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| **Course Code** | **09BT222/ 12BT220/ BT210** | **Duration** | **3hrs** |
| **Course Name** | **DOWNSTREAM PROCESSING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name one fundamental difference between Gram-positive and Gram-negative bacteria, considering intracellular product recovery. | | CO1 | R | 1 |
| 2. | Name an anionic detergent widely used in cell lysis protocol. | | CO1 | R | 1 |
| 3. | Differentiate between compressible and incompressible cake in filtration process. | | CO3 | U | 1 |
| 4. | Identify the variables that influence the drag force acting on a spherical particle in a Newtonian fluid. | | CO3 | An | 1 |
| 5. | Identify the meaning of g in ‘500 *× g’*. | | CO4 | U | 1 |
| 6. | List the approaches in the scale up of centrifuge. | | CO4 | R | 1 |
| 7. | List any two industrial application of adsorption. | | CO2 | R | 1 |
| 8. | Interpret the basis of separation in size exclusion chromatography. | | CO5 | U | 1 |
| 9. | Explain the implication of separation factor while choosing appropriate solvent for extraction. | | CO5 | An | 1 |
| 10. | Estimate the ionic strength of 1 M (NH4)2SO4 solution. | | CO6 | E | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain the use of alkali treatment in cell lysis and highlight the associated problems with the same. | | CO1 | U | 3 |
| 12. | Estimate the batch filtration time for 10 L of cell suspension using a 0.5 m2 membrane, if 20 L of the same suspension takes 5 min on a 1.0 m2 membrane. | | CO3 | E | 3 |
| 13. | Interpret the significance of RCF in the selection of centrifuge. | | CO4 | U | 3 |
| 14. | Determine the amount of protein adsorbed per amount of adsorbent from a solution with 1mg/l of protein. The feed will exhaust 90% of solute and K=3 litre/g based on linear isotherm. | | CO2 | A | 3 |
| 15. | Classify the chromatography techniques. | | CO5 | A | 3 |
| 16. | Highlight the different stages in crystallization. | | 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 physical and chemical-enzymatic methods of cell lysis, while referring their benefits and limitations. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Write the expression for batch filtration rate as a function of pressure drop, liquid viscosity, resistance of filter medium, and cake. | CO3 | A | 4 |
|  | b. | Estimate specific cake resistance of the solid deposited. To a Fermentation broth which is filtered using a batch setup and the filtration time data is provided. If the surface area of membrane filter is 0.1 m2 against a pressure drop 10 kPa, viscosity 0.005 Nsm-2, and solid content of slurry 10 kg/m3,   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Time (s) | 5 | 10 | 20 | 30 | | Vol. filtrate (m3) | 0.040 | 0.055 | 0.080 | 0.095 | | CO3 | E | 8 |
|  |  |  |  |  |  |
| 19. |  | Determine the volumetric capacity with which the centrifuge can be operated on scale up for the same broth and when the bowl radius and length are doubled and it operates at the same speed for a bowl centrifuge is used to concentrate a suspension of *E coli* prior to cell disruption. The bowl of this unit has inside radius of 12.7cm and a length of 73.0cm. The speed of the bowl is 16000r/min and the volumetric capacity is 200L/h. where the Ʃ factor for a tubular bowl centrifuge is given by . | CO4 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Estimate the dextran needed to adsorb 90% of the protein in 1.21itres of solution initially containing 4 10-6 mol/1. As a modified dextran will adsorb up to 8 \*10-8 mol of immunoglobulin G per cm3 dextran. The adsorption follows a Langmuir isotherm with a constant K equal to 2 \* 10-8 mol/l. | CO2 | A | 6 |
|  | b. | State the different adsorption isotherms. | CO2 | R | 6 |
|  |  |  |  |  |  |
| 21. | a. | Evaluate the mathematical expression relating initial aqueous feed concentration to final raffinate concentration in multiple stage batch extraction. | CO5 | E | 4 |
|  | b. | Summarize the applicability of precipitation methods in the downstream processing. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 22. | a. | Explain the use of membrane separation process in downstream processing considering process performance, and highlight the different varieties of membrane available and mechanism involved in the same. | CO4 | An | 6 |
|  | b. | Distinguish the structural and operational differences between different membrane modules. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 23. |  | Explain the principle and working of ion exchange chromatography. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Interpret the freeze drying process used for product polishing. | CO6 | U | 12 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 15 |  |  |  |  | 17 |
| CO2 | 7 |  | 9 |  |  |  | 16 |
| CO3 |  | 1 | 4 | 1 | 11 |  | 17 |
| CO4 | 1 | 10 | 12 | 6 |  |  | 29 |
| CO5 |  | 21 | 3 | 1 | 4 |  | 29 |
| CO6 |  | 15 |  |  | 1 |  | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **12BT225/ 12BI202 / BI201/ 09BT227** | **Duration** | **3hrs** |
| **Course Name** | **BASICS OF BIOINFORMATICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | List the role of ftp and http in network. | | CO1 | R | 1 |
| 2. | Define primary databases and its examples. | | CO1 | R | 1 |
| 3. | Identify the role of PAM. | | CO1 | U | 1 |
| 4. | State the functions of strings. | | CO1 | R | 1 |
| 5. | Interpret parametric sequence alignment. | | CO1 | U | 1 |
| 6. | Give examples of substitution matrices. | | CO1 | U | 1 |
| 7. | State any one tool to construct phylogenetic tree. | | CO1 | R | 1 |
| 8. | Explain the features of CATH. | | CO1 | U | 1 |
| 9. | Summarize the difference between ultrametric and min-ultrametric trees. | | CO1 | U | 1 |
| 10. | Label any one polymorphic and one monomorphic molecular marker. | | CO1 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Define edit graph. By using edit graph find out the edit manuscript of the strings ATTG and CTG. | | CO1 | R | 3 |
| 12. | Distinguish the importance of biomolecule function on the interior of protein channel to be hydrophobic or hydrophilic. | | CO1 | U | 3 |
| 13. | Describe the algorithmic issues in database search. | | CO1 | R | 3 |
| 14. | Discuss the relation between multiple sequence alignments on tree construction. | | CO1 | U | 3 |
| 15. | Explain the gene prediction methods with examples. | | CO1 | R | 3 |
| 16. | Define microsatellites and mention the process to detect them in biomolecular function. | | 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. | Identify the the significant features of nucleotide sequential databases in computational biology. | CO1 | U | 8 |
|  | b. | Describe different sequence file formats and application. | CO1 | R | 4 |
|  |  |  |  |  |  |
| 18. | a. | Extend a detailed account of protein structural databases and their applications in structural bioinformatics. | CO1 | U | 8 |
|  | b. | Describe the techniques used for structure determination of proteins. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Construct the algorithmic functional sequence of BLAST program in detail. | CO1 | A | 6 |
|  | b. | Differentiate the FASTA tools on its various versions and application. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Classify the amino acid substitution matrices on proteomic and genomic functional characteristic prediction. | CO1 | U | 8 |
|  | b. | Describe the construction of BLOSUM substitution matrices. | CO1 | R | 4 |
|  |  |  |  |  |  |
| 21. | a. | Explain evolutionary tree and distance based phylogenetic tree building method in detail. | CO1 | U | 6 |
|  | b. | Summarize a detailed account on application of MSA in phylogenetic tree construction. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Describe a detailed explanation about map alignment and sequence assembly. | CO1 | R | 6 |
|  | b. | Illustrate Sanger’s method of sequencing, in reference with the shot gun approach. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Interpret the physical and genetic maps and their construction methods. | CO1 | U | 6 |
|  | b. | Explain the various approaches to gene prediction. | CO1 | R | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Categorize and analyse dynamic programming algorithm for sequence alignment. Using smith waterman to find out the alignment of the following strings  ACTGATTCAT and ACGCATCAT  score for match = 5, score for mismatch = –3, indel = 5 | CO1 | An | 12 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | At the end of the course, the students would have learn Sequencing Alignment and Dynamic Programming, Sequence Databases, Evolutionary Trees and Phylogeny |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 34 | 72 | 6 | 12 |  |  | 124 |
|  | | | | | | | **124** |



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| **Course Code** | | **09BT234/12BT224** | **Duration** | **3hrs** |
| **Course Name** | **ANIMAL BIOTECHNOLOGY AND TISSUE CULTURE** | | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Marks** | |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | |
| 1. | List the growth factors used in cell culture. | | 1 | |
| 2. | Identify the antibiotics used in cell culture medium. | | 1 | |
| 3. | Name the cell line which is used for cervical cancer studies. | | 1 | |
| 4. | Recall the formula for cell counting using hemocytometer. | | 1 | |
| 5. | Name any one adherent type of cell line. | | 1 | |
| 6. | Identify the pore size of the membrane filter used in media sterilization. | | 1 | |
| 7. | Define embryo transfer technology. | | 1 | |
| 8. | Write about ovarian hyperstimulation. | | 1 | |
| 9. | Define gene knockout in animals. | | 1 | |
| 10. | Recite *on In vitro* fertilization. | | 1 | |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | |
| 11. | Interpret on transformed cell line. | | 3 | |
| 12. | Define monolayer in cell culture. | | 3 | |
| 13. | Explain the process of super ovulation. | | 3 | |
| 14. | Discuss on gene therapy. | | 3 | |
| 15. | Define embryo biopsy. | | 3 | |
| 16. | Illustrate on chimeric animal production. | | 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 process of sub culturing of cell line with illustrations. | | 6 |
|  | b. | Explain about the establishment of cell lines. | | 6 |
| 18. | a. | Describe about serum and serum free media used for cell culturing. | | 6 |
|  | b. | Discuss on cell culture as a source of valuable products with examples. | | 6 |
| 19. |  | Describe the viral and bacterial diseases in animals. | | 12 |
| 20. |  | Appraise on the steps involved in the production of monoclonal antibodies. | | 12 |
| 21. |  | Infer on the vaccine production and their applications in animal infections. | | 12 |
| 22. |  | Evaluate on the enrichment of X and Y bearing sperms. | | 12 |
| 23. |  | Describe the methods of gene transfer for the production of transgenic animals. | | 12 |
| **COMPULSORY QUESTION** | | | | |
| 24. | a. | Report on the use of stem cells for the development of transgenic animals. | | 6 |
|  | b. | Discuss on the ethical issues in animal biotechnology. | | 6 |



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| **Course Code** | **12BT208** | **Duration** | **3hrs** |
| **Course Name** | **HEAT TRANSFER OPERATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Recall the numerical expression of thermal conductivity. | | CO1 | R | 1 |
| 2. | What is the rate of heat transfer per unit area called as? | | CO2 | U | 1 |
| 3. | Define the expression of Reynold’s number. | | CO2 | U | 1 |
| 4. | List the different types of boiling. | | CO2 | R | 1 |
| 5. | Recall the principle behind the black body radiation. | | CO1 | R | 1 |
| 6. | Quote the expansion of LMTD. | | CO1 | R | 1 |
| 7. | Define steam economy. | | CO1 | R | 1 |
| 8. | Give examples of different feeding methods available in a reactor. | | CO2 | U | 1 |
| 9. | List the types of condensation. | | CO3 | R | 1 |
| 10. | Recall the unit of heat transfer coefficient. | | CO1 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain the law of heat conduction and heat transfer coefficients. | | CO1 | U | 3 |
| 12. | Define fouling factor and list the preventive methods. | | CO2 | An | 3 |
| 13. | Describe the law of thermal conductivity of composite materials. | | CO1 | R | 3 |
| 14. | Explain the law of radiation with an example. | | CO1 | U | 3 |
| 15. | Differentiate drop wise and film wise condensation. | | CO3 | An | 3 |
| 16. | Analyze the mass balance equation for single | | CO3 | 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. | Derive the expression for heat flux in one dimensional conduction through a composite wall. | CO1 | R | 8 |
|  | b. | What is thermal conductivity? Derive heat transfer rate for a plane wall. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Derive heat transfer expression through a hollow cylinder. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Derive thermal conductivity equation and also derive the steady-state heat transfer through a hollow spherical shell. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Derive the dimensional equation for convective heat transfer | CO3 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Define Mass Transfer. Explain on Molecular Diffusivities. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Define Fourier’s Law for Thermal Conductivity and Newton’s law of cooling.. | CO2 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Distinguish Natural and Forced Convections. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Give a detailed account on Heat Exchanger Equipments with neat diagrams. | CO3 | C | 12 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Explain the principles of diffusion and mass transfer coefficient. |
| CO2 | Understand the principles of gas liquid operations |
| CO3 | Describe vapour liquid operations in biotech industries |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 16 | 10 |  |  |  |  | 26 |
| CO2 | 1 | 15 | 24 | 3 |  |  | 43 |
| CO3 | 1 | 12 | 15 | 15 |  | 12 | 55 |
|  | | | | | | | **124** |



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| **Course Code** | **12BT210** | **Duration** | **3hrs** |
| **Course Name** | **CHEMICAL AND ENZYME REACTION ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Define molecularity of a reaction. | CO1 | R | 1 |
| 2. | Determine the reaction order for a chemical reaction, doubling reactant concentration results in eight time change in reaction rate. | CO1 | A | 1 |
| 3. | Identify the chemical reaction where a single stoichiometric equation and single rate equation are chosen to represent the progress of the reaction. | CO4 | R | 1 |
| 4. | Differentiate between elementary and non- elementary reaction. | CO2 | U | 1 |
| 5. | Classify the reactors used in industries. | CO6 | An | 1 |
| 6. | Illustrate RTD curve for plug flow reactor. | CO3 | U | 1 |
| 7. | Classify enzyme based biosensors. | CO5 | A | 1 |
| 8. | Categorize enzyme inhibition. | CO5 | An | 1 |
| 9. | Distinguish between Space time and Holding time. | CO3 | A | 1 |
| 10. | Define specific activity of enzyme. | CO4 | A | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Classify chemical reactions. | CO1 | A | 3 |
| 12. | List the application of biosensor in healthcare industry. | CO4 | R | 3 |
| 13. | Explain the expression for irreversible uni-molecular-type first-order reactions using integral method of analysis of data. | CO2 | U | 3 |
| 14. | Identify the rate of reaction when CA = 10 mol/liter?If -rA = -(dC/dt) = 0.2 mol/liter.sec when CA = 1 mol/liter | CO3 | A | 3 |
| 15. | Explain the characteristics of biosensor. | CO5 | An | 3 |
| 16. | Summarize the principle and working of packed bed bioreactors. | CO6 | U | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | |
| 17. |  | Calculate the activation Energy for this reaction. Using following data for the bimolecular second-order formation of methyl-ethyl ether in ethyl alcohol solution,   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Temp 0C | 0 | 6 | 12 | 18 | 24 | 30 | | K  (l/mol.s) | 5.6X  105 | 11.8X105 | 24.5X  105 | 48.8X  105 | 100X  105 | 208X  105 | |  |  |  |  |  |  |  | | CO1 | A | 12 |
|  |  |  |  |  |  |
| 18. |  | Estimate the amount of tracer injected for a pulse tracer experiment the exit concentration is noted as below. Calculate the fraction of tracer residing less than 5 min, and mean residence time. If flow rate is 4 L/min   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Time (min) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | Conc (mg/L) | 0 | 0 | 4 | 7 | 9 | 6 | 5 | 3 | 1 | 0 | | CO3 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Estimate the reaction order and calculate rate constant assuming F=80%.For the aqueous reaction A🡪 Products the following data were obtained at 250C in which the concentration of A is given at different intervals of time   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | t (min) | 0 | 10 | 20 | 30 | 40 | | CA (mol/lit) | 0.86 | 0.74 | 0.635 | 0.546 | 0.405 | | CO2 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the principle and design of  (i) Optical biosensor.  (ii) Amperometric biosensors. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the Michaelis –Menton equation for a single substrate reaction catalyzed enzyme  (i) Michaelis Menton Approach.  (ii) Briggs Haldane Approach. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Solve the expression for Toxic compound Inhibition models for enzymes. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | State the design equation for plug flow reactor. | CO6 | R | 6 |
|  | b | Identify the design equation for mixed flow reactor. | CO6 | R | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Compare the different methods of enzyme immobilization. | CO5 | An | 12 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the kinetics of reactions. |
| CO2 | Apply the design equations and the performance of ideal reactors. |
| CO3 | Analyze models for describing non- ideal behavior of reactors. |
| CO4 | Apply enzyme kinetics. |
| CO5 | Evaluate enzymes in industrial application. |
| CO6 | Design of various fermenter / bioreactors. |

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



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| **Course Code** | **12BT239** | **Duration** | **3hrs** |
| **Course Name** | **NANOBIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Recall two examples of nanomaterials. | | CO1 | R | 1 |
| 2. | Name the scientist who was first to use and define the term *Nanotechnology.* | | CO1 | R | 1 |
| 3. | Identify any one physical property of nanoparticles. | | CO1 | R | 1 |
| 4. | Define carbon nanoplates. | | CO1 | R | 1 |
| 5. | State the significance of MEMS. | | CO1 | R | 1 |
| 6. | State one use of nanomaterials in medicine. | | CO1 | R | 1 |
| 7. | Recall the applications of nanobots in therapy. | | CO1 | R | 1 |
| 8. | Identify the distinctiveness of a nanosensor as a tool for nanotechnology. | | CO1 | R | 1 |
| 9. | Specify the importance of artificial neurons in research. | | CO1 | R | 1 |
| 10. | List any two applications of nanomedicine. | | CO1 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Identify the scope of nanotechnology in India. | | CO1 | R | 3 |
| 12. | Interpret the use of nanofabrication in production of structures and devices. | | CO1 | A | 3 |
| 13. | Infer the role of DNA sensors in medicine. | | CO1 | R | 3 |
| 14. | Describe the role of nanoparticles in cancer therapy. | | CO1 | U | 3 |
| 15. | Identify the use of nanomedicine in modern medicine. | | CO1 | R | 3 |
| 16. | State any three Social and Ethical Issues in nanotechnology. | | CO1 | 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. |  | Summarize the evolution and prospects of nanotechnology from inception. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. |  | Describe the outlook of Silicon based Technology as a future trend. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Analyze the various techniques used to synthesize nanoparticles. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain any two methods for characterization of nanoparticles. | CO1 | A | 06 |
| b. | Categorize the types of nanoparticles used in biotechnology. | CO1 | An | 06 |
|  |  |  |  |  |  |
| 21. |  | Assess the techniques for detecting biological agents using nanocrystals. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 22. |  | Identify the innovative biomaterials used for nanotechnology applications. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Examine the various applications of real-time nanosensors in nanomedicine. | CO1 | A | 08 |
| b. | Discuss any **FOUR** clinical applications of nanodevices in medicine. | CO1 | U | 04 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Justify the ethical Issues in Nanotechnology with respect to Nanomedicine. | CO1 | E | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Learn about the nanoparticles, clinical application and ethical issues of nanobiotechnology |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 22 | 31 | 17 | 18 | 36 | - | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Name the enzyme that occurs in several different molecular forms but catalyzes the same reaction. | | CO1 | R | 1 |
| 2. | Name the enzyme involved in the inter-conversion of L and D stereoisomers. | | CO1 | U | 1 |
| 3. | State the unit of Km. | | CO2 | R | 1 |
| 4. | Define turnover number. | | CO2 | R | 1 |
| 5. | Define international unit of enzyme activity. | | CO3 | R | 1 |
| 6. | Name a reactor used for immobilized enzyme. | | CO4 | U | 1 |
| 7. | In a reaction mixture containing 15 µmol of starch and amylase enzyme, it took 10 minutes for the complete conversion of starch. The mixture’s protein content is 5mg. Determine the specific activity. | | CO3 | A | 1 |
| 8. | List the environment application of enzyme based biosensor. | | CO5 | R | 1 |
| 9. | Identify the signal measured in calorimetric biosensors. | | CO5 | U | 1 |
| 10. | Suggest a method for the determination of molecular weight of enzyme. | | CO3 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Establish Hanes Wolf plot in the determination of MM parameters. | | CO4 | U | 3 |
| 12. | For an enzyme catalyzed reaction, with an initial enzyme concentration of 0.075g/L, constants were determined as Km= 9 g[S]/L and Vmax=1.7g/L min. Determine k2. | | CO4 | A | 3 |
| 13. | Classify uncompetitive and non-competitive inhibition. | | CO6 | A | 3 |
| 14. | List out the properties of carrier matrix in enzyme immobilization. | | CO5 | U | 3 |
| 15. | Comprehend the principle of optical biosensors. | | CO5 | U | 3 |
| 16. | Explain the application of enzymes in organic synthesis | | CO2 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Elaborate the Enzyme Commission's system of classification. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. | a. | The enzyme fumerase has the following kinetic constants  Capture1.PNG  k1=109 Ms-1  k-1=4.4\*104 s-1  k2=109 s-1  k-2=0  a. What is the value of Michaelis constant for this enzyme?  b. At an enzyme concentration of 10-6M, what will be the initial rate of product formation at a substrate concentration of 10-3M? | CO4 | E | 12 |
|  |  |  |  |  |  |
| 19. | a. | The following results were obtained for an enzyme- catalyzed reaction.  Estimate Km and Vmax by Lineweaver-Burk plot.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Substrate concentration (mmol L-1) | 5.0 | 6.67 | 10.0 | 20.0 | 40.0 | | Initial velocity (µmol L-1 min-1) | 147 | 182 | 233 | 323 | 400 | | CO6 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain with examples various methods of immobilization of enzymes and explain the working principle of a packed bed reactor. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Examine the characteristics of a biosensor | CO5 | An | 6 |
|  | b. | Classify the different electrochemical enzyme-based biosensors. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Derive the expression for competitive and noncompetitive inhibition reactions and explain it with the help of a line-weaver burk plot. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 23. | a. | Examine the extraction and purification of enzymes from plant source. | CO5 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Examine the application of various enzymes in food and pharmaceutical industries with examples. | CO2 | A | 12 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 13 | 1 |  |  |  |  | 14 |
| CO2 | 2 | 3 | 12 |  |  |  | 17 |
| CO3 | 1 | 1 | 13 |  |  |  | 15 |
| CO4 |  | 4 | 15 |  | 12 |  | 31 |
| CO5 | 1 | 7 |  | 12 | 12 |  | 32 |
| CO6 |  |  | 3 | 12 |  |  | 15 |
|  | | | | | | | **124** |

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Interpret the role of lysozyme in cell lysis protocol. | | CO1 | A | | 1 |
| 2. | Identify the role of alkali treatment and detergent solubilization in releasing intracellular product. | | CO1 | U | | 1 |
| 3. | Give an example of filter aid. | | CO2 | R | | 1 |
| 4. | Name a matrix used to perform cation exchange chromatography. | | CO4 | R | | 1 |
| 5. | Indicate a method to prevent fouling on membranes. | | CO3 | U | | 1 |
| 6. | Interpret the role of spacer arms on the matrix of affinity chromatography is……. | | CO3 | U | | 1 |
| 7. | Mention the significance of break point on the breakthrough curve for a fixed bed adsorption | | CO3 | R | | 1 |
| 8. | A high value of retention coefficient for extraction indicates \_\_\_\_. | | CO4 | A | | 1 |
| 9. | Calculate ionic strength of 2 M NH4SO4 solution. | | CO5 | A | | 1 |
| 10. | List the industrial dryers used in bioprocess industry. | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Classify the bioproducts based on volume, market value and price index. | | CO1 | | An | 3 |
| 12. | Illustrate the steps involved in continuous rotary filters during a filtration cycle. | | CO2 | | A | 3 |
| 13. | Differentiate between salting in and salting out of proteins. | | CO3 | | A | 3 |
| 14. | Deduce the expression for repeated batch extraction. | | CO5 | | A | 3 |
| 15. | Assess the significance of retention volume and retention time in chromatography. | | CO4 | | An | 3 |
| 16. | List the stages in crystallization process. | | 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. | Give a detailed account on physical and chemical-enzymatic methods of cell lysis, while referring their benefits and limitations. | CO1 | | U | 12 |
|  |  |  |  | |  |  |
| 18. | a. | Using a test filter, we find the following data for a broth containing the antibiotic erythromycin and added filter aid   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Filtration time (s) | 5 | 10 | 20 | 30 | | Volume of filtrate (liters) | 0.040 | 0.055 | 0.080 | 0.095 |   The leaf has a total area of 0.1ft2 and the filtrate has a viscosity of 1.1cP. The pressure drop is 6.78\*105 g cm -1s2 and the feed contains 0.015 kg dry cake per liter.  Determine the specific cake resistance α and the medium resistance RM. | CO2 | | A | 12 |
|  |  |  |  | |  |  |
| 19. | a. | Enzyme adsorption on polyacrylamide gel is described by the following isotherm  q=100y0.1  where q is in mg/cm3carbon and y in mg/liter. We plan to add 10cm3of previously unused carbon to 3.0 liters of a fermentation beer containing 26mg/liter antibiotic. Calculate what percent recovery can we expect | CO3 | | A | 12 |
|  |  |  |  | |  |  |
| 20. | a. | Deduce the expression for residual concentration of target compound in heavy phase after counter-current staged extraction process. | CO4 | | R | 6 |
|  | b. | Water containing 6.8mg liter-1 of steroid is extracted with initially pure methylene dichloride. The equilibrium constant for the steroid is 170 and the ratio of water to solvent is 82. Evaluate the concentration in the organic after the extraction.Determine fraction of the steroid has been removed | CO4 | | A | 6 |
|  |  |  |  | |  |  |
| 21. | a. | Explain the utility ofultrafiltration membrane in downstream processing and also highlightits associated limitations. | CO4 | | U | 6 |
|  | b. | Summarize the efficacy of reverse osmosis in downstream processing and also mention its applications | CO4 | | R | 6 |
|  |  |  |  | |  |  |
| 22. | a. | The stability of protein X is sensitive to the changes in pH and ionic concentration of the solvent. Suggest a chromatographic technique to separate the protein from cell lysate. Summarize its basic principle, materials used and procedure | CO5 | | A | 12 |
|  |  |  |  | |  |  |
| 23. | a. | Choose a chromatographic technique to separate enzyme substrate complex. Summarize its basic principle, materials used and procedure | CO5 | | A | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Describe the design and working of lyophilizer. | CO6 | | U | 6 |
|  | b. | Explain the theoretical considerations in drying process and specify the significance of critical moisture content | CO6 | | U | 6 |

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

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 13 | 1 | 3 |  |  | 17 |
| CO2 | 1 |  | 15 |  |  |  | 16 |
| CO3 | 1 | 2 | 15 |  |  |  | 18 |
| CO4 | 13 | 6 | 7 | 3 |  |  | 29 |
| CO5 |  |  | 28 |  |  |  | 28 |
| CO6 | 1 | 15 |  |  |  |  | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Define order of a reaction. | CO1 | R | 1 |
| 2. | Identify the reaction order for a chemical reaction, doubling reactant concentration results in eight time change in reaction rate. | CO1 | A | 1 |
| 3. | Identify the chemical reaction where a single stoichiometric equation and single rate equation are chosen to represent the progress of the reaction. | CO1 | R | 1 |
| 4. | Choose the best way to achieve higher degree of conversion in a given reactor system (a) increase flow rate (b) decrease flow rate | CO6 | U | 1 |
| 5. | Categorize the following reactor assemblies in **decreasing order of performance** for equivalent feed and flow rates (i) a 20 L MFR, (ii) two 10 L MFR in series, (iii) a 20 L PFR | CO4 | An | 1 |
| 6. | Distinguish weather the area of C-curve will increase if the flow rate is decreased. | CO3 | U | 1 |
| 7. | Interpret the graphical approach to find *rate constant* for a second order reaction. | CO2 | A | 1 |
| 8. | Infer if it advisable to replace a 60 L MFR with two 30 L MFR in series. | CO2 | An | 1 |
| 9. | Distinguish between Space time and Holding time. | CO5 | A | 1 |
| 10. | Estimate the area under E-curve, if area under C-curve is 5 mg/L. min | CO5 | A | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Classify chemical reactions. | | | CO1 | U | 3 |
| 12. | Write the activation energy of this sterilization process.Milk is pasteurized if it is heated to 63OC for 30 min, but if it is heated to 74°C it only needs 15 s for the same result. | | | CO2 | A | 3 |
| 13. | Interpret the expression for irreversible uni-molecular-type first-order reactions using integral method of analysis of data. | | | CO3 | U | 3 |
| 14. | Calculate mean residence time of a reactor by deriving the expression to from pulse tracer input. | | | CO4 | A | 3 |
| 15. | Estimate the time required for 80% conversion of liquid reactant in a batch reactor with initial concentration of 50 mol/L. Given -rA =2.5 mol l-1 min-1 . | | | CO5 | E | 3 |
| 16. | Evaluate the final exit concentration, for a 1st order chemical reaction in a MFR the inlet and outlet concentrations are 100 mol/l and 50 mol/l. If we connect two additional reactors of same size in series. | | | CO6 | E | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | | |
| 17. |  | Solve for the final exit concentration, if intermediate concentration (between PFR and MFR) is = 2 mol/L. The reaction is 1st order with respect to A, and the volume of the PRF and MFR are same An aqueous reactant stream (4 mol/L) passes through a PFR followed by a MFR.. | | CO4 | A | 12 |
|  |  |  | |  |  |  |
| 18. |  | Calculate the fraction of tracer residing less than 5 min, and mean residence time. If flow rate is 4 L/min, estimate the amount of tracer injected. In a pulse tracer experiment the exit concentration is noted as below.   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Time (min) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | Conc (mg/L) | 0 | 0 | 4 | 7 | 9 | 6 | 5 | 3 | 1 | 0 | | | CO5 | An | 12 |
|  |  |  | |  |  |  |
| 19. |  | Calculate rate constant assuming F=80% and find the reaction order for a aqueous reaction A🡪 Products the following data were obtained at 250C in which the concentration of A is given at different intervals of time   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | t (min) | 0 | 10 | 20 | 30 | 40 | | CA (mol/lit) | 0.86 | 0.74 | 0.635 | 0.546 | 0.405 | | | CO1 | E | 12 |
|  |  |  | |  |  |  |
| 20. |  | Solve for finding a rate equation , to reactant **A** decomposes in a batch reactor  The composition of A in the reactor is measured at various times with results shown in the following to represent the data.   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Time. t, s | 0 | 20 | 40 | 60 | 120 | 180 | 300 | | Concentration CA, mol/liter | 10 | 8 | 6 | 5 | 3 | 2 | 1 | | | CO1 | A | 12 |
|  |  |  | |  |  |  |
| 21. |  | Estimate the time required to drop the concentration of A from CA0= 1.3mol/l to CAf= 0.30mol/l, if it proposed to operate a batch reactor for converting A into R. This is a liquid phase reaction with stoichiometry A🡪R.   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | CA, mol/l | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 1.0 | 1.3 | 2.0 | | -rA, mol/l.min | 0.1 | 0.3 | 0.5 | 0.6 | 0.5 | 0.25 | 0.1 | 0.06 | 0.05 | 0.045 | 0.042 | | | CO6 | An | 12 |
|  |  |  | |  |  |  |
| 22. | a. | Evaluate the conversion under new situation for a plug flow reactor is used in a liquid phase homogeneous 1st order chemical reaction A🡪P, resulting in 40% conversion, if the flow rate is doubled. | | CO3 | E | 8 |
| b. | Illustrate the graphical approach to calculate τ in MFR and plug flow reactor. | | CO3 | A | 4 |
|  |  |  | |  |  |  |
| 23. | a. | State the derivation for the design equation for plug flow reactor. | | CO2 | R | 6 |
|  | b | State the derivation for design equation for mixed flow reactor. | | CO2 | R | 6 |
|  |  |  | **Compulsory:** | | | |
| 24. |  | Analyze the complications arising out of heterogeneous reaction system. Show the overall reaction rate expression for a solid-liquid system using appropriate diagram. | | CO5 | An | 12 |

CO – COURSE OUTCOME BL – BLOOMS’ LEVEL

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 3 | 13 |  | 12 |  | 30 |
| CO2 | 12 |  | 4 | 1 |  |  | 17 |
| CO3 |  | 4 | 4 |  | 8 |  | 16 |
| CO4 |  |  | 15 | 1 |  |  | 16 |
| CO5 |  |  | 2 | 24 | 3 |  | 29 |
| CO6 |  | 1 |  | 12 | 3 |  | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Explain structural organization in proteins and application of bioinformatics. | | CO1 | U | | 1 |
| 2. | Describe the different sequence formats available for biomolecules. | | CO1 | R | | 1 |
| 3. | Name different types of biological database. | | CO2 | R | | 1 |
| 4. | Define FTP. | | CO2 | R | | 1 |
| 5. | Describe the reason for aligning two sequences. | | CO3 | R | | 1 |
| 6. | List any two methods available for alignment of pair of sequence. | | CO3 | R | | 1 |
| 7. | Describe few advanced techniques used in Genomics. | | CO4 | U | | 1 |
| 8. | Describe Newick format for the following tree | | CO4 | R | | 1 |
| 9. | Comparative modeling is also known as \_\_\_\_\_\_\_. | | CO5 | U | | 1 |
| 10. | Define CADD. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | List the various file formats used in biological sequences | | CO1 | | A | 3 |
| 12. | Explain any tertiary protein structural databases with few applications. | | CO2 | | A | 3 |
| 13. | Explain about local alignment | | CO3 | | R | 3 |
| 14. | Explain the types of clustering. | | CO4 | | A | 3 |
| 15. | Define homology and illustrate its role in bioinformatics | | CO5 | | An | 3 |
| 16. | Illustrate the benefits of High throughput screening. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. | a. | Explain the elementary commands and protocol involved in Bioinformatics. | CO1 | | A | 10 |
|  | b. | List out the scope of bioinformatics. | CO1 | | A | 2 |
|  |  |  |  | |  |  |
| 18. | a. | Interpret a complete note on NCBI as the centralized resource for biological science and structural database information. | CO2 | | A | 9 |
|  | b. | Describe a brief note on sequence similarity search. | CO2 | | A | 3 |
|  |  |  |  | |  |  |
| 19. | a. | Compute local sequence alignment of GATGAATTCAT (sequence 1) and GACTTAC (sequence 2) and represent the final alignment. The scoring scheme is as follows: Match =5, Mismatch = -3, and Gap: -4 | CO3 | | A | 10 |
|  | b. | Compare and contrast global vs local alignment. | CO3 | | R | 2 |
|  |  |  |  | |  |  |
| 20. | a. | Compare maximum parsimony and maximum likelihood methods for tree building for method, advantages and limitations. | CO4 | | E | 10 |
|  | b. | Explain the role of DNA microarray in bioinformatics. | CO4 | | R | 2 |
|  |  |  |  | |  |  |
| 21. | a. | Analyze how protein structure prediction methods are useful for research and also explain the most accurate protein structure prediction method. | CO5 | | An | 9 |
|  | b. | Define threading with examples. | CO5 | | An | 3 |
|  |  |  |  | |  |  |
| 22. |  | Explain Microarray methodology and clustering types and techniques. | CO6 | | An | 10 |
|  |  | Describe a note on the concept of gap penalty. | CO6 | | A | 2 |
|  |  |  |  | |  |  |
| 23. | a. | Explain the process of Ab initio protein modeling. | CO5 | | An | 7 |
|  | b. | Differentiate between global and local alignment. | CO3 | | U | 5 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Explain the steps of drug designing using bioinformatics. | CO6 | | A | 10 |
|  | b. | Describe few industrial applications of CADD | CO6 | | U | 2 |

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

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 1 | 15 | - | - | - | 17 |
| CO2 | 2 | - | 15 | - | - | - | 17 |
| CO3 | 7 | 5 | 10 | - | - | - | 22 |
| CO4 | 3 | 1 | 3 | - | 10 | - | 17 |
| CO5 | - | 1 | - | 22 | - | - | 23 |
| CO6 | - | 6 | 12 | 10 | - | - | 28 |
|  | | | | | | | **124** |



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| **Course Code** | **19BT2040** | **Duration** | **3hrs** |
| **Course Name** | **PLANT AND ANIMAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | List the micronutrients in MS media. | | CO1 | R | 1 |
| 2. | Define soma clonal variation. | | CO1 | R | 1 |
| 3. | Define synthetic seed. | | CO2 | R | 1 |
| 4. | Identify the role of protoplast in plant genetic transformation. | | CO2 | U | 1 |
| 5. | State the size of Ti plasmid. | | CO2 | R | 1 |
| 6. | List the marker genes used in plant transformation. | | CO3 | R | 1 |
| 7. | Write one example for disease resistance trangenic plants. | | CO3 | U | 1 |
| 8. | Calculate the number of cells in 1 ml of HeLa cell suspension. | | CO4 | A | 1 |
| 9. | Identify the enzyme used for the disaggregation of cells from tissue. | | CO5 | R | 1 |
| 10. | State the role of serum in culturing of cells. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Infer the role of vitamins in MS media. | | CO1 | An | 3 |
| 12. | Write the significance of somatic embryogenesis in plant tissue culture. | | CO2 | A | 3 |
| 13. | State the features of Ti plasmid. | | CO3 | R | 3 |
| 14. | Describe the concentration of antibiotics and percentage of serum used in the medium for cell culture. | | CO4 | U | 3 |
| 15. | Interpret membrane integrity assay. | | CO5 | U | 3 |
| 16. | Identify the role of microcarriers in cell culture. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the growth pattern of plant cells for *In Vitro* drug production using cell suspension culture. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the protocol to develop transgenic crop using biolistic gun method with a neat diagram. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the steps involved in micropropagation of endangered medicinal plants. | CO1 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Evaluate the strategies of development of disease resistance transgenic plants and its significance. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Describe the types of reporter and marker genes used in plant genetic transformation with suitable examples. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 22. | a. | Interpret hemocytometer cell counting analysis with neat diagram. | CO4 | U | 6 |
|  | b. | Discuss the role of CO2 in animal cell culture system. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Discuss about serum and serum free medium in animal cell culture. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe assisted hatching and preimplantation genetic diagnosis in micromanipulation technique. | CO6 | U | 8 |
|  | b. | Summarize the ethical issues involved in animal research in biotechnology. | CO6 | E | 4 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Acquire knowledge in plant biotechnology and its applications. |
| CO2 | Gain the knowledge about to increase the production in agriculture products. |
| CO3 | Prepare them to work in the Agricultural industries. |
| CO4 | Demonstrate *In vitro* cell culture, fertilization and the manipulation of embryo done for genetic screening will provide wider understating among the students and create awareness |
| CO5 | Development of transgenic animals for breed development for enhanced milk production |
| CO6 | Adapt appropriate ethical guidelines in animal biotechnology |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 12 | 12 | 3 |  |  | 29 |
| CO2 | 2 | 1 | 3 | 12 |  |  | 18 |
| CO3 | 16 | 1 |  |  | `12 |  | 29 |
| CO4 |  | 15 | 3 |  |  |  | 18 |
| CO5 | 1 | 15 |  |  |  |  | 16 |
| CO6 | 1 | 9 |  |  | 4 |  | 14 |
|  | | | | | | | **124** |



**END SEMESTER EXAMINATION- NOV / DEC- 2023**

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| --- | --- | --- | --- |
| **COURSE CODE** | **19BT2054** | **Duration:** | **3hrs** |
| **COURSE NAME** | **ENVIRONMENTAL BIOTECHNOLOGY** | **Max. Marks:** | **100** |

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| **Q. No.** | **Questions** | **CO** | **BL** | **Marks** |
|  | **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | List different types of environmental pollution. | CO1 | R | 1 |
| 2. | Name the liquid component of oil spill in oceans due to human activity. | CO1 | R | 1 |
| 3. | Differentiate between point and nonpoint sources of water pollution. | CO1 | An | 1 |
| 4. | Tabulate different layers of atmosphere. | CO1 | R | 1 |
| 5. | Identify the major hydrocarbon present in biogas. | CO2 | R | 1 |
| 6. | Define Lagoons. | CO3 | R | 1 |
| 7. | Mention the full form of CPCB. | CO4 | R | 1 |
| 8. | Write the reason for high adsorption capacity of activated carbon in treating wastewater. | CO6 | C | 1 |
| 9. | Determine the number of bacterial strains present in Oil zapper. | CO6 | A | 1 |
| 10. | Define biofertilizer. | CO6 | R | 1 |

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|  | **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Illustrate the significance of pH and color of the sewage water as indicators. | CO1 | A | 3 |
| 12. | Differentiate between BOD and COD. | CO2 | A | 3 |
| 13. | Summarize the environmental impact of solid wastes. | CO3 | E | 3 |
| 14. | Illustrate the scientific understanding on acid rain. | CO4 | U | 3 |
| 15. | Compare slope leaching with heap leaching. | CO5 | E | 3 |
| 16. | Write a short note on biomining. | CO6 | A | 3 |

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|  | | **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 importance of microbes as bioadsorbent for the removal of heavy metal contaminated wastewater. | CO1 | U | 12 |
|  |  | |  |  |  |  |
| 18. | a. | | Describe the process of adsorption in the removal of waste water contaminants. | CO2 | U | 6 |
|  | b. | | Explain the working principle of trickling filter. | CO2 | A | 6 |
|  |  | |  |  |  |  |
| 19. | a. | | Recognize the principle and working mechanisms of settling chamber, cyclone separator and venturi scrubber with schematic diagrams. | CO3 | R | 12 |
|  |  | |  |  |  |  |
| 20. | a. | | Distinguish between dynamic precipitators and electrostatic precipitators. | CO4 | E | 5 |
|  | b. | | List the control devices for gaseous pollutants and explain their working principle with suitable diagram. | CO4 | R | 7 |
|  |  | |  |  |  |  |
| 21. | a. | | Summarize *in situ* and *ex situ* bioremediation of soil pollutants with examples. | CO5 | E | 12 |
|  |  | |  |  |  |  |
| 22. | a. | | Explain in details on the biological activity of *Bacillus thuringiensis* against the insects. | CO6 | U | 12 |
|  |  | |  |  |  |  |
| 23. | a. | | Explain the efficacy of microbial populations for the degradation of xenobiotic compounds. | CO3 | An | 6 |
|  | b. | | Discuss the role of “oil zapper” in oil sludge treatment. | CO6 | An | 6 |
|  |  | |  |  |  |  |
|  |  | | **Compulsory:** | | | |
| 24. | a. | | Illustrate the types of biosensors employed for the monitoring of environmental pollution. | CO6 | A | 12 |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 3 | 12 | 3 | 1 | - | - | 19 |
| CO2 | 1 | 6 | 9 | - | - | - | 16 |
| CO3 | 13 | - | - | 6 | 3 | - | 22 |
| CO4 | 8 | 3 | - | - | 5 | - | 16 |
| CO5 | - | - | - | - | 15 | - | 15 |
| CO6 | 1 | 12 | 16 | 6 | - | 1 | 36 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Formulate the output of the following expression print(6\*2\*\*3//2). | | CO4 | U | 1 |
| 2. | Identify the output of the given python code.  tuple1=(5,6,7)  tuple3=tuple1\*3  print(tuple3) | | CO2 | U | 1 |
| 3. | Evaluate the output of the following code.  print("aabaabcaa".count("aa")) | | CO2 | U | 1 |
| 4. | Find the output of the given python code.  list1 = [1, 2, 3, 4, 5]  print(list1[3]) | | CO2 | U | 1 |
| 5. | Specify the difference between remove( ) and discard( ) functions in set. | | CO1 | R | 1 |
| 6. | Predict the output of the following code segment.  t = "Welcome"  print ("S"+ t[4:]) | | CO2 | U | 1 |
| 7. | Examine and write the output of the following pythonic code.  list1 = [14, 22, 42, 18, 30]  print(list1[-2]) | | CO2 | U | 1 |
| 8. | Find the output of the given code.  R=(1,2,3,4,1)  print(R.index(3)) | | CO2 | U | 1 |
| 9. | Find the output of the given code. | | CO6 | U | 1 |
| 10. | List some built-in modules in python. | | CO3 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Predict the output of the given python code.  num=1/3 print("%2.4f" %num) | | CO4 | U | 3 |
| 12. | Apply the following string slicing for the input string S = " UNIVERSITY" and find the output.   * 1. S[ : : -1]   2. S[ : : -2]   3. S[5: :-1] | | CO2 | A | 3 |
| 13. | Develop a program that combines the elements of List1 with List2. The elements in List1 and List2 are as follows:  List1 **=** [1, 2, 3]  List2 **=** [2, 3, 4, 5] | | CO2 | U | 3 |
| 14. | Discuss the basic operation of Tuple with suitable example. | | CO2 | R | 3 |
| 15. | Develop a Python program to print the range of numbers from 10 to 15 using control structures | | CO1 | U | 3 |
| 16. | Create a python program to generate an even random integer between 0 and 30. | | 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. | Elucidate the type casting with a suitable python code. | CO1 | R | 6 |
|  | b. | Explain the relational and logical operators with sample code segments. | CO4 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | Develop a Python program to perform the following operations on the given input string S = "Well done"   * Perform capitalization of the input string. * Calculate the length of the input string. * Convert the input string to lower case. * Access the last character of the string. | CO3 | U | 6 |
|  | b. | “Strings in Python are Immutable”. Justify this statement with an example. Construct the pythonic code to accept the string “karunya” and display the entire string with first and last character in uppercase. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Create the Python code to perform the following operations on a list car\_name=["Ford", "Maruti", "BMW"]   * Find the length of the list. * Update the second item of the list as " Renault" * Remove the last item in the list and print the list. | CO1 | U | 6 |
|  | b. | Construct a Python program to write the content "This is a sample file" in a text file and calculate the number of words in that file using file operations. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Build a Python code to perform the following operations by considering two tuples i = (1,2,3,4,2) and j = (5,6,7,8).   * Concatenate the two tuples. * Repeat the elements of tuple ‘i’ three times. * Calculate the number of occurrences of a particular element in   the tuple ‘i’.   * Find the maximum value of the tuple ‘j’ | CO1 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Write the Python program to perform the following conditional actions on the input integer, N between 3 and 20:   * If N is odd, print Odd * If N is even and in between 3 to 20, print Even * If N is greater than 20, print Invalid | CO6 | A | 6 |
|  | b. | Develop a Python program to print your department name ten times using loop structure in python | CO2 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Compare and contrast the different sequence datatype with an example. | CO2 | R | 6 |
|  | b. | Design a Python program to print ‘n’ natural numbers using "while" loop. | CO6 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explicate join(), split() and append() methods in a list with examples. | CO2 | R | 6 |
|  | b. | Construct a Python program to find the average of the marks of all the students stored in the given tuple.  T1=(("Samuel",75),( "Glory",35),( "Ravi",50)) | CO6 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the packages and discuss the package creation with a suitable example in Python. | CO3 | U | 6 |
|  | b. | Discuss about Biopython module and its features. | CO6 | U | 6 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand, write, compile, and run Python programs. |
| CO2 | Analyze Python structures that implement decisions, loops, and store arrays and use these structures in a well designed, OOP program. |
| CO3 | Create Python programs that make use of various modules and packages |
| CO4 | Understand regular expressions and extract required information from file and databases. |
| CO5 | Relate and arrange information from multiple files |
| CO6 | Apply the principles of object-oriented programming and well-documented programs in the Python language, including use of the Bio-python packages in big data analytics. |
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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 7 | 9 | 12 | - | - | - | 28 |
| CO2 | 15 | 9 | 9 | - | - | - | 33 |
| CO3 | 1 | 12 | - | - | - | - | 13 |
| CO4 | 6 | 4 | 6 | - | - | - | 16 |
| CO5 | - | - | 6 | - | - | - | 6 |
| CO6 | 0 | 7 | 21 | - | - | - | 28 |
|  | | | | | | | **124** |



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

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| **Q.**  **No.** | **Questions** | | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Show the structure of fructose in furanose form. | | | CO1 | U | 1 |
| 2. | List the major buffer systems of blood. | | | CO1 | R | 1 |
| 3. | List two examples of disaccharides. | | | CO2 | R | 1 |
| 4. | Write the Henderson and Hasselbalch equation. | | | CO2 | A | 1 |
| 5. | How denaturation and denaturation of DNA is monitored? | | | CO3 | An | 1 |
| 6. | What is maltose composed of? | | | CO3 | R | 1 |
| 7. | List two sources for vitamin C. | | | CO4 | U | 1 |
| 8. | State the nitrogenous bases present in DNA. | | | CO4 | R | 1 |
| 9. | Write the importance of buffers in biological system. | | | CO5 | A | 1 |
| 10. | Compare the sugar structure between DNA and RNA. | | | CO6 | An | 1 |
| PART – B (6 X 3 = 18 MARKS) | | | | | | |
| 11. | Why does a buffer solution resist any change in pH? | | | CO1 | R | 3 |
| 12. | What are ketone bodies and when are they produced? | | | CO2 | R | 3 |
| 13. | Define isoelectric point of proteins. | | | CO3 | R | 3 |
| 14. | Name three significant natural and artificial peptides (three each). | | | CO4 | R | 3 |
| 15. | List essential fatty acids and draw any one structure. | | | CO5 | U | 3 |
| 16. | Write the role of fat in hibernating animals. | | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. | a. | | Explain one buffering system of blood in detail. | CO1 | R | 6 |
|  | b | | Discuss the chemical properties of water and its importance to life. | CO1 | U | 6 |
|  |  | |  |  |  |  |
| 18. | a. | | Enumerate on physical properties and functions of fatty acids. | CO1 | R | 8 |
|  | b | | Give two examples for heteropolysaccharide with a structure. | CO4 | U | 4 |
|  |  | |  |  |  |  |
| 19. | a. | | Explain the Chargaff's rule on DNA base composition with a suitable diagram. | CO2 | R | 8 |
|  | b | | State the functions of different types of RNA. | CO3 | R | 4 |
|  |  | |  |  |  |  |
| 20. | a. | | Classify the classes of amino acids with suitable examples. | CO4 | An | 8 |
|  | b. | | Differentiate between proteoglycan and glycolipid. | CO2 | U | 4 |
|  | |  |  |  |  |  |
| 21. | | a. | Discuss the structure and properties of nucleotides present in DNA and RNA. | CO5 | U | 8 |
|  | | b. | Write the properties of nucleic acids. | CO5 | A | 4 |
|  | |  |  |  |  |  |
| 22. | | a. | Generalize the structure, classification and properties of glycoprotein. | CO3 | U | 12 |
|  | |  |  |  |  |  |
| 23. | | a. | Classify compound lipids with suitable examples and diagrams. | CO3 | An | 8 |
|  | | b | Represent the various forms of secondary structure of DNA. | CO4 | U | 4 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | | a. | Explain the sources, biochemical functions and deficiency diseases of vitamin E. | CO6 | U | 6 |
|  | | b. | List the functions of micro minerals. | CO6 | R | 6 |

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

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 18 | 7 | - | - |  |  | 25 |
| CO2 | 12 | 4 | 1 | - |  |  | 17 |
| CO3 | 8 | 12 | - | 9 |  |  | 29 |
| CO4 | 4 | 9 | - | 8 |  |  | 21 |
| CO5 | - | 11 | 5 | - |  |  | 16 |
| CO6 | 6 | 6 | 3 | 1 |  |  | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **QUESTIONS** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | Specify the site of transcription and translation in a cell. | | CO1 | A | 1 |
| 2. | Name an imaging technique that uses lasers to scan the object. | | CO6 | A | 1 |
| 3. | Distinguish between benign and malignant cells. | | CO5 | U | 1 |
| 4. | Identify connective tissues that have abundant extracellular matrix. | | CO3 | R | 1 |
| 5. | Differentiate between cotransport and anti-transport of molecules across membranes. | | CO2 | A | 1 |
| 6. | List any four second messengers in a cell. | | CO4 | R | 1 |
| 7. | Define ‘Blank Cells’. | | CO4 | A | 1 |
| 8. | Mention any four proteins of intermediate filaments. | | CO3 | R | 1 |
| 9. | Expand ‘FISH’ – a cytogenic technique to locallize DNA sequences in chromosomes. | | CO6 | A | 1 |
| 10. | Name any TWO notable diseases caused by pathogenic bacteria. | | CO1 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the Questions)** | | | | | |
| 11. | Compare and contrast the structure and functions of Endoplasmic reticulum and Golgi apparatus in an animal cell. | | CO1 | An | 3 |
| 12. | Examine the different modes of cell signaling and comment on their significance. | | CO4 | An | 3 |
| 13. | Highlight the differences between prokaryotic and eukaryotic mRNA. | | CO1 | A | 3 |
| 14. | Construct a mRNA with 4 codons specific for 4 amino acids. | | CO1 | C | 3 |
| 15. | List the series of intracellular reactions induced by the activation of cell surface receptors. | | CO4 | A | 3 |
| 16. | The life and death of a cell is determined by pro-apoptotic and anti-apoptotic proteins – Justify with a diagram. | | CO2 | 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. | Write descriptive notes on the phases of cell cycle and the molecular mechanism of its regulation. | CO2 | An | 6 |
|  | b. | Evaluate the nature of any two bacterial toxins and explain the mechanism of action. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain signal transduction and amplification in a cell. | CO4 | An | 6 |
|  | b. | Describe the types of enzyme-linked receptor and their mode of action. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Compare and contrast carrier and channel proteins. | CO2 | U | 6 |
|  | b. | Draw and describe three significant molecular models of plasma membrane. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Write an essay on the synthesis and transport of proteins in cells. | CO2 | An | 8 |
|  | b. | Illustrate the process of glycosylation of proteins in Eukaryotic cells. | CO2 | An | 4 |
|  |  |  |  |  |  |
| 21. | a. | Summarize the types of cell junctions and highlight their interaction with adjacent cells and the extracellular matrix. | CO3 | A | 6 |
|  | b. | Write a short note on programmed cell death and enumerate the events associated with the process. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Depict the stages of tumor development and list the characteristics of cancer cells. | CO5 | A | 5 |
|  | b. | Discuss the unique features and types of stem cells. Explain the myths and controversies related to their sourcing and applications. | CO5 | A | 5 |
|  | c. | Comment on any one recent and significant discovery in Cell Physiology that was recognized for Nobel Prize. | CO6 | E | 2 |
|  |  |  |  |  |  |
| 23. | a. | Demonstrate the role of protein filaments in the following:  i) Muscles ii) Villi iii) Cilia | CO3 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Compare the working principle of fluorescence and confocal microscopy with illustrations. | CO6 | An | 6 |
|  | b. | Stem cell therapy has revolutionized healthcare. Justify with case studies. | CO6 | E | 6 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 |  | 10 | 3 |  | 3 | 17 |
| CO2 |  | 6 | 4 | 30 |  |  | 40 |
| CO3 | 2 |  | 6 | 12 |  |  | 20 |
| CO4 | 1 |  | 10 | 9 |  |  | 20 |
| CO5 |  | 1 | 10 |  |  |  | 11 |
| CO6 |  |  | 2 | 6 | 8 |  | 16 |
| **Total** | **4** | **7** | **42** | **60** | **8** | **3** | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Name an accessory used in a fermentor for aeration purpose. | | CO1 | | U | 1 |
| 2. | Which was the year AILR was invented? | | CO1 | | R | 1 |
| 3. | How many moles of Carbon are present in Sucrose molecule? | | CO2 | | R | 1 |
| 4. | Define GRAS? | | CO2 | | R | 1 |
| 5. | Name an enzyme which could be used as an animal feed additive. | | CO3 | | U | 1 |
| 6. | Which was year when the first rDNA vaccine developed? | | CO3 | | R | 1 |
| 7. | Which microorganism is employed for the production of citrate? | | CO4 | | U | 1 |
| 8. | Name a class of Bioreactor wherein silica beads are employed. | | CO4 | | R | 1 |
| 9. | Name any two uncertain varaibles involved in modelling of biooprocess. | | CO5 | | U | 1 |
| 10. | Which equipment is used for drying the final product? | | CO6 | | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Analyze the importance of using an airlift and a stir tank reactor. | | CO1 | An | | 3 |
| 12. | What is solid state fermentation? Mention its significance in Bioprocessing. | | CO2 | U | | 3 |
| 13. | Categorize the different types of bioreactors. | | CO3 | An | | 3 |
| 14. | Summarize dry anaerobic digestion. | | CO4 | U | | 3 |
| 15. | State the differences between essential and non essential amino acids. | | CO5 | An | | 3 |
| 16. | Highlight on Lysine biosynthesis. | | CO6 | U | | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. | a. | Summarize the operations of a bioreactor along with a neat sketch of the reactor. | CO1 | U | | 12 |
| 18. | a. | Elaborate on the history of Biotechnology and future perspectives. | CO2 | R | | 6 |
|  | b. | Elaborate on the history of reactors and microscopes with diagrams. | CO2 | R | | 6 |
| 19. | a. | Classify the types of microorganisms used in bioprocess industry. | CO3 | U | | 12 |
|  |  |  |  |  | |  |
| 20. | a. | Illustrate the significance Process Flow Sheeting, Modeling and Simulation of Bioprocesses. | CO3 | An | | 12 |
| 21. | a. | Describe in detail the industrial production of Lysine. | CO4 | A | | 12 |
| 22. | a. | What is a bio preservative? Explain how Nisin is produced industrially. | CO4 | E | | 12 |
| 23. | a. | Define anaerobic fermentation. Elaborate the production of Beer. | CO5 | U | | 6 |
|  | b. | What are antibodies? Describe the production of Monoclonal antibodies in *in vitro.* | CO5 | A | | 6 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | What is bioremediation? Elaborate on the importance and application of Bioremediation. | CO6 | An | | 12 |

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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. |
| CO4 | Analyze industrial-market value of these bio products and relate them with the scope of  biotechnology |
| CO5 | Relate the clinical and biological significance of these bio products for sustainable bioprocess  engineering |
| CO6 | Evaluate the difference in manufacturing commercial bio products and all the ethical issues  Involved in it. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 13 | - | 3 | - | - | 17 |
| CO2 | 14 | 3 | - | - | - | - | 17 |
| CO3 | 1 | 13 | - | 15 | - | - | 29 |
| CO4 | 1 | 4 | 12 | - | 12 | - | 29 |
| CO5 | - | 7 | 6 | 3 | - | - | 16 |
| CO6 | - | 4 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |



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

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

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

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

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



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the enzyme responsible for the conversion of pyruvate into lactate. | | CO1 | R | 1 |
| 2. | Determine the number of ATP synthesized from 1 mole of glucose under anaerobic conditions. | | CO1 | A | 1 |
| 3. | Define essential amino acids with an example. | | CO2 | R | 1 |
| 4. | Write the structure of glycine. | | CO2 | A | 1 |
| 5. | Name the protein complex in Electron Transport Chain (ETC) which uses proton gradient to drive the ATP synthesis. | | CO3 | R | 1 |
| 6. | Name of the final electron acceptor in ETC cycle. | | CO3 | R | 1 |
| 7. | Write the source of N7 in the structure of purine nucleus. | | CO4 | R | 1 |
| 8. | Name the compound which is accumulated in Rey’s syndrome. | | CO4 | R | 1 |
| 9. | Identify the amino acid responsible for Hartnup’s disease. | | CO5 | R | 1 |
| 10. | Name the molecule based on which steroid molecules are synthesized. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | | Enumerate the importance of pentose phosphate pathway. | CO1 | A | 3 |
| 12. | | Compare di and tri- peptides with respect to the number of amino acids and peptide bonds. Give an example for each. | CO2 | An | 3 |
| 13. | | Mention the importance of reducing equivalents in ETC. | CO3 | An | 3 |
| 14. | | Differentiate between purine and pyrimidine in case of DNA and RNA, separately. | CO4 | An | 3 |
| 15. | | Mention the name of defective enzymes and characteristics/symptoms for Tarui’s disease and Lesch- Nyhan syndrome. | CO5 | An | 3 |
| 16. | | List the major ketone bodies. How and when they are produced? | 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. | | Discuss the metabolic reactions involved in the oxidative and non-oxidative phases of pentose phosphate pathway. | CO1 | An | 12 |
|  | |  |  |  |  |
| 18. | | State the metabolic features of urea cycle with a neat diagram. | CO2 | C | 12 |
|  | |  |  |  |  |
| 19. | | Explain in detail on the role of five protein complexes for the generation of ATP during the process of ETC with diagram. | CO3 | U | 12 |
|  | |  |  |  |  |
| 20. | | Describe the metabolic pathways involved in purine biosynthesis. | CO4 | U | 12 |
|  | |  |  |  |  |
| 21. | | List and explain six inborn errors mentioning the name of the defective enzyme and symptoms of amino acids and nucleotide metabolisms. | CO5 | R | 12 |
|  | |  |  |  |  |
| 22. | | Explain the coordinated metabolic regulation in glycolysis and gluconeogenesis. | CO1 | U | 12 |
|  | |  |  |  |  |
| 23. | | Discuss the steps involved in the synthesis of fatty acids. | CO6 | E | 12 |
|  | | **Compulsory:** | | | |
| 24. | | Summarize the β-oxidation of fatty acids. | CO6 | U | 12 |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 12 | 4 | 12 | - | - | 29 |
| CO2 | 1 | - | 1 | 3 | - | 12 | 17 |
| CO3 | 2 | 12 | - | 3 | - | - | 17 |
| CO4 | 2 | 12 | - | 3 | - | - | 17 |
| CO5 | 13 | - | - | 3 | - | - | 16 |
| CO6 | 1 | 15 | - | - | 12 | - | 28 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

**END SEMESTER EXAMINATION – NOVEMBER 2023**

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | The cell wall of gram-negative and gram-positive bacteria contains \_\_\_\_. | | CO1 | R | 1 |
| 2. | Phase contrast microscope is used for visualizing \_\_\_\_\_. | | CO1 | U | 1 |
| 3. | Name a drug used for the treatment of malaria. | | CO2 | An | 1 |
| 4. | The genome of the virus is made up of \_\_\_\_\_\_. | | CO2 | U | 1 |
| 5. | During the stationary phase of growth of microorganisms the rate of cell division \_\_\_\_\_. | | CO3 | U | 1 |
| 6. | What is the S phase in a growth curve called? | | CO3 | R | 1 |
| 7. | What is the difference between a disinfectant and an antiseptic? | | CO4 | A | 1 |
| 8. | The infective viral particle is called as \_\_\_. | | CO5 | R | 1 |
| 9. | Which stage in syphilis is found to be most infective? | | CO5 | A | 1 |
| 10. | Define aerosols. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain the principle and applications of a light microscope with a neat illustration. | | CO1 | A | 3 |
| 12. | What are lichens? Explain how lichens exhibit symbiotic relationships. | | CO2 | U | 3 |
| 13. | Write a note on the nutritional requirements of microorganisms. | | CO3 | U | 3 |
| 14. | Mention few preventive measures for bacterial growth. | | CO4 | A | 3 |
| 15. | Narrate the clinical conditions and symptoms of tuberculosis. | | CO5 | A | 3 |
| 16. | Give a schematic representation of freshwater microflora. | | 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. | Explain the principle and specimen preparation for TEM with a neat sketch. | CO1 | U | 6 |
|  | b. | Define differential staining and enumerate the steps involved in gram staining. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | Write a note on the life cycle of a) Chlamydomonas b) actinomycetes | CO2 | R | 6 |
|  | b. | Comment on the morphology and structure of prokaryotes. | CO2 | R | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the bacterial growth curve pattern and factors affecting the growth of microorganisms | CO3 | A | 6 |
|  | b. | Describe briefly the concept of geometric growth and arithmetic growth | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | What are antiviral agents used? Explain with some examples. | CO4 | An | 6 |
|  | b. | How can you prevent and control the growth of bacteria? Explain. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Write a note on 1) Covid 19 2) H1N1 | CO5 | R | 4 |
|  | b. | Elaborate on the epidemiology, pathogenesis, and laboratory diagnosis of AIDS. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 22. | a. | Explain various types of Biofertilizers. What are its advantages and uses? | CO6 | U | 6 |
|  | b. | Give a detailed account of microbes in yogurt. | CO6 | R | 6 |
|  |  |  |  |  |  |
| 23. | a. | Describe the structure and life cycle of bacteriophage. | CO2 | R | 6 |
|  | b. | Explain the microbial treatment process for sewage disposal. | CO6 | C | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the chemical methods used to control bacterial growth. | CO4 | A | 6 |
|  | b. | Discuss any two diseases caused by protozoans. | CO5 | U | 6 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 7 | 7 | 3 |  |  |  | 17 |
| CO2 | 18 | 4 |  | 1 |  |  | 23 |
| CO3 | 1 | 10 | 6 |  |  |  | 17 |
| CO4 |  |  | 16 | 6 |  |  | 22 |
| CO5 | 5 | 6 | 12 |  |  |  | 23 |
| CO6 | 7 | 6 |  | 3 |  | 6 | 22 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Differentiate between real fluid and ideal fluid in terms of viscosity. | | CO1 | U | 1 |
| 2. | Explain the working principle of the piezometer | | CO3 | U | 1 |
| 3. | Identify the energy heads that a U-tube manometer measures in a flow. | | CO2 | U | 1 |
| 4. | Analyze the entrance and exit loss when a pipe is connecting two tanks. | | CO1 | An | 1 |
| 5. | Recall a method to measure the surface tension of the liquid. | | CO4 | R | 1 |
| 6. | Differentiate between major and minor losses in fluid flow. | | CO4 | U | 1 |
| 7. | Name a simple flow-measuring device and the assumption behind its use. | | CO5 | U | 1 |
| 8. | Select the device/approach used to measure flow in an open channel (i) pitot tube (ii) orifice (iii) weir | | CO1 | U | 1 |
| 9. | Infer the design variables impacting flow through syphon. | | CO5 | An | 1 |
| 10. | State the general expressions used to account for minor losses in bending and turns through pipes. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Water flowing through a pipe of 15 cm gets bifurcated into two branches with a diameter of 10 cm and 5 cm, respectively. If discharge in the main pipe is 10 m3/s, estimate the flow rates in branches. | | CO1 | E | 3 |
| 12. | A simple U-tube manometer containing oil (sp. gr. 0.9) is connected to two horizontal pipes carrying water. If the difference between limbs is 40 cm, estimate the pressure difference between the two pipes. | | CO2 | E | 3 |
| 13. | Formulate the expression for the capillary rise of a liquid using surface tension. | | CO3 | C | 3 |
| 14. | The diameter of large and small pistons in a hydraulic gauge is 10 cm and 3 cm, respectively. Determine the minimum force to be applied on the small piston to lift a load of 900 N on the large piston. | | CO3 | A | 3 |
| 15. | Calculate the change in discharge rate through an orifice if the water level in the tank is doubled. Is there any impact on the orifice diameter? | | CO4 | An | 3 |
| 16. | Analyze the change in head loss if the diameter of the pipe is increased while keeping the same volumetric flow rate. | | CO5 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | The space between two horizontal large plane surfaces (2.4 cm apart) is filled with oil. Estimate the minimum force required to drag a thin plate of 0.5 m2 surface area at a speed of 0.6 m/s located in middle between the large planes | CO1 | E | 8 |
|  | b. | Calculate the capillary rise of water in a 2 mm diameter glass tube, if the surface tension of water is 0.07 N/m. | CO1 | E | 4 |
|  |  |  |  |  |  |
| 18. | a. | Water is flowing upward through a vertical pipe having a diameter of 20 cm and 10 cm at the bottom and top sections, respectively. The pressure and velocity of flow at the bottom section are 29.43 N/cm2 and 2 m/s, respectively. (i) Estimate the pressure at the top section? (ii) If a mercury manometer is connected to both ends, calculate the manometric reading. Assume there is no energy loss in the flow. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 19. | a. | A horizontal venturi meter with inlet and throat diameters of 20 cm and 10 cm, respectively is used to measure the flow of oil of specific gravity of 0.8. Estimate the reading of the oil-mercury manometer, if the discharge rate is 60 L/s. Assume C*d* = 0.98. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 20. | a. | A horizontal pipe of diameter 50 cm is suddenly contracted to 25 cm. Determine the discharge rate through the pipe if pressure intensities in larger and smaller pipes are 13.73 N/cm2 and 11.77 N/cm2, respectively. Given *C*c = 0.62 | CO2 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Determine the water flow rate of a pipe (diameter 10 cm, length 60 cm), when one end is connected to a tank and another end is open to the atmosphere. The water level in the tank is 20 cm above the centre of the pipe. Consider all losses, given f= 0.01 | CO3 | E | 6 |
|  | b. | The difference in elevation between two water surfaces in two tanks connected by a 30 cm diameter 100 m long pipe is 20 cm. Calculate the rate of flow if *f*=0.01, considering all losses, i.e., friction, entrance, and exit loss. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 22. | a. | Derive the expression for volumetric discharge over a rectangular weir used for flow measurement. | CO4 | C | 8 |
|  | b. | Find the discharge over a rectangular notch of 2 m length when the constant head over the notch is 30 cm. Assume *Cd* = 0.60 | CO4 | E | 4 |
|  |  |  |  |  |  |
| 23. | a. | A pipe of 10 cm diameter is connected to a nozzle of 5 cm diameter and discharges water at 20 L/s. Estimate the theoretical discharge if the pressure at the base of the nozzle is 6 N/cm2. | CO5 | E | 8 |
|  | b | Differentiate between orifices and mouthpieces on the structural aspect. | CO5 | U | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the Buckingham’s π-theorem, and method of selecting repeating variables in dimension analysis. | CO6 | An | 6 |
|  | b. | Connect the steps involved in solving the problem by Rayleigh’s method with an appropriate example | CO6 | An | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Understand the nature of fluids, statics and dynamics of fluid flow |
| CO2 | Summarize the principles for flow in transportation of fluids in the problems related to the process engineering |
| CO3 | Relate flow through pipe and flow past immersed object |
| CO4 | Analyze the equations of fluid flow |
| CO5 | Evaluate principles of fluid flow phenomena in scale up |
| CO6 | Create empirical relations using dimensional analysis to understand fluid flow phenomena |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 0 | 2 | 0 | 1 | 15 | 0 | 18 |
| CO2 | 0 | 1 | 0 | 0 | 39 | 0 | 40 |
| CO3 | 0 | 1 | 3 | 0 | 12 | 3 | 19 |
| CO4 | 1 | 1 | 0 | 3 | 4 | 8 | 17 |
| CO5 | 0 | 5 | 0 | 4 | 8 | 0 | 17 |
| CO6 | 1 | 0 | 0 | 12 | 0 | 0 | 13 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define endogenous metabolism. | | CO1 | U | 1 |
| 2. | What do you mean by cryptic growth? | | CO1 | R | 1 |
| 3. | List out any two pressure measuring devices. | | CO5 | R | 1 |
| 4. | What is an offline sensor? | | CO5 | U | 1 |
| 5. | Name the dual role played by the microorganisms. | | CO2 | A | 1 |
| 6. | What are non-nutritional media supplements? | | CO2 | An | 1 |
| 7. | For optimizing carbon, vitamin, and nitrogen of 6 concentrations each using the classical method, calculate the number of experiments to be performed. | | CO2 | E | 1 |
| 8. | The initial number of microbes present in 2 liters of medium is 10x10 16 cells/ml. calculate the del factor for sterilization. | | CO3 | E | 1 |
| 9. | Air is passed at a rate of 1.9m3/sec for 300 sec in a depth filter. Calculate the initial number of microbes present in the air. | | CO6 | E | 1 |
| 10. | How are the microorganisms isolated by auxonography? | | CO4 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | How is sampling done? Draw a sampling unit and list out the steps involved. | | CO1 | U | 3 |
| 12. | What are chelators? Give example. | | CO2 | R | 3 |
| 13. | The Del factor for heating and cooling is 1.5 and 1.3 respectively. The initial no. of microbes before sterilization is 2.6x1016. Calculate Holding time if k is 2.54 min-1. | | CO3 | An | 3 |
| 14. | List out the principles by which filtration is carried out in a depth filter. | | CO6 | A | 3 |
| 15. | State the methods to isolate microorganisms based on their desired characteristics. | | CO4 | R | 3 |
| 16. | Draw the flow diagram for the process of inoculum development. | | CO4 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Elaborate on five groups of commercially important fermentation processes for product development. | CO1 | U | 6 |
|  | b. | Explain in detail with a neat sketch the overview of the fermentation process. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Differentiate between various types of sensors with an example. | CO5 | R | 6 |
|  | b. | Explain the working principle of any two dissolved oxygen sensors used in fermenters. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Elaborate the process of medium optimization using the Placket Burmann method with Nelson's example. | CO2 | An | 6 |
|  | b. | For the following data calculate the difference, average difference, mean square, experimental error, and factors showing a larger effect where, D-1, D-2 and D-3 are dummy variables.   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Factor** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **D-1** | **D-2** | **D-3** | | **Σ(H)** | 10 | 23 | 8 | 9 | 7 | 11 | 6 | 6 | 7 | 2 | 9.8 | | **Σ(L)** | 8 | 11 | 4 | 6 | 4 | 5 | 3 | 1 | 4 | 1 | 9.6 | | CO2 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | A fermentation process requires an 8.8 liters batch of complex medium to be steam-sterilized at 121 °C. Assuming that the medium before sterilization contains 8.5xl011 bacterial spores of *Bacillus stearothermophilus* per ml and the probability of non-sterility after sterilization is 1 in 1000, Determine the holding time at 121°C and ▼holding. The time of heating from 100°C to 121°C is 8 min and the time of cooling from 121°C to 102°C is 12 min. Assume that the spore death below 100°C is insignificant. The value of ▼table=12.549, A=9.5x1037min-1, E=283 KJ/mol and R=8.314 J/(mol K). | CO3 | E | 6 |
|  | b. | Derive the expression for thermal death kinetics of microbes. | CO3 | R | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain the utility of different ingredients used to formulate fermentation medium, focusing on different carbon and nitrogen sources in particular. | CO2 | U | 8 |
|  | b. | Differentiate between Batch and continuous sterilization. | CO3 | A | 4 |
|  |  |  |  |  |  |
| 22. | a. | Derive the expression for the design of holding time in a batch sterilization process. Add a note on batch and continuous sterilization equipment. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Air is sterilized through a depth filter and is sent at a flow rate of 14 m3/min for the fermentation process for 45 min with a linear velocity of 0.17m/min and the value of the rate constant is 1.55 m-1. Calculate: 1. Initial number of microorganisms present in air. 2. Radius of the filter 3. Length of the filter 4. The cross-sectional area of filter 5. X90 6. Efficiency of filtration | CO6 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain in detail various methods of isolation of industrially important microbes. Add a note on how microbes are preserved using the lyophilization process. | CO4 | U | 12 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 16 | - | - | - | - | 17 |
| CO2 | 3 | 8 | 1 | 13 | 1 | - | 26 |
| CO3 | 6 | - | 4 | 15 | 7 | - | 32 |
| CO4 | 7 | 12 | - | - | - | - | 17 |
| CO5 | 7 | 7 | - | - | - | - | 14 |
| CO6 | - | - | 3 | - | 13 | - | 16 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | How many carbon atoms are in a pyrimidine ring? | | CO1 | U | 1 |
| 2. | In a ds DNA, if adenine content is 28%, then the content of guanine is \_\_\_\_\_\_\_. | | CO1 | An | 1 |
| 3. | RNA primer for leading strand synthesis contains ─── nucleotides. | | CO2 | A | 1 |
| 4. | What did Hershey and Chase prove by their experiment on bacteriophage and E. coli? | | CO2 | U | 1 |
| 5. | Which of the following enzymes is **not** involved in the repair of methylated bases?  (a) Dam methylase (b) O6- methyl guanine methyl transferase  (c) AP endonuclease (d) DNA glycosylase | | CO3 | R | 1 |
| 6. | Proofreading exonuclease activity of DNA polymerase functions in --- | | CO3 | R | 1 |
| 7. | Monocistronic mRNA is found in \_\_\_\_\_\_\_\_\_\_\_\_\_. | | CO4 | An | 1 |
| 8. | Name the inhibitor for RNA synthesis. | | CO4 | U | 1 |
| 9. | What does the degeneracy of the genetic code denote? | | CO5 | R | 1 |
| 10. | Which enzyme is not produced by the lac structural genes? | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Which is the most unstable type of RNA molecule? Why? | | CO1 | R | 3 |
| 12. | Write a note on prokaryotic promoters. | | CO2 | R | 3 |
| 13. | Discuss how mutations can increase variation within a population and Add a note on the different types of mutations | | CO3 | A | 3 |
| 14. | Comment on intron removal and exon splicing. | | CO4 | U | 3 |
| 15. | Why codons are redundant? | | CO5 | A | 3 |
| 16. | If all cells in a given organism carry the same genes, how can gene expression that is localized in time and space be explained? | | 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. | Give an account of the Hershey and Chase experiment. What did it conclusively proved? If both DNA and proteins contained phosphorus and sulphur do you think the result would have been the same? | CO1 | E | 7 |
|  | b. | How will you differentiate a chromatid from a chromatin? Explain the packing of eukaryotic chromosomes. | CO1 | An | 5 |
|  |  |  |  |  |  |
| 18. | a. | Explain the three steps involved in DNA replication. How does a discontinuous strand synthesis differ from a continuous strand synthesis? | CO2 | A | 6 |
|  | b. | What background information did Watson and Crick have made available for developing a model of DNA? Also, mention the salient features of the Watson and Crick DNA model. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | How does DNA replication in eukaryotes differ from prokaryotes? | CO3 | R | 6 |
|  | b. | Describe any three types of DNA repair mechanisms. | CO3 | R | 6 |
|  |  |  |  |  |  |
| 20. | a. | Examine the role of RNA polymerase, proteins, and Pribnow box in transcription. | CO4 | U | 6 |
|  | b. | How is transcription initiated and terminated in E. coli? Explain. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Wobble’s hypothesis states that genetic code is degenerative. Explain. | CO5 | A | 6 |
|  | b. | How is protein made from mRNA? Write about the function of RNA in protein synthesis. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | With the help of a detailed diagram, explain the action of repressor protein on lac operon in the presence and absence of Lactose. | CO6 | A | 6 |
|  | b. | Discuss the organization of the tryptophan operon. Also, explain its regulation. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the different models of DNA synthesis. | CO2 | R | 6 |
|  | b. | Narrate Avery–MacLeod–McCarty experiment to prove DNA is genetic material. | CO1 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | How is an initiation complex formed during translation? | CO5 | U | 6 |
|  | b. | Differentiate generalized and specialized transduction in bacteria. | CO6 | R | 6 |

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

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

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 3 | 7 |  | 6 | 7 |  | 23 |
| CO2 | 9 | 7 | 7 |  |  |  | 23 |
| CO3 | 14 |  | 3 |  |  |  | 17 |
| CO4 |  | 16 |  | 1 |  |  | 17 |
| CO5 | 1 | 12 | 9 |  |  |  | 22 |
| CO6 | 6 | 7 | 6 |  | 3 |  | 22 |
|  | | | | | | | **124** |



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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Identify the base sequences in mRNA, if the DNA strand has nitrogenous base sequence ATTGCC. | | CO1 | U | 1 |
| 2. | Recall the first isolated restriction enzyme. | | CO2 | R | 1 |
| 3. | Name the cloning vector which has both bacteriophage and plasmid properties. | | CO3 | R | 1 |
| 4. | Recognize the process of transferring macromolecules from a gel to the   solid surface of an immobilized membrane. | | CO4 | R | 1 |
| 5. | Indicate the source of Ti plasmid. | | CO5 | R | 1 |
| 6. | Name the standing committee responsible for reviewing  all University research activities that involve the use of biological  agents. | | CO6 | R | 1 |
| 7. | Identify the genetic variation in the DNA samples: | | CO2 | U | 1 |
| 8. | Calculate how many DNA duplex is obtained from one DNA duplex after 4 cycles of PCR. | | CO4 | A | 1 |
| 9. | Name the scientist who developed the DNA fingerprinting technique. | | CO5 | R | 1 |
| 10. | Give an example for GMO. | | CO6 | U | 1 |
|  |  | |  |  |  |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write short notes on “RM system” in bacteria. | | CO1 | A | 3 |
| 12. | Define enzyme unit. | | CO2 | R | 3 |
| 13. | Cite the importance of “cos sites” in cosmid vector. | | CO3 | U | 3 |
| 14. | List the components required for PCR. | | CO4 | R | 3 |
| 15. | Distinguish transformation from transfection. | | CO5 | U | 3 |
| 16. | Record the societal issues pertaining to rDNA technology. | | 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 northern hybridization. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. | a. | Cite the importance of homopolymer tailing in DNA cloning. | CO2 | U | 4 |
|  | b. | Explain the types and functions of polymerase enzymes. | CO2 | R | 8 |
|  |  |  |  |  |  |
| 19. | a. | Describe the structure and features of plasmid cloning vector with examples. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | List the applications of PCR techniques. | CO4 | R | 6 |
|  | b. | Illustrate the structure and principle of molecular beacons. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Describe the physical, chemical and biological methods of  transformation. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 22. | a. | Define Blue-White selection. How does alpha- complementation help in Blue-White selection? | CO3 | R | 12 |
|  |  |  |  |  |  |
| 23. | a. | Distinguish between genomic library and cDNA library. List out their applications. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Write in detail about different levels of containment. | CO6 | A | 12 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 12 | 1 | 3 | - | - | - | 16 |
| CO2 | 12 | 5 | - | - | - | - | 17 |
| CO3 | 13 | 15 | - | - | - | - | 28 |
| CO4 | 10 | 6 | 1 | - | - | - | 17 |
| CO5 | 14 | 15 | - | - | - | - | 29 |
| CO6 | 1 | 1 | 15 | - | - | - | 17 |
|  | | | | | | | **124** |



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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Identify the method of preservation of microbes with liquid nitrogen. | | CO1 | U | 1 |
| 2. | Name one parameter assessed during quality control of preserved culture. | | CO1 | R | 1 |
| 3. | Classify the different phases in a typical growth curve for a bacterial population. | | CO2 | U | 1 |
| 4. | Define maintenance coefficient. | | CO2 | U | 1 |
| 5. | Determine the degrees of reduction of ethanol (C2H5OH). | | CO3 | A | 1 |
| 6. | Analyze the significance of the yield coefficient. | | CO3 | An | 1 |
| 7. | Identify the advantage of the sodium sulphite oxidation method in oxygen-transfer rates determination. | | CO4 | U | 1 |
| 8. | Suggest a method to improve mass transfer in the fermentor. | | CO4 | A | 1 |
| 9. | Deduce the steady-state conditions in a chemostat used to grow microbial culture. | | CO6 | A | 1 |
| 10. | State the unit for maintenance coefficient in microbial culture. | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Analyze the role of the culture medium in obtaining suitable inoculum. | | CO1 | An | 3 |
| 12. | Classify the methods to determine cell mass concentration. | | CO3 | A | 3 |
| 13. | Consider the ethanol fermentation by *Saccharomyces cerevisiae* as described by the following overall reaction. Estimate maximum yield coefficient for CO2. | | CO2 | A | 3 |
| 14. | Estimate the effect of air flow rate on the KLa of an aerated and agitated vessel. | | CO4 | U | 3 |
| 15. | Explain the utility of fed-batch operation in bioprocess and write the mass balance equation relevant to the system. | | CO5 | A | 3 |
| 16. | Differentiate between apparent and true yield coefficients using appropriate mathematical expressions. | | CO2 | 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. | Examine the criteria for the choice of organism in the industrial process. | CO1 | U | 6 |
|  | b. | Explain the isolation of organisms by enrichment culture technique. | CO1 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | Ethanol formation from glucose is accomplished in a batch culture of *Saccharomyces cerevisiae* and obtained the following data.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Time, h | 0 | 2 | 5 | 10 | 15 | 20 | 25 | 30 | | Glucose (S), g/L | 100 | 95 | 85 | 58 | 30 | 12 | 5 | 2 | | Biomass (X), g/L | 0.5 | 1.0 | 2.1 | 4.8 | 7.7 | 9.6 | 10.4 | 10.7 | | Ethanol (P), g/L | 0.0 | 2.5 | 7.5 | 20.0 | 34.0 | 43.0 | 47.5 | 49 |   a. By fitting the biomass data to the logistic equation, determine the carrying capacity coefficient, k  b. Determine yield coefficient YP/S, YX/S | CO3 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | Production of single-cell protein from hexadecane is by the following reaction:  C16H34+a O2+b NH3→c CH1.66O0.27N0.20 + d CO2+ e H2O  If RQ equals 0.43,  a. Estimate the stoichiometric coefficients, and  b. Biomass yield coefficient on hexadecane. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 20. | a. | Compare the different methods for the determination of KLa | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Derive the expression for the specific growth rate for a steady-state CSTR with sterile feed. | CO5 | A | 6 |
|  | b. | A 100 L chemostat operates under steady-state conditions with a feed flow rate of 10 L/h and substrate concentration of 20 g/L. If the maximum specific growth rate of the culture is 0.5/h, and ks equals 50 g/L, estimate the substrate concentration in the reactor and biomass productivity assuming biomass yield coefficient YX/S = 0.4 g g-1 | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | The batch cultivation of Atropa belladonna hairy roots in a bubble-column fermenter resulted in the following biomass and sugar concentrations.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Time(h) | 0 | 2 | 4 | 8 | 10 | 12 | 14 | 16 | 18 | | Cell concentration(X) (kg/m3) | 0.2 | 0.211 | 0.302 | 0.95 | 1.77 | 3.2 | 5.6 | 6.15 | 6.2 | | Glucose concentration (g/L) | 9.23 | 9.21 | 9.07 | 8.03 | 6.8 | 4.6 | 0.92 | 0.077 | 0 |   Calculate   1. Yield on substrate (Yx/s) 2. Net specific growth rate (µnet) 3. Doubling time (td) | CO3 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | Establish the mass-transfer steps involved in transport of oxygen from the interior of gas bubbles to the site of intracellular reaction | CO4 | A | 6 |
|  | b. | Formulate the mathematical expression for estimation of volumetric oxygen mass transfer coefficient in “static gassing out” technique. | CO4 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Analyze the significance of packed bed reactors in bioprocess while assessing their advantage/disadvantages | CO6 | An | 12 |

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

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 7 | 7 |  | 3 |  |  | 17 |
| CO2 |  | 2 | 3 |  | 12 |  | 17 |
| CO3 |  | 3 | 16 | 1 | 12 |  | 32 |
| CO4 |  | 4 | 19 | 6 |  |  | 29 |
| CO5 |  | 1 | 15 |  |  |  | 16 |
| CO6 |  |  | 1 | 12 |  |  | 13 |
|  | | | | | | | **124** |



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

**Note:** Students **may use cartesian graph paper** for solving numerical problems

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define the unit of enzyme activity. | | CO1 | R | 1 |
| 2. | Infer the model that describe the interaction between active site and substrate. | | CO1 | U | 1 |
| 3. | Identify the enzyme that catalyzes the isomerization of geometric isomers. | | CO3 | U | 1 |
| 4. | A single subunit of enzyme converts 360 micro moles of substrate to product in one minute. Determine the enzyme activity in SI unit. | | CO4 | A | 1 |
| 5. | Determine the Km of enzyme if the initial velocity is reduced to one- fourth of the maximum velocity. | | CO4 | A | 1 |
| 6. | Name the methods for observing the progress of enzyme reaction. | | CO5 | R | 1 |
| 7. | Identify the type of inhibition observed with inhibitor that can bind to the free enzyme as well as enzyme substrate complex. | | CO6 | A | 1 |
| 8. | Recall an enzyme used in the organic synthesis. | | CO2 | R | 1 |
| 9. | Name the immobilization technique that may be accomplished without the solid matrix. | | CO3 | U | 1 |
| 10. | Name the enzyme used in the detergent industry. | | CO2 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Comprehend the activation energies of enzymatically catalyzed and uncatalyzed reactions. | | CO1 | An | 3 |
| 12. | Compare the substrate inhibited and uninhibited enzymatic reactions. | | CO6 | An | 3 |
| 13. | Explain immobilized enzyme packed bed reactor with a diagram. | | CO3 | U | 3 |
| 14. | Illustrate the elements of biosensor.­ | | CO3 | U | 3 |
| 15. | Compare the detection methods used in enzyme assay. | | CO5 | A | 3 |
| 16. | Interpret the role of nanobiocatalyst in bioprocessing. | | CO2 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the Enzyme Commission’s system of classification of enzymes | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. | a. | The hydrolysis of urea by urease is only partially understood reaction and shows inhibition. Data for the hydrolysis of the reaction are given below.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Substrate concentration | 0.2M | | 0.02M | | |  | 1/v | I | 1/v | I | |  | 0.22 | 0 | 0.68 | 0 | |  | 0.33 | 0.0012 | 1.02 | 0.0012 | |  | 0.51 | 0.0027 | 1.50 | 0.0022 | |  | 0.76 | 0.0044 | 1.83 | 0.0032 | |  | 0.88 | 0.0061 | 2.04 | 0.0037 | |  | 1.10 | 0.0080 | 2.72 | 0.0044 | |  | 1.15 | 0.0093 | 3.46 | 0.0059 |   Where v=moles L-1min-1 and I is the inhibitor molar concentration.  a. Determine the Michaelis- Menten constant for this reaction.  b. What type of inhibition reaction is this? Substantiate the answer  c. Based on the answer to part b, what is the value of Ki | CO4 | A | 12 |
|  |  |  |  |  |  |
| 19. | a. | The hydration of CO2 is catalyzed by carbonic anhydrase as follows  H2O+CO2⇔HCO3- +H+  The following data were obtained for the forward and reverse reaction rates at pH=7.1 and an enzyme concentration of 2.8\*10-9M   |  |  |  |  | | --- | --- | --- | --- | | Hydration | | Dehydration | | | 1/v, M-1  (s\*10-3) | [CO2]  (M\*103) | 1/v, M-1  (s\*10-3) | [CO2]  (M\*103) | | 36 | 1.25 | 95 | 2 | | 20 | 2.5 | 45 | 5 | | 12 | 5 | 29 | 10 | | 6 | 20 | 25 | 15 |   v is the initial reaction rate at the given substrate concentration. Calculate the forward and reverse catalytic and Michaelis constants. | CO6 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain with examples the suitability of direct and indirect methods for enzyme detection. | CO 5 | U | 6 |
|  | b | Record the precautions and practical considerations to be followed during enzyme assay. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Analyze the different methods for the purification of enzyme. | CO 5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Summarize on different enzyme based biosensors used in industry. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Compare the different immobilization methods of enzyme with examples. | CO3 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Examine the application of enzymes in different industries. | CO 2 | A | 12 |

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

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 13 | 1 |  | 3 |  |  | 17 |
| CO2 | 1 | 13 | 15 |  |  |  | 29 |
| CO3 |  | 8 |  | 12 |  |  | 20 |
| CO4 |  |  | 14 |  |  |  | 14 |
| CO5 | 1 | 12 | 3 | 12 |  |  | 28 |
| CO6 |  |  | 1 | 15 |  |  | 16 |
|  | | | | | | | **124** |



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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Mention a disadvantage of using enzymes for cell disruption. | | CO2 | R | 1 |
| 2. | What are bio products? | | CO1 | R | 1 |
| 3. | What is cake compressibility? | | CO2 | R | 1 |
| 4. | Write down the different classifiers in the sedimentation process. | | CO2 | R | 1 |
| 5. | Name any four adsorption isotherm. | | CO3 | U | 1 |
| 6. | How does the ammonium sulphate aid in the precipitation of protein molecules? | | CO5 | An | 1 |
| 7. | Give any two examples of evaporative crystallizers. | | CO4 | U | 1 |
| 8. | Write down the principle of vacuum drying. | | CO6 | R | 1 |
| 9. | Define lyophilization. | | CO6 | R | 1 |
| 10. | Write a few antifoaming agents used in the fermentation process. | | CO1 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain cell disruption using French press and sonication. | | CO2 | R | 3 |
| 12. | Describe Darcy’s law. | | CO1 | U | 3 |
| 13. | Briefly discuss the method of aqueous two-phase extraction method. | | CO3 | A | 3 |
| 14. | Differentiate between cation and anion exchangers with examples. | | CO5 | An | 3 |
| 15. | Comment on Miers super saturation theory with a neat illustration. | | CO4 | U | 3 |
| 16. | Give a short note on lactic acid fermentation. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Write a short note on the pretreatment and stabilization of bioproducts. Illustrate the general flow diagram of downstream processing. | CO1 | An | 6 |
|  | b. | Explain the cell disruption of products by enzymatic methods with suitable case studies. | CO2 | E | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the general theory of filtration. Explain the equipment involved in conventional filtration with its industrial applications. | CO2 | A | 6 |
|  | b. | Explain the following in detail:  i) Theory and types of thickeners  ii) Applications of sedimentation in the recovery of bioproducts from industrial perspectives. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | What is membrane separation? Elucidate the different methods of the membrane separation process in detail. | CO3 | An | 6 |
|  | b. | Elucidate the purification of proteins by precipitation method with a neat schematic representation. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 20. | a. | Describe the methods involved in scaling the separation of bioproducts using high-performance liquid chromatography. | CO5 | U | 6 |
|  | b. | Explain the instrumentation, and efficiency of Ion exchange chromatography. Comment on its limitations in industrial scales. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Elaborate on the steps involved in the crystallization of products with neat illustrations. Discuss the crystallization equipment in biotechnological industries. | CO6 | U | 6 |
|  | b. | Comment on heat and mass transfer in the drying process. Explain the process and instrumentation of rotary dryers. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Comment on the molecular alterations that lead to the loss of a product's biological activity. | CO2 | U | 6 |
|  | b. | Discuss the state-of-the-art techniques in downstream processing of monoclonal antibodies (mAb). | CO6 | An | 6 |
|  |  |  |  |  |  |
| 23. | a. | How the time required for filtration is determined? Elaborate on different types of filter media and pretreatment methods available to purify the bioproducts. | CO5 | R | 6 |
|  | b. | Schematic overflow of industrial production, recovery, and purification of citric acid with suitable examples. Provide the recent trends in the design of the process. | CO6 | A | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the recent advances in the downstream process of insulin production in pharma industries. | CO6 | An | 6 |
|  | b. | Explain how the molecular weight of the products can be determined by the gel permeation chromatographic method. | CO5 | A | 6 |

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

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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 bioproduct recovery. | | | | | | | | |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | | | |
| **CO / BL** | | | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | | | 1 | 4 | - | 6 | - | - | 11 |
| CO2 | | | 6 | 6 | 12 | - | 6 | - | 30 |
| CO3 | | | - | 1 | 3 | 6 | - | - | 10 |
| CO4 | | | - | 4 | 6 | - | - | - | 10 |
| CO5 | | | 6 | 6 | 12 | 4 | - | - | 28 |
| CO6 | | | 2 | 15 | 6 | 12 | - | - | 35 |
|  | | | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | What is the role of plasma cells in immune system? | | CO1 | U | 1 |
| 2. | Name the first cell which recruited at the site of infection. | | CO1 | R | 1 |
| 3. | List the name of scientists who were instrumental in defining microorganisms as the etiological agents for large number of diseases. | | CO2 | An | 1 |
| 4. | Name the maturation site of B lymphocytes and T lymphocytes. | | CO2 | A | 1 |
| 5. | What type of immunity is present since birth? | | CO3 | R | 1 |
| 6. | Name the immunoglobulin which participates in hypersensitivity but is not in the secretion of tears. | | CO3 | U | 1 |
| 7. | What is meant by clonal selection of B cells? | | CO4 | U | 1 |
| 8. | List any two potential side effects of immunosuppressive drugs. | | CO4 | R | 1 |
| 9. | Name the cell which recognizes the antigen presented by MHC class I molecule. | | CO5 | U | 1 |
| 10. | Write the importance of fluorophores in immunological techniques. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Describe the process of hemagglutination. | | CO1 | U | 3 |
| 12. | Write the properties of opsonin. | | CO2 | R | 3 |
| 13. | What causes erythroblastosis fetalis? | | CO3 | U | 3 |
| 14. | Describe T cells activation. | | CO4 | An | 3 |
| 15. | What is meant by immunodeficiency? Give an example. | | CO5 | An | 3 |
| 16. | What is bare leucocyte syndrome? | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Describe the life cycle of eosinophils. | CO1 | U | 6 |
|  | b. | Explain the functions of neutrophils and basophils in immune function. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the types and functions of lymphocytes. | CO2 | U | 6 |
|  | b. | Explain the properties of B cell and T cell epitopes with examples. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Discuss the importance of complement system and the various types of pathways involved. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the types and functions of antibodies with neat diagrams. | CO3 | R | 6 |
|  | b. | Describe the antigen processing and presentation of Class II MHC molecule. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Discuss the process of phagocytosis. | CO4 | U | 6 |
|  | b. | Explain neutralization of antigens with suitable examples. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Describe immune response mechanism involved during viral infections | CO5 | U | 6 |
|  | b. | Illustrate the types of transplantation with examples. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Describe abzymes and its role in immunology. | CO5 | U | 6 |
|  | b. | Discuss the antivaccine movement and its adverse impact on society. | CO6 | R | 6 |
| **COMPULSORY QUESTION** | | | | | |  |  | CO2 | U | 6 |
| 24. | a. | Describe the properties and types of enzyme-linked immunosorbent assay | CO6 | An | 6 |
|  | b. | Explain the principle and applications of immunofluorescence technique with suitable illustrations. | CO6 | An | 6 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 16 |  |  |  |  | 17 |
| CO2 |  | 15 | 1 | 1 |  |  | 17 |
| CO3 | 7 | 22 |  |  |  |  | 29 |
| CO4 | 1 | 13 |  | 3 |  |  | 17 |
| CO5 |  | 19 |  | 3 |  |  | 22 |
| CO6 | 9 | 1 |  | 12 |  |  | 22 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | | | | | | **CO** | | **BL** | | **Marks** |
|  | | | | **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | |
| 1. | If, F=C-P+2; then determine the value of F for the system, Ice-Water-Vapor. | | | | | | | CO1 | | An | | 1 |
| 2. | Differentiate between isobaric and adiabatic processes. | | | | | | | CO1 | | An | | 1 |
| 3. | Specify the condition when work done by the system is equal the heat supplied to the system. | | | | | | | CO2 | | R | | 1 |
| 4. | Mention the condition at when the fugacity of a non-ideal solution will start to behave like an ideal. | | | | | | | CO2 | | U | | 1 |
| 5. | Define critical point. | | | | | | | CO3 | | R | | 1 |
| 6. | Determine the compressibility factor for an ideal gas. | | | | | | | CO3 | | An | | 1 |
| 7. | Write the condition when van der Waals equation will behave like an ideal gas. | | | | | | | CO4 | | U | | 1 |
| 8. | Express the unit for partial molar volume. | | | | | | | CO4 | | R | | 1 |
| 9. | Virial equation of state is written as PV = A + BP + CP + . . .  Identify the correct assessment on “A”  (1) “A” is always constant at all temperature and all gases.  (2) “A” depends on pressure and temperature.  (3) “A” only depends on temperature and independent of gases.  (4) “A” depends on pressure alone. | | | | | | | CO5 | | An | | 1 |
| 10. | State the condition when two components in a system is said to be an azeotrope. | | | | | | | CO5 | | U | | 1 |
|  | | | | | **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | | Calculate the change in internal energy in J, when a mixture of gas expands from 0.06 m3 to 0.09 m3 at a constant pressure of 1000 Pa and absorbs 80 J of heat during the process. | | | | | | CO1 | | E | | 3 |
| 12. | | A paddle wheel is employed in a rigid container for stirring a hot fluid to be cooled. The internal energy of the hot fluid is 1000 kJ. During the cooling process, the fluid loses 600 kJ of heat. For this process, the work done by the paddle-wheel on the fluid is 100 kJ. Calculate the final internal energy of the fluid in kJ. | | | | | | CO2 | | E | | 3 |
| 12. | | 8.0 m3 of air is enclosed by a frictionless piston at in a cylinder at 300 KPa. The gas undergoes a compression process with no change in temperature and its volume becomes 2.0 m3. Determine the pressure in KPa of air after compression? Air is assumed to be an ideal gas. | | | | | | CO3 | | An | | 3 |
| 13. | | A vessel contains 6m3 of air at a pressure of 500 kPa. If one fifth of the air be removed by an air pump, what will be the pressure of the remaining air in kPa, the temperature being constant? We are given that characteristics gas constant, R=0.287 kJ/kg K. | | | | | | CO4 | | An | | 3 |
| 14. | | The fugacity of component 1 in binary liquid mixture of components 1 and 2 at 298 K and 20 bar is given by-  ()= 50 x1-80x12+40x13  where () is in bar and x1 is the mole fraction of component 1. Determine,  (a) The fugacity f1 of pure component 1 in bar and (b) The activity coefficient (γ1). | | | | | | CO5 | | An | | 3 |
| 15. | | A gas mixture containing 3 moles of N2, 8 mol of H2 and 1 mol of NH3 initially, undergoing reaction; N2+3H2 →2NH3. After some time ε = 0.6. Evaluate the estimated mole fraction of NH3 in the mixture. | | | | | | CO6 | | E | | 3 |
|  | | | **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23, Q.no 24 is compulsory)** | | | | | | | | | |
| 17. | | | Calculate ∆U, ∆H, Q and W in J/mol, if 1 mole of an organic liquid is converted reversibly into vapour at 353 K by supplying heat from external source. The expansion of vapour takes place at the pressure of 1 atm. The heat of vaporization and the molecular weight of the liquid are 380 J/g and 78 g/mol, respectively. Consider R= 8.314 J/mol-K | | | | CO1 | | E | | 12 | |
|  | | |  | | | |  | |  | |  | |
| 18. | | | If a cylinder of volume 0.1 m3 is filled with 1.373 kg of ammonia at 1.95 MPa then, determine the temperature in K at which ammonia exists in the cylinder. Assume that NH3 obeys the van der Walls equation of state. The van der Walls constants, a and b for ammonia are 422.546 ×10-3 Nm4/mol2 and b= 37×10-6 m3/mol, respectively and R= 8.314 J/mol-K. | | | | CO2 | | E | | 12 | |
|  | | |  | | | |  | |  | |  | |
| 19. | | | Prove that, dU= CV dT+[  Where, α= Isothermal compressibility and β= Volume expansivity. | | | | CO3 | | C | | 12 | |
|  | | |  | | | |  | |  | |  | |
| 20. | | | Derive the following maxwell equation-  = - . | | | | CO4 | | C | | 12 | |
|  | | |  | | | |  | |  | |  | |
| 21. | | | If, PV= RT+BP+CP2+……where, B and C are the second and third virial coefficients then prove that, B’= and C’ = . | | | | CO4 | | C | | 12 | |
|  | | |  | | | |  | |  | |  | |
| 22. | | | From the plot of α vs P for CO, the area under the curve between 0 to 100 is found to be 0.0875 atm dm-3 mol-1. Calculate the fugacity in atm at 100 atm pressure and 0 ⸰C temperature. | | | | CO5 | | E | | 12 | |
|  | | |  | | | |  | |  | |  | |
| 23. | | | The azeotrope of the benzene and ethanol system have a composition of 44.8 mole% of ethanol with a boiling point of 341.4 K at 101.3 kPa. At this temperature, the vapour pressure of benzene is 68.9 kPa and ethanol is 67.4 kPa. Calculate the van Laar constants. | | | | CO5 | | E | | 12 | |
|  | | |  | | | **Compulsory** | | | | | | |
| 24. | | | A gas mixture containing 3 mol CO2, 5 mol H2 and 1 mol water is undergoing the following reactions:  CO2+3H2 = CH3OH+H2O  CO2+H2 = CO+H2O  Develop expressions for the mole fraction of the species in terms of the extent of reaction. | | | | CO6 | | E | | 12 | |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | - | - | 2 | 15 | - | 17 |
| CO2 | 1 | 1 | - | - | 15 | - | 17 |
| CO3 | 1 | - | - | 4 | - | 12 | 17 |
| CO4 | 1 | 1 | - | 3 | - | 24 | 29 |
| CO5 | - | 1 | -- | 4 | 24 |  | 29 |
| CO6 | - | - | - | - | 15 | - | 15 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Identify the type of sequence alignment generated by the Smith-Waterman algorithm. | | CO3 | U | 1 |
| 2. | State the field in the GenBank file format that describes a post-translational modification. | | CO1 | R | 1 |
| 3. | Speculate the number of peptide bonds present in the sequence of protein neurogranin obtained from *Bos taurus* in the FASTA file format below.  >NP\_001106784.1 neurogranin [Bos taurus]  MDCCTESACSKPDDDILDIPLDDPGANAAAAKIQASFRGHMARKKIKSGERGRKGPGPGGPGGAGGARGG  AGGGPSGD | | CO1 | C | 1 |
| 4. | Describe the format of the data specified by the field ‘polyA\_site’ in the GenBank file format. | | CO1 | U | 1 |
| 5. | State the name of the matrix BLOSUM in the full form. | | CO3 | R | 1 |
| 6. | Write the name of the method that uses probability calculations to build a phylogenetic tree. | | CO6 | U | 1 |
| 7. | Define homologous genes. | | CO6 | R | 1 |
| 8. | Illustrate the calculation of the odds score for a pair of amino acids in a sequence alignment. | | CO3 | U | 1 |
| 9. | Describe the term ‘Blocks’ used for classifying protein structures. | | CO4 | U | 1 |
| 10. | Define the tree length in an evolutionary tree. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Write the chemical reaction for the formation of a peptide bond. | | CO1 | U | 3 |
| 12. | Describe the chirality of the naturally-occuring amino acids. | | CO1 | R | 3 |
| 13. | Write the names of any three nonpolar amino acids. | | CO3 | R | 3 |
| 14. | Discuss the codon bias observed in eukaryotic genomic sequences. | | CO4 | U | 3 |
| 15. | Illustrate the composition of a phylogenetic tree. | | CO6 | U | 3 |
| 16. | Write the format of the data specified by the field ‘map’ in the GenBank file format. | | CO1 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the scientific basis for the development of amino acid substitution scoring matrices for generating protein sequence alignments. | CO2 | U | 4 |
|  | b. | Describe the various steps involved in protein homology modelling. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 18. | a. | The amino acid sequence of a newly sequenced protein is below in the FASTA file format.  >Protein1  MLDQQTINIIKATVPVLKEHGVTITTTFYKNLFAKHPEVRPLFDMGRQE  The above sequence is to be reported in the PDB file format.  Rewrite the above sequence using the appropriate field in the PDB file format. | CO2 | C | 6 |
|  | b. | Explain, with a suitable example, the analysis of protein sequences using the information retrieved from the Protein Information Resource database. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Report the different classes of protein structure. | CO5 | U | 4 |
|  | b. | Describe, with a suitable example, the maximum parsimony method for building a phylogenetic tree. | CO2 | C | 8 |
|  |  |  |  |  |  |
| 20. | a. | Explain, with suitable examples, any five fields that specify protein data in the PDB file format. | CO5 | An | 10 |
|  | b. | Define a protein class. | CO5 | R | 2 |
|  |  |  |  |  |  |
| 21. | a. | Explain, with a suitable example, the biological information that you can study in the UniProt database for a protein molecule. | CO4 | An | 6 |
|  | b. | Describe, with a suitable example, the distance based method for building a phylogenetic tree. | CO6 | C | 6 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate the structural features of a protein molecule using the information obtained from the Protein Data Bank database. | CO4 | An | 6 |
|  | b. | Describe any two tools used for protein sequence analysis. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Describe the various computational energy minimization methods employed in protein structural modelling. | CO5 | E | 6 |
|  | b. | The sequence record for *Biomphalaria glabrata* partial mRNA for hemoglobin (hb gene) is below in the FASTA file format.  >AJ865381.1 Biomphalaria glabrata partial mRNA for hemoglobin (hb gene), clone 4  AGTTCTCAAGAAAGCATAAACAAGGAAACAGCTCTCAGAAAAACTGACTTTACTTAGCACTCGGACCACG  AAACTCTTTCATATGGAACTTTTTGATAGACGAACAAGTGTTGATATTGAAATAAATTGTTGATATTTGT  TAATTTTTTTCTTGCACAAATCTCACGGGTGAGCGCATTGATCATACATCTTCATACATCTGACTTAAAC  ATTTCTCTTGTACTTTATTCAACTCAGGCATTGTTTCAGAAAACAAATTCCATCTTGAAAATCTGTTATT  Write the above sequence in the GenBank file format. | CO2 | C | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe, with a suitable example, the significance of the multiple sequence alignment of protein sequences. | CO3 | U | 6 |
|  | b. | Explain the scientific principle used for designing the Dayhoff amino acid substitution matrices to score the pair-wise protein sequence alignments. | CO2 | An | 6 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 10 | 3 | 0 | 0 | 1 | 18 |
| CO2 | 0 | 4 | 0 | 6 | 0 | 12 | 22 |
| CO3 | 4 | 8 | 8 | 0 | 0 | 0 | 20 |
| CO4 | 0 | 4 | 0 | 18 | 0 | 0 | 22 |
| CO5 | 2 | 4 | 0 | 10 | 6 | 0 | 22 |
| CO6 | 2 | 4 | 8 | 0 | 0 | 06 | 20 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | State when was UCIL established? | | CO1 | R | 1 |
| 2. | Predict the chemical gas leaked from Union Carbide plant. | | CO1 | U | 1 |
| 3. | State the primary cause of death due to MIC gas leak. | | CO2 | R | 1 |
| 4. | Define hazard. | | CO2 | R | 1 |
| 5. | Expand MSDS. | | CO3 | R | 1 |
| 6. | List under which law MSDS has been mandated. | | CO3 | R | 1 |
| 7. | Examine the route for entry of hazardous chemical into the human body. | | CO5 | R | 1 |
| 8. | Name a toxic substance produced by biological system. | | CO4 | R | 1 |
| 9. | List the first stage of risk assessment. | | CO6 | R | 1 |
| 10. | Relate the act which establishes responsibilities and rights for employers and employees. | | CO2 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Define the flammable limit of the chemical substance. | | CO4 | R | 3 |
| 12. | Compare between teratogenic and mutagenic effect. | | CO2 | U | 3 |
| 13. | Define industrial safety. | | CO1 | R | 3 |
| 14. | Describe OSHA assignment. | | CO3 | R | 3 |
| 15. | Group the levels of biosafety for GLSP. | | CO6 | U | 3 |
| 16. | Cite the role of NFPA. | | CO5 | 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. | Correlate the various recognition factors that can help the safety analyst to visualize the hazards. | CO2 | AN | 12 |
|  |  |  |  |  |  |
| 18. | a. | Describe the hazards caused by Bhopal Gas Tragedy. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 19. | a. | Discuss the event tree method for the risk assessment. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Analyze the occupational health and risks in industries. | CO3 | AN | 12 |
|  |  |  |  |  |  |
| 21. | a. | Classify the various safety measures for chemical handling in industries. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate the hazard analysis types in the system safety. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Summarize the engineering control approach in hazard control. | CO5 | U | 6 |
|  | b. | Explain the employees responsibility regarding personal protective equipment. | CO6 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the Large Scale Biosafety (LSB) guideline for Biosafety Level 3 - Large Scale (BL3-LS). | CO6 | U | 12 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 16 | 1 |  |  |  |  | 17 |
| CO2 | 2 | 28 |  | 12 |  |  | 42 |
| CO3 | 5 | - |  | 12 |  |  | 17 |
| CO4 | 4 | 12 |  |  |  |  | 16 |
| CO5 | 1 | 9 |  |  |  |  | 10 |
| CO6 | 1 | 21 |  |  |  |  | 22 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Give two examples of non-biodegradable pollutants. | | CO1 | U | 1 |
| 2. | Name any two diseases caused due to contaminated water. | | CO1 | R | 1 |
| 3. | Define the term “sewer”. | | CO2 | R | 1 |
| 4. | List out any two main sources of air pollution. | | CO2 | R | 1 |
| 5. | Recall 3R’s in pollution control. | | CO3 | U | 1 |
| 6. | Classify microorganisms according to schedule. | | CO3 | An | 1 |
| 7. | List out any three cleanup technologies. | | CO4 | U | 1 |
| 8. | Who is the chairman of the district-level committee? | | CO5 | R | 1 |
| 9. | Indicate any two environmental laboratories. | | CO6 | R | 1 |
| 10. | Define baseline situation. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | What do you mean by hazardous waste? Give an example. | | CO1 | U | 3 |
| 12. | What is trade effluent? Give Example. | | CO2 | U | 3 |
| 13. | Differentiate between incineration and shredding. | | CO3 | An | 3 |
| 14. | Analyze the role of material reuse in waste reduction. | | CO4 | An | 3 |
| 15. | Describe the role of Environmental audit. | | CO5 | An | 3 |
| 16. | Summarize the steps to arrive at a finding in EIA. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain in detail on Air Prevention and Control of Pollution Act. | CO2 | R | 6 |
|  | b. | Describe the importance of air quality standards with its ambient levels. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Classify different types of pollution. Elaborate on any three social issues and effects related to pollution. Suggest some solutions for the issues you are discussing. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Explain the importance of the Environmental Protection Act (EPA) in conserving the environment. Examine the constitution, function and fund of central & state boards mentioned in EPA. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Describe the process of manufacture, use, import, export and storage of genetically engineered organisms or cells rules, 1989 and list out the members of various committees in it with their members and their roles and responsibilities. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate with a case study the process of industrial symbiosis and add a note on the advantages and disadvantages of industrial symbiosis. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. | a. | Write a detailed note on various clean technologies that can be implemented and their need for controlling pollution. Explain the methods to recycle and reuse the generated waste with Examples. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain in detail the stages in handling, management and transport of biomedical waste. | CO5 | An | 6 |
|  | b. | Summarize the disadvantages of treating biomedical wastes. | CO5 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate a detailed note on stages in environmental impact assessment, impact factors and areas of consideration, measurement of environmental impact, organization and methodologies with a neat flowsheet. | CO6 | An | 12 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 16 | - | - | - | - | 17 |
| CO2 | 8 | 9 | - | 12 | - | - | 29 |
| CO3 | 12 | 1 | - | 4 | - | - | 17 |
| CO4 | - | 1 | 12 | 15 | - | - | 28 |
| CO5 | 1 | - | - | 9 | 6 | - | 16 |
| CO6 | 2 | - | 3 | 12 | - | - | 17 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | What are the defining features of leukemia? | | CO1 | R | 1 |
| 2. | What is micro metastasis? | | CO1 | U | 1 |
| 3. | List etiologic factors causing cancer. | | CO2 | An | 1 |
| 4. | Name the HPV onco-protein that binds to p53. | | CO2 | R | 1 |
| 5. | What is the process of formation of new blood vessels in cancer site called? | | CO3 | R | 1 |
| 6. | Explain the role of MAPK in cancer. | | CO3 | R | 1 |
| 7. | Describe the immunotherapy of cancer. | | CO5 | U | 1 |
| 8. | Mention any one lab test used to detect tumor marker protein in blood. | | CO6 | R | 1 |
| 9. | Which type of therapy uses tyrosine kinase inhibitors as drugs? | | CO5 | U | 1 |
| 10. | Brachytherapy uses which of the following?  a. Internal radiation as unsealed source, b. Internal radiation as sealed source | | CO6 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Define the nomenclature of common tumors. | | CO1 | An | 3 |
| 12. | Explain the growth characteristics of cancer cells. | | CO4 | A | 3 |
| 13. | Explain the metabolic alterations in cells undergoing neoplastic transformation. | | CO2 | An | 3 |
| 14. | Discuss about the stages of chemical carcinogenesis with an example. | | CO3 | R | 3 |
| 15. | What are the products of oncogenes? Mention their role in cancer progression. | | CO5 | U | 3 |
| 16. | Explain the mechanism of drugs used in chemotherapy. | | 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. | Differentiate benign and malignant tumors with examples. | CO1 | U | 8 |
|  | b. | Write about the factors influencing angiogenesis. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | What are the salient features of tumor markers? Give examples. | CO2 | U | 8 |
|  | b. | Explain the note on:  a) cell cycle check points b) Cancer genes. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Explain the role of plasma membrane components in metastasis. | CO3 | An | 8 |
|  | b. | Describe the role of extracellular matrix components and the basement membranes in tumor metastasis. | CO3 | An | 4 |
|  |  |  |  |  |  |
| 20. | a. | Comprehend on ‘seed and soil’ hypothesis for metastasis and illustrate the metastatic cascade with neat diagram. | CO5 | U | 8 |
|  | b. | Illustrate the molecular mechanism of cancer angiogenesis. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 21. | a. | Write the types of tumor markers with suitable examples. | CO5 | R | 8 |
|  | b. | Write about the early detection of cervical cancer by screening. | CO5 | R | 4 |
|  |  |  |  |  |  |
| 22. | a. | Compare and tabulate any two cancer imaging techniques. | CO6 | R | 6 |
|  | b. | Write the methods of biopsy retrieval for detection. | CO6 | R | 6 |
|  |  |  |  |  |  |
| 23. | a. | Classify the chemotherapeutic agents with their mechanism of action. | CO6 | E | 8 |
|  | b. | Differentiate neoadjuvant and adjuvant therapies with an example. | CO6 | E | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe briefly the available radiotherapy methods, their merits and demerits. | CO6 | An | 8 |
|  | b. | What is normal cell cycle regulation? What factors contribute to loss of regulation in cell cycle leacing to cancer? | CO6 | An | 4 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 13 |  | 3 |  |  | 17 |
| CO2 | 1 | 12 |  | 4 |  |  | 17 |
| CO3 | 5 |  |  | 12 |  |  | 17 |
| CO4 |  |  | 3 |  |  |  | 3 |
| CO5 | 12 | 17 |  |  |  |  | 29 |
| CO6 | 13 | 3 |  | 13 | 12 |  | 41 |
|  | | | | | | | **124** |



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| **Course Code** | **20BT2042** | **Duration** | **3hrs** |
| **Course Name** | **PLANT AND ANIMAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define micro propagation. | | CO1 | R | 1 |
| 2. | Name the most common nutritional media used in plant tissue culture. | | CO1 | R | 1 |
| 3. | Name the significance of particle bombardment method of gene transfer in plants. | | CO2 | R | 1 |
| 4. | List the disadvantage of PEG mediated gene transfer in plants. | | CO2 | A | 1 |
| 5. | Define herbicides. | | CO2 | R | 1 |
| 6. | What is the disadvantage of conventional plant breeding? | | CO3 | R | 1 |
| 7. | Define transgene silencing. | | CO3 | R | 1 |
| 8. | Name any one product produced through plant cell culture. | | CO4 | R | 1 |
| 9. | List the essential amino acids present in animal cell culture media. | | CO5 | R | 1 |
| 10. | Name the central government department which issues ethical guidelines for animal research. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Outline the stages of hardening of tissue culture plants. | | CO1 | U | 3 |
| 12. | Illustrate the method of gene transfer using microinjection. | | CO2 | U | 3 |
| 13. | List the gene transfer techniques used for development of insect resistance plants. | | CO3 | R | 3 |
| 14. | List the reporter genes used in plant genetic transfer. | | CO3 | R | 3 |
| 15. | Outline the important factors for contamination in cell line. | | CO4 | U | 3 |
| 16. | Summarize the ethical issues in animal biotechnology. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the nutritional composition of MS media used in plant tissue culture. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the steps involved in establishment of cell suspension culture for in vitro drug production in plants. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Write the basic features of Ti plasmid of *Agrobacterium tumefaciens.* | CO2 | R | 2 |
|  | b. | Outline the process of gene transfer in plants using Gene gun method with neat diagram. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 20. | a. | Name one disease resistant transgenic plant. | CO3 | R | 2 |
|  | b. | Illustrate the steps involved in development of disease resistant transgenic plant. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 21. | a. | How many copies of chloroplast genome is present in one cell? | CO3 | R | 2 |
|  | b. | Explain the method of chloroplast transformation in the modern scenario. | CO3 | E | 10 |
|  |  |  |  |  |  |
| 22. | a. | What is plant selectable marker? | CO3 | R | 2 |
|  | b. | Illustrate the steps involved in genome editing technology CRISPR/CAS towards crop improvement. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 23. | a. | Explain the media used in animal cell culture and its method of sterilization. | CO4 | E | 6 |
|  | b. | Outline the strategies on scale up of cell culture for product development in animal cell culture in the modern research. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the various steps involved in the process of In vitro fertilization. | CO6 | E | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Acquire knowledge in plant biotechnology and its applications |
| CO2 | Gain the knowledge about to increase the production in agriculture products. |
| CO3 | Prepare them to work in the agriculture industries |
| CO4 | Demonstrate *In vitro* fertilization and the manipulation of embryo done for genetic screening will  provide wider understating among the students and create awareness |
| CO5 | Development of transgenic animals for breed development for enhanced milk production |
| CO6 | Adapt appropriate ethical guidelines in animal biotechnology |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 15 |  |  | 12 |  | 29 |
| CO2 | 4 | 13 |  | 1 |  |  | 18 |
| CO3 | 14 | 20 |  |  | 10 |  | 44 |
| CO4 | 1 | 3 |  |  | 6 |  | 10 |
| CO5 | 1 | 6 |  |  |  |  | 7 |
| CO6 | 4 |  |  |  | 12 |  | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define pleuripotency. | | CO1 | R | 1 |
| 2. | Write briefly about Hayflick’s limit. | | CO1 | C | 1 |
| 3. | What is passage number in cell culture? | | CO2 | R | 1 |
| 4. | Name the special graduated slide on which cells are counted. | | CO2 | R | 1 |
| 5. | List two growth factors. | | CO3 | U | 1 |
| 6. | Write the name of the cryopreservant used to preserve cord blood cells. | | CO4 | C | 1 |
| 7. | List the Yamanaka factors. | | CO5 | R | 1 |
| 8. | Name the scientist who coined the term “stem cell niche". | | CO5 | R | 1 |
| 9. | Write the name of the microenvironment, within the specific anatomic location where stem cells are found which interacts with stem cells to regulate stem cell fate. | | CO6 | A | 1 |
| 10. | Identify the gene that was transfected to mouse embryonic fibroblasts such that they transdiffrentiated to myoblasts. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Describe how you would distinguish between live and dead cells while counting using a haemocytometer. | | CO1 | U | 3 |
| 12. | Explain teratoma. | | CO2 | An | 3 |
| 13. | Tabulate the differences between totipotent, pluripotent and multipotent cells. | | CO3 | R | 3 |
| 14. | Examine feeder cells or feeder layer. | | CO4 | A | 3 |
| 15. | Describe confluency. | | CO5 | U | 3 |
| 16. | Summarize the advantages of trans differentiated cells. | | 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. | List the advantages and disadvantages of animal cell culture. | CO1 | R | 6 |
|  | b. | Write a note on how a contamination free culture could be achieved. | CO1 | A | 6 |
| 18. | a. | Describe in detail how you would enumerate live cells harvested from a culture vessel to be seeded on a new culture dish. Draw diagrams wherever needed. | CO2 | U | 12 |
| 19. | a. | Define stem cell niche illustrating it with an example and elaborate on the conservered components of stem cell niche. | CO3 | R | 12 |
| 20. | a. | Discuss the potential and the challenges of induced pleuripotent stem cells. | CO4 | U | 12 |
| 21. | a. | Illustrate the prospects of stem cell technology for the treatment of cardiac disorders. | CO5 | An | 12 |
| 22. | a. | Evaluate the method of isolation of stem cells from the umbilical cord and elaborate on its applications. | CO5 | E | 12 |
| 23. | a. | Explain the role of stem cells in the treatment of malignant tumors. | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the ethical implications of stem cell technology. | CO6 | A | 12 |

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

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

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



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| **Course Code** | **20BT2044** | **Duration** | **3hrs** |
| **Course Name** | **BIOPHARMACEUTICAL TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define Pharmacokinetics. | | CO1 | U | 1 |
| 2. | What is wet granulation method? | | CO1 | R | 1 |
| 3. | What is phase 1 of drug metabolism? | | CO2 | R | 1 |
| 4. | What types of molecules cannot be used in oral formulations? | | CO2 | R | 1 |
| 5. | Describe the use of hopper in tablet press. | | CO3 | U | 1 |
| 6. | Define medication administered by placing them under the tongue. | | CO3 | U | 1 |
| 7. | Name the tablet that which react rapidly in the presence of water by releasing carbon dioxide. | | CO4 | R | 1 |
| 8. | Name the part of tablet press that helps to force the feed/ the granules into the dies especially during faster rotation. | | CO5 | R | 1 |
| 9. | Name the drug that kills harmful microbes without damaging the host. | | CO6 | U | 1 |
| 10. | Mention the harmful effects due to long term use of laxatives. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Define potency of the drug. | | CO1 | R | 3 |
| 12. | Define therapeutic index of drug. | | CO2 | U | 3 |
| 13. | Describe ointments and their types. | | CO3 | R | 3 |
| 14. | Describe briefly about nasal drop formulations. | | CO4 | U | 3 |
| 15. | Describe micro-dosing and its advantages. | | CO5 | U | 3 |
| 16. | Explain the major functions of CDSCO. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Describe in detail about the absorption and distribution of drug | CO1 | A | 6 |
|  | b. | Illustrate the mode of action of agonist and antagonist. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate with suitable diagram the routes of drug administration. | CO2 | A | 9 |
|  | b. | Define bioavailability of drug. | CO2 | R | 3 |
|  |  |  |  |  |  |
| 19. | a. | Describe the working and applications of nebulizer. | CO3 | A | 4 |
|  | b. | Describe in detail the process of making tablet using single punch machine. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 20. | a. | Define pharmaceutical granulation and its types. | CO4 | U | 2 |
|  | b. | Describe in detail the various analytical techniques for drug testing. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 21. | a. | Describe stages of clinical trials and their importance. | CO5 | R | 10 |
|  | b. | Explain GMP and GLP in biotechnology industries. | CO5 | R | 2 |
|  |  |  |  |  |  |
| 22. | a. | Describe the action of Laxatives and Analgesics with suitable example. | CO6 | R | 2 |
|  | b. | Explain the tests involved in quality control of tablets and Capsules. | CO6 | A | 10 |
|  |  |  |  |  |  |
| 23. | a. | Define enemas. | CO5 | R | 1 |
|  | b. | Describe the mechanism of any two antibiotics. | CO5 | A | 4 |
|  | c. | Describe Biologics and its classification. | CO5 | U | 7 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain suppository and their application. | CO4 | R | 3 |
|  | b. | Describe in detail the process of making tablet using multiple station machine. | CO4 | An | 9 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Recall the steps in preparation of biopharmaceutical products. |
| **CO2** | Illustrate knowledge on drug development, principles and mechanism of actions of drug. |
| **CO3** | Compare various pharmaceutical products available commercially. |
| **CO4** | Infer various testing and quality assurance procedures in drug formulation. |
| **CO5** | Evaluate the advances in drug manufacturing process. |
| **CO6** | Relate the regulations in clinical trial and management |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 3 | 6 | 6 | - | - | 17 |
| CO2 | 3 | 5 | 9 | - | - | - | 17 |
| CO3 | 12 | 3 | 2 | - | - | - | 17 |
| CO4 | 5 | 4 | - | 19 | - | - | 28 |
| CO5 | 11 | 14 | 3 | - | - | - | 28 |
| CO6 | 4 | 3 | 10 | - | - | - | 17 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | List the role of heterosis in plant breeding. | | CO1 | R | 1 |
| 2. | Write the importance of Apomixis in crop improvement. | | CO1 | A | 1 |
| 3. | Define the term dedifferentiation. | | CO2 | R | 1 |
| 4. | State the objectives of population improvement programme. | | CO2 | R | 1 |
| 5. | Name the enzyme responsible for removal of 5 – phosphate group from nucleic acid. | | CO3 | R | 1 |
| 6. | Write the importance of Isoschizomers in plant biotechnology. | | CO3 | A | 1 |
| 7. | **Differentiate *In-Situ* conservation from *Ex-Situ* conservation.** | | CO4 | U | 1 |
| 8. | Distinguish between biome and ecosystems. | | CO4 | U | 1 |
| 9. | Define bioprospecting with examples. | | CO5 | R | 1 |
| 10. | Give examples for biopiracy. | | CO5 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Illustrate the effects of inbreeding depression. | | CO1 | An | 3 |
| 12. | Explain the main features of interspecific hybridization. | | CO2 | U | 3 |
| 13. | Describe the general features of cloning vectors in plant systems. | | CO3 | U | 3 |
| 14. | Discuss the objectives of red data book. | | CO4 | U | 3 |
| 15. | Compare invention and inventive step in a patent. | | CO5 | An | 3 |
| 16. | Explain the significance of expressed sequence tag. | | 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 significance of plant breeding in crop development. | CO1 | U | 8 |
|  | b. | Summarize the challenges in plant breeding with reference to climate change. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Explain tissue culture technology and their applications in agriculture. | CO2 | U | 8 |
|  | b. | Draw schematic flow chart for clonal selection. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Compare the functions of Alkaline phosphatase and Polynucleotide kinase. | CO3 | An | 6 |
|  | b. | Summarize the steps involved in recombinant DNA technology. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the principles of conservation biology with strategies leading to successful studies. | CO4 | A | 6 |
|  | b. | Explain the genetics and evolutionary principles of conservation. | CO4 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain the reasons why the patent on basmati should not have gone to an American Company. | CO5 | An | 8 |
|  | b. | Describe the basic principles underlying the plant variety protection laws in India. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate the different methods of breeding cross pollinated crops. | CO2 | An | 8 |
|  | b. | Explain the different factors that controls cellular totipotency. | CO2 | An | 4 |
|  |  |  |  |  |  |
| 23. | a. | Assess the usage of embryo culture and protoplast fusion in crop improvement. | CO2 | E | 6 |
|  | b. | Explain the various steps involved in somatic hybridization. | CO2 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe gene annotation methods with examples. | CO6 | U | 6 |
|  | b. | Discuss the importance of biological databases with suitable examples. | CO6 | U | 6 |

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

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



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | What is a hypothesis? | | CO1 | U | 1 |
| 2. | Describe one example of a dependent variable. | | CO1 | R | 1 |
| 3. | Name the research design used to investigate a problem which is not clearly defined. | | CO2 | R | 1 |
| 4. | Define the characteristics of a good sample. | | CO2 | R | 1 |
| 5. | When is Chi square testing used? | | CO3 | R | 1 |
| 6. | Describe univariate analysis. | | CO3 | U | 1 |
| 7. | Define sampling error. | | CO4 | R | 1 |
| 8. | Name the two types of criterion-related validity. | | CO5 | R | 1 |
| 9. | What is DOI? | | CO5 | R | 1 |
| 10. | Describe fabrication in plagiarism. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Explain the types of longitudinal research design. | | CO1 | R | 3 |
| 12. | Explain the principles in designing good questionnaire. | | CO2 | R | 3 |
| 13. | Describe the formula to calculate the population standard deviation. | | CO3 | A | 3 |
| 14. | Explain the difference between population and sample. | | CO4 | An | 3 |
| 15. | Explain the four elements present in most plagiarism definition. | | CO5 | U | 3 |
| 16. | Explain the various reasons for retraction. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | What should be considered for formulation of a research question? | CO1 | R | 6 |
|  | b. | Describe hypothesis testing with suitable examples. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the types of descriptive research design. | CO2 | R | 3 |
|  | b. | Describe in detail about uses, importance and limitations of descriptive research design. | CO2 | A | 9 |
|  |  |  |  |  |  |
| 19. | a. | What are the common errors in measurement? | CO3 | U | 1 |
|  | b. | Explain the difference between Type-I and Type-II errors. | CO3 | An | 2 |
|  | c. | Explain the types of validity methods in research process. | CO3 | U | 9 |
|  |  |  |  |  |  |
| 20. | a. | Differentiate and explain the sampling and non-sampling errors. | CO3 | An | 9 |
|  | b. | Explain the difference between cluster and stratified sampling. | CO3 | A | 3 |
|  |  |  |  |  |  |
| 21. | a. | Describe any two software that aids in manuscript preparation. | CO6 | U | 8 |
|  | b. | List the layout of the sections of a typical research paper. | CO6 | R | 4 |
|  |  |  |  |  |  |
| 22. | a. | Define Impact factor with the formula. | CO5 | R | 3 |
|  | b. | Describe the Peer review process. | CO5 | U | 4 |
|  | c. | Differentiate the Introduction and Discussion sections of a research paper. | CO5 | U | 5 |
|  |  |  |  |  |  |
| 23. | a. | Explain the types and levels of measurement. | CO4 | R | 7 |
|  | b. | Describe difference between validity and reliability | CO4 | An | 5 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Define Plagiarism and how to avoid them. | CO6 | R | 5 |
|  | c. | Explain the plagiarism penalties for students, faculty and researchers of HEI. | CO6 | R | 7 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 10 | 7 |  |  |  |  | 17 |
| CO2 | 8 |  | 9 |  |  |  | 17 |
| CO3 | 1 | 11 | 6 | 11 |  |  | 29 |
| CO4 | 8 |  |  | 8 |  |  | 16 |
| CO5 | 5 | 12 |  |  |  |  | 17 |
| CO6 | 16 | 12 |  |  |  |  | 28 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define acid rain. | | CO1 | R | 1 |
| 2. | Give an example for biological waste water treatment system. | | CO2 | U | 1 |
| 3. | Name the apparatus used for the separation of fine particles suspended in air by centrifugal force. | | CO3 | R | 1 |
| 4. | Write the full form of CPCB. | | CO4 | A | 1 |
| 5. | State the significance of 3R’s in solid waste management. | | CO5 | R | 1 |
| 6. | Define biofertilizer. | | CO6 | R | 1 |
| 7. | Differentiate between point and nonpoint sources of water pollution. | | CO1 | An | 1 |
| 8. | Name the major hydrocarbon present in biogas. | | CO3 | R | 1 |
| 9. | Define acidogenesis. | | CO4 | R | 1 |
| 10. | Determine the number of bacterial strains present in Oil Zapper. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Categorize different types of environmental pollutants. | | CO1 | An | 3 |
| 12. | Differentiate between nitrification and denitrification process in the biological nitrogen removal. | | CO2 | U | 3 |
| 13. | Explain the environmental impact of solid wastes. | | CO3 | A | 3 |
| 14. | Examine the legal and administrative systems for air pollution control. | | CO4 | An | 3 |
| 15. | Write a suitable process to degrade recalcitrant compounds using microorganisms. | | CO5 | C | 3 |
| 16. | Describe the properties of Vesicular Arbuscular Mycorrhiza (VAM). | | 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 various physical and chemical analysis involved in the pollution management. | CO1 | U | 6 |
|  | b. | Illustrate the role of fungi as a biosorbent for the removal of heavy metal. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the process and importance of activated sludge in sewage water treatment. | CO2 | U | 6 |
|  | b. | Explain the working principle of sedimentation process and fluidized bed reactor in waste water treatment. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Write a detailed note on cyclone collector, venturi scrubber and electrostatic precipitator. | CO3 | R | 8 |
|  | b. | Define the principle and working mechanisms of settling chamber and fabric filters with schematic diagrams. | CO3 | R | 4 |
|  |  |  |  |  |  |
| 20. | a. | Write a note on metagenomics. Speculate the bioremediation process through genomic tools for cleaner environment. | CO4 | C | 6 |
|  | b. | Evaluate the mechanism of action of various types of biofertilizers. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. | a. | Determine the applicability of biomining process to prevent the effect of metal pollution on environment. | CO5 | A | 8 |
|  | b. | Describe the process of direct and indirect bacterial leaching with examples. | CO5 | R | 4 |
|  |  |  |  |  |  |
| 22. | a. | Explain in detail about the quorum sensing mechanism in Gram positive bacteria. | CO6 | U | 6 |
|  | b. | Illustrate the types of biosensors employed for monitoring environmental pollution. | CO6 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the process of anaerobic biogas production. | CO6 | U | 5 |
|  | b. | Evaluate the importance of adsorption by activated carbon and chlorination to remove contaminants from waste water. | CO2 | An | 7 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the production process of biogas for the generation of electricity with neat sketch. | CO6 | A | 6 |
|  | b. | Analyze the mode of action of Cry protein. | CO6 | An | 6 |

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

|  |  |
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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 environmentally sustainable products. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 6 | - | 10 | - | - | 17 |
| CO2 | - | 10 | 6 | 7 | - | - | 23 |
| CO3 | 14 | - | 3 | - | - | - | 17 |
| CO4 | 1 | - | 1 | 3 | 6 | 6 | 17 |
| CO5 | 5 | - | 8 | - | - | 3 | 16 |
| CO6 | 1 | 14 | 13 | 6 | - | - | 34 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | List any two examples of transgenic organisms. | | CO1 | U | 1 |
| 2. | State the minimum velocity of air permissible in class I BSC Room. | | CO1 | R | 1 |
| 3. | Infer the significance of Biosafety Clearing House (BCH). | | CO2 | R | 1 |
| 4. | State the mandate of State Biotechnology Coordination Committee. | | CO2 | R | 1 |
| 5. | Recognize the success of “law of one price” in Kerala using the concept of embedded technology transfer. | | CO3 | R | 1 |
| 6. | Identify the significance of Budapest treaty for IPR protection. | | CO3 | R | 1 |
| 7. | Name the father of Eugenics. | | CO4 | R | 1 |
| 8. | Judge the unethical consequence of Biowarfare. | | CO4 | R | 1 |
| 9. | List any two guidelines for rDNA research. | | CO5 | U | 1 |
| 10. | Define Isograft. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Illustrate the process work flow of international treaties. | | CO1 | U | 3 |
| 12. | List the categories of LMOs in terms of their use. | | CO2 | R | 3 |
| 13. | Infer the objectives of World Intellectual Property Organization. | | CO3 | R | 3 |
| 14. | Name any three ethical implications of Human Genome. | | CO4 | R | 3 |
| 15. | Identify the environmental impact of GMO’s and LMO’s. | | CO5 | U | 3 |
| 16. | Interpret the use of Pigs over Monkey for organ transplant. | | 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. | Appraise the working mechanism of a Class II biosafety cabinet with a neat labelled diagram. | CO1 | An | 08 |
|  | b. | Infer the role of institutional biosafety committee. | CO1 | An | 04 |
|  |  |  |  |  |  |
| 18. |  | Explain 'Biosafety guidelines' and recommended 'Biosafety levels' for infectious agents and infected animals. | CO2 | A | 12 |
| 19. | a. | Examine the various treaties formulated for IPR. | CO3 | A | 06 |
|  | b. | Debate the impact of IPR in context of biotechnology industry. | CO3 | E | 06 |
|  |  |  |  |  |  |
| 20. |  | Summarize the difference between embryonic and adult stem cell research with reference to ethics. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | *Discuss the involvement of the following organizations for Bioethics:* | CO5 | U |  |
|  | a. | Blue Cross |  |  | 06 |
|  | b. | Greenpeace |  |  | 06 |
|  |  |  |  |  |  |
| 22. |  | Discuss in detail the patent filing procedures in India. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Justify the statement *“Biopiracy threatens the integrity of the development of commercial biological products”* | CO5 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | **a.** | Debate the legal and social impact of Xenotransplantation globally. | CO6 | E | 8 |
|  | **b.** | Discuss the bioethical issues circumventing Xenotransplants. | CO6 | U | 4 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 4 | - | 12 | - | - | 17 |
| CO2 | 5 | - | 12 | - | - | - | 17 |
| CO3 | 5 | 12 | 6 | - | 6 | - | 29 |
| CO4 | 5 | - | - | - | 12 | - | 17 |
| CO5 | - | 16 | - | - | 12 | - | 28 |
| CO6 | 1 | 7 | - | - | 8 | - | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define Tag Readers. | | CO1 | U | 1 |
| 2. | Expand ELLIOT. | | CO1 | R | 1 |
| 3. | Give an example of an actuator which is rotatory in nature. | | CO2 | R | 1 |
| 4. | What is an Analog Sensor? | | CO2 | R | 1 |
| 5. | Name the government assisted app which can be used to get the market price of crops in the markets within 50 km of the device’s location capture by GPS and another option is to get the price of any market and any crop. | | CO3 | U | 1 |
| 6. | Name the food tech startup that combines drone scouting and multi-sensor analysis to predict crop health for longevity. | | CO3 | R | 1 |
| 7. | What is autonomous Harvesting in IoT based Agriculture? | | CO4 | U | 1 |
| 8. | Name the robots used in smart warehouses that resemble robotic vacuums**.** | | CO4 | R | 1 |
| 9. | Give the RF that Bluetooth technology operates on. | | CO5 | U | 1 |
| 10. | Define laboratory automation. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | List the Technology Challenges in IoT from inception. | | CO1 | R | 3 |
| 12. | Differentiate between Scalar and Vector sensors. | | CO2 | U | 3 |
| 13. | Describe this picture with respect to the technology used. | | CO3 | U | 3 |
| 14. | State the importance of ethics in supply chain management. | | CO4 | U | 3 |
| 15. | Differentiate between RF Vs Bluetooth technologies. | | CO5 | U | 3 |
| 16. | What is AIDC packaging for pharmaceutical products? | | 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. | Show the Emergence of IoT as a trending technology. | CO1 | U | 06 |
|  | b. | Classify the 6 levels of Automation levels in driverless cars laid down by the traffic safety administration in the USA. | CO1 | U | 06 |
|  |  |  |  |  |  |
| 18. | a. | Explain the evolution of Internet which enabled IoT. | CO2 | A | 06 |
|  | b. | Assess the significance of Solar Photovoltaic Cells and their types. | CO2 | An | 06 |
|  |  |  |  |  |  |
| 19. |  | Evaluate the Smart Greenhouses methodologies and their respective challenges. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | Categorize the most common 2D barcode types used today. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | Describe the IoT-ization of a synthetic biotechnology and renewable chemical company, Amyris, Inc. | CO5 | A | 06 |
|  | b. | Discuss the innovation drive of Bayer Crop Science in Precision Agriculture Using AWS IoT. | CO5 | U | 06 |
|  |  |  |  |  |  |
| 22. |  | Explain the various supply chain models in pharma industry. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Summarize the regulations for GDP and GMP laid down by the pharmaceutical industry with respect to IoT. | CO4 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Discuss the skepticism and unpredictability of biological processes in the discovery of novel organisms owing to rising industrial demand for bio-based products. | CO6 | E | 12 |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | 04 | 13 | - | - | - | - | 17 |
| **CO2** | 02 | 03 | 06 | 06 | - | - | 17 |
| **CO3** | 01 | 04 | - | - | 12 | - | 17 |
| **CO4** | 01 | 13 | - | 24 | - | - | 38 |
| **CO5** | - | 10 | 06 | - | - | - | 16 |
| **CO6** | 01 | 03 | - | 12 | - | - | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Describe the role of mimicry in adaptation. | | CO1 | U | 1 |
| 2. | Define camouflage. | | CO1 | R | 1 |
| 3. | List the components of eukaryotic cells. | | CO2 | R | 1 |
| 4. | Name the various stages of cell cycle. | | CO2 | R | 1 |
| 5. | Compare between homo and hetero polysaccharides. | | CO3 | U | 1 |
| 6. | Recall the examples for disaccharides. | | CO3 | R | 1 |
| 7. | Give examples for culture media. | | CO4 | U | 1 |
| 8. | Describe moist and dry heat. | | CO4 | R | 1 |
| 9. | Group the significance of crossing over. | | CO5 | U | 1 |
| 10. | Differentiate between transcription and translation. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Indicate the chemical adaptation in evolution. | | CO1 | U | 3 |
| 12. | State the role of M phase in cell cycle. | | CO2 | R | 3 |
| 13. | Recite the role of ligases. | | CO3 | R | 3 |
| 14. | Recall the functions of culture media. | | CO4 | R | 3 |
| 15. | Review on Mendel’s law of dominance. | | CO5 | U | 3 |
| 16. | Trace the components of genetic code. | | 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. | Relate the various concepts of evolution with examples. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Indicate with suitable diagram the components of both eukaryotic and prokaryotic cells. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 19. | a. | Describe the structure of DNA and RNA. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 20. | a. | Reproduce how microorganisms are identified. | CO4 | R | 12 |
|  |  |  |  |  |  |
| 21. | a. | Summarize on Mendel’s law of inheritance. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. | a. | Explain the various types of genetic diseases with examples. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Describe the various classification of enzymes. | CO3 | R | 6 |
|  | b. | Recall the techniques for cloning of dolly sheep. | CO4 | R | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the wobble hypothesis with suitable diagram. | CO6 | U | 6 |
|  | b. | Tabulate the process of translation in prokaryotes. | CO6 | R | 6 |

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

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 28 |  |  |  |  | 29 |
| CO2 | 17 | - |  |  |  |  | 17 |
| CO3 | 10 | 13 |  |  |  |  | 23 |
| CO4 | 22 | 1 |  |  |  |  | 23 |
| CO5 | - | 16 |  |  |  |  | 16 |
| CO6 | 6 | 10 |  |  |  |  | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name the father of plant tissue culture. | | CO1 | R | 1 |
| 2. | Define somatic embryo. | | CO1 | R | 1 |
| 3. | What is electroporation? | | CO2 | R | 1 |
| 4. | Mention the role of protoplast in genetic transformation. | | CO2 | U | 1 |
| 5. | What is a Ti plasmid? | | CO3 | R | 1 |
| 6. | List the genes involved in nitrogen fixation. | | CO3 | R | 1 |
| 7. | Define precursor. | | CO4 | U | 1 |
| 8. | What is a breeder seed? | | CO4 | R | 1 |
| 9. | Write two methods of germplasm conservation. | | CO5 | R | 1 |
| 10. | Identify the significance of illumination in plant bioreactors. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Discuss the role of hormones in organogenesis. | | CO1 | U | 3 |
| 12. | Describe the protoplast fusion. | | CO2 | A | 3 |
| 13. | Summarize the role of gene banks in germplasm conservation. | | CO3 | R | 3 |
| 14. | Classify various immobilization technique in plant cell drug production. | | CO4 | R | 3 |
| 15. | Distinguish the systemic acquired resistance (SAR) in plants. | | CO5 | A | 3 |
| 16. | Derive the growth kinetics of secondary metabolite production in cell suspension cultures of plants. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the composition of MS media and the role of various hormones used in organogenesis. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the protocol to develop transgenic crop using *Agrobacterium* mediated gene transfer technique. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Analyze the molecular mechanism of nitrogen fixation in legumes. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Evaluate the process of *in vitro* production of secondary metabolite Vincristine using plant cell suspension culture. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Describe the various genetic resources and methods in marker assisted selection for crop improvement. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 22. | a. | Summarize the process adapted in cultivar release and commercial seed production in India. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 23. | a. | Narrate the abiotic stress and biotic stress tolerance mechanism in plants | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Elaborate different types of bioreactors used for *in vitro* production of pharmaceutical compounds from plant cells. | CO6 | E | 12 |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 2 | 15 |  |  |  |  | 17 |
| CO2 | 1 | 1 | 3 | 12 |  |  | 17 |
| CO3 | 5 |  |  | 12 |  |  | 17 |
| CO4 | 4 | 1 |  |  | 12 |  | 17 |
| CO5 | 13 |  | 15 |  | 12 |  | 40 |
| CO6 |  | 4 |  |  | 12 |  | 16 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | What is passaging of cells? | | CO 1 | R | 1 |
| 2. | Name one cervical cancer cell line. | | CO 2 | R | 1 |
| 3. | Give examples of any two-polymer biomaterial used in tissue engineering. | | CO 3 | U | 1 |
| 4. | Write a note on spheroid culture. | | CO 3 | A | 1 |
| 5. | Identify any two fibro lytic bacteria of rumen. | | CO 5 | R | 1 |
| 6. | Name the probiotic strains used in sausage fermentation. | | CO 5 | R | 1 |
| 7. | Cite on intercytoplasmic sperm injection. | | CO 4 | U | 1 |
| 8. | Define artificial insemination. | | CO 4 | R | 1 |
| 9. | Name the flourescent stain used for staining X and Y chromosomes of the sperm. | | CO 4 | C | 1 |
| 10. | Trace any one regulatory issue in animal biotechnology. | | CO 6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Experiment on preservation of cell lines. | | CO1 | An | 3 |
| 12. | State the use of micro carrier cell culture with example. | | CO2 | R | 3 |
| 13. | Discuss the protocol for cardiovascular tissue engineering. | | CO3 | U | 3 |
| 14. | State the importance of lignocellulosic bioconversion. | | CO 5 | A | 3 |
| 15. | Illustrate on chimeric animal production. | | CO 4 | An | 3 |
| 16. | Interpret on knockout mice. | | CO 6 | 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. | Infer on the role of serum and serum free media in cell culture with examples. | CO1 | An | 6 |
|  | b. | Describe in detail about the establishment of cell line. | CO1 | U | 6 |
| 18. | a. | Report on bead bed reactor in scaling up of cell culture. | CO2 | U | 4 |
|  | b. | Explain scale up of suspension culture with necessary illustrations. | CO2 | An | 8 |
| 19. | a. | Analyze the process involved in electro spinning method of scaffold synthesis with illustrations. | CO3 | An | 4 |
|  | b. | Validate the importance of stem cell in tissue engineering with examples. | CO3 | E | 8 |
| 20. | a. | Appraise on genetic manipulation of microbes for improved feed utilization and health. | CO5 | An | 12 |
| 21. | a. | Write about the nutritional role of fermentation of meat in human diet. | CO5 | R | 4 |
|  | b. | Summarize on fermentation of comminuted meat matrix. | CO5 | E | 8 |
| 22. | a. | Express the albumin gradient method involved in sperm sexing. | CO4 | C | 6 |
|  | b. | Write a detailed note on embryo transfer technology in animals. | CO4 | C | 6 |
| 23. | a. | Articulate the principle and process of fluorescence activated cell sorter. | CO6 | A | 8 |
|  | b. | Describe the isopycnic density gradient centrifugation. | CO6 | A | 4 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Identify any four diseases in cattle and its targeted genes used for molecular diagnosis of disease detection. | CO5 | U | 4 |
|  | b. | Summarize the role of stem cells in the development of transgenic animals and discuss the ethical issues in animal biotechnology. | CO5 | E | 8 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 1 | 6 | - | 9 | - | - | 16 |
| CO2 | 4 | 4 | - | 8 | - | - | 16 |
| CO3 | - | 4 | 1 | 4 | 8 | - | 17 |
| CO4 | 1 | 1 | - | 3 | - | 13 | 18 |
| CO5 | 6 | 4 | 3 | 12 | 8 | - | 33 |
| CO6 | - | 1 | 15 | - | 8 | - | 24 |
|  | | | | | | | **124** |



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| **Course Code** | **20BT3001** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCES IN BIOPOLYMER AND APPLICATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | List the internal roles of lectins in human and describe any two roles. | CO1 | R | 8 |
|  | b. | Describe the role of glycan as vaccines and small molecule drugs. | CO1 | R | 8 |
|  |  |  |  |  |  |
| 2. | a. | Illustrate the structure-function relation of hemoglobin. | CO4 | An | 8 |
|  | b. | Compare the structure and function between myoglobin and hemoglobin. | CO4 | An | 8 |
|  |  |  |  |  |  |
| 3. | a. | Justify the role of hormone replacement therapy for anti-aging. | CO6 | E | 8 |
|  | b. | Critically comment on the advantages of abzyme with examples and explain its production process. | CO6 | E | 8 |
|  |  |  |  |  |  |
| 4. | a. | State the significant roles of lipids in pharmaceutical industries. | CO2 | R | 8 |
|  | b. | Describe the food and pharmaceutical applications of structured lipids. | CO2 | R | 8 |
|  |  |  |  |  |  |
| 5. | a. | Write the therapeutic significance of aptamers and antisense RNA. | CO2 | A | 8 |
|  | b. | Write the different approaches and applications of gene therapy. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 6. | a. | Illustrate the glycosylation engineering approaches for EPO and mAb. | CO3 | U | 8 |
|  | b. | Explain the enzyme engineering and its various industrial applications. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 7. | a. | Explain how glycan is used for metabolic disorders and cancer therapy. | CO5 | U | 8 |
|  | b. | Describe the therapeutic applications of peptides. | CO5 | U | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Analyze and write the role of biopolymers in bioremediation. | CO6 | An | 10 |
|  | b. | Critically analyze the novel applications of liposomes in nano-biotechnology. | CO6 | An | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Recall the basic structure, composition and functions of biopolymers. |
| CO2 | Demonstrate 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 | Compile, discuss and critically review the recent updates / progress in biopolymers research and their applications |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 16 |  |  |  |  |  | 16 |
| CO2 | 16 |  | 16 |  |  |  | 32 |
| CO3 |  | 16 |  |  |  |  | 16 |
| CO4 |  |  |  | 16 |  |  | 16 |
| CO5 |  | 16 |  |  |  |  | 16 |
| CO6 |  |  |  | 20 | 16 |  | 36 |
|  | | | | | | | **132** |



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| **Course Code** | **20BT3002** | **Duration** | **3hrs** |
| **Course Name** | **GENETIC ENGINEERING AND RECOMBINANT PRODUCTS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | What are the different steps followed in genetic engineering? List the applications of recombinant products. | CO1 | U | 10 |
|  | b. | How has rDNA technology changed the way we produce food, medicine, and agriculture? | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | What are the different types of cloning vectors, and how are they used? | CO3 | R | 10 |
|  | b. | Outline the tools used in rDNA technology to clone and express the gene of interest. | CO3 | R | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain any two types of PCR used in genetic manipulation. | CO2 | An | 10 |
|  | b. | Enumerate the steps followed in nucleic acid sequencing methods. | CO2 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Illustrate the steps involved in PCR cloning of DNA for gene expression. | CO2 | A | 10 |
|  | b. | Explain the applications of cDNA libraries and genomic DNA libraries. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the use of recombinant DNA technology to produce hormones and enzymes that are more effective. | CO6 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Analyze and write the development of plant crops using genetic engineering. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | What are the economic implications of developing and commercializing hypoallergenic cows? | CO5 | A | 10 |
|  | b. | Write the different methods used for transferring recombinant DNA into target cells. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Evaluate the various gene editing tools used in genetic manipulation for commercial purpose. | CO5 | E | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the genetic manipulation techniques employed for the production of insulin and growth hormone for therapeutic use. | CO6 | A | 20 |

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

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

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



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| **Course Code** | 20BT3008 | **Duration** | **3hrs** |
| **Course Name** | ENZYME TECHNOLOGY AND INDUSTRIALAPPLICATIONS | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Discuss the structures of enzymes and the concept behind ray-crystallography of enzyme. | CO3 | U | 10 |
|  | b. | Describe the production of catalytic antibiotics. | CO5 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Classify oligomeric enzymes with examples. | CO3 | U | 10 |
|  | b. | Explain the enzyme deactivation kinetics. | CO6 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate diffusional limitations in case of an immobilized enzymatic system. | CO1 | U | 10 |
|  | b. | Evaluate the potential of pectinases and protease enzymes for industrial application. | CO4 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Write the conventional characterization methods applied for industrial enzymes. | CO4 | A | 10 |
|  | b. | Summarize various industrial applications of enzyme with appropriate examples. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Analyze the methods used for investigating the kinetics of enzyme catalyzed reaction. | CO2 | An | 10 |
|  | b. | Write on the production of tyrosine kinase and its applications. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss on stability and the aspect of thermodynamics of the enzymes. | CO2 | U | 10 |
|  | b. | Explain the usage of mutagenesis to increase the substrate specificity towards enzyme. | CO5 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Discuss on the enzyme dynamics and flexibility. | CO2 | U | 10 |
|  | b. | Write a basic understanding on the allosteric regulation of enzymes. | CO6 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the rate constant and the constants of Alberty and Dalziel model. | CO6 | U | 10 |
|  | b. | Elaborate the mechanisms for multi-substrate enzyme catalyzed reaction. | CO6 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain on substrate and product inhibition of the enzyme. | CO6 | U | 10 |
|  | b. | Write in detail on Monod Changeux Wyman model. | CO6 | A | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the concept of kinetics of immobilization. |
| CO2 | Understand molecular understanding of enzymes. |
| CO3 | Apply enzymes in stereospecific reactions. |
| CO4 | Evaluate application of enzymes. |
| CO5 | Analyze commercial production of enzyme. |
| CO6 | Create inhibition kinetics of the enzymatic reactions**.** |

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



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| **Course Code** | **20BT3008** | **Duration** | **3hrs** |
| **Course Name** | **ENZYME TECHNOLOGY AND INDUSTRIAL APPLICATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Explain the two types of mechanisms of enzyme action with neat diagrams. | CO2 | R | 8 |
|  | b. | Enzymes are highly specific. Illustrate. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Illustrate various methods of enzyme immobilization with its advantages and disadvantages. | CO1 | U | 10 |
|  | b. | Elaborate on the construction and working of an immobilized bioreactor | CO1 | A | 6 |
|  |  |  |  |  |  |
| 3. | a. | The kinetics of an enzyme-catalyzed reaction were analyzed in the absence and presence of inhibitor A. Determine,   1. Michaelis Menton (MM) parameters for no inhibition using LB plot 2. Type of inhibition 3. Inhibitor constant A  |  |  |  | | --- | --- | --- | | **S (mM)** | **V (mM/Lmin)** | | | **I=0** | **IA=1.26mM** | | 0.25 | 1.02 | 0.73 | | 0.33 | 1.39 | 0.87 | | 0.4 | 1.67 | 1.09 | | 0.5 | 1.89 | 1.3 | | 0.6 | 2.08 | 1.41 | | 0.75 | 2.44 | 1.82 | | 1.0 | 2.5 | 2.71 | | CO6 | E | 12 |
|  | b. | What is competitive inhibition and explain it with the help of a line-weaver Burk plot. | CO6 | An | 4 |
|  |  |  |  |  |  |
| 4. | a. | Elaborate on any three industrial enzymes and their applications. | CO4 | A | 16 |
|  |  |  |  |  |  |
| 5. | a. | Describe with a neat sketch, the working of potentiometric enzyme-based biosensors. | CO5 | U | 8 |
|  | b. | Derive the expression for the film diffusion in immobilized enzymes. | CO1 | An | 8 |
|  |  |  |  |  |  |
| 6. | a. | With a neat flow diagram, explain the process of extraction and purification of the enzyme glucose isomerase with their applications. | CO5 | U | 16 |
|  |  |  |  |  |  |
| 7. | a. | Write a detailed note on Allostery using an example. | CO2 | An | 8 |
|  | b. | List out the uses of the catalytic antibodies. | CO4 | U | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Elaborate on the application of enzymes in various industries. | CO4 | A | 20 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Understand the kinetics of immobilization. |
| CO2 | Understand the molecular stability of enzymes. |
| CO3 | Apply enzymes in stereospecific reactions |
| CO4 | Evaluate the application of enzymes |
| CO5 | Analyze commercial production of an enzyme |
| CO6 | Create inhibition kinetics for the enzymatic reactions. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 10 | 6 | 8 | - | - | 24 |
| CO2 | 8 | - | - | 8 | - | - | 16 |
| CO3 | - | 8 | - | - | - | - | 8 |
| CO4 | - | 8 | 36 | - | - | - | 44 |
| CO5 | - | 24 | - | - | - | - | 24 |
| CO6 | - | - | - | 4 | 12 | - | 16 |
|  | | | | | | | **132** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the different approaches employed for strain improvement in industrial biotechnology. | CO1 | A | 10 |
|  | b. | Illustrate how the modern techniques are advanced for the identification of novel drug producing microorganisms. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Summarize the objectives of metagenomics and their diversified applications. | CO2 | U | 10 |
|  | b. | Discuss the mechanism of Multi Drug Resistance with a neat diagram. Add a note on its rising challenges in the 21st century. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Describe the working principle of 2D gel electrophoresis and their applications in life sciences. | CO2 | U | 12 |
|  | b. | Design a workflow for high throughput proteomic approaches to screen for novel microbial enzymes. | CO2 | C | 08 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Quorum sensing causes some pathogens to express virulence factors that promote infection of gram positive and gram negative bacteria-Justify with suitable examples. | CO4 | E | 12 |
|  | b. | Assess the role of human gut microbiome in health and diseases. | CO4 | E | 08 |
|  |  |  |  |  |  |
| 5. | a. | Explain the importance of Vesicular-arbuscular mycorrhiza (VAM) fungi in agriculture. Distinguish between ecto and endomycorrhiza. | CO6 | U | 10 |
|  | b. | Illustrate the production of bacteriocin using suitable lactic acid bacteria. Add a note on their applications in food industry. | CO6 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss about staphylococcal food intoxication. | CO4 | U | 10 |
|  | b. | Explain food preservation through use of high temperature. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Illustrate the role of probiotics in health and disease management with suitable examples. | CO3 | An | 12 |
|  | b. | Write the impact of structural proteomics on drug discovery. | CO2 | A | 08 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the production of any one important recombinant vaccine using rDNA technology. | CO3 | An | 10 |
|  | b. | Write the production process of glucose isomerase using suitable microorganism. Add a note on their stability and formulation. | CO5 | C | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Microbial fuel cells are considered as source of sustainable energy- Discuss with suitable illustrations. | CO5 | U | 10 |
|  | b. | What is Metagenomics? Discuss the stages involved in enumerating microbial population from environmental samples. | CO3 | U | 10 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | - | 20 | - | - | - | 20 |
| CO2 | - | 20 | 10 | - | - | 10 | 40 |
| CO3 | - | 10 | - | 20 | - | - | 30 |
| CO4 | - | 20 | 10 | - | 20 | - | 50 |
| CO5 | - | 10 | - | - | - | 10 | 20 |
| CO6 | - | 20 | - | - | - | - | 20 |
|  | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Illustrate the salient features of the biotechnology incubation park and its status in the current scenario in the development of Bio entrepreneurs. | CO3 | A | 10 |
|  | b. | Evaluate the process of integrated pest and nutrient management in sustaining ecosystem functions in agriculture. | CO1 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | “Plant growth promoting rhizobacteria play an important role in plant growth” Illustrate the statement with necessary examples. | CO2 | An | 10 |
|  | b. | Evaluate the factors involved in induced systemic resistance of plants and its significance in modern agriculture. | CO2 | E | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the types of bioreactors used in industrial production of secondary metabolites used in agriculture. | CO3 | A | 15 |
|  | b. | Analyze the significance of the method of screening of microorganism for new products. | CO2 | An | 5 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Illustrate the role of biotechnology in natural and artificial flavor and fragrance production with suitable examples. | CO4 | A | 10 |
|  | b. | Explain the concept of bio-preservation of foods in the current scenario of food safety regulations. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 5. | a. | Summarize the process involved in the extended shelf-life of food as per food safety regulations in India. | CO5 | E | 15 |
|  | b. | Discuss on biodegradable plastics and its importance in food packaging. | CO5 | U | 5 |
|  |  |  |  |  |  |
| 6. | a. | Illustrate the principles and methods of food preservation in the current scenario of food industries in India. | CO6 | A | 20 |
|  |  |  |  |  |  |
| 7. | a. | Summarize the scope and importance of the food processing sector in India. | CO4 | E | 10 |
|  | b. | Articulate the significance and techniques of immobilized enzymes in the food industry with suitable examples. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe the current status, policy, and prospects of quality parameters and quarantine procedures of export in India. | CO6 | U | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the various sources of food borne infections and intoxication in humans with suitable examples. | CO4 | An | 20 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  |  |  |  | 10 |  | 10 |
| CO2 |  |  |  | 15 | 10 |  | 25 |
| CO3 |  |  | 25 |  |  |  | 25 |
| CO4 |  |  | 20 | 20 | 10 |  | 50 |
| CO5 |  | 5 | 10 |  | 15 |  | 30 |
| CO6 |  | 20 | 20 |  |  |  | 40 |
|  | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Discuss the good manufacturing and laboratory practices to be followed by a biotechnology industry. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain the different levels of biosafety in biologic production industries. | CO5 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | What are the criteria for patentability? Describe the steps for filing the patents. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Illustrate the importance of IPR in Biotechnology. Describe two examples of IPR disputes in rDNA domain. | CO3 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | State the importance and advantages of cell-cultures as alternatives to use of animals in biotechnology research. | CO2 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Describe the process of whole organism cloning and summarize the reasons why cloning humans is ethically unacceptable. | CO4 | E | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain the ethical issues involved in xenotransplantation with relevant examples. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Discuss organ culture and the principle of informed consent of the parties involved. | CO1 | U | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Analyze the guidelines of department of biotechnology India for GMO’s use in India. | CO6 | An | 20 |

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

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



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| **Course Code** | **20BT3014** | **Duration** | **3hrs** |
| **Course Name** | **IMMUNOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A(4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Give a detailed account on the role and functions of the organs of the immune system. | CO1 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe the cells and the process involved in the antigen processing and presentation. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. | a. | Discuss the various pathways of Complement activation with suitable diagrams. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the Structure, Classes, Genes and Diversity of Antibodies. | CO3 | E | 20 |
|  |  |  |  |  |  |
| 5. | a. | Discuss primary and secondary immunodeficiency | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss the types and mechanism of autoimmune diseases. | CO4 | R | 20 |
|  |  |  |  |  |  |
| 7. | a. | Elaborate on the large scale manufacture of antibodies for immunodiagnostics. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Discuss the principle, working and applications of Flow cytometry and immunoelectron microscopy techniques. | CO6 | E | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe the process involved in T cell activation with suitable diagrams. | CO1 | R | 10 |
|  | b. | Differentiate cell mediated and humoral immunity. | CO1 | R | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Account for the structure and function of the immune system both at the molecular and cellular level. |
| CO2 | Account for polyclonal, monoclonal and humanized antibodies and production of these. |
| CO3 | Describe immunization/vaccination, immunological disease and immunotherapy. |
| CO4 | Plan, carry out and present achieved results of immunological serum analyses by means of different immunotechniques. |
| CO5 | Discuss immunological techniques and on the instrumentation involved. |
| CO6 | Implement various immnotechniques in immunology related applications. |

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



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| **Course Code** | **20BT3015** | **Duration** | **3hrs** |
| **Course Name** | **COMPUTATIONAL BIOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | | |
| 1. | a. | Describe the key steps in physical phenomenon on Morse Potential and Harmonic Oscillator Model in classical molecular mechanics. | CO1 | R | | 10 |
|  | b. | Explain the principles of DNA computing. | CO1 | R | | 6 |
|  |  |  |  |  | |  |
| 2. | a. | Describe the types of potentials. | CO1 | U | | 6 |
|  | b. | What is force field? Describe briefly the characteristics of various types of force fields. | CO2 | R | | 10 |
|  |  |  |  |  | |  |
| 3. | a. | Explain the working principle of illumina type - next generation sequencing techniques and application. | CO2 | R | | 8 |
|  | b. | Compare the working principles of three NGS platforms. | CO3 | U | | 8 |
|  |  |  |  |  | |  |
| 4. | a. | Describe the following:   1. Whole genome sequencing (ii) Transcriptome sequencing | CO3 | A | | 10 |
|  | b. | Describe the Relational database model. How does it ensure data reliability? | CO4 | R | | 6 |
|  |  |  |  |  | |  |
| 5. | a. | Explain the components of a network diagram with a neat diagram. | CO6 | U | | 8 |
|  | b. | What is data mining? Explain the steps in data mining process. | CO4 | R | | 8 |
|  |  |  |  |  | |  |
| 6. | a. | Describe the role of systems biology in identifying key molecules involved in disease. | CO4 | R | | 9 |
|  | b. | Illustrate the concept of adjacency matrix with a suitable example. | CO5 | A | | 7 |
|  |  |  |  |  | |  |
| 7. | a. | Explain the Newtonian dynamics and algorithms in molecular dynamics. | CO6 | U | | 8 |
|  | b. | Explain trajectory analysis of a MD Simulation. | CO6 | R | | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | | |
| 8. | a. | Briefly describe the MD models of Newtonian dynamics, Integrators Leapfrog and Varlet algorithm, Potential truncation and shifted-force potentials. | CO6 | R | | 10 |
|  | b. | Justify the importance of Implicit and explicit Solvation models, Periodic boundary conditions, Temperature and pressure control model in molecular dynamics simulations. | CO6 | U | | 10 |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 16 | 6 |  |  |  |  | 22 |
| CO2 | 18 |  |  |  |  |  | 18 |
| CO3 |  | 8 | 10 |  |  |  | 18 |
| CO4 | 23 |  |  |  |  |  | 23 |
| CO5 |  |  | 7 |  |  |  | 7 |
| CO6 | 18 | 26 |  |  |  |  | 44 |
|  | | | | | | | **132** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the component parts of a fermentation process with a neat flow chart. | CO2 | U | 10 |
|  | b. | Illustrate the various stages in downstream processing and add a note on their applications. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the basic design and operation of a membrane reactor with a neat diagram. | CO5 | U | 10 |
|  | b. | Derive the expression for the power requirement of an agitator in a bioreactor. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Apply Leudeking - Piret model to study the kinetics of microbial product formation. | CO4 | A | 12 |
|  | b. | Explain the applications of cellulase based catalysis process with suitable examples. | CO3 | A | 08 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Illustrate the operating cost and profitability assessment of a bioreactor with a case study. | CO6 | U | 10 |
|  | b. | Describe the environmental assessment for a sustainable bioprocess with a case study. | CO6 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Derive the expression for the design of Fed-Batch operation of a mixed reactor. | CO4 | An | 10 |
|  | b. | Describe the design and working of a Plug-Flow reactor. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Write the general steps involved in industrial bioprocess with a suitable case study. | CO2 | A | 10 |
|  | b. | Explain the various factors which were considered while scaling up process in the bioreactor. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Discuss downstream processing with respect to industrially important microbial product. | CO1 | U | 12 |
|  | b. | List out the advantages of animal cell bioreactor. | CO2 | R | 08 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe the design and operation of Continuous Stirred Tank Reactor. | CO5 | U | 12 |
|  | b. | Illustrate the factors to be considered in designing a fermentor for animal cell culture. | CO5 | U | 08 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe the design consideration to be taken into account during the bioprocessing of animal cell culture. Add a note on the factors to be considered in designing a fermentor for animal cell culture. | CO3 | U | 20 |

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

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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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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 12 | - | - | - | - | 12 |
| CO2 | 8 | 20 | 20 | - | - | - | 48 |
| CO3 | - | 20 | 10 | - | - | - | 30 |
| CO4 | - | - | 10 | 20 | - | - | 30 |
| CO5 | - | 40 | - | - | - | - | 40 |
| CO6 | - | 20 | - | - | - | - | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20BT3019** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED ANIMAL BIOTECHNOLOGY AND TISSUE CULTURE** | **Max. Marks** | **100** |

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| **Q. No.** | | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | | |
| 1. | a. | | Explain in detail on the cryopreservation of sperms and ova. Detail the procedure of culturing, transferring, splitting and preservation of embryos. | CO2 | An | 20 |
|  |  | | **(OR)** |  |  |  |
| 2. | a. | | Differentiate various types germplasm preservation techniques and explain the procedure for testing of foetus for genetic disorders. | CO3 | An | 20 |
|  |  | |  |  |  |  |
| 3. | a. | | Explain on the following:   1. Pregnancy diagnostic kit 2. Mouse model for COVID-19 | CO1 | A | 20 |
|  |  | | **(OR)** |  |  |  |
| 4. | a. | | Classify animal cloning from embryonic cells and adult cells and explain the applications of transgenic animal technology in detail. | CO4 | An | 20 |
|  |  | |  |  |  |  |
| 5. | a. | | Write the ethical, moral and social issues related to cloning with relevant case studies. | CO5 | C | 10 |
|  | b. | | Explain the production of antifertility animal vaccines. | CO5 | An | 10 |
|  |  | | **(OR)** |  |  |  |
| 6. | a. | | Illustrate the importance of genetic characterization of livestock breeds and explain various methods to identify meat adulteration. | CO6 | A | 20 |
|  |  | |  |  |  |  |
| 7. | a. | | Assess the application of animal cell culture for in-vitro testing of drugs. Add a detailed note on scale up of cell culture. | CO5 | E | 20 |
|  |  | | **(OR)** |  |  |  |
| 8. | a. | | Explain in detail on cell line preservation and authentication. List out the importance of cell culture products with examples. | CO5 | An | 20 |
| **COMPULSORY QUESTION** | | | | | | |
| 9. | a. | | Appraise and summarize on the following:   1. Biomaterials in tissue engineering 2. Artificial blood vessels 3. Artificial liver and pancreas 4. 3D culture | CO6 | E | 20 |

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



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| **Course Code** | **20BT3024** | **Duration** | **3hrs** |
| **Course Name** | **PHARMACEUTICAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Illustrate Pre-clinical toxicity assessment and steps involved in Clinical trial phases and design. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | List the pharmacogenomics in preclinical and clinical development of drugs**.** | CO1 | U | 20 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the importance of genetically engineered animals in development of pharmecutics. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the concept of personalized medicines and its prospects in health care. | CO3 | An | 20 |
|  |  |  |  |  |  |
| 5. | a. | Explain absorption, distribution and metabolism pathways and its significance in drug metabolism. | CO4 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Describe the immunodiagnostic assay based on solid phase system. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Outline the synthesis of genetically engineered vaccines with reference to SARS-CoV-2. | CO5 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Narrate the steps followed in miniaturization of biopharmaceuticals and therapeutics for drug delivery. | CO5 | An | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Outline various factors considered in enhancing shelf life of protein based therapeutics. | CO6 | A | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Understand and evaluate different pharmaceutical parameters for the current and future biotechnology related products on the market. |
| CO2 | Aanalyze 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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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 40 |  |  |  |  | 40 |
| CO2 |  | 20 |  |  |  |  | 20 |
| CO3 |  |  |  | 20 |  |  | 20 |
| CO4 |  | 20 |  | 20 |  |  | 40 |
| CO5 |  |  |  | 20 | 20 |  | 40 |
| CO6 |  |  | 20 |  |  |  | 20 |
|  | | | | | | | **180** |



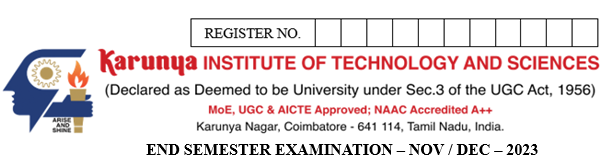
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| **Course Code** | **20BT3026** | **Duration** | **3hrs** |
| **Course Name** | **STEM CELL THERAPEUTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Analyze the pros and cons of animal cell culture. | CO1 | U | 10 |
|  | b. | Give a detailed account on aseptic technique. | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Distinguish between primary and secondary cultures. | CO1 | R | 20 |
|  |  |  |  |  |  |
| 3. |  | Illustrate stem cell niche with an example. | CO2 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Describe the important reagents and equipment employed in cell culture. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 5. | a. | Give a detailed account on the various types of stem cells and their mode of division. | CO3 | An | 10 |
|  | b. | Define ES and describe its applications. | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Explain mesenchymal stem cells. | CO4 | A | 20 |
|  |  |  |  |  |  |
| 7. |  | Elaborate on tissue engineering and the scaffolds used. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain iPSC and its pros and cons. | CO6 | R | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Discuss the various ethical issues regarding stem cell technology you foresee in the future. | CO6 | E | 20 |

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

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

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



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Discuss the bottom- up approach in nanofabrication. | CO1 | U | 10 |
|  | b. | Describe five nanomaterials used in various biological applications. | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the methods in characterization for nanoparticles using microscopic and spectroscopic methods. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. | a. | Examine the functions and application of DNA nanostructures. | CO1 | A | 10 |
|  | b. | Evaluate the biomedical application of biomimicry with Gecko foot as a case study for biological generation of adhesive forces. | CO3 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Evaluate the functions and application of Protein nanostructures. | CO1 | E | 10 |
|  | b. | Compare the different methods in the fabrication of protein nanostructure. | CO1 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Discuss the benefits and applications of Microfluidic devices with examples. | CO5 | U | 10 |
|  | b. | Examine microfluidic device as organ on chip platform with suitable example. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Analyze the use of Microneedles and nanoparticles for targeted and highly controlled drug delivery. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Describe nano sensors, their types and mention their application in diagnosis. | CO4 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Evaluate the applications of Nanotechnology in Biomaterial Scaffolds. | CO3 | E | 10 |
|  | b. | Analyze the applications of electronic nose and tongue. | CO3 | An | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Examine the environmental, health, and safety issues related to nanomaterials. | CO6 | A | 10 |
|  | b. | Discuss in-vitro nanotoxicology and nanoparticle interaction with macromolecules. | CO6 | R | 10 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 10 | 10 | 20 |  | 10 |  | 50 |
| CO2 |  |  |  | 20 |  |  | 20 |
| CO3 |  |  |  | 10 | 20 |  | 30 |
| CO4 |  | 10 |  | 30 |  |  | 40 |
| CO5 |  | 10 | 10 |  |  |  | 20 |
| CO6 | 10 |  | 10 |  |  |  | 20 |
|  | | | | | | | **180** |



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| **Course Code** | **20BT3029** | **Duration** | **3hrs** |
| **Course Name** | **CANCER MANAGEMENT TECHNIQUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the pathologic characteristics and hallmarks of cancer cell. | CO1 | R | 10 |
|  | b. | What are the different classes and types of cancer? | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Illustrate the metastatic cascade. | CO2 | An | 10 |
|  | b. | Explain how the cancer cells mimic immune cells for metastasis. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | What are the general and specific symptoms of various types of cancer? Explain how breast cancer is screened for early diagnosis. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | List the imaging techniques with its advantages used for cancer detection. | CO4 | U | 10 |
|  | b. | Describe the immunodiagnostic techniques used for cancer marker detection. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the chemotherapy used for cancer and the present challenges. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Analyze the challenges of gene therapy and critically comment on the immunotherapy with examples. | CO5 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Justify the signaling molecules of mitogen-induced oncogenic Ras pathway are signal targets for cancer detection and therapy. | CO3 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | What is the role of diet and nutrition in cancer prevention? What are the new innovative ways to prevent cancer? Describe. | CO6 | R | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | What are the newly approved plant-based drugs for cancer? Explain the palliative care parameters and post therapeutic preventive measures. | CO6 | An | 20 |

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

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

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



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the genetic features of prokaryotic genomes. | CO1 | U | 10 |
|  | b. | Explain the restriction fragment length polymorphism observed in eukaryotic genomes. | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | How do mass spectroscopy instruments work? | CO6 | An | 10 |
|  | b. | Explain, with suitable examples, the difference between gene markers and DNA markers for genetic mapping. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain with suitable examples Mendel’s laws of inheritance. | CO1 | U | 10 |
|  | b. | How can northern blotting technique be used to experimentally detect gene location in eukaryotic organisms? | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Write a note on pyrosequencing method used for sequencing a DNA molecule. | CO3 | U | 10 |
|  | b. | Explain the various levels of organization of protein sequences into three-dimensional structures. | CO1 | R | 10 |
|  |  |  |  |  |  |
| 5. | a. | How can two-dimensional SDS-PAGE and MALDI-TOF MS experiments be used to mining proteomes? | CO4 | An | 10 |
|  | b. | Describe the various protein digestion techniques. | CO3 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | How can biochemical markers be used for genetic analysis of *Saccharomyces cerevisiae*? | CO2 | U | 10 |
|  | b. | Explain different types of microarrays. | CO5 | R | 10 |
|  |  |  |  |  |  |
| 7. | a. | What are the different applications of proteomics? | CO5 | U | 10 |
|  | b. | Describe the experimental method of resolving proteins using one-dimensional sodium dodecyl sulfate–polyacrylamide gel electrophoresis. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the various stages of meiotic cell division cycle in humans. | CO1 | U | 10 |
|  | b. | Why open reading frames scans are less effective with DNA sequences of higher eukaryotic organisms? | CO4 | An | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Locate the genes present on the following sequence of DNA molecule by scanning for open reading frames in all six reading frames.  5’-TGATCCATGC ACCGCCGCAG GGCAGAACGA TGTCTAAACC ACGGCGATAG ATTAGCGCCT -3’ | CO4 | E | 10 |
|  | b. | How can site-directed mutagenesis be performed using the polymerase chain reaction? | CO5 | An | 10 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 10 | 30 | 0 | 0 | 0 | 0 | 40 |
| CO2 | 0 | 10 | 10 | 0 | 0 | 0 | 20 |
| CO3 | 20 | 20 | 0 | 10 | 0 | 0 | 50 |
| CO4 | 0 | 0 | 0 | 20 | 10 | 0 | 30 |
| CO5 | 10 | 10 | 0 | 10 | 0 | 0 | 30 |
| CO6 | 0 | 0 | 0 | 10 | 0 | 0 | 10 |
|  | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Categorize the nature of different environmental pollutants. Explain the detrimental effect and mitigation of water pollution. | CO1 | An | 10 |
|  | b. | Describe the transformation mechanism and importance of carbon and nitrogen cycle in soil by microorganisms. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Define pollution indicators. Assess the role of pollution indicators in air quality monitoring. | CO2 | E | 10 |
|  | b. | Describe the different approaches for strain improvement in environmental management. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Describe the treatment process of up-flow anaerobic sludge blanket reactor for wastewater treatment. | CO3 | A | 10 |
|  | b. | Summarize the characteristics and different process steps involved in the treatment of pharmaceutical industry effluent. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Classify the methods to eliminate the gaseous and volatile organic contaminants using pollution controlling devices. | CO4 | An | 15 |
|  | b. | Calculate the Detention Time for a 260,000 gallon digester that receives 7,200 gallons of sludge per day. | CO4 | E | 5 |
|  |  |  |  |  |  |
| 5. | a. | Explain the recalcitrant compound degradation pattern and how the hydrocarbon products are degraded? | CO5 | A | 14 |
|  | b. | Calculate the pounds of dry solids and the pounds of volatile solids using the given data:  Volume of Sludge 7,500 Gallons  Solids Concentration 3.6%  Volatile Solids 78% | CO4 | E | 6 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Write the types of bioremediation. Discuss the role of microorganisms  *in situ* bioremediation in detail. | CO5 | A | 10 |
|  | b. | Simulate the production process of biodegradable plastics using biopolymers. | CO6 | C | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the structural and catabolic diversity approach for the identification of metagenomes in environmental niche for bioremediation. | CO5 | An | 14 |
|  | b. | Critique the different methods to manage medical waste and solid waste. | CO2 | E | 6 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Define bioleaching. Illustrate bioleaching process with suitable examples. | CO4 | A | 12 |
|  | b. | Compile the production process of compositing and vermicomposting in solid waste management. | CO6 | C | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Comment on biosensor. Explain the role of biosensors in environmental monitoring. | CO6 | A | 14 |
|  | b. | Validate the production process and extraction of biosurfactants. | CO6 | C | 6 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 10 |  | 10 |  |  | 20 |
| CO2 |  | 10 |  |  | 16 |  | 26 |
| CO3 |  | 10 | 10 |  |  |  | 20 |
| CO4 |  |  | 12 | 15 | 11 |  | 38 |
| CO5 |  |  | 24 | 14 |  |  | 38 |
| CO6 |  |  | 14 |  |  | 24 | 38 |
|  | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Describe the different approaches for strain improvement in environmental management. | CO4 | U | 12 |
|  | b. | Summarize the current status of biotechnology in environmental protection and its future prospects. | CO4 | U | 08 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain any TWO traditional methods in Biodiversity Conservation. | CO1 | U | 10 |
|  | b. | Describe the sources of any THREE pollutants with suitable examples. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | With a neat sketch, explain the working of an up-flow anaerobic sludge blanket reactor (UASBR). List its main advantages and disadvantages. | CO3 | An | 12 |
|  | b. | Illustrate the process of aerated Lagoons for waste water treatment. | CO3 | An | 08 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the working of a Rotating Biological Contactor. What are the assumptions and design criteria adopted for the design of a rotating biological contactor? | CO2 | C | 12 |
|  | b. | Explain the removal of nutrients using suitable biological methods. | CO2 | A | 08 |
|  |  |  |  |  |  |
| 5. | a. | Assess the characteristics of pharmaceutical industry effluent and explain the different process steps in the treatment of pharmaceutical industry effluent. | CO3 | E | 10 |
|  | b. | Critically analyze the impact of environmental pollutants caused by pesticide industries and suggest the microbial methods for detoxification of pesticides. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the different process steps involved in bioleaching of heavy metals. | CO3 | U | 12 |
|  | b. | Summarize the role of bacteria and fungi in bioremediation with suitable examples. | CO5 | U | 08 |
|  |  |  |  |  |  |
| 7. | a. | Explain the steps involved in biodiesel production with a neat flow chart. | CO6 | U | 12 |
|  | b. | Summarize the production process and extraction of biosurfactants. | CO6 | E | 08 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the role of quorum sensing in environmental monitoring. | CO4 | U | 10 |
|  | b. | Develop an eco-friendly and sustainable biodegradable products using suitable strategies. | CO6 | C | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Illustrate how the modern techniques are advanced for the identification of microbial genes than conventional techniques in bioremediation. | CO5 | A | 12 |
|  | b. | Explain the role of biosensors in environmental monitoring. | CO4 | U | 08 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 20 | - | - | - | - | 20 |
| CO2 | - | - | 8 | - | - | 12 | 20 |
| CO3 | - | 12 | - | 20 | 10 | - | 42 |
| CO4 | - | 38 | - | - | - | - | 38 |
| CO5 | - | 8 | 12 | 10 | - | - | 30 |
| CO6 | - | 12 | - | - | 8 | 10 | 30 |
|  | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Categorize the different types of hazardous waste and its management through bioremediation process. | CO1 | U | 10 |
|  | b. | “Lichens – A pollution indicator” – Justify the statement. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 2. | a. | Describe the role of microorganisms in biogeochemical cycle with suitable examples. | CO1 | U | 10 |
|  | b. | Distinguish between attached and suspended growth reactor. Illustrate the steps involved for the wastewater treatment with neat flow chart. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 3. | a. | Describe the treatment process and importance of fluidized bed biological reactor in wastewater treatment. | CO2 | E | 8 |
|  | b. | Explain the characteristics and different process steps for the treatment of electrochemical industrial effluent. | CO3 | An | 8 |
|  |  |  |  |  |  |
| 4. | a. | Calculate the organic loading into the digester in lbs of volatile solid per day per ft3 using the following data.  Digester Volume = 11,000 ft3  Raw sludge pumped = 4,600 gal/day  Raw sludge solids concentration = 3.5 %  Raw sludge volatile solids = 74 % | CO3 | An | 6 |
|  | b. | Define eutrophication. Discuss the treatment process for the biological removal of phosphorus from wastewater. | CO3 | E | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the different process steps involved in the bioleaching of heavy metals with equations. | CO4 | An | 10 |
|  | b. | Define superbug. Write the biodegradation process of oil spills. | CO4 | C | 6 |
|  |  |  |  |  |  |
| 6. | a. | Describe the methods to eliminate the gaseous and volatile organic contaminants using pollution controlling devices. | CO4 | A | 10 |
|  | b. | Summarize the methods of bioplastic production – an ecofriendly substitute. | CO5 | C | 6 |
|  |  |  |  |  |  |
| 7. | a. | Illustrate the production process of biogas for the generation of electricity with neat sketch. | CO5 | E | 12 |
|  | b. | Write the uses of white rot fungi in paper production. | CO6 | C | 4 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Formulate the steps involved for the production of biohydrogen with flow diagram. | CO6 | C | 8 |
|  | b. | Comment on biosensor. Explain the role of biosensor in environmental monitoring. | CO6 | A | 12 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 20 | 6 |  |  |  | 26 |
| CO2 |  |  |  | 6 | 8 |  | 14 |
| CO3 |  |  |  | 14 | 10 |  | 24 |
| CO4 |  |  | 10 | 10 |  | 6 | 26 |
| CO5 |  |  |  |  | 12 | 6 | 18 |
| CO6 |  |  | 10 |  |  | 14 | 24 |
|  | | | | | | | **132** |



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| **Course Code** | **20BT3032** | **Duration** | **3hrs** |
| **Course Name** | **ENTREPRENUERSHIP AND MANAGEMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Assess the role and classification of SSI in economic development of India. | CO1 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain the identification and management of the steps, opportunity assessment and types of business risk analysis for the preparation and execution of any Business Plan. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. | a. | Discuss the challenges and difficulties in starting an enterprise with respect to scalability and innovation of the product or business. | CO3 | U | 10 |
|  | b. | Categorize and explain the challenges and difficulties faced by Woman entrepreneurs in India. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Debate and discern the impact of factors across sectors that are affecting entrepreneurship in bio-sectors. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 5. | a. | Explain the pricing strategy in the journey from lab to the market for bio markets. | CO5 | An | 10 |
|  | b. | Recall and write the basic principles, types of agreement and terms in a contract. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Discuss the various knowledge centers, technology transfer agencies their compliance and procedures in the management of Technologies. | CO6 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Classify any FOUR funding agencies based on vision, strategy and values. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Assess the factors shaping opportunities for innovation and entrepreneurship in bio-sectors. | CO4 | E | 10 |
|  | b. | Distinguish between Bio-entrepreneurship and Entreprenuership. | CO4 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Organize the path of technology from its assessment, development, and upgradation in technology management. | CO6 | An | 20 |

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|  | **COURSE OUTCOMES** |
| **CO1** | Understand principles of product design, basic management techniques, entrepreneurial skills and funding agencies. |
| **CO2** | Apply knowledge to the fundamentals of business plan, practical management concepts like leadership and motivation. |
| **CO3** | Induce entrepreneurial intent as well as innovation, scalability and marketing of the product. |
| **CO4** | Demonstrate the ability to provide a self-analysis in the context of an entrepreneurial career. |
| **CO5** | Assess the commercial viability of a new technology-based idea to prototype |
| **CO6** | Transfer technology and process of the product for commercialization |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| **CO1** | - | - | - | - | 20 | - | 20 |
| **CO2** | - | - | - | 20 | - | - | 20 |
| **CO3** | - | 10 | - | 10 | - | - | 20 |
| **CO4** | - | 10 | - | 20 | 10 | - | 40 |
| **CO5** | - | 10 | - | 10 | - | - | 20 |
| **CO6** | - | 20 | - | 20 | - | - | 40 |
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| **Course Code** | **20BT3033** | **Duration** | **3hrs** |
| **Course Name** | **INDUSTRIAL WASTE MANAGEMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Categorize the nature of different environmental pollutants. Explain the detrimental effect and mitigation of water pollution. | CO1 | An | 10 |
|  | b. | Describe the transformation mechanism and importance of carbon and nitrogen cycle in soil by microorganisms. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Define pollution indicators. Assess the role of pollution indicators in air quality monitoring. | CO2 | E | 10 |
|  | b. | Discuss the scope and functions of recycle and reuse approaches in pollution management. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Describe the treatment process of up-flow anaerobic sludge blanket reactor for wastewater treatment. | CO3 | A | 10 |
|  | b. | Summarize the characteristics and different process steps involved in the treatment of electroplating industry effluent. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Suggest a suitable process of waste management for a municipal administration with example. | CO4 | An | 15 |
|  | b. | Calculate the Detention Time for a 1,20,000 gallon digester that receives 3,200 gallons of sludge per day. | CO4 | E | 5 |
|  |  |  |  |  |  |
| 5. | a. | Explain the process of incineration and solidification of treatment of hazardous waste. | CO5 | A | 14 |
|  | b. | Calculate the pounds of dry solids and the pounds of volatile solids using the given data:  Volume of Sludge 6,000 Gallons  Solids Concentration 3.0%  Volatile Solids 73% | CO4 | E | 6 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | “Hazardous waste management has become essential in today social life pattern betterment” – Discuss with illustration. | CO5 | A | 10 |
|  | b. | Explain the procedure involved in industrial waste audit. | CO6 | E | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain how a combined effluent treatment plant can be used to treat wastes of different industries along with municipal wastewater? | CO5 | An | 14 |
|  | b. | Write a note on reclamation of wastewater. | CO2 | A | 6 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Discuss the effects of industrial effluents on streams, land, sewage treatment plants and human health. | CO4 | A | 12 |
|  | b. | Compile the production process of compositing and vermicomposting in solid waste management. | CO6 | C | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | With the help of flow diagram, explain the various sources, characteristics and treatment options for wastes from paper and pulp industry. | CO6 | A | 14 |
|  | b. | Explain the physico-chemical treatment methods for hazardous wastes. | CO6 | C | 6 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | List different industrially relevant waste and their challenges in management. |
| CO2 | Learn suitability of available treatment options depending on nature of waste. |
| CO3 | Make use of bio-chemical reactions to develop optimal treatment system. |
| CO4 | Examine energy and eco-friendly of solid waste and wastewater treatment. |
| CO5 | Recommend advanced treatment technologies with different industrial scenarios. |
| CO6 | Formulate cleaner production and waste management technologies. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 |  | 10 |  | 10 |  |  | 20 |
| CO2 |  | 10 |  |  | 16 |  | 26 |
| CO3 |  | 10 | 10 |  |  |  | 20 |
| CO4 |  |  | 12 | 15 | 11 |  | 38 |
| CO5 |  |  | 24 | 14 |  |  | 38 |
| CO6 |  |  | 14 |  | 10 | 14 | 38 |
|  | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Discuss the functions and classification of carbohydrates. | CO1 | U | 10 |
|  | b. | Describe the structural features of the double helix structure of DNA. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the primary and secondary structures of protein. | CO1 | An | 10 |
|  | b. | Discuss on the structures and functions of major types of RNA. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | List the water and fat soluble vitamins, their functions, coenzymes derived from them and the deficiency diseases. | CO3 | C | 10 |
|  | b. | Describe the Beta oxidation pathway of fatty acids. | CO4 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Write a detailed note on the dietary sources and deficiency syndromes of micro elements. | CO3 | C | 10 |
|  | b. | Discuss the pentose phosphate pathway and state its importance. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Discuss the complexes and steps involved in electron transport chain with a neat diagram. | CO4 | U | 10 |
|  | b. | Describe the biosynthetic pathway of Tryptophan. | CO5 | C | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the TCA cycle with a neat illustration. | CO4 | U | 10 |
|  | b. | Describe the metabolic steps involved in the synthesis of palmitate from acetyl CoA. | CO5 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the metabolic pathways for the conversion of glucose to pyruvate and lactate. | CO5 | U | 10 |
|  | b. | Describe five inborn errors of metabolism. | CO6 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Write a detailed note on different types of phospholipids and its functions. | CO6 | R | 10 |
|  | b. | Explain the molecular function and key structural features of myoglobin and hemoglobin. | CO5 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe the properties and classification of different types of lipids with appropriate examples. | CO6 | R | 10 |
|  | b. | Write a short note on de-novo and salvage pathways for purine biosynthesis. | CO2 | C | 10 |

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

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

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



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Illustrate biosynthesis of terpenoids with its functions. | CO1 | A | 10 |
|  | b. | Illustrate the Phenylpropanoid Metabolic Pathway highlighting its significance. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Narrate the role of secondary metabolites in chemical defense of plant pathogens. | CO2 | A | 20 |
|  |  |  |  |  |  |
| 3. | a. | Evaluate the phrase – “Secondary metabolism is an integral part of plant function”. | CO3 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Enumerate the production of secondary metabolites by endophytes. Discuss their applications. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 5. | a. | Describe types and the usage of various excipients as pharmaceutical ingredients. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the cloning and characterization of enzymes involved in MEP Pathways. | CO2 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Evaluate the various production technologies for production of secondary metabolites in higher plants. | CO3 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe the considerations for the manufacture of hard and soft gelatin capsules. | CO6 | A | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Justify the inhalation therapy in delivery of drugs for demulcents and expectorants. | CO6 | E | 20 |

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

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



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the impact of 16S rRNA gene sequence analysis for identification of bacteria with suitable examples. | CO1 | U | 10 |
|  | b. | Illustrate the role of Denaturing Gradient Gel Electrophoresis (DGGE), Single Stranded Conformation Polymorphism (SSCP) in identification of microorganisms. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Quorum sensing causes some pathogens to express virulence factors that promote infection of gram positive and gram negative bacteria-Discuss with suitable illustrations. | CO2 | E | 10 |
|  | b. | Explain the importance of phenol, alcohol, and detergents in control of microbial growth. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Describe the structure, mode of transmission, pathogenesis, symptoms and prevention of H1NI virus. | CO3 | U | 10 |
|  | b. | Illustrate the role of human gut microbiome in health and diseases. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Genetic analysis and mapping in bacteria and bacteriophages-Discuss with suitable diagrams. | CO4 | An | 10 |
|  | b. | Explain the genetic fine structure analysis of r11 locus and its outcome. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Assess the structural organization and mechanism of transposition of prokaryotic transposons. | CO5 | E | 10 |
|  | b. | Discuss transposons in Drosophila with suitable illustrations. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Describe the importance of Vesicular-arbuscular mycorrhiza (VAM) fungi in agriculture. Distinguish between ecto and endomycorrhiza. | CO3 | U | 12 |
|  | b. | Outline the stepwise development of root nodule in leguminous plants on infection by *Rhizobium* *sp*. | CO3 | U | 08 |
|  |  |  |  |  |  |
| 7. | a. | Explain the reaction, regulation and energy production of TCA cycle. | CO2 | An | 12 |
|  | b. | Illustrate how energy is produced during anaerobic processes. | CO2 | An | 08 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the molecular basis of mutations with suitable examples. | CO6 | U | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the mode of action of mutagens: 5-Bromouracil (BU), 2Aminopurine (AP) and N-Mrthyl-N’-nitro-N-nitrosoguanidine (NTG). | CO6 | U | 10 |
|  | b. | Assess the molecular basis of mutation and origin of spontaneous mutations using Fluctuation test. | CO6 | E | 10 |

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

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

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



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Define animal biotechnology and its applications. | CO2 | R | 10 |
|  | b. | Illustrate the advances in *invitro* fertilization employing animal models. | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Write about culturing of animal embryos. | CO1 | A | 10 |
|  | b. | Explain the applications of embryo transfer, splitting and sexing in animal biotechnology. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Describe the importance of transgenic animal models in scientific research. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Summarize on DNA based methods to detect meat adulteration. | CO3 | U | 20 |
|  |  |  |  |  |  |
| 5. | a. | Discuss on types of ELISA in detail. | CO4 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Report on RIA and immunoblotting methods. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 7. | a. | Explain the production of monoclonal antibodies with and without hybridoma technology. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe plantibodies and production of abymes. | CO5 | R | 10 |
|  | b. | Write the importance of antifertility vaccines and their applications. | CO3 | R | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Write about vaccines in detail. | CO6 | A | 20 |

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

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

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



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Evaluate the factors that help in selecting and narrowing down the scope of a scientific project. Indicate the incentives a researcher would expect from his/her work. | CO1 | U | 10 |
|  | b. | Highlight the difference and relationship between research method and research methodology. | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Highlight the importance of guidelines and a checklist designed to improve the quality and transparency of reporting systematic reviews and meta-analysis. Explain the structured PRISMA framework for authors to report various elements. | CO2 | An | 12 |
|  | b. | Explain the different types of control experiments in research design, as they help researchers isolate and manipulate variables to establish causal relationships and ensure the validity of their findings. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 3. | a. | Explain the desirable attributes the “Materials & Method section” should reflect in a typical research article. | CO3 | U | 10 |
|  | b. | Examine the purpose of the 'Introduction' section of the research paper. Highlight the key strategies one should adopt to make it more logical and comprehensible. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Discuss the commonly accepted criteria for authorship in scientific papers, and then anticipate the situations where authorship disputes may arise. Propose strategies that can help prevent or resolve authorship conflicts. | CO4 | U | 10 |
|  | b. | Examine the different aspects of “publication ethics” the author should conform to while submitting a manuscript for publication. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Distinguish between precession, accuracy, and bias when performing an analytical method validation. Employ strategies to quantify those parameters. | CO2 | A | 10 |
|  | b. | Justify the conditions or circumstances when “duplicate” publication may not be an unethical practice in scientific communication. | CO4 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the pros- and cons- of different publication models where research findings, scholarly work, and academic content are disseminated to the broader scientific community. | CO4 | An | 10 |
|  | b. | Distinguish between possible outcomes when a manuscript is routed in a typical publication process. Identify different quality indicators the author should consider before choosing a journal for manuscript submission. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | The maximum specific growth rate of *E. Coli* is normally distributed with a mean of 0.25 h-1 and a standard deviation of 0.05 h-1. Estimate the probability that a specific growth rate in a randomly selected batch would be between 0.22 h-1 and 0.28 h-1. | CO5 | E | 10 |
|  | b. | In a factory, the mean weight of a randomly selected sample of 30 boxes of a product is 12 kg, with a standard deviation of 2 kg. Calculate a 99% confidence interval for the population mean weight of these boxes. | CO5 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | A researcher believes that a new drug reduces blood pressure. In a clinical trial, 50 patients were randomly assigned to receive the drug, and their average reduction in blood pressure was 8 mm Hg with a standard deviation of 2 mm Hg. Test whether the drug has a significant effect on reducing blood pressure at a 5% significance level. | CO5 | E | 10 |
|  | b. | Mean systolic blood pressure (SBP) levels between two different groups of individuals are to be compared. In Group A, the mean SBP from randomly selected 30 individuals is 125 mm Hg and a standard deviation of 10 mm Hg. In Group B, the mean SBP from randomly selected 40 individuals is 130 mm Hg and a standard deviation of 15 mm Hg. Test the hypothesis that the mean blood pressure of population B is > that of population A. | CO5 | E | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the strategy to estimate the coefficient of model term in a multiple linear model. Justify the need to calculate the regression coefficient, even if we minimize SSE. | CO6 | E | 10 |
|  | b. | Calculate the regression coefficient for a model from the dataset provided.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Expt. value | 1 | 2 | 3 | 4 | 5 | 6 | | Model. Resp. | 0.5 | 1.5 | 3.5 | 5 | 6.5 | 8 | | CO6 | E | 10 |

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

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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 | | Understand key steps to transform a wobbly idea into a convincing research proposal report -  connecting the small objectives to big-picture | | | | | | | | |
| CO3 | | Perform hypothesis testing based on a parametric and non-parametric approach in statistical package, office tools | | | | | | | | |
| CO4 | | Analyze the need for literature, experimental data, and supporting information in the realm of research publication | | | | | | | | |
| CO5 | | Practice good-research and publication ethics | | | | | | | | |
| CO6 | | Understand the need for statistical analysis pertinent to their experimental data | | | | | | | | |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | | |
| **CO / P** | | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | | 10 | 10 | 0 | 0 | 0 | 0 | 20 |
| CO2 | | 0 | 0 | 18 | 12 | 0 | 0 | 30 |
| CO3 | | 0 | 10 | 10 | 0 | 0 | 0 | 20 |
| CO4 | | 0 | 10 | 10 | 20 | 10 | 0 | 50 |
| CO5 | | 0 | 0 | 0 | 0 | 40 | 0 | 40 |
| CO6 | | 0 | 0 | 0 | 0 | 20 | 0 | 20 |
|  | | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Discuss the basic configurations of fermenter and its importance. | CO1 | U | 10 |
|  | b. | Write a detailed note on sterilization and death kinetics. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Determine the effect of pressure, flow measurement and biomass weight in a fermentation process. | CO1 | A | 10 |
|  | b. | Define fermentation process with an elaboration on media optimization and its importance. | CO2 | R | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain different steps applied for the isolation of industrially important microbes. | CO3 | U | 10 |
|  | b. | Illustrate the kinetic expressions for substrate consumption and product formation by explaining the Leude king-piret model. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Ethanol fermentation from glucose by *S. cerevisiae* is known to follow logistic growth and the following data were obtained. Evaluate μmax and YX/S for the culture. Given .   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | t (h) | 0 | 2 | 5 | 10 | 15 | 20 | 25 | 30 | | S (g/l) | 100 | 95 | 85 | 58 | 30 | 12 | 5 | 2 | | X(g/l) | 0.5 | 1 | 2.1 | 4.8 | 7.7 | 9.6 | 10.4 | 10.7 |   You may use a graphical or numerical approach for the same. | CO4 | E | 10 |
|  | b. | Differentiate between primary and secondary screening methods for industrially important microorganisms. | CO3 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Differentiate between bio-affinity and chromatography. | CO5 | An | 10 |
|  | b. | Explain cell determination methods and the phases of a typical growth curve. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Write a note on mechanical and non-mechanical methods of cell disruption. | CO5 | C | 10 |
|  | b. | Discuss on size exclusion and reverse phase chromatography techniques. | CO5 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the adsorption, dialysis, reverse osmosis and ultrafiltration methods used for cell separation. | CO5 | U | 10 |
|  | b. | Illustrate the product formation and substrate consumption kinetics in a batch reactor using appropriate mathematical expressions. Explain each term with appropriate units. | CO4 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Discuss the lyophilization process utilized for purification of the products. | CO5 | U | 10 |
|  | b. | Write a detail note on the substrate inhibition and its impact on product formation through the kinetic model. | CO4 | A | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Summarize the industrial processes involved for the production of citric acid. | CO6 | U | 10 |
|  | b. | Write the aerobic process for produce the baker’s yeast. | CO6 | A | 10 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 10 | 10 | - | - | - | 20 |
| CO2 | 10 | 10 | - | - | - | - | 20 |
| CO3 | - | 10 | - | 10 | - | - | 20 |
| CO4 | - | 30 | 10 | - | 10 | - | 50 |
| CO5 | - | 20 | 10 | 10 | - | 10 | 50 |
| CO6 | - | 10 | 10 | - | - | - | 20 |
|  | | | | | | | **180** |



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

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

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 10 | 10 |  |  |  |  | 20 |
| CO2 |  | 10 | 10 | 10 |  |  | 30 |
| CO3 |  | 20 |  |  |  |  | 20 |
| CO4 |  |  |  | 10 | 10 |  | 20 |
| CO5 | 30 | 10 |  |  |  |  | 40 |
| CO6 | 40 | 10 |  |  |  |  | 50 |
|  | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Record the milestones in Biotechnology and modern biotechnology. | CO1 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the production of glycine and mention on its metabolism. | CO1 | R | 20 |
| 3. | a. | Illustrate the media preparation strategies employed in industrial biotechnology. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Analyze the importance of sterilization and its types in Bioprocessing. | CO2 | An | 5 |
|  | b. | Describe the industrial production of Lysine and mention its applications. | CO3 | U | 15 |
| 5. | a. | Discuss on upstream processing in industrial biotechnology with special emphasis on process flow sheeting. | CO3 | U | 15 |
|  | b. | Illustrate the applications of PHB in a Biotech industry. | CO4 | A | 5 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain on the industrial production of Cyanocobalamine. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 7. | a. | Examine the industrial production of Lipase and Cellulase. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Illustrate with a neat process flow diagram on the Bioremediation and Biorefinery. | CO6 | A | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the fermentation and the production of Wine. | CO2 | U | 20 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 40 | - | - | - | - | - | 40 |
| CO2 | - | 40 | - | 5 | - | - | 45 |
| CO3 | - | 30 | - | - | - | - | 30 |
| CO4 | - | 20 | 5 | - | - | - | 25 |
| CO5 | - | - | 20 | - | - | - | 20 |
| CO6 | - | - | 20 | - | - | - | 20 |
|  | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Classify the natural source used for drug discovery, detail with one example. | CO1 | **U** | 10 |
|  | b. | Briefly describe the various routes by which a drug can be administered? | CO1 | **R** | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Define First pass metabolism. | CO1 | **R** | 3 |
|  | b. | Explain the pharmacological track of pharmacokinetics mechanism in human. | CO1 | **R** | 17 |
|  |  |  |  |  |  |
| 3. | a. | Infer the importance of chemical organic reaction mechanism helps on the biological unit process on drug synthesis and application. | CO2 | **U** | 12 |
|  | b. | Illustrate the mechanical and biochemical process behind the fermenter functional process. | CO2 | **R** | 8 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the methods of preantral formulation manufacturing process and analysis. | CO3 | **R** | 10 |
|  | b. | Contrast the techniques and classification of oral liquid using suitable samples. | CO3 | **U** | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain manufacturing of Tablet formulation. | CO4 | **R** | 14 |
|  | b. | Describe the importance of enteric coating tablets. Name at least two enteric coating materials used in tablet coating. | CO4 | **R** | 6 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Relate a formulation manufacturing difference on a. Cream b. paste c. Gel | CO5 | **U** | 12 |
|  | b. | Explain in natural and synthetic bases used in semisolid cosmetics. | CO5 | **R** | 8 |
|  |  |  |  |  |  |
| 7. | a. | Define bioavailability. | CO5 | **R** | 2 |
|  | b. | Describe the recent advances in the manufacture of drugs using  r-DNA technology on drug discovery. | CO6 | **R** | 18 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Define clinical trial. | CO6 | **R** | 2 |
|  | b. | Explain briefly about various clinical trial phases used to define pharmacological activity of drugs. | CO6 | **R** | 18 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Define gelatin. Briefly explain the manufacturing hard gelatin capsule formulation. | CO4 | **R** | 10 |
|  | b. | Explain capsule quality testing methods and analysis. | CO4 | **R** | 10 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 30 | 10 |  |  |  |  | 40 |
| CO2 | 12 | 8 |  |  |  |  | 20 |
| CO3 | 10 | 10 |  |  |  |  | 20 |
| CO4 | 40 |  |  |  |  |  | 40 |
| CO5 | 10 | 12 |  |  |  |  | 22 |
| CO6 | 38 |  |  |  |  |  | 38 |
|  | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Write a detailed note on different microalgal culturing systems. | CO1 | C | 14 |
|  | b. | Write the importance of lag phase, log phase, stationary phase and death phase during microalgal growth. | CO1 | A | 6 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Compile the significance of filtration, centrifugation, flocculation and flotation for microalgal harvesting. | CO1 | C | 14 |
|  | b. | Differentiate between the compositions for BG-11 and BB medium. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 3. | a. | Discuss open and closed modes of microalgal cultivation systems. | CO2 | U | 14 |
|  | b. | Summarize the steps involved in the maintenance and development of stock microalgal culture. | CO2 | R | 6 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Demonstrate agricultural application of cyanobacteria in detail. | CO3 | U | 14 |
|  | b. | Tabulate the challenges and strategies of heavy metal removal by microalgae. | CO3 | R | 6 |
|  |  |  |  |  |  |
| 5. | a. | Discuss the technological advancement in the production of biodiesel from microalgae. | CO3 | U | 14 |
|  | b. | Comment on emergence of microalgae over other conventional techniques for removal of textile dyes. | CO3 | C | 6 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Define biomarker and write the importance of any two biomarkers in oxidative stress of microalgae. | CO4 | U | 14 |
|  | b. | Infer the significance of various peaks observed during FTIR analysis of a microalgal sample. | CO4 | C | 6 |
|  |  |  |  |  |  |
| 7. | a. | Summarize the steps involved in the extraction of DNA from microalgae. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Summarize the basic understanding on production of microalgal based single cell protein. | CO5 | E | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Write a detailed note on molecular biomarkers in oxidative stress of microalgae. | CO6 | C | 10 |
|  | b. | Write a detailed note on extraction of chlorophyll from microalgae. | CO6 | C | 10 |

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

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | - | 6 | 6 | - | - | 28 | 40 |
| CO2 | 6 | 14 | - | - | - | - | 20 |
| CO3 | 6 | 28 | - | - | - | 6 | 40 |
| CO4 | - | 14 | - | - | - | 6 | 20 |
| CO5 | - | 20 | - | - | 20 | - | 40 |
| CO6 | - | - | - | - | - | 20 | 20 |
|  | | | | | | | **180** |



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Analyze the steps involved in MTT cytotoxic assay used for testing drugs. | CO1 | An | 10 |
|  | b. | Describe cell line preservation and authentication. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Discuss the protocol for 3D culturing and the use of different types of cells in liver transplantation. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Describe the types of cell substrate and support materials used in tissue engineering. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Appraise the role of 3D printing for organ printing stating the advantages and disadvantages. | CO2 | E | 20 |
|  |  |  |  |  |  |
| 5. |  | Discuss the various scaffold fabrication techniques that have been developed for tissue engineering and regenerative medicine. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Illustrate on the types of stem cells based on their sources and its applications in tissue regeneration. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Interpret the importance of embryonic and adult stem cells. | CO4 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Appraise the steps involved for the differentiation of stem cells to osteoblast cells. | CO5 | E | 10 |
|  | b. | Enumerate the importance of cord blood cells in the treatment of Leukemia. | CO5 | R | 10 |
| **PART – B(1 X 20= 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss the role of stem cells in cancer treatment. | CO6 | U | 10 |
|  | b. | Express the ethical and social concern of stem cell technology. | CO6 | U | 10 |

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

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



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the structural and functional characteristics of epithelial tissue. | CO1 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Summarize ten major systems of human body. | CO1 | U | 20 |
|  |  |  |  |  |  |
| 3. | a. | Discuss the anatomy of cell. | CO2 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Describe the mechanism involved in muscle contraction and generation of nerve impulse. | CO3 | R | 20 |
|  |  |  |  |  |  |
| 5. | a. | Explain on the following:   1. Body fluids 2. Composition and functions of blood 3. Blood grouping 4. Transfusion | CO4 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Classify peripheral nervous system and explain the structure and function of sympathetic and parasympathetic nervous system in detail. | CO5 | U | 20 |
|  |  |  |  |  |  |
| 7. | a. | Discuss the structure and physiological functions of artery, veins, and capillaries. | CO5 | U | 10 |
|  | b. | Categorize the regulation of blood pressure, pulse, and disorders of heart. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Summarize the causes, modes of transmission and prevention measures of the following communicable diseases.   1. Chicken pox 2. Measels 3. Poliomycetes 4. Tetanus | CO6 | U | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Assess the components of a balanced diet and elaborate on deficiency disorders of various nutrients, disease prevention and treatment methods. | CO6 | E | 20 |

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

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

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



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| **Course Code** | **20BT3070** | **Duration** | **3hrs** |
| **Course Name** | **VACCINE TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Give a detailed account on the history of vaccination. | CO1 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Analyze the Epidemiology and Pathophysiology of Tetanus. What is the outcome of the vaccination for Tetanus? | CO2 | An | 20 |
|  |  |  |  |  |  |
| 3. | a. | Indicate the steps significant to vaccine designing in exogenous and endogenous pathway of antigen processing. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the various types of vaccines. | CO3 | E | 20 |
|  |  |  |  |  |  |
| 5. | a. | Discuss adjuvants, their types and function. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss attenuation and inactivation and the various modes and chemicals used. | CO4 | R | 20 |
|  |  |  |  |  |  |
| 7. | a. | Elaborate on the various routes of immunization along with their advantages and disadvantages. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Discuss storage and handling of vaccines. Write a note on the assessment of vaccine safety. | CO6 | E | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Analyze the different types of vaccines available against the SARS-CoV-2 virus. | CO6 | An | 20 |

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

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



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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)**  **(Answer all the questions)** | | | | | |
| 1. | Define Good Laboratory Practices. | | CO1 | R | 1 |
| 2. | What is an active substance? | | CO1 | R | 1 |
| 3. | Name the ISO standard for auditing in food industry. | | CO2 | R | 1 |
| 4. | Define quality control. | | CO2 | R | 1 |
| 5. | State the importance of validation in pharma industry. | | CO3 | R | 1 |
| 6. | Write one example for design of experiment in process development. | | CO3 | A | 1 |
| 7. | Define quality assurance in food industry. | | CO4 | R | 1 |
| 8. | Write the role of biosafety committee for GMO. | | CO5 | A | 1 |
| 9. | Name one bacteria of biosafety level 4. | | CO5 | R | 1 |
| 10. | Write the role of Animal ethical committee in pre-clinical studies. | | CO6 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)**  **(Answer all the questions)** | | | | | |
| 11. | Illustrate the principle of standard operating protocol for LAF in microbiology laboratory. | | CO1 | A | 3 |
| 12. | Summarize the advantages of quality standards in food industry. | | CO2 | U | 3 |
| 13. | Explain the different methods of sanitation followed in industrial warehouse. | | CO3 | U | 3 |
| 14. | State the function of ISO 14000. | | CO4 | R | 3 |
| 15. | Write the different containment facilities used for control of infectious agents in pharma industry. | | CO5 | An | 3 |
| 16. | Write the steps involved in production of pharma drug for commercialization as per the Government of India guidelines. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the WHO guidelines on Good Manufacturing Practices and its significance in pharma industry. | CO1 | U | 10 |
|  | b. | State the principle of Good Clinical Practices. | CO1 | R | 2 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the different International and National quality system and standards in industrial product development with suitable examples. | CO2 | A | 10 |
|  | b. | Name the ISO standard for food safety. | CO2 | R | 2 |
|  |  |  |  |  |  |
| 19. | a. | Explain the principles and steps of design of experiments in food industry with necessary example. | CO3 | An | 8 |
|  | b. | Summarize the application of DOE in development of medicine for arthritis in biotechnology industry. | CO3 | E | 4 |
|  |  |  |  |  |  |
| 20. | a. | Discuss the process of Critical Control Points in product development in food industry. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain the principle and guidelines of NABL accreditation of food Laboratory for oil analysis. | CO4 | An | 8 |
|  | b. | Summarize the principles of ISO 9002 standard in industrial quality assurance. | CO4 | E | 4 |
|  |  |  |  |  |  |
| 22. | a. | Discuss the DBT guidelines of Government of India on Biosafety levels of animals with suitable examples. | CO5 | U | 10 |
|  | b. | Define biosafety. | CO5 | R | 2 |
|  |  |  |  |  |  |
| 23. | a. | Discuss on laboratory associated infections and other hazards in biotechnology labs with suitable examples. | CO5 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the guidelines involved in animal studies in biotechnology research. | CO6 | An | 10 |
|  | b. | Compile the steps involved in formulation of drugs for commercialization. | CO6 | C | 2 |

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

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

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| **CO / P** | **R** | **U** | **A** | **An** | **E** | **C** | **Total** |
| CO1 | 4 | 10 | 3 |  |  |  | 17 |
| CO2 | 4 | 3 | 10 |  |  |  | 17 |
| CO3 | 1 | 3 | 1 | 8 | 4 |  | 17 |
| CO4 | 4 | 12 |  | 8 | 4 |  | 28 |
| CO5 | 3 | 22 | 1 | 3 |  |  | 29 |
| CO6 | 3 |  | 1 | 10 |  | 2 | 16 |
|  | | | | | | | **124** |