly different viscosity readings for the same olive oil sample. Explain the possible reasons for this difference and examine the impact of spindle geometry on the accuracy of viscosity measurement. | 4c | An | 4 |
| 15. | Explain the quantum confinement effect in 3D,2D,1D and 0D nanomaterials with a suitable sketch in about 250 words. | 5a | U | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Distinguish between bright field and phase contrast microscopy based on the optical setup, working principle, specimen appearance, advantages, limitations, and applications. | 1b | A | 1 |
| **(OR)** | | | | |
| 17 | An unknown liquid shows the following IR spectral features:   * A broad absorption around **3300 cm⁻¹** * A sharp absorption near **1050 cm⁻¹** * Peaks around **2950 cm⁻¹**   (a) Identify the functional groups responsible for each of these absorptions. (b) Utilisethe combination of these peaks to confirm the presence of an alcohol group in the molecule.  (c) **Apply** your knowledge of IR spectroscopy to determine whether the sample could be ethanol. | 1d | A | 1 |
| 18 | **Explain the calorimetric data to determine the enthalpy (ΔH) and entropy (ΔS) changes for the unfolding of a protein, and evaluate the thermodynamic significance of these values in terms of protein stability. Given:** Melting/unfolding temperature: Tm=330K and calorimetric enthalpy (area under DSC peak): ΔH =200kJ/mol | 2c | E | 2 |
| **(OR)** | | | | |
| 19 | **Explain the industrial implications of high bioenergetic efficiency in fermentation, using the bioethanol industry as an example. Discuss how high efficiency affects:**   * Industrial production * Product yield * Process optimization and cost-effectiveness | 2d | E | 2 |
| 20 | Illustrate your understanding of ionizing and non-ionizing radiation to decide whether X-ray imaging or MRI should be used for a soft tissue (brain or spinal cord) abnormality. Explain your choice by relating the differences in radiation type, tissue interaction, image suitability, and potential biological effects. | 3d | U | 3 |
| **(OR)** | | | | |
| 21 | Explain the principle of CT imaging in diagnosing internal  injuries in accident and trauma patients in emergency medicine. | 3c | U | 3 |
| 22 | The principle of rotational viscometry is used to determine the viscosity of water and olive oil using a Brookfield viscometer. The instrument is operated at 60 rpm with spindle no. 1, having a viscosity constant (K) of 0.1 mPa per % torque. At 25°C, the observed torques are as follows:   * Water: 10% * Olive oil: 45%   Evaluate the viscosities of both liquids and explain the effect of using a larger or smaller spindle on the measured torque and the accuracy of viscosity determination. Justify these observations in relation to the molecular properties of the two liquids. | 4c | E | 4 |
| **(OR)** | | | | |
| 23 | Two biopolymers **Polylactic acid (PLA)** and **Polycaprolactone (PCL)** are tested for their suitability in **tissue scaffold fabrication.** During a tensile test, the following data are obtained:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Biopolymer** | **Applied Force (N)** | **Cross-sectional Area (mm²)** | **Original Length (mm)** | **Extension (mm)** | | PLA | 150 | 10 | 50 | 1.0 | | PCL | 80 | 10 | 50 | 2.0 |  1. Evaluatethe **stress, strain,** and **Young’s modulus** for both polymers. 2. Determinethe material more suitable for **load-bearing scaffold applications,** providing reasoning based on mechanical properties. | 4b | E | 4 |
| **Compulsory Question:** | | | | |
| 24 | A nanobiomaterial sample of **zinc oxide nanoparticles (ZnO NPs)** synthesized using **plant extract** shows an **absorption peak at 370 nm** in its UV–Visible spectrum.   1. **Determine** the optical band gap (Eg);given h=6.626×10−34 J/s , c=3×108 m/s, λ=370nm. 2. **Interpret** the relationship between the band gap(given bandgap of bulk ZnO is 3.2 eV) and nanoparticle size in terms of the **quantum confinement effect.** 3. **Evaluate** the suitability of this material for **bioimaging** based on its optical properties. | 5c | E | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25BT203** | **Duration** | **3hrs** |
| **Course Title** | **CHEMISTRY OF BIOMOLECULES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | Distinguish mono from disaccharides | 1a | An | 1 |
| 2. | List the applications of lipids | 2b | R | 2 |
| 3. | Name few essential fatty acids with structure | 2a | R | 2 |
| 4. | List the isomers of fatty acid | 2c | R | 2 |
| 5. | Give examples for uncommon amino acids | 3a | U | 3 |
| 6. | Distinguish DNA from RNA | 4b | An | 4 |
| 7. | List the secondary forms of DNA | 4a | R | 4 |
| 8. | Define nutraceuticals | 5b | R | 5 |
| 9. | Cite the functions of antioxidants | 4a | U | 4 |
| 10. | Define Zwitterion | 3b | R | 3 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Classify ***polysaccharides*** with suitable examples. | 1a | An | 1 |
| 12. | Explain the various types of chemical bonding | 2b | A | 2 |
| 13. | Summarize the biological significance of minerals | 5a | E | 5 |
| 14. | Interpret the properties of amino acid. | 3b | A | 3 |
| 15. | Write the industrial applications of carbohydrates. | 4c | A | 4 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Explain the Chargaff's rule on DNA base composition and its role as genetic information. | 4c | An | 4 |
| **(OR)** | | | | |
| 17 | Classify simple, compound and derived lipids with suitable examples. | 2e | A | 2 |
|  |  |  |  |  |
| 18 | Explain the structure, properties and functions of monosaccharides. | 1b | An | 1 |
| **(OR)** | | | | |
| 19 | Write the structure, properties and functions of nucleotides. | 4c | A | 4 |
|  |  |  |  |  |
| 20 | Summarize the types and functions of RNA with suitable diagram. | 4d | E | 4 |
| **(OR)** | | | | |
| 21 | Write the structure of aliphatic R group and aromatic amino acids. | 3f | A | 3 |
|  |  |  |  |  |
| 22 | Explain the industrial and clinical significance of amino acids and peptides. | 3c | A | 3 |
| **(OR)** | | | | |
| 23 | Illustratethe physical and chemical properties of fatty acids. | 2e | An | 2 |
| **Compulsory Question:** | | | | |
| 24 | Interpret the deficiency symptoms of vitamin A, D,E and K. | 5d | A | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| --- | --- | --- | --- |
| **Course Code** | **25BT204** | **Duration** | **3hrs** |
| **Course Title** | **FUNDAMENTALS OF BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | List the two Sustainable Development Goals (SDGs) that biotechnology can support. | 1a | R | 1 |
| 2. | Name two genetically modified crops that enhance nutritional value. | 1b | R | 1 |
| 3. | Explain the role of the enzyme involved in breaking down starch into simpler sugars during ethanol production. | 2a | U | 2 |
| 4. | List two factors that affects the yield of biofuel. | 2b | R | 2 |
| 5. | Explain the application of *E. coli* in plastic degradation. | 3c | A | 3 |
| 6. | Explain the role of a biotechnology-based approach in supporting the circular economy model. | 3d | U | 3 |
| 7. | Give a real-world example of a GM crop used to solve a specific agricultural challenge. | 4a | U | 4 |
| 8. | Use an example to show the way organic farming improves soil fertility. | 4c | U | 4 |
| 9. | State the fluorescent protein used in GloFish and its purpose in making the fish glow. | 5b | A | 5 |
| 10. | Explain two ways in which AI is applied in biotechnology. | 5f | U | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Examine the role of green biotechnology to control pest damage and improve crop yield. | 1d | A | 1 |
| 12. | Evaluate the stages of anaerobic digestion in biogas production and the role of the key microbial groups at each stage. | 2b | An | 2 |
| 13. | Examine the enzymes and pathways used in plastic degradation using your knowledge of microbial metabolism. | 3c | A | 3 |
| 14. | Compare the pest control strategies of Bt cotton with conventional methods with reference to their effects on crop yield and pesticide use. | 4d | An | 4 |
| 15. | Examine the role of biotechnology showing the differences between gene editing and genetic modification, using CRISPR as a reference tool. | 5d | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Explain the interdisciplinary role of biotechnology in addressing food security, clean energy, and environmental conservation | 1c | U | 1 |
| **(OR)** | | | | |
| 17 | Justify the potential of bioplastics in replacing conventional plastics in terms of benefits, limitations, and industrial applicability. | 1f | E | 1 |
|  |  |  |  |  |
| 18 | Evaluate the technical and economic viability of Simultaneous Saccharification and Fermentation (SSF) in the production of second-generation bioethanol. | 2a | E | 2 |
| **(OR)** | | | | |
| 19 | Interpret biotechnology concepts to compare biomass energy with fossil fuels in terms of land use, emissions, and energy return. | 2d | A | 2 |
|  |  |  |  |  |
| 20 | Evaluate the potential of genetically engineered *E. coli* in large-scale biodegradation of synthetic plastics. | 3c | An | 3 |
| **(OR)** | | | | |
| 21 | Design a biotechnology-based model for integrating carbon sequestration into industrial operations to earn carbon credits. | 3e | A | 3 |
|  |  |  |  |  |
| 22 | Evaluate the long-term agricultural and ecological impact of Bt cotton adoption in India with examples. | 4b | E | 4 |
| **(OR)** | | | | |
| 23 | Explain the role of organic farming in sustainable agriculture in terms of productivity, health, and market demand with examples. | 4c | An | 4 |
| **Compulsory Question:** | | | | |
| 24 | Design a stepwise workflow for screening chromosomal anomalies in newborns in a cytogenetic lab. | 5a | C | 5 |

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**END SEMESTER EXAMINATION – NOV / DEC 2025**

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| **Course Code** | **25BT205** | **Duration** | **3hrs** |
| **Course Title** | **C PROGRAMMING FOR BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | **LUO** | **RBT Level** | **Related CO** |
| **PART – A (10 X 2 = 20 MARKS)** | | | | |
| 1. | State the function of the return 0; statement in a C program. | 1a | R | 1 |
| 2. | Name the different data types available in C. | 1b | R | 1 |
| 3. | Explain with a program how to store and display 5 integers using a one-dimensional array. | 2a | U | 2 |
| 4. | Write a C program to input a 2×2 matrix and display its elements. | 2b | U | 2 |
| 5. | State the difference between a function declaration and a function definition. | 3a | R | 3 |
| 6. | List the different ways to pass arguments to a function. | 3b | R | 3 |
| 7. | Interpret the role of the ‘&’ operator when used with pointers. | 4a | U | 4 |
| 8. | State the difference between a pointer and an array in C. | 4b | U | 4 |
| 9. | Define a structure and give an example in C. | 5a | R | 5 |
| 10. | Interpret how loops and conditional statements are used to handle basic game logic in C. | 5b | U | 5 |
| **PART – B (5 X 6 = 30 MARKS)** | | | | |
| 11. | Write a C program to calculate the factorial of a number using a for loop. | 1a | A | 1 |
| 12. | Write a C program to reverse a string entered by the user without using built-in functions. | 2f | An | 2 |
| 13. | Write a C program to create a function add () that takes two integers as arguments and returns their sum. | 3a | A | 3 |
| 14. | Write a C program to pass an array to a function using pointers and calculate the sum of its elements. | 4b | An | 4 |
| 15. | Write a C program to define a struct GameBoard for a 3×3 Tic-Tac-Toe board and display the initial empty board. | 5c | A | 5 |
| **PART – C (5 X 10 = 50 MARKS)** | | | | |
| 16 | Discuss the working of if-else and switch statements in C with suitable examples. | 1c | U | 1 |
| **(OR)** | | | | |
| 17 | Apply loops and conditional statements to display all even numbers between 1 and 100. | 1d | A | 1 |
|  |  |  |  |  |
| 18 | Write a C program that asks the user to input all elements of a 2×2 matrix and then displays the matrix in proper row and column format. | 2e | An | 2 |
| **(OR)** | | | | |
| 19 | Write a program to find the largest number in an array of 5 elements. | 2b | A | 2 |
|  |  |  |  |  |
| 20 | Compare and contrast the concepts of call by value and call by reference in C with an example. | 3c | An | 3 |
| **(OR)** | | | | |
| 21 | Evaluate and write a program that uses multiple functions: one to read an array, one to display it, and another to calculate the average of its elements. | 3f | An | 3 |
| 22 | Examine dynamic memory allocation to create an array of N integers, input values, and display them. | 4c | A | 4 |
| **(OR)** | | | | |
| 23 | Write a program using file handling that counts the number of lines, words, and characters in a text file. | 4e | A | 4 |
| **Compulsory Question:** | | | | |
| 24 | Design a simple text-based Snake Game using structures and loops in C. The program should display the board, move the snake based on user input, and terminate when the snake collides with the wall. | 5d | A | 5 |