**Graphical user interface, application

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| **Course Code** | **14BT2054** | **Duration** | **3hrs** |
| --- | --- | --- | --- |
| **Course Name** | **BIOENERGY AND BIOMATERIALS** | **Max. Marks** | **100** |

| **Q. No.** | **Questions** | | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | Name a secondary Feed-stock for liquid biofuel. | | | CO1 | R | | 1 |
| 2. | Give an example of array of products in biomass pyrolysis. | | | CO1 | U | | 1 |
| 3. | Describe specific advantages of 3rd generation biofuel when using microalgae. | | | CO2 | U | | 1 |
| 4. | Explain the possible mechanism in ammonia toxicity. | | | CO2 | U | | 1 |
| 5. | Compare biomass energy to other energy sources. | | | CO3 | A | | 1 |
| 6. | Illustrate potential benefits from biogas technology. | | | CO3 | A | | 1 |
| 7. | Write use of two energy crops and their products. | | | CO4 | A | | 1 |
| 8. | Illustrate advantages of lingo cellulosic crops over food-crops in the bioenergy sector. | | | CO4 | A | | 1 |
| 9. | Name the enzyme involved in the nitrogen fixation process. | | | CO5 | R | | 1 |
| 10. | Recite the consequence of the Annamox process. | | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Name the major three reservoirs in the carbon cycle. | | | CO1 | | R | 3 |
| 12. | Explain the working of a cogeneration plant. | | | CO2 | | U | 3 |
| 13. | Describe the obligate intermediate in denitrification. | | | CO3 | | U | 3 |
| 14. | Explain how the overuse of fertilizer is going to destabilize the N-cycle. | | | CO4 | | A | 3 |
| 15. | Differentiate phytodegradation to phytoextraction. | | | CO5 | | U | 3 |
| 16. | Identify organic contaminants requiring anaerobic degradation 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. | |  | Analyze the oil based energy trend in India. Explain the challenges and opportunities. | CO1 | | An | 12 |
| 18. | |  | Explain the method for improvement of biooil quality. | CO2 | | U | 12 |
| 19. | |  | Define bioenergy chain. Describe the conversion process and energy products. | CO3 | | R | 12 |
| 20. | |  | Describe the inhibited steady-state condition in AD. Explain the management of the same. | CO4 | | A | 12 |
| 21. | |  | Illustrate the different stages of the Nitrogen cycle and explain the connection between the stages. | CO5 | | U | 12 |
| 22. | |  | Illustrate various C exchange processes between atmosphere and terrestrial biosphere. | CO2 | | A | 12 |
| 23. | |  | Explain “biostimulation”, “bioaugmentation” strategy in contaminant removal. Discuss the major factors that determine bioremediation efficiency. | CO3 | | An | 12 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. | |  | Illustrate and explain the AD pathways and its intermediates. | CO6 | | A | 12 |

|  | **COURSE OUTCOMES** |
| --- | --- |
| CO1 | Understand the fundamental principles. |
| CO2 | Know principles underlying the design and operation of waste and biomass to energy. |
| CO3 | Be aware of the techniques and limitations of Biomass preprocessing. |
| CO4 | Be able to compare Biomass conversion processes. |
| CO5 | Be familiar with current research issues in biodiesel production. |
| CO6 | To be familiar with the Environmental impacts of biofuels. |

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

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| --- | --- | --- | --- |
| **Course Code** | **19BT2015** | **Duration** | **3hrs** |
| **Course Name** | **GENETIC ENGINEERING AND BIOETHICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Define endonucleases. | | CO1 | U | | 1 |
| 2. | Report on probe. | | CO1 | E | | 1 |
| 3. | Identify the restriction enzyme which has GAATTC site. | | CO2 | R | | 1 |
| 4. | Define plasmid. | | CO1 | R | | 1 |
| 5. | Recite the role of Shuttle vectors. | | CO3 | R | | 1 |
| 6. | Infer about RFLP. | | CO4 | R | | 1 |
| 7. | Quote one physical method used for gene transfer. | | CO4 | R | | 1 |
| 8. | Identify the enzyme codes for the gene LacZ. | | CO3 | U | | 1 |
| 9. | Illustrate one ethical issues in rDNA technology. | | CO6 | U | | 1 |
| 10. | Interpret the rule involved to regulate the activities concerning the biological research. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Discuss tandemly repeated sequence. | | CO4 | | U | 3 |
| 12. | Analyze the importance of phage vectors. | | CO3 | | An | 3 |
| 13. | Infer the role of nested PCR. | | CO4 | | U | 3 |
| 14. | Define RACE PCR. | | CO4 | | U | 3 |
| 15. | Summarize any three ethical issues in genetic engineering. | | CO6 | | E | 3 |
| 16. | Discuss the levels of containment in rDNA technology. | | 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 steps involved in probe preparation and the methods of labelling. | CO2 | | An | 6 |
|  | b. | Experiment southern hybridization with illustrations. | CO2 | | An | 6 |
|  |  |  |  | |  |  |
| 18. | a. | Discuss the properties of an ideal vectors. | CO3 | | U | 6 |
|  | b. | Express the role of phagemids as cloning vector. | CO3 | | U | 6 |
|  |  |  |  | |  |  |
| 19. |  | Discuss blue and white screening method and expression vectors. | CO3 | | U | 12 |
|  |  |  |  | |  |  |
| 20. |  | Interpret the mechanism of polymerase chain reaction in gene amplification and discuss its applications. | CO4 | | A | 12 |
|  |  |  |  | |  |  |
| 21. |  | Report on Restriction Fragment Length Polymorphism with suitable example. | CO5 | | U | 12 |
|  |  |  |  | |  |  |
| 22. |  | Enumerate the physical and chemical methods of gene transformation. | CO5 | | R | 12 |
|  |  |  |  | |  |  |
| 23. |  | Discuss the procedure involved to produce recombinant products. | CO5 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Illustrate the biosafety regulations followed in recombinant DNA technology and discuss rDNA guidelines. | CO6 | | An | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Describe the basics of genetic engineering. |
| CO2 | Understand the basic tools employed in genetic engineering. |
| CO3 | To 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 | To analyze the need of Bioethics and IPR in biotechnological research. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 1 |  |  | 1 |  | 3 |
| CO2 | 1 |  |  | 12 |  |  | 13 |
| CO3 | 1 | 25 |  | 3 |  |  | 29 |
| CO4 | 2 | 9 | 12 |  |  |  | 23 |
| CO5 | 12 | 24 |  |  |  |  | 36 |
| CO6 |  | 5 |  | 12 | 3 |  | 20 |
|  | | | | | | | **124** |

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| **Course Code** | **19BT2017** | **Duration** | **3hrs** |
| **Course Name** | **BIOPROCESS ENGINEERING** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | Calculate Respiratory Quotient. | | | CO1 | E | | 1 |
| 2. | Find the available electron present in glucose. | | | CO2 | An | | 1 |
| 3. | Find when? | | | CO3 | E | | 1 |
| 4. | What is diauxic growth? | | | CO3 | U | | 1 |
| 5. | Write the reaction for non-competitive substrate inhibition. | | | CO2 | R | | 1 |
| 6. | What are Logistic Equations? | | | CO3 | U | | 1 |
| 7. | Write the unit for volumetric mass transfer coefficient? | | | CO4 | An | | 1 |
| 8. | Suggest a reactor which is suitable for product inhibition reaction. | | | CO5 | A | | 1 |
| 9. | Name various types of spargers. | | | CO6 | R | | 1 |
| 10. | Give an example of filamentous organism | | | CO5 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Write the elemental balance for the following equation & RQ = 0.9 | | CO1 | | | An | 3 |
| 12. | Derive the kinetic equation for log phase. | | CO2 | | | U | 3 |
| 13. | The initial and final concentration of biomass in a batch reactor was found to be 2 and 3.5 g/L at time 1.1 and 5.4 hours respectively. Calculate doubling time? | | CO3 | | | An | 3 |
| 14. | State the relation between rheology of broth and OTR. | | CO5 | | | U | 3 |
| 15. | What are the steps involved in transport of oxygen from gas state to cell? | | CO4 | | | A | 3 |
| 16. | Classify different types of sensors based on its applications in process control. | | 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. |  | Assume that experimental measurement for a certain organism has shown that cells can convert substrate carbon to biomass.  i) Calculate the stoichiometric coefficients for following biological reactions:    ii) Calculate the yield coefficients biomass with respect to substrate and oxygen supply for both the reactions. Also, comment on the differences. | CO1 | | | E | 12 |
|  |  |  |  | | |  |  |
| 18. |  | Find the stoichiometric coefficients, Biomass & product yield co-efficient, degrees of reduction of substrate and bacteria for the given biological reaction when RQ = 0.9?  **C6H5COOH + a O2 + b NH3cC5H7NO2 + d H2O + e CO2** | CO2 | | | An | 12 |
|  |  |  |  | | |  |  |
| 19. |  | A strain of mold was grown in batch culture on glucose and the following data were obtained,   |  |  |  |  | | --- | --- | --- | --- | | **Time (Hrs)** | **Cell Conc. (g/L)** | **Ethanol Conc. (g/L)** | **glucose Conc. (g/L)** | | 0 | 1.25 | 0 | 100 | | 9 | 2.45 | 2.5 | 97 | | 16 | 5.1 | 7.5 | 90.4 | | 23 | 10.5 | 20 | 76.9 | | 30 | 22 | 34 | 48.1 | | 34 | 33 | 43 | 20.6 | | 36 | 37.5 | 47 | 9.38 | | 40 | 41 | 50 | 0.63 |   Calculate,  a. By fitting biomass data to logistic equation determine carrying  capacity coefficient k.  b. Biomass yield coefficient. c. Product yield coefficient. | CO3 | | | E | 12 |
|  |  |  |  | | |  |  |
| 20. |  | Differentiate unstructured and structured model? Derive the expression for any two unstructured non-segregated models. | CO3 | | | An | 12 |
|  |  |  |  | | |  |  |
| 21. |  | Interpret and illustrate in detail about various methods to determine KLa. | CO4 | | | An | 12 |
|  |  |  |  | | |  |  |
| 22. |  | Elaborate on the principle and working of fluidized bed bioreactors with a neat sketch. | CO5 | | | U | 12 |
|  |  |  |  | | |  |  |
| 23. |  | Explain the working and principle of various air lift loop bioreactor also state its advantages and disadvantages. | CO5 | | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. |  | Illustrate a detailed note on the monitoring and controlling in fermentation process for different variables. | CO6 | | | R | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Remember principles of stoichiometry and concepts of bioreactor engineering. |
| CO2 | Understand elemental balance equations and models of growth and product formation. |
| CO3 | Classify various growth and product formation kinetics. |
| CO4 | Apply methods to calculate volumetric mass transfer coefficients in bioreactors |
| CO5 | Analyze various bioreactors for fermentation process. |
| CO6 | Evaluate process control in Fermentation processes. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | - | - | 3 | 13 | - | 16 |
| CO2 | 1 | 3 | - | 13 | - | - | 17 |
| CO3 | - | 2 | - | 15 | 13 | - | 30 |
| CO4 | - | - | 3 | 13 | - | - | 16 |
| CO5 | 1 | 27 | 1 | - | - | - | 29 |
| CO6 | 13 | 3 | - | - | - | - | 16 |
|  | | | | | | | **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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name an enzyme used in chemical industry. | | CO1 | U | 1 |
| 2. | To what does a substrate binds to? | | CO1 | R | 1 |
| 3. | Name a chemical extensively used to purify enzymes. | | CO2 | R | 1 |
| 4. | Expand LB plot. | | CO2 | R | 1 |
| 5. | What is the energy used generally to activate an enzymatic reaction? | | CO3 | U | 1 |
| 6. | Name a coenzyme. | | CO3 | R | 1 |
| 7. | What enzyme is used for DNA ligation process? | | CO1 | U | 1 |
| 8. | What forms when apoenzyme and a coenzyme react? | | CO2 | R | 1 |
| 9. | What is the term used to describe blocking of enzyme action? | | CO3 | U | 1 |
| 10. | What are enzymes made up of? | | CO3 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | What is a coenzyme? Mention its significance. | | CO1 | An | 3 |
| 12. | Give a brief account on Michaelis-Menten Kinetics. | | CO2 | U | 3 |
| 13. | Describe enzyme immobilization techniques. | | CO3 | An | 3 |
| 14. | Write a note on checking enzyme purity. | | CO2 | U | 3 |
| 15. | What is a biosensor? Mention its significance. | | CO1 | An | 3 |
| 16. | Discuss on oxidoreductases. | | CO3 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. | a. | Discuss in detail about the general properties of enzymes. | CO1 | R | 8 |
|  | b. | Illustrate the chemical nature of enzymes. | CO1 | U | 4 |
| 18. |  | Describe about LB plot and EH plots in detail. | CO2 | U | 12 |
| 19. |  | Describe in detail how is ammonium sulphate used in purification of enzymes. | CO3 | U | 12 |
| 20. |  | Describe in detail about the applications of immobilized enzymes. | CO3 | An | 12 |
| 21. |  | Illustrate the features of the extraction medium used for enzyme separation. | CO2 | A | 12 |
| 22. |  | Describe the Lock & Key model of substrate binding with enzyme. | CO2 | A | 12 |
| 23. |  | Illustrate the features of the extraction medium used for enzyme separation. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Describe the principle and design of biosensors. | CO3 | C | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Classify enzymes and enzymatic reactions towards various concepts in biotechnology. |
| CO2 | Apply the theoretical and practical aspects of reaction kinetics will provide the importance and usage towards research. |
| CO3 | Formulate the concepts of enzyme immobilization and its applications in food, pharmaceutical and chemical industries. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 9 | 6 | - | 6 | - | - | 21 |
| CO2 | 3 | 6 | 12 | - | - | - | 21 |
| CO3 | 1 | 18 | 12 | 15 | - | 12 | 58 |
|  | | | | | | | **100** |

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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. | Recall 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. | Recall 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. |  | Give a detailed account on physical and chemical-enzymatic methods of cell lysis, while referring their benefits and limitations. | CO1 | | U | 12 |
|  |  |  |  | |  |  |
| 18. |  | 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. |  | 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 of ultra filtration membrane in downstream processing and also highlight its associated limitations. | CO4 | | U | 6 |
|  | b. | Summarize the efficacy of reverse osmosis in downstream processing and also mention its applications. | CO4 | | R | 6 |
|  |  |  |  | |  |  |
| 22. |  | 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. |  | 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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 13 | 1 | 3 |  |  | 17 |
| CO2 | 1 |  | 15 |  |  |  | 16 |
| CO3 | 1 | 2 | 15 |  |  |  | 18 |
| CO4 | 13 | 6 | 7 | 3 |  |  | 26 |
| 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** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Recommend if molecularity of chemical reaction is estimable in all scenarios? | | CO1 | R | | 1 |
| 2. | Recall the unit of rate constant for a second order reaction. | | CO1 | R | | 1 |
| 3. | Explain the strategy one would use to calculate mean residence time in a non-ideal reactor system. | | CO3 | U | | 1 |
| 4. | Identify order of chemical reaction if it takes 10 min for 50% conversion and 20 min for 75% conversion. | | CO1 | R | | 1 |
| 5. | Recall the reaction order, if doubling reactant concentration does not alter reaction rate. | | CO1 | A | | 1 |
| 6. | Calculate space time for a 4 L mixed flow reactor with steady state flowrate of 2 L/min. | | CO2 | R | | 1 |
| 7. | Recognise the special condition when batch reaction time and plug-flow space time will be identical. | | CO2 | U | | 1 |
| 8. | For which reaction order, the degree of conversion for a given spacetime in MFR will be independent of initial reactant concentration? | | CO6 | R | | 1 |
| 9. | Choose the best alternative for chemical reaction: (i) one 10 L MFR, (ii) two 5 L MFR in series, (iii) one 10 L PFR. | | CO4 | U | | 1 |
| 10. | Estimate εA a gas phase reaction A🡪2B. | | CO3 | A | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Liquid A decomposes by second-order kinetics, and in a batch reactor 50% of A is converted in a 5-minute run. How much longer would it take to reach 75% conversion? | | CO1 | | A | 3 |
| 12. | Describe methodology one can adopt to find order of reaction from multiple runs at different flow rate in MFR system. | | CO2 | | U | 3 |
| 13. | The degree of conversion in MFR for a first order reaction is 80%. Estimate the conversion, if the reactor is changed to PFR while keeping volume, flow rate unchanged. | | CO2 | | An | 3 |
| 14. | For non-ideal PFR (10 L) with flow rate 2 L/min, two different tracer peaks are identified, one at 0 min, and another at 3 min. Identify the problem associated with this PFR. | | CO3 | | An | 3 |
| 15. | Highlight utility of three different enzyme immobilization techniques that can be appropriate in packed bed bioreactor systems. | | CO6 | | An | 3 |
| 16. | Explain the graphical approach to estimate space time requirement in MFR and PFR for a given degree of conversion. | | CO5 | | 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. |  | Aqueous A at a concentration CA0 = 1000 mol/m3 is introduced into a batch reactor where it reacts away to form product R according to stoichiometry A🡪R. The concentration of A in the reactor is monitored at various times, as shown below:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Time (min) | 0 | 100 | 200 | 300 | 400 | | CA (mol/m3) | 1000 | 500 | 333 | 250 | 200 |   Find the conversion of reactant after 5 hours if CA0 = 500 mol/m3.  Note: order of reaction is unknown | CO1 | | E | 12 |
|  |  |  |  | |  |  |
| 18. |  | Pure gaseous reactant A (CAo = 100 mol/L) is fed at a steady rate into a mixed flow reactor (V = 0.1 L) where it dimerizes (2A🡪R).  For different gas feed rates, the following data are obtained:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Run No | 1 | 2 | 3 | 4 | | Flow rate (L/h) | 10 | 3 | 1.2 | 0.5 | | CAf (mol/L) | 85.7 | 66.7 | 50 | 33.4 |   Find a rate equation for this reaction | CO2 | | An | 12 |
|  |  |  |  | |  |  |
| 19. |  | For a given enzyme concentration in catalyzed reaction the aqueous feed stream (25 L/min) containing A (2 mol/L) in PFR gets 95% conversion having a kinetics of  mol/L. min. Estimate the volume of PFR required for the conversion. | CO2 | | An | 12 |
|  |  |  |  | |  |  |
| 20 | a. | Discuss about the compartmental model that may explain non-ideality of reactor behavior. | CO3 | | An | 4 |
|  | b. | The second order aqueous reaction A + B🡪 R + S is run in a large tank reactor (V = 6 m3) and for an equimolar feed stream (CA0 = CB0) conversion of reactants is 60%. Unfortunately, agitation in our reactor is rather inadequate as indicated in the flow model. What size of mixed flow reactor will equal the performance of our present unit? | CO3 | | A | 8 |
|  |  |  |  | |  |  |
| 21. |  | Reactant A (A🡪R, CA0 = 26 mol/m3) passes through four equal-size MFRs in series (τtotal = 2 min). When steady state is achieved the concentration of A is found to be 11, 5, 2, 1 mol/m3 in the four units. For this reaction, what must be τplug as to reduce concentration from CA0 = 26 to CAf = 1 mol/m3? | CO4 | | A | 12 |
|  |  |  |  | |  |  |
| 22. | a. | Formulate the performance equation for *n* number of equal volume of MFR in series for 1st order chemical reaction. | CO4 | | An | 8 |
|  | b. | For a 1st order chemical reaction 5 MFR each of 6 L volume are operated in series with a flowrate of 3L/min. If the reactant concentration drops from CA0 = 96 mol/L to CAf = 3 mol/L, find the reaction rate constant | CO4 | | An | 4 |
|  |  |  |  | |  |  |
| 23. | a. | Describe the mass transfer process involved in heterogeneous reaction involving G-L and S-L systems | CO5 | | U | 8 |
|  | b. | Analyze different isotherm models projecting different adsorption mechanism | CO5 | | An | 4 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Describe the design aspects of different packed bed, bubble reactor systems used in bioprocess. Highlight the advantage and the limitations pertinent to such designs. | CO6 | | U | 12 |

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

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 3 | 0 | 4 | 0 | 12 | 0 | 19 |
| CO2 | 1 | 4 | 0 | 27 | 0 | 0 | 32 |
| CO3 | 0 | 1 | 9 | 7 | 0 | 0 | 17 |
| CO4 | 0 | 1 | 12 | 12 | 0 | 0 | 25 |
| CO5 | 0 | 8 | 3 | 4 | 0 | 0 | 15 |
| CO6 | 1 | 12 | 0 | 3 | 0 | 0 | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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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. | Define Bioinformatics. | CO 1 / R | 1 |
| 2. | Write any two uses of bioinformatics. | CO 2 / R | 1 |
| 3. | What is a database? | CO 1 / R | 1 |
| 4. | Name any two protein sequence databases. | CO 1 / R | 1 |
| 5. | Recall pairwise alignment. | CO 2 / R | 1 |
| 6. | Define e-value. | CO 2 / U | 1 |
| 7. | List any two applications of DNA microarray. | CO 3 / R | 1 |
| 8. | List the methods used to construct a phylogenetic tree. | CO 4 / U | 1 |
| 9. | Define homology. | CO 4 / R | 1 |
| 10. | Write note on ligand. | CO 5 / R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | List the various file formats used in biological sequences. | CO 1 / R | 3 |
| 12. | Discuss about the primary protein sequence databases. | CO 2 / U | 3 |
| 13. | Comment on local alignment. | CO 4 / U | 3 |
| 14. | Write a note on any one Gene prediction tool. | CO 4 / A | 3 |
| 15. | Define homology. Illustrate its role in bioinformatics. | CO 3 / An | 3 |
| 16. | Write the steps involved in the optimization of a ligand. | CO 5 / 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. | List out the scope of Bioinformatics. | CO1 / R | 4 |
| b. | List the applications of bioinformatics in any two fields. | CO2 / R | 4 |
| c. | Write a note on ftp and telnet. | CO1 / U | 4 |
|  |  |  |  |  |
| 18. | a. | Elaborate primary nucleotide sequence databases with examples. | CO2 / U | 4 |
| b. | Discuss the composite sequence databases. | CO2 / R | 4 |
| c. | Explain the organization of databases. | CO2 / U | 4 |
|  |  |  |  |  |
| 19. | a. | Compare and contrast global vs local alignment. | CO3 / An | 4 |
| b. | Relate how amino acid substitution matrices are used in the sequence analysis. | CO4 / A | 4 |
| c. | Write a brief note on sequence similarity search. | CO3 / U | 4 |
|  |  |  |  |  |
| 20. | a. | Comment on Comparative genomics. | CO3 / R | 4 |
| b. | Explain the role of DNA microarray in bioinformatics. | CO3 / A | 4 |
| c. | Explain how Phylogenetic analysis is used in the sequence analysis. | CO4 / An | 4 |
|  |  |  |  |  |
| 21. | a. | Define threading with example. | CO4 / U | 4 |
| b. | Write a note on Molecular simulation. | CO5 / U | 4 |
| c. | Comment on *abinitio* protein structure modeling. | CO6 / U | 4 |
|  |  |  |  |  |
| 22. | a. | List out the importance of Bioinformatics. | CO1 / R | 4 |
| b. | Write a note on the concept of gap penalty and e-value. | CO2 / U | 4 |
| c. | How are the data retrieved from world wide web? | CO1 / U | 4 |
|  |  |  |  |  |
| 23. | a. | Elaborate multiple sequence alignment. | CO4 / U | 4 |
| b. | Write short notes on GenBank. | CO2 / U | 4 |
| c. | List the levels of organization of protein. | CO4 / An | 4 |
|  |  | **COMPULSORY** | | |
| 24. | a. | Define docking and elaborate how docking is used in the drug discovery process. | CO5 / An | 4 |
| b. | How is a virtual ligand library prepared? | CO5 / An | 4 |
| c. | Write down the industrial applications of CADD. | CO6 / U | 4 |

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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 Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 14 | 8 | - | - | - | - | 22 |
| CO2 | 10 | 20 | - | - | - | - | 30 |
| CO3 | 5 | 4 | 4 | 7 | - | - | 20 |
| CO4 | 1 | 12 | 7 | 8 | - | - | 28 |
| CO5 | 1 | 4 | 3 | 8 | - | - | 16 |
| CO6 | - | 8 | - | - | - | - | 8 |
|  | | | | | | | **124** |

**Graphical user interface, application

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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** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | List four important micronutrients in MS media. | | CO1 | R | | 1 |
| 2. | Recall the biological principle of soma clonal variation. | | CO1 | R | | 1 |
| 3. | What are synthetic seeds? | | CO2 | R | | 1 |
| 4. | Enumerate the role of protoplast in plant genetic transformation. | | CO2 | U | | 1 |
| 5. | Recall the size in base pairs of Ti plasmid. | | CO2 | R | | 1 |
| 6. | List two marker genes used in plant transformation. | | CO3 | R | | 1 |
| 7. | Cite two examples of disease resistancetrangenic 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 primary animal tissue. | | CO5 | R | | 1 |
| 10. | State the role of serum in culturing of cells. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | List the roles of vitamins in MS media. | | CO1 | | An | 3 |
| 12. | State the significance of somatic embryogenesis in plant tissue culture. | | CO2 | | A | 3 |
| 13. | Recall the salient features of Ti plasmid. | | CO3 | | R | 3 |
| 14. | Enumerate the concentration of antibiotics and percentage of serum used in the medium for cell culture. | | CO4 | | U | 3 |
| 15. | Discuss membrane integrity assay. | | CO5 | | U | 3 |
| 16. | State 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. |  | Explain the growth pattern of plant cells for *In Vitro* drug production using cell suspension culture. | CO1 | | U | 12 |
|  |  |  |  | |  |  |
| 18. |  | Illustrate the protocol to develop transgenic crop using biolistic gun method with a neat diagram. | CO2 | | An | 12 |
|  |  |  |  | |  |  |
| 19. |  | Explain the steps involved in micro propagation of endangered medicinal plants. | CO1 | | A | 12 |
|  |  |  |  | |  |  |
| 20. |  | Evaluate the strategies of development of disease resistance transgenic plants and its significance. | CO3 | | E | 12 |
|  |  |  |  | |  |  |
| 21. |  | Describe the types of reporter and marker genes used in plant genetic transformation with suitable examples. | CO3 | | R | 12 |
|  |  |  |  | |  |  |
| 22. | a. | Describe the 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. |  | Discuss the role and significance of serum and serum free medium in animal cell culture. | CO5 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Describe assisted hatching and pre-implantation genetic diagnosis in micro manipulation technique. | CO6 | | U | 8 |
|  | b. | List the important ethical issues in animal biotechnology. | CO6 | | E | 4 |

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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 Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **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** |

**Graphical user interface, application

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| --- | --- | --- | --- |
| **Course Code** | **19BT2042** | **Duration** | **3hrs** |
| **Course Name** | **BIOPHARMACEUTICAL TECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Define drugs. | | CO1 | U | | 1 |
| 2. | Name some oral dosage forms in pharmaceutics. | | CO1 | R | | 1 |
| 3. | Write a note on Agonist and antagonist. | | CO2 | R | | 1 |
| 4. | Define first pass metabolism. | | CO2 | R | | 1 |
| 5. | Define Biopharmaceutical technology. | | CO3 | U | | 1 |
| 6. | Illustrate the mechanism of drugs dynamics until reach excretion sites. | | CO3 | R | | 1 |
| 7. | Define different types of solid dosage forms. | | CO4 | U | | 1 |
| 8. | Write a note on the capsule base used in dosage formulation. | | CO4 | R | | 1 |
| 9. | Define different types of solid dosage forms. | | CO5 | U | | 1 |
| 10. | Write a note on the ointment base used in dosage formulation. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Classify routs of drug entry into body. | | CO1 | | R | 3 |
| 12. | Write a note on controlled release drugs. | | CO2 | | U | 3 |
| 13. | Define and differentiate pills and caplet. | | CO3 | | R | 3 |
| 14. | Write a short note enteric coated Tablets. | | CO4 | | U | 3 |
| 15. | Define prodrug. | | CO5 | | R | 3 |
| 16. | Write a short note on oral prolonged action in pharmaceuticals. | | 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. | Schematically explain a ADME properties of drugs and pharmacological effects of oral dosage forms. | CO1 | | R | 6 |
|  | b. | Explain in detail about drug metabolism phase testing and analysis. | CO1 | | U | 6 |
| 18. | a. | Explain briefly the pharmacodynamic properties of oral drug and physiological role in human body. | CO2 | | R | 6 |
|  | b. | Define drug incompatibility? Write a note on parenteral dosage and toxicity. | CO2 | | R | 6 |
| 19. | a. | Enumerate the ideal characteristics of ointment bases. Describe any one method of manufacturing Ointments in detail. | CO3 | | U | 6 |
|  | b. | Describe the evaluation test for ointment. | CO2 | | R | 6 |
| 20. | a. | Write a detail note on Cream, Paste, Gel. | CO3 | | R | 6 |
|  | b. | Explain in natural and synthetic bases used in semisolid cosmetics. | CO3 | | U | 6 |
| 21. | a. | Define gelatin? Briefly explain the manufacturing hard gelatin capsule formulation. | CO4 | | R | 8 |
|  | b. | Explain capsule quality testing methods and analysis. | CO4 | | U | 4 |
| 22. | a. | Explain in detail about manufacturing of Tablet formulation. | CO4 | | U | 6 |
|  | b. | What is the importance of enteric coating tablets? Name at least two enteric coating materials used in tablet coating. | CO4 | | R | 6 |
| 23. | a. | Explain in detail about the analytical methods and tests for various drugs and pharmaceuticals. | CO5 | | R | 5 |
|  | b. | Briefly describe the standard of hygiene and good manufacturing practice implies on pharmaceutical industries. | CO5 | | U | 7 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Define clinical trial. | CO6 | | R | 3 |
|  | b. | Explain briefly about various clinical trial phases used to define pharmacological activity of drugs. | CO6 | | U | 9 |

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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 Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 10 | 7 |  |  |  |  | 17 |
| CO2 | 20 | 3 |  |  |  |  | 23 |
| CO3 | 16 | 19 |  |  |  |  | 35 |
| CO4 | 15 | 14 |  |  |  |  | 29 |
| CO5 | 6 | 10 |  |  |  |  | 16 |
| CO6 | 3 | 13 |  |  |  |  | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

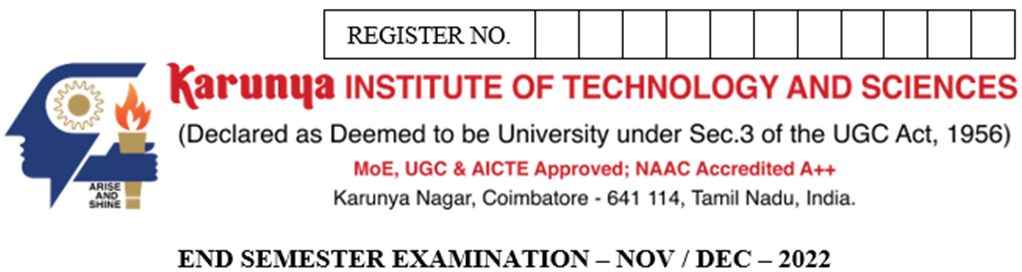
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| **Course Code** | **19BT2046** | **Duration** | **3hrs** |
| **Course Name** | **MOLECULAR FORENSICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Among the two techniques for measuring evidence indoors, one is rectangular coordinates and the other is \_\_\_\_\_\_\_\_\_. | | CO1 | R | | 1 |
| 2. | Manner of death, there are four type of deaths, homicide, natural, accidental, and \_\_\_\_\_\_\_\_. | | CO1 | R | | 1 |
| 3. | \_\_\_\_\_\_\_\_\_\_ asphyxia occurs when the position of a person’s body interferes with respiration, resulting in death from asphyxia or suffocation | | CO2 | R | | 1 |
| 4. | The second stage of decomposition begins when the body begins to swell and it is called \_\_\_\_\_\_\_\_\_\_\_\_. | | CO3 | U | | 1 |
| 5. | Men and women have different proportions of long bones to total height, so separate formulas have been developed for each and If complete long bones are available, the following formulas may be used to estimate height within a range of \_\_\_\_\_\_\_\_\_\_. | | CO4 | U | | 1 |
| 6. | \_\_\_\_\_\_\_\_\_\_ can be determined from variations in the facial structure, especially the nose and eye sockets. | | CO4 | U | | 1 |
| 7. | For \_\_\_\_\_\_\_\_\_ analysis, autosomal STR markers are the most discriminating and are used routinely in The Forensic Science Service. | | CO5 | R | | 1 |
| 8. | It’s been almost 100 years since Russia’s last royal family was brutally executed, bringing an end to the three-century-old dynasty, and the lives and deaths of this family still fascinate the world. They were the \_\_\_\_\_\_\_. | | CO5 | R | | 1 |
| 9. | \_\_\_\_\_\_\_\_ is different from conventional PCR as it needs one primer for amplification and the size of primer is normally short (10 nucleotides), and therefore, less specific. | | CO6 | U | | 1 |
| 10. | \_\_\_\_\_\_\_\_ are used as an important source of RFLP genetic markers for linkage analysis of diploid genomes. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Classify the contribution of Mr. J. Edgar Hoover to Criminalistics. | | CO1 | | An | 3 |
| 12. | Compare the significance of wound ballistics with other types. | | CO2 | | U | 3 |
| 13. | Categorize the fundamental principles fingerprints follow according to a criminal investigator? | | CO3 | | An | 3 |
| 14. | Translate the use DNA Fingerprinting in an investigation as a tool? | | CO4 | | U | 3 |
| 15. | Distinguish STR and VNTR. | | CO5 | | An | 3 |
| 16. | Interpret the importance of Amelogenin as a marker? | | 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 roles and responsibilities of a forensics Scientist. | CO1 | | U | 6 |
|  | b. | Interpret the importance of collection of Crime Scene evidence. | CO1 | | U | 6 |
|  |  |  |  | |  |  |
| 18. |  | Examine the various steps involved in an Autopsy. | CO2 | | A | 12 |
|  |  |  |  | |  |  |
| 19. |  | Discuss the DNA technologies used in forensic investigations. | CO3 | | An | 12 |
|  |  |  |  | |  |  |
| 20. | a. | Paraphrase the consequences of the Pompei incident. | CO4 | | E | 6 |
|  | b. | Show the evidence of a crime committed 1800 years ago, “Who killed Little Georgie?” in Vindolanda, as the archeologist found it. | CO4 | | An | 6 |
|  |  |  |  | |  |  |
| 21. | a. | Survey the cause of death of Anna Nicole Smith. | CO5 | | An | 6 |
|  | b. | Differentiate the type of Hair according to the different parts in a body. | CO5 | | An | 6 |
|  |  |  |  | |  |  |
| 22. | a. | Assess the greatest archaeological find of the 20th century, and perhaps of all time, the discovery in 1922, that of a tomb and support the story using Forensic evidence thereof. | CO6 | | E | 10 |
|  | b. | What is DNA-based kinship analysis? | CO6 | | R | 2 |
|  |  |  |  | |  |  |
| 23. | a. | Appraise the technique MALDI-ToF\_MS as an investigative tool? | CO3 | | E | 6 |
|  | b. | Relate the importance of Blood in a criminal investigation. | CO2 | | U | 6 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Justify the significance of PCR directed Y-chromosome sequences in Forensics for Paternity disputes | CO6 | | E | 12 |

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|  | **COURSE OUTCOMES** |
| **CO1** | Exhibit the current state of forensic biological testing and infer forensic investigation. |
| **CO2** | To find evidence with proper methods of investigation through biological samples. |
| **CO3** | To Categorize the investigation and identify the criminals based on molecular based techniques for paternal disputes. |
| **CO4** | Appraise the knowledge in paleobiology and anthropology and its importance in Forensics. |
| **CO5** | Find evidence and identify the suspects through case studies. |
| **CO6** | Discover the role of PCR in Forensics. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| **CO / P** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| **CO1** | 02 | 12 | - | 03 | - | - | 17 |
| **CO2** | 01 | 09 | 12 | - | - | - | 22 |
| **CO3** | - | 01 | - | 15 | 06 | - | 22 |
| **CO4** | - | 05 | - | 06 | 06 | - | 17 |
| **CO5** | 02 | - | - | 15 | - | - | 17 |
| **CO6** | 02 | 05 | - | - | 22 | - | 29 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Mention the components of biosphere. | CO1 | R | 1 |
| 2. | Name the gel forming adsorbent for oil spills. | CO1 | R | 1 |
| 3. | Differentiate surface and ground water pollution. | CO1 | An | 1 |
| 4. | List different pollutants of air. | CO1 | R | 1 |
| 5. | Identify the major hydrocarbon present in biogas. | CO2 | R | 1 |
| 6. | Define *in situ* bioremediation. | CO3 | R | 1 |
| 7. | Define acidogenesis. | 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 biodegradable waste. | CO6 | R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | List the different types of settling processes. | CO1 | An | 3 |
| 12. | Enumerate the difference between BOD and COD. | CO2 | C | 3 |
| 13. | Summarize the environmental impact of solid wastes. | CO3 | E | 3 |
| 14. | Illustrate the scientific understanding on the formation of photochemical smog. | CO4 | U | 3 |
| 15. | List and explain three biodegradability tests for bioplastics. | CO5 | R | 3 |
| 16. | Write the mode of action of Cry protein. | 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. |  | Explain the harmful effects due to disposal of industrial wastes without adequate treatment and deccribe how to solve the problem using 3 R methodology. | CO6 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Demonstrate the working process and significance of secondary wastewater treatment in aerobic conditions with the examples of any TWO bioreactors. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. |  | Write a detailed note on Cyclone collector, Dynamic precipitator and Electrostatic precipitator. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 20. |  | Write a note on metagenomics. Enumerate the role of genomic tools for bioremediation process. | CO4 | C | 12 |
|  |  |  |  |  |  |
| 21. |  | Summarize on the applicability of biomining process to prevent the effect of metal pollution on environment. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 22. |  | Review the *in situ* and *ex situ* bioremediation of soil pollutants with examples. | CO6 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Summarize the working mechanism of various types of biofertilizers. | CO3 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the production process of biogas for the generation of electricity with neat sketch. | 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 | - | - | 4 | - | - | 7 |
| CO2 | 1 | - | - | 12 | - | 3 | 16 |
| CO3 | 13 | 12 | - | - | 3 | - | 28 |
| CO4 | 1 | 3 | - | - | - | 12 | 16 |
| CO5 | 3 | - | - | - | 12 | - | 15 |
| CO6 | 1 | 12 | 16 | 12 | - | 1 | 42 |
|  | | | | | | | **124** |



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| **Course Code** | **19BT3031** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED ENVIRONMENTAL BIOTECHNOLOGY** | **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. | Appraise the detrimental effect and mitigation of water pollution. | CO1 | An | 10 |
|  | b. | Classify the major causes of air pollution leads to global warming and greenhouse gas effects. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe the process of activated sludge system employed in waste water treatment. Add a note on its merits and demerits. | CO2 | U | 10 |
|  | b. | Discuss the working principle of Trickling filter which acts as attached growth biological reactor. | CO2 | U | 10 |
|  |  |  |  |  |  |
| 3. | a. | Assess the characteristics of pharmaceutical industrial effluent and explain the different process steps in the treatment of the pharmaceutical industry effluent. | CO3 | E | 12 |
|  | b. | Illustrate the process of aerated Lagoons for waste water treatment. | CO3 | A | 8 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Comment on biosensor. Explain the role of biosensors in environmental monitoring. | CO4 | U | 10 |
|  | b. | Describe cleaner technologies with respect to textile dye and tannery effluents. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Articulate the role of microorganisms *In situ* and *Ex situ* bioremediation in detail. | CO5 | A | 10 |
|  | b. | Explain the recalcitrant compound degradation pattern and how the hydrocarbon products are degraded. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Critically analyze the impact of environmental pollutants caused by pesticide industries and suggest the microbial methods for detoxification of pesticides. | CO3 | An | 12 |
|  | b. | Critique the different methods to manage medical and solid waste. | CO2 | E | 8 |
|  |  |  |  |  |  |
| 7. | a. | Interpret how the modern techniques are advanced for the identification of microbial genes than conventional techniques in bioremediation. | CO5 | A | 10 |
|  | b. | With a neat sketch, explain the working of an up-flow anaerobic sludge blanket reactor (UASBR). Enlist its main advantages and disadvantages? | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the different process steps in the treatment of the electrochemical industrial effluent. | CO6 | An | 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. | Appraise the different process steps involved in the bioleaching of heavy metals. | CO6 | An | 10 |
|  | b. | Nanotechnology has enormous potential for providing innovative solutions to a wide range of environmental issues- Discuss. | CO6 | U | 10 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | - | - | 20 | - | - | 20 |
| CO2 | - | 20 | - | - | 8 | - | 28 |
| CO3 | - | 10 | 8 | 12 | 12 | - | 42 |
| CO4 | - | 20 | - | - | - | - | 20 |
| CO5 | - | - | 30 | - | - | - | 30 |
| CO6 | - | 10 | - | 20 | - | 10 | 40 |
|  | | | | | | | **180** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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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** | | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Name the types of Bitwise operator. | | | CO2 | U | 1 |
| 2. | Python is an interpreted language. Justify your answer. | | | CO1 | U | 1 |
| 3. | Predict the output of the following code  string = "PROGRAMMING"  for i in string:  print (i, end=", ") | | | CO1 | A | 1 |
| 4. | Suppose a string S = “PYTHON", what is the index of the character ‘T’? | | | CO2 | A | 1 |
| 5. | What is the use of len(list) in Python? | | | CO3 | U | 1 |
| 6. | Interpret the output of the following code.  L=["abcd","efghi","xyz","Longest Word"]  print(max(L)) | | | CO3 | A | 1 |
| 7. | Deduce the output of the following code.  a=(12,13,16,10,5) print(a[0]+a.index(5)) | | | CO5 | A | 1 |
| 8. | What is the best way to create a one-element tuple? | | | CO5 | U | 1 |
| 9. | Display the output of the following code  p = 1  while p<= 2:  print(p)  p = p + 1  print("END") | | | CO4 | U | 1 |
| 10. | Find the output of the following if i = 9      if (i > 5 and i<=10):       print("Python")      else:       print("C++") | | | CO2 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Compose the importance of indentation in python. | | | CO1 | R | 3 |
| 12. | Develop a Python program to calculate the length of a string without using a built-in function. | | | CO2 | U | 3 |
| 13. | Compare and contrast between pop() and remove() list functions. | | | CO5 | U | 3 |
| 14. | Develop a program to accept five numbers from the user and store it in a tuple ‘T1’. | | | CO4 | A | 3 |
| 15. | Distinguishbetween for loop and while loop. | | | CO2 | U | 3 |
| 16. | Discriminate between Python Modules and Packages. | | | CO3 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. | | a. | Create a Python program to display different data types using variables and literal constants. | CO1 | A | 6 |
|  | | b. | Demonstrate how an input and output function is performed using a Python example. | CO1 | R | 6 |
|  | |  |  |  |  |  |
| 18. | |  | “Strings in Python are Immutable”. Explain this statement with example. Construct the pythonic code to find the factorial of any number entered through the keyboard. | CO2 | A | 12 |
|  | |  |  |  |  |  |
| 19. | |  | Explain join(),split() and append() methods in a list with examples.Develop pythonic code to input information about 10 students as given below:  1. Roll number.  2. Name  3. Total marks  Get the input from the user for student name. The program should display the roll number and total marks for the given student name. Also find the average marks of all the students. Use dictionaries. | CO4 | A | 12 |
|  | |  |  |  |  |  |
| 20. | | a. | Explain the basic Tuple Operations with examples. | CO2 | U | 6 |
|  | | b. | Construct a python program to check whether the elements “y” and “n” belongs to the tuple My\_tuple =(“p”, “y”, “t”, “h”, “o”, “n” ) and after printing the result, delete the tuple. | CO2 | A | 6 |
|  | |  |  |  |  |  |
| 21. | |  | Develop a function in python to count the number of lowercase alphabets present in a text file “file.txt”. | CO5 | A | 12 |
|  | |  |  |  |  |  |
| 22. | |  | Explain in detail the various operators in python with suitable examples. | CO2 | R | 12 |
|  | |  |  |  |  |  |
| 23. | | a. | Describe the built-in functions with tuples. | CO4 | U | 6 |
|  | | b. | Illustrate List Comprehension with suitable examples. | CO4 | A | 6 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | |  | What are modules in python? How will you import them? Explain the concept by creating and importing a module. | CO3 | A | 12 |

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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 Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 9 | 1 | 7 | - | - | - | 17 |
| CO2 | 12 | 14 | 19 | - | - | - | 45 |
| CO3 | - | 4 | 13 | - | - | - | 17 |
| CO4 | - | 7 | 21 | - | - | - | 28 |
| CO5 | - | 4 | 13 | - | - | - | 17 |
| CO6 | - | - | - | - | - | - | - |
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**Graphical user interface, application

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Show the role of pentoses. | | CO1 | U | | 1 |
| 2. | List the components of matter. | | CO1 | R | | 1 |
| 3. | Define fatty acids. | | CO2 | R | | 1 |
| 4. | Tell the functions of proteins. | | CO2 | R | | 1 |
| 5. | Compare between mono and disaccharides. | | CO3 | U | | 1 |
| 6. | Recall the composition of maltose. | | CO3 | R | | 1 |
| 7. | Cite the sources for vitamin D. | | CO4 | U | | 1 |
| 8. | Tell the sugars present in RNA and DNA. | | CO4 | R | | 1 |
| 9. | Group the various classes of macro and micronutrients. | | CO5 | U | | 1 |
| 10. | Compare MUFA and PUFA. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Cite the role of acids and bases. | | CO1 | | U | 3 |
| 12. | Label the double helical structure of DNA. | | CO2 | | R | 3 |
| 13. | Give examples for heptose sugar. | | CO3 | | R | 3 |
| 14. | Recite the functions of potassium. | | CO4 | | R | 3 |
| 15. | Indicate the functions of vitamin E. | | CO5 | | U | 3 |
| 16. | Represent the types of monosaccharide sugars. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. |  | Describe the role of various buffers in biological system. | CO1 | | U | 12 |
|  |  |  |  | |  |  |
| 18. |  | Enumerate on Daltons atomic theory with suitable examples. | CO1 | | R | 12 |
|  |  |  |  | |  |  |
| 19. |  | Show the double helical structure of Deoxyribonucleic acid. | CO2 | | R | 12 |
|  |  |  |  | |  |  |
| 20. |  | Recall the structure of non polar aliphatic and aromatic amino acids. | CO4 | | R | 12 |
|  |  |  |  | |  |  |
| 21. |  | Discuss the industrial and clinical significance of amino acids, peptides and proteins. | CO5 | | U | 12 |
|  |  |  |  | |  |  |
| 22. |  | Generalize mono, oligo and polysaccharides with structures and examples. | CO3 | | U | 12 |
|  |  |  |  | |  |  |
| 23. |  | Describe the various classification and properties of lipids. | CO3 | | R | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Explain the functions and deficiency diseases caused by vitamin A and C. | CO6 | | U | 6 |
|  | b. | Tabulate the functions of macro 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 | 13 | 16 |  |  |  |  | 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** | **20BT2003** | **Duration :** | **3hrs** |
| **Course Name** | **CELL BIOLOGY** | **Max. Marks :** | **100** |

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| **Q. No.** | **Questions** | | | **Course Outcome** | | | | **Bloom’s Level** | | | **Marks** | |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | | | | | |
| 1. | Write the resting membrane potential of nerve cells. | | | CO2 | | | | R | | | 1 | |
| 2. | Define Prophage. | | | CO1 | | | | R | | | 1 | |
| 3. | Name any two endotoxin releasing bacteria. | | | CO2 | | | | An | | | 1 | |
| 4. | List the proteins present in intermediate filaments. | | | CO3 | | | | R | | | 1 | |
| 5. | Write the subunit of activated G-proteins. | | | CO4 | | | | C | | | 1 | |
| 6. | Categorize the two end products of PIP2, catalyzed by the enzyme phospholipase C. | | | CO4 | | | | AN | | | 1 | |
| 7. | Name the enzyme which can either activate or inactivate proteins by addition of phosphate group. | | | CO4 | | | | R | | | 1 | |
| 8. | Mention the role of inositol triphosphate. | | | CO5 | | | | R | | | 1 | |
| 9. | State the importance of ligands. | | | CO5 | | | | An | | | 1 | |
| 10. | Write the immediate source of energy for active transport. | | | CO3 | | | | U | | | 1 | |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | | | | | |
| 11. | | Write the ultimate fate of lysosome in digestive vacuoles. | | | CO1 | | A | | | 3 | | |
| 12. | | Recall plasmodesmata communicate with its adjacent cell in plants | | | CO2 | | E | | | 3 | | |
| 13. | | Distinguish symport and antiport. | | | CO3 | | An | | | 3 | | |
| 14. | | Substantiate the activation process of cAMP as second messenger with neat sketch. | | | CO4 | | E | | | 3 | | |
| 15. | | With a neat sketch, write the steps involved in the activation of calmodulin/Ca2+ dependent protein kinase. | | | CO5 | | A | | | 3 | | |
| 16. | | Illustrate the plant growth hormone auxin induced gene expression | | | CO6 | | U | | | 3 | | |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | | | | | | | | |
| 17. | | a. | Elaborate the different molecular models of plasma membrane with neat diagrams and highlight its functions. | | | CO1 | | | U | | | 8 |
| b. | Give a brief account of the organization of mitochondria with a neat diagram. | | | CO1 | | | A | | | 4 |
|  | |  |  | | |  | | |  | | |  |
| 18. | | a. | Explain the function of Na+K+ pump with a neat diagram,. How does the pump help to maintain the osmotic balance of the cell? | | | CO2 | | | An | | | 8 |
| b. | Write a note on Symport and Antiport. | | | CO2 | | | E | | | 4 |
|  | |  |  | | |  | | |  | | |  |
| 19. | | a. | Define action potential. With a neat illustration, explain the process of nerve impulse transmission in neurons. | | | CO3 | | | An | | | 8 |
| b. | Define Osmosis? List the types and functions. | | | CO3 | | | R | | | 4 |
|  | |  |  | | |  | | |  | | |  |
| 20. | | a. | Define cytoskeleton proteins and give detailed notes on microtubules for cell structure and cell movement. | | | CO2 | | | An | | | 8 |
| b. | Relate muscle contraction with sliding filament theory. | | | CO4 | | | A | | | 4 |
|  | |  |  | | |  | | |  | | |  |
| 21. | | a. | Classify proteins of the extracellular matrix (ECM) and explain their functions. | | | CO2 | | | An | | | 8 |
| b. | Comment on endocytosis and exocytosis. | | | CO3 | | | E | | | 4 |
|  | |  |  | | |  | | |  | | |  |
| 22. | | a. | Illustrate how G-proteins activate cAMP dependant protein kinase and highlight its finctions with a neat sketch. | | | CO4 | | | A | | | 8 |
| b. | Define cell signaling and its mode of action with examples. | | | CO4 | | | An | | | 4 |
|  | |  |  | | |  | | |  | | |  |
| 23. | | a. | Name the phases of cell cycle with its major features and the molecules that regulate cell cycle. | | | CO3 | | | E | | | 8 |
|  | | b. | Write the importance of check point in cell cycle regulation. | | | CO3 | | | E | | | 4 |
| **Compulsory:** | | | | | | | | | | | | |
| 24. | | a.  b.  c. | Describe the principle and applications of cell imaging techniques with a neat sketch.  Fluorescence Microscopy  Confocal Microscopy  Flow cytometry | | | CO6 | | | A | | | 4  4  4 |

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|  | **COURSE OUTCOMES** |
| CO1 | Exhibit a knowledge base in cell structure, organelles and their functions. |
| CO2 | Outline the process that regulates membrane transport, control cell cycle, and cell death. |
| CO3 | Relate cell movement to cytoskeleton and cell-cell, cell-matrix interactions to communication. |
| CO4 | Infer the role of ligands and receptors in cell signaling and signal transduction. |
| CO5 | Categories the different types of cancer and stem cell therapy |
| CO6 | Apply the imaging techniques in cell biology to analyze the characterization of cell organelles. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 8 | 7 |  |  |  | 16 |
| CO2 | 1 |  |  | 25 | 7 |  | 33 |
| CO3 | 5 | 1 |  | 11 | 16 |  | 33 |
| CO4 | 1 |  | 12 | 5 | 3 | 1 | 22 |
| CO5 | 1 |  | 3 | 1 |  |  | 5 |
| CO6 |  | 3 | 12 |  |  |  | 15 |
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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** | | **Course Outcome** | | **Bloom’s Level** | | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | | |
| 1. | Name an accessory used in a stirred tank bioreactor to enable fluid mixing. | | CO1 | | U | | | 1 |
| 2. | Name two organisms widely used to produce bioproducts. | | CO1 | | R | | | 1 |
| 3. | What is the science of wine making called as? | | CO2 | | R | | | 1 |
| 4. | Define ROI. | | CO2 | | R | | | 1 |
| 5. | Name a bioproduct used as a blending agent in food industries. | | CO3 | | U | | | 1 |
| 6. | Name two antibiotics along with the process to produce them. | | CO3 | | R | | | 1 |
| 7. | List the applications of lipases in industry. | | CO4 | | U | | | 1 |
| 8. | Name a class of Bioreactor wherein a riser fluid is employed. | | CO4 | | R | | | 1 |
| 9. | Acclimatization of microbial growth takes place in which microbial growth phase. | | CO5 | | U | | | 1 |
| 10. | Name an equipment used for de -hydrating a bioproduct. | | CO6 | | U | | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | | |
| 11. | Analyze the importance of using a UASB reactor. | | CO1 | | An | | | 3 |
| 12. | What is submerged fermentation? Mention its significance in Bioprocessing? | | CO2 | | U | | | 3 |
| 13. | Describe the steps involved in Pencillin V production. | | CO3 | | An | | | 3 |
| 14. | List the stages of cheese production. | | CO4 | | U | | | 3 |
| 15. | State the differences between baffled and unbaffled reactors. | | CO5 | | An | | | 3 |
| 16. | Highlight on the applications of Single Cell Proteins. | | CO6 | | U | | | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | | | |
| 17. |  | Summarize the steps involved in Upstream and Downstream processing involved in bioprocess industries. | | CO1 | | U | 12 | |
|  |  |  | |  | |  |  | |
| 18. | a. | Elaborate on the Uncertaininty analysis in industries. | | CO2 | | R | 6 | |
|  | b. | Elaborate on the key differences between traditional and modern biotechnology. | | CO2 | | R | 6 | |
|  |  |  | |  | |  |  | |
| 19. |  | Describe the industrial production of Ethanol. | | CO3 | | U | 12 | |
|  |  |  | |  | |  |  | |
| 20. |  | Describe the process involved in the production of Wine. | | CO3 | | An | 12 | |
|  |  |  | |  | |  |  | |
| 21. |  | Describe in detail Biogas production with a neat diagram. | | CO4 | | A | 12 | |
|  |  |  | |  | |  |  | |
| 22. |  | Describe the industrial production of Xanthan Gum with a neat sketch. | | CO4 | | E | 12 | |
|  |  |  | |  | |  |  | |
| 23. | a. | What are biofertilizers? Explain the use of Algae for feed production. | | CO5 | | U | 6 | |
|  | b. | Describe the steps involved in Monoclonal Antibody production. | | CO5 | | A | 6 | |
| **COMPULSORY QUESTION** | | | | | | | | |
| 24. |  | Elaborate the types of Biofertilizers, their production and advantages. | | 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** |

**Graphical user interface, application

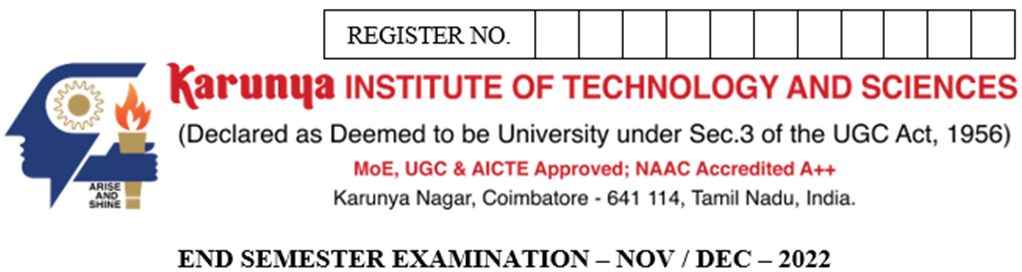
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| **Course Code** | **20BT2007** | **Duration** | **3hrs** |
| **Course Name** | **BIO-ANALYTICAL TECHNIQUES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | What is meant by calibration of an instrument? | | CO1 | R | | 1 |
| 2. | Recall the concept of precision. | | CO1 | R | | 1 |
| 3. | List the principle of fluorimeter. | | CO2 | R | | 1 |
| 4. | Give any two applications of conductivity meter. | | CO2 | A | | 1 |
| 5. | What is a centrifugal force? | | 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)** | | | | | | |
| 11. | Outline the concept of accuracy in instrumental methods. | | CO1 | | U | 3 |
| 12. | Illustrate any three applications of spectrofluorometer. | | CO2 | | U | 3 |
| 13. | Recall the principle of zonal centrifugation. | | CO3 | | R | 3 |
| 14. | Outline the various stationary phase materials used in gel permeation 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. |  | Explain the concept of Good’s buffer and other buffers used in extraction of various biological molecules with suitable examples. | CO1 | | E | 12 |
|  |  |  |  | |  |  |
| 18. |  | Illustrate the principle and method of solvent extraction of 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. |  | Explain the working principle and instrumentation in structural elucidation of compounds using mass spectrometry with a neat diagram. | CO5 | | E | 12 |

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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 Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **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** | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Name the enzymes involved in the irreversible reactions during glycolysis. | CO1 | R | 1 |
| 2. | Determine the number of ATP synthesized from 1 mole of glucose in aerobic condition during glycolysis and TCA cycle. | CO1 | A | 1 |
| 3. | Name two basic amino acids. | CO2 | R | 1 |
| 4. | Write the name for pyrrolidine ring containing aromatic amino acid. | CO2 | A | 1 |
| 5. | Name the protein complex in Electron Transport Chain(ETC) which uses proton gradient to drive ATP synthesis. | CO3 | R | 1 |
| 6. | State the name of the final electron acceptor in Electron Transport Chain. | CO3 | R | 1 |
| 7. | Recall the source of N3 and N9 in the structure of the purine ring. | CO4 | R | 1 |
| 8. | Name two diseases due to inborn errors of nucleotide metabolism. | CO4 | R | 1 |
| 9. | Identify the amino acid responsible for Alkaptonuria disease. | CO5 | R | 1 |
| 10. | List two hormones involved in regulation of carbohydrate metabolism. | CO6 | R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Mention the importance of glycolysis in aerobic and anaerobic conditions. | CO1 | A | 3 |
| 12. | Define essential amino acids with examples. | CO2 | An | 3 |
| 13. | Mention three different sources of phosphorus in synthesis of energy rich molecules. | CO3 | An | 3 |
| 14. | Differentiate DNA and RNA in terms of nitrogen bases and sugars. | 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. | Explain the hydrolysis reaction of triglycerides. | CO6 | U | 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. |  | Discuss the metabolic pathways of TCA cycle. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Sketch the reasons of Urea cycle and state its importance. | CO2 | C | 12 |
|  |  |  |  |  |  |
| 19. |  | Explain in detail on the role of five protein complexes in the generation of ATP during the process of ETC with diagram. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Describe the metabolic pathways in pyrimidine bio synthesis. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Enumerate the inborn errors mentioning the name of defective enzyme and symptoms of amino acids and nucleotide metabolism. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the oxidative and non-oxidative pathways involved in HMP shunt. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Discuss the steps involved in the synthesis of fatty acids. | CO6 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Summarize in detail 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** |

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

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| **Q. No.** | **Questions** | **Course Outcome / Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | Which of the following is based on evolutionary relationships?  a. Phenetic classification b. Nomenclature  c. Phylogenetic classification d. Identification | CO3 / R | 1 |
| 2. | In Scanning Electron Microscopy, raised areas on the sample appear lighter on the image due to \_\_\_\_\_\_\_\_\_ (high/low) number of secondary electrons generated. | CO3/ A | 1 |
| 3. | Under conditions of environmental stress, *Chlamydomonas* sp. undergoes \_\_\_\_\_\_\_\_\_\_ reproduction. | CO5 / U | 1 |
| 4. | In lichens, the \_\_\_\_\_\_\_\_\_\_\_\_ protects the phycobiont from high light intensities and provides water and minerals. | CO2 / R | 1 |
| 5. | To maintain the structure of the cell, halophiles use compatible solutes to keep the osmotic concentration of their cytoplasm \_\_\_\_\_\_\_\_\_(above/below) that of the habitat. | CO2/ U | 1 |
| 6. | In diauxic growth, the number of growth phases depends on the number of \_\_\_\_\_\_\_ sources. | CO5 / A | 1 |
| 7. | \_\_\_\_\_\_\_\_\_\_\_\_\_ method of sterilization uses intermittent heat. | CO4 / U | 1 |
| 8. | Polyoxycin D prevents the activity of the enzyme chitin synthase. Hence, it is used as anti \_\_\_\_\_\_\_\_\_\_ agent. | CO4 /U | 1 |
| 9. | Identify the incorrect statement about cholera.  a. **Transmitted by contaminated water.**  b. Toxin produced by prophage leads to watery stools.  c. **Can be prevented by vaccination.**  d. **Treatment involves oral rehydration therapy.** | CO2/ A | 1 |
| 10. | Candidiasis is a mycosis caused by the dimorphic fungi \_\_\_\_\_\_\_\_\_. | CO6 / R | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Define Taxonomy and explain its components. | CO1 / R | 3 |
| 12. | Differentiate the structures of gram positive and gram negative bacterial cell walls. | CO3 / A | 3 |
| 13. | List out the factors affecting microbial growth. | CO5 / R | 3 |
| 14. | Discuss the principle of autoclaving. | CO4 / U | 3 |
| 15. | Name the microbes which cause the following diseases: Gonorrhea, Plague, AIDS. | CO6 / R | 3 |
| 16. | Why VAM is considered a biofertilizer? | CO2 / U | 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. | Briefly explain the techniques used in determining microbial taxonomy and phylogeny. | CO1 / R | 5 |
| b. | If a specimen is viewed using a 5X objective in a microscope with a 15X eyepiece, how many times has the image been magnified? | CO3 / E | 2 |
| c. | Give the principle of acid fast staining. | CO3 / U | 5 |
|  |  |  |  |  |
| 18. |  | Describe the life cycle of *Plasmodium vivax*. What stages of the life cycle occur in humans? | CO6 / U | 12 |
|  |  |  |  |  |
| 19. | a. | Describe the four phases of the growth curve and discuss the causes of each. | CO5 / A | 10 |
| b. | In a plate count method, if 1milliliter of a solution is diluted by a factor of 1 x 106 yielded 150 colonies, then what is number of cells in the original sample? | CO5 / A | 2 |
|  |  |  |  |  |
| 20. | a. | Differentiate disinfection and sterilization. | CO4 / U | 4 |
| b. | Explain why there are far fewer antifungal agents than there are antibacterial agents. | CO4 / E | 4 |
| c. | Why do sulfa drugs have selective toxicity towards bacteria and protozoa? | CO4 / E | 4 |
|  |  |  |  |  |
| 21. | a. | Discuss the mechanism of action of *C. diphtheria* in causing disease. | CO6 / U | 6 |
| b. | List out the modes of Transmission of HIV from person to person. | CO6 / U | 6 |
|  |  |  |  |  |
| 22. | a. | Illustrate and explain the working of Scanning Electron Microscope. | CO3 / U | 8 |
| b. | Explain the structure of a prokaryotic cell with a neat diagram. | CO2 / R | 4 |
|  |  |  |  |  |
| 23. | a. | What is the generation time of a bacterial population that increases from 10,000 cells to 10,000,000 cells in four hours of growth? | CO5 / A | 6 |
| b. | Explain five ways in which chemotherapeutic agents kill or damage bacterial pathogens. | CO4 / U | 6 |
|  |  | **Compulsory:** | | |
| 24. | a. | How the Membrane Filter Technique is useful in assessing whether the given water sample is potable? Explain. | CO6/ R | 4 |
| b. | Outline the process by which cheese is made. | CO1/ U | 8 |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 8 | 8 | - | - | - | - | 16 |
| CO2 | 5 | 4 | 1 | - | - | - | 10 |
| CO3 | 1 | 13 | 4 | - | 2 | - | 20 |
| CO4 | - | 15 | - | - | 8 | - | 23 |
| CO5 | 3 | 1 | 19 | - | - | - | 23 |
| CO6 | 8 | 24 | - | - | - | - | 32 |
|  | | | | | | | **124** |



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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Give examples of Newtonian fluids. | | CO1 | U | 1 |
| 2. | Highlight the overall expression for density. | | CO1 | R | 1 |
| 3. | Give the relationship expression between shear and strain. | | CO2 | R | 1 |
| 4. | Name an equipment used to measure radiation. | | CO2 | R | 1 |
| 5. | What is the SI unit of viscosity? | | CO3 | U | 1 |
| 6. | Express the measure of universal gas constant. | | CO3 | R | 1 |
| 7. | What is the defined Reynold’s number for Laminar flow fluid? | | CO1 | U | 1 |
| 8. | What is the density of water? | | CO2 | R | 1 |
| 9. | What is the area of a circle? | | CO3 | U | 1 |
| 10. | Give the expression for vacuum pressure. | | CO3 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | What is a manometer? Mention its significance. | | CO1 | An | 3 |
| 12. | What is Capillarity? Give its importance for fluid behavior. | | CO2 | U | 3 |
| 13. | Give the expression of coefficient of discharge of a Venturimeter and write a note on it. | | CO3 | An | 3 |
| 14. | What is called a piston head? Where it is applied? | | CO2 | U | 3 |
| 15. | Give the importance of terminal velocity of a fluid. | | CO1 | An | 3 |
| 16. | Give the importance of filtration process. | | CO3 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. | a. | Give a detailed account of different types of manometers. | CO1 | R | 8 |
|  | b. | Elaborate on specific gravity and specific density with mathematical expressions. | CO1 | U | 4 |
| 18. |  | Derive Bernoulli’s theorem for fluid flow. | CO2 | U | 12 |
| 19. |  | What is similitude? Elaborate on its importance. | CO3 | U | 12 |
| 20. |  | What is a rotatmeter? Mention its application and significance. | CO3 | An | 12 |
| 21. |  | Elaborate on pumps involved in fluid mechanics. | CO2 | A | 12 |
| 22. |  | What is an orifice meter? Derive the Cd value expression. | CO2 | A | 12 |
| 23. |  | What is an Venturi meter? Derive the Cd value expression. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Give a detailed account on the different types of manometers. | CO3 | C | 12 |

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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 Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 9 | 6 | - | 6 | - | - | 21 |
| CO2 | 3 | 18 | 24 | - | - | - | 45 |
| CO3 | 1 | 15 | 12 | 15 | - | 12 | 58 |
|  | | | | | | | **124** |

**Graphical user interface, application

Description automatically generated with medium confidence**

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Fermentation. | | CO1 | R | 1 |
| 2. | What is cryptic growth? | | CO5 | U | 1 |
| 3. | Name an enzyme used in pharmaceutical industry with its application. | | CO1 | R | 1 |
| 4. | Deduce the number of experiments to be performed for optimizing carbon, vitamin and nitrogen of 5 concentrations each using classical method. | | CO2 | E | 1 |
| 5. | The initial number of microbes in a medium before sterilization is 7x1019. Estimate nabla factor. | | CO2 | An | 1 |
| 6. | Estimate holding time if k and del holding are 2.54min-1 and 36 respectively. | | CO3 | E | 1 |
| 7. | The del factor for heating, overall and cooling was found to be 1.7, 36 and 2.4 respectively. Calculate del holding. | | CO3 | An | 1 |
| 8. | Relate the principle of inertial impaction. | | CO6 | A | 1 |
| 9. | Identify a method for sterilization of medium containing heat liable compounds. | | CO6 | U | 1 |
| 10. | What is the temperature of the stored culture in a liquid nitrogen storage? | | CO4 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare and contrast log phase and stationary phase of microbial growth. | | CO1 | An | 3 |
| 12. | Describe the function of the sensors in contact with fermentation broth. | | CO5 | U | 3 |
| 13. | Describe the role of metabolic regulators with example. | | CO2 | E | 3 |
| 14. | The summation of H and L for carbon is 120 and 70 respectively. Estimate experimental error if F-test is 700 for 7 variables. | | CO3 | E | 3 |
| 15. | Differentiate between absolute filters and depth filters. | | CO6 | An | 3 |
| 16. | Enumerate the procedure of maintaining quality of stock cultures. | | CO4 | C | 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 five overlapping stages in the development of fermentation industry. | CO1 | R | 6 |
|  | b. | Elaborate on five groups of commercially important fermentation process. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | With a neat sketch explain the basic configuration of fermentor. Elaborate on various parameters to be monitored and controlled during fermentation process. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | For the following data calculate the difference, average difference, mean square, experimental error and factors showing larger effect.   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Experiment/ Variable | Car | Vit | Min | Dum-1 | Pre | Dum-2 | Hor | | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 1 | | 2 | 2 | 1 | 3 | 1 | 1 | 2 | 1 | | 3 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | | 4 | 2 | 2 | 3 | 1 | 2 | 1 | 2 | | 5 | 1 | 1 | 2 | 1 | 1 | 1 | 3 | | 6 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | | 7 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | | 8 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | | CO2 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | Design a batch sterilization process to carry out medium sterilization in order to calculate sterilization time. | CO3 | C | 12 |
|  |  |  |  |  |  |
| 21. |  | A fermentation process requires 9.7 liters batch of complex medium to be steam sterilized at 121°C. Assuming that the medium before sterilization contains 5x1018 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 15 min and the time of cooling from 121°C to 100°C is 8 min. Assume that the spore death below 100°C is insignificant. And the value of ▼table =12.55, K= 2.6 min-1. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 22. |  | Air is sterilized through a depth filter and is sent at an flow rate of 20 m3/min for an fermentation process for 460x103 min with an linear velocity of 0.15m/min. the value of the rate constant is 2.54 m-1 .Calculate   * + 1. Initial number of microorganism present in air.     2. Radius of the filter. c. Length of the filter.  1. Cross sectional area of filter. | CO6 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe in detail the various preservation techniques to store isolated industrially important microbes. | CO4 | C | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate and elaborate various steps in isolating industrially important microorganisms based on its desired characteristics. | CO4 | U | 12 |

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

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 8 | 6 | - | 3 | - | - | 17 |
| CO2 | - | - | - | 1 | 16 | - | 17 |
| CO3 | - | - | - | 1 | 16 | 12 | 29 |
| CO4 | 1 | 12 | - | - | - | 15 | 28 |
| CO5 | - | 16 | - | - | - | - | 16 |
| CO6 | - | 1 | 1 | 15 | - | - | 17 |
|  | | | | | | | **124** |

**Graphical user interface, application

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

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| **Q. No.** | **Questions** | **Course Outcome / Pattern** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | |
| 1. | ----------------- is a left handed DNA z DNA. | CO1/R | 1 |
| 2. | **This is the role undertaken by bacteriophage in transduction**  (a) episome (b) recipient (c) donor (d) vector | CO1/R | 1 |
| 3. | **Which of the following enzymes separates the two strands of DNA during replication?**  (a) Gyrase (b) Topoisomerase (c) Helicase (d) DNA polymerase | CO1/ U | 1 |
| 4. | **The 3’ – 5’ phosphodiester linkage joins**  (a) two DNA strands (b) two nucleotides  (c) a nitrogenous base with pentose sugar (d) two nucleosides | CO1/ R | 1 |
| 5. | In case of eukaryotes replication initiates at \_\_\_\_\_\_\_\_ a) TATA b) CpG islets c) AUG d)ARS | CO4 / U | 1 |
| 6. | In SOS repair system cleavage of LexA and UmuD is mediated by \_\_\_\_\_\_\_\_\_ a) RecB b) RecA c) RecC d) UvrA | CO4 / U | 1 |
| 7. | **Transcription in eukaryotes is initiated when**  (a) RNA strand is present (b) RNA polymerase is present  (c) Core promoter sequence is present (d) None of these | CO5 / U | 1 |
| 8. | **The longest primary transcript is generated by**  (a) dystrophin gene (b) Tintin gene (c) neuromedin u  (d) centromere protein A | CO5 / U | 1 |
| 9. | When was genetic code completed? | CO6 / U | 1 |
| 10. | The human proteome is dynamic. a) False b) True | CO6 / U | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | |
| 11. | Critically comment on bacterial conjugation. | CO1/ U | 3 |
| 12. | Elaborate Meselson Stahl experiment. | CO1/ R | 3 |
| 13. | Discuss about mis-match repair. | CO3/ U | 3 |
| 14. | Elaborate RNA splicing. | CO4/ U | 3 |
| 15. | Explain briefly about inhibitors. | CO5/ U | 3 |
| 16. | Illustrate and explain the trp operon. | CO6/AN | 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. | Explain in detail the molecular structure of DNA. | CO1/A | 4 |
| b. | List the enzymes involved in bacterial transformation. | CO1/AN | 4 |
| c. | Elaborate on the forms of RNA. | CO1/U | 4 |
|  |  |  |  |  |
| 18. | a. | Describe D-loop mode of replication. | CO2/U | 4 |
| b. | Explain the enzymes involved in replication. | CO2/R | 4 |
| c. | Explain the role of reverse transcriptase. | CO2/R | 4 |
|  |  |  |  |  |
| 19. | a. | Briefly explain telomere replication. | CO3/U | 4 |
| b. | Explain in detail recombination repair. | CO3/AN | 4 |
| c. | Critically comment on SOS repair. | CO3/AN | 4 |
|  |  |  |  |  |
| 20. | a. | Write short notes on promoters. | CO4/AN | 4 |
| b. | Discuss about RNA editing. | CO4 /R | 4 |
| c. | Elaborate on enhancers. | CO4/AP | 4 |
|  |  |  |  |  |
| 21. | a. | Briefly explain Post translational modification. | CO4/AP | 4 |
| b. | Critically comment on Elucidation of genetic code. | CO5/ R | 4 |
| c. | Discuss the Process involved in the translation in eukaryotes. | CO5/R | 4 |
|  |  |  |  |  |
| 22. | a. | Discuss about the bacterial transcription. | CO5/ R | 4 |
| b. | Explain the rolling circle mode of replication. | CO6/ R | 4 |
| c. | Comment on methylation. | CO5/ R | 4 |
|  |  |  |  |  |
| 23. | a. | Write in detail the Prokaryotic transcription. | CO6 / U | 4 |
| b. | Elaborate on the Process involved in the translation in prokaryotes | CO6 / U | 4 |
| c. | Explain about Photo reactivation repair. | CO6/ U | 4 |
|  |  | **Compulsory:** | | |  |
| 24. | a. | Describe cis and trans elements | CO4 / A | 4 |
| b. | Briefly review on loss of regulation and defect in DNA repair system leading to genetic disorders and diseases. | CO4 / R | 4 |
| c. | Comment on lac operons. | CO6 / U | 4 |

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|  | **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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 6 | 8 | 4 | 4 | - | - | 22 |
| CO2 | 8 | 4 | - | - | - | - | 12 |
| CO3 | - | 7 | - | 8 | - | - | 15 |
| CO4 | 8 | 5 | 12 | 4 | - | - | 29 |
| CO5 | 16 | 5 | - | - | - | - | 21 |
| CO6 | 4 | 18 | - | 3 | - | - | 25 |
|  | | | | | | | **124** |

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the conditions required to grow a microbial culture at its maximum specific growth rate. | | CO1 | U | 1 |
| 2. | Analyze the impact of increasing the feed flow rate in a chemostat culture | | CO2 | U | 1 |
| 3. | Estimate empirical formulae for a microorganism containing 40% C, 20% N, 30% O and 10% hydrogen on a mass basis. | | CO3 | U | 1 |
| 4. | Identify one option to increase the volumetric oxygen mass transfer coefficient in a fermenter. | | CO4 | R | 1 |
| 5. | Express a mathematical relation relating product inhibition on microbial growth. | | CO3 | R | 1 |
| 6. | Explain the effect of increasing agitation speed on oxygen transfer in a bioreactor system. | | CO4 | U | 1 |
| 7. | Describe the influence of viscosity on the volumetric mass transfer coefficient. | | CO4 | U | 1 |
| 8. | Estimate the biomass yield coefficient on a substrate, if 2 g of substrate consumption results in 1 g of biomass increase. | | CO4 | R | 1 |
| 9. | State one advantage of the sulphite oxidation method in measuring kLa | | CO4 | R | 1 |
| 10. | Identify the variable that remains constant in fed-batch operation: volume, biomass concentration, biomass content. | | CO5 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | *E. Coli* culture is grown in six different flasks with different initial substrate concentrations, and biomass is measured from each flask on every 15 min interval. Explain the strategy you would adopt to estimate Monod kinetic parameters. | | CO3 | An | 3 |
| 12. | Describe the basic methodology involved in the measurement of the volumetric oxygen transfer coefficient using dynamic gassing out method. | | CO4 | U | 3 |
| 13. | Differentiate apparent and true yield coefficients using appropriate mathematical expressions. | | CO2 | An | 3 |
| 14. | Identify the bioreactor conditions used to calculate the dilution rate for a washout scenario and project the relevant expression. | | CO5 | U | 3 |
| 15. | Select the mathematical models that can be used to express substrate inhibition on microbial growth based on the Monod model. | | CO5 | An | 3 |
| 16. | Deduce the mathematical expression adopted in the Fed-batch system for biomass and substrate concentration under pseudo-steady-state conditions. | | 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. | Differentiate between primary and secondary screening methods available for important microorganisms. | CO1 | U | 6 |
|  | b. | Examine the steps involved in inoculum preparation for industrial fermentation. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. |  | Ethanol fermentation from glucose by S. cerevisiae is known to follow logistic growth and following data 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. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 19. | a. | Illustrate the microbial growth, product formation, and substrate consumption kinetics in a batch reactor using appropriate mathematical expressions. Explain each term with appropriate units. | CO3 | A | 8 |
|  | b. | Explain a strategy that you may adopt to estimate the maintenance requirement of microbial culture. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 20. |  | Production of single-cell protein from hexadecane is given by the following reaction:  C16H34+*a*O2+*b*NH3🡪*c* CH1.66O0.27N0.20 + *d* CO2+ *e* H2O  If RQ equals 0.43, estimate the stoichiometric coefficients, and biomass yield coefficient on hexadecane. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 21. | a. | In the dynamic method for *k*La measurement, the dissolved-oxygen concentration during the re-oxygenation step changes as follows.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | t (s) | 10 | 15 | 20 | 30 | 40 | 50 | 70 | 100 | 130 | | % Sat | 43.5 | 53.5 | 60 | 67 | 70 | 72 | 73 | 73.5 | 73.5 |   Determine *k*L*a* using a graphical approach. | CO4 | A | 8 |
|  | b. | Explain how microbial growth conditions may impact *k*L*a* measurement. | CO4 | U | 4 |
|  |  |  |  |  |  |
| 22. |  | A 100 L chemostat operating under steady-state conditions with a feed flowrate 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 *k*s equals 50g/L, estimate the substrate concentration in the reactor and biomass productivity assuming biomass yield coefficient YX/S = 0.4 g g-1 | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Relate between power number and Reynolds number in the context of oxygen transfer in a bioreactor system.Also,develop a simplified relationship that may be used to scale-up bioreactors maintaining the same power input to the reactor system. | CO4 | C | 12 |
|  |  |  |  |  |  |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Appraise the considerations for development of packed bed reactors in bioprocess while assessing their advantage/disadvantages. Use appropriate justifications to justify your points, if required. | CO6 | E | 12 |

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|  | **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. |

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 0 | 7 | 6 | 0 | 0 | 0 | 13 |
| CO2 | 0 | 1 | 0 | 15 | 0 | 0 | 16 |
| CO3 | 1 | 5 | 8 | 3 | 12 | 0 | 29 |
| CO4 | 3 | 9 | 8 | 0 | 0 | 12 | 32 |
| CO5 | 1 | 3 | 0 | 15 | 0 | 0 | 19 |
| CO6 | 0 | 0 | 0 | 3 | 12 | 0 | 15 |
|  | | | | | | | **124** |

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

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| **Q. No.** | **Questions** | | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | The length of the peptide binding cleft is in the MHC-I molecule is around \_\_\_\_\_\_\_\_. | | | CO1 | U | | 1 |
| 2. | List the granulocytes and agranulocytes. | | | CO1 | A | | 1 |
| 3. | Distinguish serum and plasma in a sentence. | | | CO1 | A | | 1 |
| 4. | CLIP stands for \_\_\_\_\_\_\_. | | | CO2 | R | | 1 |
| 5. | The immunoglobulin that can cross the placenta is \_\_\_\_\_\_\_. | | | CO3 | U | | 1 |
| 6. | List two the multimeric immunoglobulins found in humans. | | | CO3 | R | | 1 |
| 7. | HIV causes \_\_\_\_\_\_\_. | | | CO4 | An | | 1 |
| 8. | List any four defense systems employed by leucocytes. | | | CO5 | R | | 1 |
| 9. | Expand ELISA. | | | CO5 | E | | 1 |
| 10. | Kohler and Milstein were awarded the Nobel prize for \_\_\_\_\_\_\_ technology. | | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Briefly comment on commensals/normal flora also known as microbiota. | | | CO1 | | An | 3 |
| 12. | Outline the organization of the immune system. | | | CO2 | | U | 3 |
| 13. | Define neutralization, opsonization and complement activation. | | | CO3 | | R | 3 |
| 14. | Differentiate Affinity and Avidity of antibodies. | | | CO4 | | U | 3 |
| 15. | Distinguish between epitope and paratope and mention the molecular interactions between them. | | | CO5 | | E | 3 |
| 16. | Explain hypersensitivity and at least two medications used to treat it. | | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | | |
| 17. | |  | Describe in detail the structure and function of primary lymphoid organs. | CO1 | | R | 12 |
|  | |  |  |  | |  |  |
| 18. | |  | Explain Hematopoisis with a neat diagram. | CO2 | | U | 12 |
|  | |  |  |  | |  |  |
| 19. | |  | Describe in detail the classes of antibodies, their properties and their functions | CO3 | | A | 12 |
|  | |  |  |  | |  |  |
| 20. | |  | Enumerate the processing and presentation of endogenous antigens. | CO4 | | E | 12 |
|  | |  |  |  | |  |  |
| 21. | | a. | Elaborate on the Alternate pathway of complement activation. | CO5 | | R | 8 |
|  | | b. | Examine how cytotoxic CD8 T-cells kill infected cells | CO5 | | R | 4 |
|  | |  |  |  | |  |  |
| 22. | |  | Elucidate the types, properties and the role of cytokines in regulating the immune system. | CO5 | | U | 12 |
|  | |  |  |  | |  |  |
| 23. | |  | Describe the molecular basis of two auto-immune diseases. | CO6 | | E | 12 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. | |  | Discuss the different types of vaccines against COVID-19. | CO6 | | An | 12 |

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|  | **COURSE OUTCOMES** | | | | | | | |
| CO1 | Learn the history and development and controversies of the field of immunology. | | | | | | | |
| CO2 | Recognizes the types of immunity, the basic plan of the immune of the immune system and the organs of the immune system. | | | | | | | |
| CO3 | Identify the cells of the immune system and their functions. | | | | | | | |
| CO4 | Understand the functioning of the innate and adaptive immune system. | | | | | | | |
| CO5 | Interpret the cellular & molecular interactions, physiology and the pathology of the immune system. | | | | | | | |
| CO6 | Infer of the applications of immunology in diagnosis and treatment of diseases. | | | | | | | |
| **Assessment Pattern as per Bloom’s Level** | | | | | | | | |
| CO / P | | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | | 12 | 1 | 2 | 3 | - | - | 18 |
| CO2 | | 1 | 15 | - | - | - | - | 16 |
| CO3 | | 4 | 1 | 12 | - | - | - | 17 |
| CO4 | | - | 3 | - | 1 | 12 | - | 16 |
| CO5 | | 13 | 12 | - | - | 4 | - | 29 |
| CO6 | | 1 | 3 | - | 12 | 12 | - | 28 |
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| **Course Code** | **20BT2029** | **Duration** | **3hrs** |
| **Course Name** | **BIOCHEMICAL THERMODYNAMICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Define closed system in thermodynamics. | CO1 | R | 1 |
| 2. | Identify the thermodynamic process where PVγ remains constant. The γ is the ratio between Cp and Cv. | CO1 | U | 1 |
| 3. | Explain intensive property of a thermodynamic system. | CO2 | R | 1 |
| 4. | Name the process, in which the temperature of the working substance remains constant during its expansion or compression. | CO2 | U | 1 |
| 5. | Define enthalpy. | CO2 | R | 1 |
| 6. | Enumerate the compressibility factor of an ideal gas. | CO2 | An | 1 |
| 7. | State the condition at which the basic expression; dG=RTd(lnf) for fugacity is valid. | CO3 | U | 1 |
| 8. | Determine the unit for characteristics constant “B” in Virial equation. | CO4 | An | 1 |
| 9. | Enumerate the degree of freedom for acetone and water system. | CO5 | An | 1 |
| 10. | Explain Azeotropic mixture. | CO5 | U | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | A mixture of biogas expands from 0.05 m3 to 0.08 m3 at a constant pressure of 1000 Pa and absorbs 84 J of heat during the process. Calculate the change in internal energy. | CO1 | E | 3 |
| 12. | 1 kilo mol NH3 occupies a volume of 0.381 m3 at 313 K. Calculate the pressure using van der Waals equation. Take the van der Waals constants as a = 0.365 Nm4/mol2 and b = 4.28×10–5 m3/mol. | CO3 | An | 3 |
| 13. | The coefficient of compressibility (k) and coefficient of volume expansion (β) of mercury at 273 K and 1 bar are 3.9×10–6 (bar)–1 and 1.8×10–4 K–1, respectively. Calculate CVin J/kg K for mercury given that CP = 0.14 kJ/kg K and density = 13.596×103 kg/m3. Given that, CP-CV= (β2VT/k). | CO3 | An | 3 |
| 14. | The fugacity of component 1 in binary liquid mixture of components 1 and 2 at 298 K and 20 bar is given by  = 50 x1-80x21+40x31  where is in bar and x1 is the mole fraction of component 1. Determine:  (a) The fugacity *f*1 of pure component 1 in bar and  (b) The activity coefficient (γ1). | CO2 | E | 3 |
| 15. | Distinguish maximum and minimum boiling azeotropes. | CO5 | An | 3 |
| 16. | A gas mixture containing 2 moles of N2, 7 mol of H2 and 1 mol of NH3 initially, undergoing reaction; N2+3H2 →2NH3. After some time ε = 0.5. Evaluate the estimated mole fraction of NH3 in the mixture. | CO6 | E | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | |
| 17. |  | 1 Kg of water is vaporized in a container at the constant temperature of 373 K and the constant pressure of 1,01,325.0 N/m2. The specific volume of liquid and vapour at these conditions are 1.04×10-3 and 1.673 m3/kg respectively. The amount of heat added to water is 2257 kJ. Calculate the change in internal energy (∆U) and enthalpy (∆H). | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. |  | Determine the second virial coefficient B` in terms of B and third virial coefficient C` in terms of C. | CO4 | C | 12 |
|  |  |  |  |  |  |
| 19. |  | Estimate the change in entropy if 5 kg of water at 350 K is mixed adiabatically with 20 kg of water at 250 K. Assume the specific heat of water is 4.2 kJ/kg-K. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | An azeotrope consists of 42.0 mol percent acetone and 58 mol percent methanol at 760 mm Hg and 313 K. At 313 K, the vapour pressure of acetone and methanol are 786 mm Hg and 551 mm Hg respectively. Calculate the van Laar constants | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | Under atmospheric condition, the acetone-chloroform azeotrope boils at 64.6⸰C and contains 33.5 mol percent acetone. The vapour pressures of acetone and chloroform at this temperature are 995 mm Hg and 885 mm Hg respectively. Calculate the composition of the vapour at this temperature in equilibrium with a liquid analyzing 11.1 mol percent acetone. Apply the van Laar equation of the following form;  ln γ1 = ln γ2 = | CO5 | E | 12 |
|  |  |  |  |  |  |
| 22. |  | Derive the following maxwell equation;  ( )S= - ( )V. | CO3 | C | 12 |
|  |  |  |  |  |  |
| 23. |  | Prove that CP-CV=  Where; CP is specific heat at constant pressure and CV is specific heat at constant volume, α= Isothermal compressibility and β= Volume expansivity. | CO2 | C | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | For a system, in which the following reaction occurs,  CH4+H2O = CO+3H2;  Assume that initially, 2 mol CH4,1 mol H2O, 1 mol CO and 4 mol H2 were present.  Determine expressions for mole fraction yi as a function of ε for the chemical species CH4, H2O, CO and H2 | 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 | 1 | 1 | - | - | 15 | - | 17 |
| CO2 | 2 | 1 | - | 1 | 3 | 12 | 19 |
| CO3 | - | 1 | - | 6 | 12 | 12 | 31 |
| CO4 | - | - | - | 1 | 12 | 12 | 25 |
| CO5 | - | 1 | - | 4 | 12 | - | 17 |
| CO6 | - | - | - | - | 15 | - | 15 |
|  | | | | | | | **124** |

**Graphical user interface, application

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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** | | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | Identify the category of hazard control for considering the ‘processes that reduce the source of exposure’. | | | CO5 | U | | 1 |
| 2. | Illustrate hazard triangle. | | | CO2 | An | | 1 |
| 3. | Recall the practices that is designated for well-characterized organisms that are not pathogenic. | | | CO4 | R | | 1 |
| 4. | Identify the method used to identify the parts and the procedures of a process that have a higher than normal probability of human error. | | | CO6 | U | | 1 |
| 5. | Recognize the guide word used for the HAZOP procedure for ‘the qualitative decrease’. | | | CO6 | R | | 1 |
| 6. | In fault tree, probabilities are multiplied across \_\_\_\_\_\_\_\_ gate and reliabilities are multiplied across \_\_\_\_\_\_\_\_ gate. | | | CO1 | R | | 1 |
| 7. | Name the facility for which no specific biosafety containment is required. | | | CO4 | R | | 1 |
| 8. | Predict a substitution for the pesticides in hazard control programme. | | | CO5 | An | | 1 |
| 9. | Illustrate the engineering control options for the hazard control. | | | CO5 | U | | 1 |
| 10. | Recall an example of organism for Good Large Scale Practices. | | | CO4 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Compile the steps in the risk assessment. | | | CO4 | | A | 3 |
| 12. | List the air emissions controls in the bioprocess industry. | | | CO3 | | R | 3 |
| 13. | Relate the basic components of hazard. | | | CO2 | | U | 3 |
| 14. | Indicate the basic facility design criteria for different biosafety level large scale processes. | | | CO1 | | U | 3 |
| 15. | Categorize the equipment to consider when planning or designing cleaning, sterilization, and inactivation methods in bioprocess industry. | | | CO4 | | An | 3 |
| 16. | Correlate the hazards identification and risk assessment procedure. | | | 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. | Interpret the hazard causal factor model. | CO1 | | U | 6 |
|  | | b. | Illustrate the hazard analysis types in the system safety discipline. | CO6 | | A | 6 |
|  | |  |  |  | |  |  |
| 18. | |  | Classify the biological hazards in the bioprocess industry and factors to be considered for safety in bioprocess industry | CO2 | | A | 12 |
|  | |  |  |  | |  |  |
| 19. | |  | Evaluate the role ergonomics in improvement of health and safety. | CO3 | | E | 12 |
|  | |  |  |  | |  |  |
| 20. | |  | Evaluate the administrative control approach in hazard control. | CO5 | | E | 12 |
|  | |  |  |  | |  |  |
| 21. | |  | Examine safety review as a method to identify safety problems in laboratory and process areas and to develop solutions. | CO4 | | An | 12 |
|  | |  |  |  | |  |  |
| 22. | |  | Demonstrate the fault tree method for the risk assessment. | CO2 | | U | 12 |
|  | |  |  |  | |  |  |
| 23. | |  | Analyze the elements of safety and health programmes. | CO3 | | An | 12 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. | |  | Explain the Large Scale Biosafety guideline forGood Large Scale Practices. | CO4 | | U | 12 |

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

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 22 |  |  |  |  | 23 |
| CO2 |  | 3 | 12 | 1 |  |  | 16 |
| CO3 | 3 |  |  | 12 | 12 |  | 27 |
| CO4 | 2 | 12 | 3 | 15 |  |  | 32 |
| CO5 |  | 2 |  | 1 | 12 |  | 15 |
| CO6 | 2 |  | 6 | 3 |  |  | 11 |
|  | | | | | | | **124** |

**Graphical user interface, application

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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** | | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | | |
| 1. | Define sewage. | | | CO1 | R | | 1 |
| 2. | Define the term ‘occupier’. | | | CO1 | R | | 1 |
| 3. | What is trade effluent? Give two examples. | | | CO2 | U | | 1 |
| 4. | Define Environmental Audit. | | | CO2 | R | | 1 |
| 5. | Indicate any two powers of central Government mentioned in Environmental Protection Act (EPA). | | | CO2 | U | | 1 |
| 6. | Assess the term ‘baseline situation’ in EIA. | | | CO3 | E | | 1 |
| 7. | List the key roles of genetic engineering approval committee. | | | CO6 | E | | 1 |
| 8. | State the role of State Biotechnology Co-ordination committee (SBCC) | | | CO3 | R | | 1 |
| 9. | List out the importance of 3R technology. | | | CO4 | R | | 1 |
| 10. | Compare incineration and shredding. | | | CO5 | E | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | | |
| 11. | Assess the role of material reuse in waste reduction. | | | CO1 | | E | 3 |
| 12. | Appraise the role of mitigation in EIA. | | | CO3 | | An | 3 |
| 13. | Classify the microbes based on its schedule with an example. | | | CO6 | | An | 3 |
| 14. | Summarize on Strategic Environmental Assessment (SEA). | | | CO6 | | U | 3 |
| 15. | Indicate the role of Institutional Bio-Safety Committee (IBSC). | | | CO2 | | U | 3 |
| 16. | Identify any three cleanup technology used in cleaning oil spills. | | | 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 the prevention and control of air Pollution act. | | CO2 | | R | 6 |
|  | b. | List the importance of air quality standards with its ambient levels. | | CO2 | | R | 6 |
|  |  |  | |  | |  |  |
| 18. |  | Classify different types of pollution. Explain various sources, effects of pollution and preventive measures to be carried out in treating and preventing the pollution in detail. | | CO1 | | U | 12 |
|  |  |  | |  | |  |  |
| 19. | a. | Describe constitution, function and fund of central & state boards mentioned in EPA. | | CO2 | | R | 6 |
|  | b. | Describe the penalties, procedure, standards of emission or discharge of environmental pollutants. | | CO2 | | R | 6 |
|  |  |  | |  | |  |  |
| 20. |  | Illustrate a detailed note on the process of conducting environmental audits with its classification. | | CO6 | | U | 12 |
|  |  |  | |  | |  |  |
| 21. | a. | Examine the importance of Environmental Impact Assessment in conserving the environment. | | CO3 | | A | 4 |
|  | b. | Explain the steps involved in implementing EIA with a neat flowsheet. | | CO3 | | A | 8 |
|  |  |  | |  | |  |  |
| 22. | a. | Write a detailed note on various clean technologies that can be implemented and its need for controlling pollution. | | CO4 | | An | 6 |
|  | b. | Explain the methods to recycle and reuse the generated waste with examples. | | CO4 | | An | 6 |
|  |  |  | |  | |  |  |
| 23. |  | Express in detail the rules for manufacture, handling and storage of genetically engineered organisms and recall various committees responsible in implementing the regulations to control pollution. | | CO6 | | C | 12 |
| **COMPULSORY QUESTION** | | | | | | | |
| 24. |  | | Illustrate in detail the stages in handling, management and transport of biomedical waste. Propose the disadvantages in treating biomedical wastes. | CO5 | | A | 12 |

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

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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 12 | - | - | 3 | - | 17 |
| CO2 | 25 | 5 | - | - | - | - | 30 |
| CO3 | 1 | - | 12 | 3 | 1 | - | 17 |
| CO4 | 4 | - | - | 12 | - | - | 16 |
| CO5 | - | - | 12 | - | 1 | - | 13 |
| CO6 | - | 15 | - | 3 | 1 | 12 | 31 |
|  | | | | | | | **124** |

**Graphical user interface, application

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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** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Father of plant tissue culture is \_\_\_\_\_\_\_\_\_\_. | | CO1 | R | | 1 |
| 2. | Define Callus. | | CO2 | U | | 1 |
| 3. | Define Ti plasmid. | | CO2 | U | | 1 |
| 4. | Infer about transposons. | | CO2 | U | | 1 |
| 5. | Identify the bacteria which causes tumour in plants. | | CO3 | R | | 1 |
| 6. | Discuss PR proteins. | | CO3 | U | | 1 |
| 7. | Name two hormones used for the growth of plants in *In vitro* condition. | | CO2 | R | | 1 |
| 8. | Define passaging. | | CO4 | U | | 1 |
| 9. | Name the medium used in animal tissue culture. | | CO5 | R | | 1 |
| 10. | Recite on ICSI. | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Explain organogenesis in plant tissue culture. | | CO1 | | An | 3 |
| 12. | Illustrate on Ri plasmid. | | CO2 | | A | 3 |
| 13. | Identify the antifungal proteins used for plant protection. | | CO3 | | U | 3 |
| 14. | Indicate the role of gene silencing in plants. | | CO4 | | U | 3 |
| 15. | Define cross contamination. | | CO5 | | U | 3 |
| 16. | Report on embryo sexing. | | CO6 | | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | | |
| 17. |  | Describe the transfer and establishment of whole plants in soil with necessary examples. | CO1 | | R | 12 |
|  |  |  |  | |  |  |
| 18. |  | Summarize on greenhouse technology in crop development. | CO3 | | E | 12 |
|  |  |  |  | |  |  |
| 19. |  | Discuss on direct and indirect methods of gene transfer in plant cells. | CO3 | | U | 12 |
|  |  |  |  | |  |  |
| 20. |  | Appraise the importance of selectable markers and reporter genes in plants. | CO4 | | An | 12 |
|  |  |  |  | |  |  |
| 21. |  | Explain the steps involved in primary cell culture and sub culturing in animal cell culture. | CO5 | | U | 12 |
|  |  |  |  | |  |  |
| 22. |  | Infer on genome editing technology and CRISPER/Cas. | CO4 | | An | 12 |
|  |  |  |  | |  |  |
| 23. |  | Discuss the process involved in scaling up of animal cell culture. | CO5 | | U | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Describe *In vitro* fertilization and write about ethical issues in animal biotechnology. | CO6 | | R | 12 |

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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 Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 13 |  |  | 3 |  |  | 16 |
| CO2 | 2 | 3 | 3 |  |  |  | 8 |
| CO3 |  | 16 |  |  | 12 |  | 28 |
| CO4 |  | 4 |  | 24 |  |  | 28 |
| CO5 | 1 | 27 |  |  |  |  | 28 |
| CO6 | 13 | 3 |  |  |  |  | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Recall the role of heterosis in plant breeding. | | CO1 | U | | 1 |
| 2. | Define cybrids. | | CO1 | R | | 1 |
| 3. | Define the term dedifferentiation. | | CO2 | R | | 1 |
| 4. | Recognize the role micro propagation in crop improvement. | | CO2 | R | | 1 |
| 5. | Give any ONE example of restriction endonuclease with their restriction site. | | CO3 | U | | 1 |
| 6. | How are protoplasts isolated? | | CO3 | R | | 1 |
| 7. | Explain any ONE cause for loss of diversity. | | CO4 | U | | 1 |
| 8. | **Cite the usefulness of In-Situ and Ex-Situ conservations.** | | CO4 | R | | 1 |
| 9. | Define biopiracy with one example. | | CO5 | U | | 1 |
| 10. | Cite one example of application of Phylogenetics in agricultural biotechnology. | | CO6 | U | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Appraise the effects of Inbreeding depression. | | CO1 | | An | 3 |
| 12. | Explain direct and indirect organogenesis. | | CO2 | | U | 3 |
| 13. | Summarize the general features of cloning vectors in plant systems. | | CO3 | | An | 3 |
| 14. | **List any three most biodiversity-rich zones in India.** | | CO4 | | U | 3 |
| 15. | List the benefits of intellectual property rights. | | 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. |  | Explain the following: Morphogenesis, Organogenesis and Embryogenesis with suitable examples. | CO1 | | U | 12 |
| 18. | a. | Explain tissue culture technology and their application in agriculture. | CO2 | | U | 8 |
|  | b. | Write a note on clonal selection with a schematic diagram. | CO2 | | U | 4 |
| 19. | a. | How are restriction endonucleases used in recombinant DNA technology? Explain with a suitable diagram. | CO3 | | U | 8 |
|  | b. | Summarize the steps involved in recombinant technology. | CO3 | | U | 4 |
| 20. | a. | List and describe the importance of biodiversity hotspots in India. | CO4 | | An | 6 |
|  | b. | Explain the genetics and evolutionary principles of conservation. | CO4 | | An | 6 |
| 21. | a. | US patent office withdraws patent on Indian herb turmeric- Explain with a suitable case study. | CO5 | | An | 8 |
|  | b. | Describe the basic principles underlying the plant variety protection laws in India. | CO5 | | U | 4 |
| 22. | a. | Examine the different methods of breeding cross pollinated crops. | CO2 | | A | 8 |
|  | b. | Articulate the significance of somaclonal variation in crop improvement. | CO2 | | A | 4 |
| 23. | a. | Appraise the usage of embryo culture and protoplast fusion in crop improvement. | CO2 | | E | 6 |
|  | b. | Germplasm Conservation is an Instrument in Agricultural Biodiversity- Justify with suitable examples. | CO2 | | E | 6 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. | a. | Illustrate gene annotation methods with suitable examples. | CO6 | | An | 8 |
|  | b. | Examine the importance of two biological sequence databases. | CO6 | | A | 4 |

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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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| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 13 |  | 3 |  |  | 17 |
| CO2 | 2 | 15 | 12 |  | 12 |  | 41 |
| CO3 | 1 | 13 |  | 3 |  |  | 17 |
| CO4 | 1 | 4 |  | 12 |  |  | 17 |
| CO5 |  | 5 |  | 11 |  |  | 16 |
| CO6 |  | 4 | 4 |  | 8 |  | 16 |
|  | | | | | | | **124** |

**Graphical user interface, application

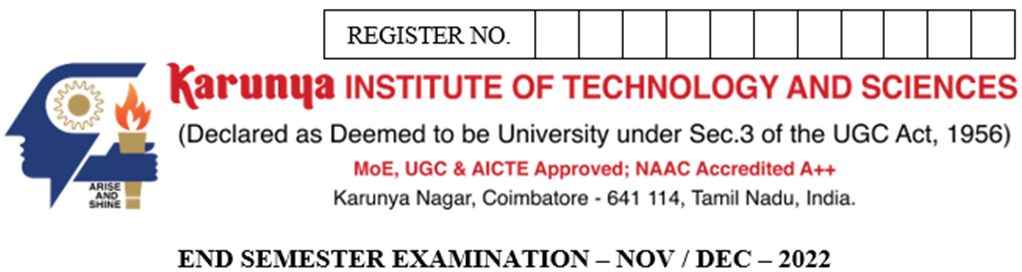
Description automatically generated with medium confidence**

| **Course Code** | **20BT2053** | **Duration** | **3hrs** |
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| **Course Name** | **BIOMASS AND BIOENERGY** | **Max. Marks** | **100** |

| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| --- | --- | --- | --- | --- | --- | --- |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | Define bioenergy. | | CO1 | R | | 1 |
| 2. | Give two examples of oil seeds used for biofuel production. | | CO1 | U | | 1 |
| 3. | Name the enzyme used for industrial hydrolysis of starch. | | CO2 | R | | 1 |
| 4. | Identify the raw material used for anaerobic digestion. | | CO2 | R | | 1 |
| 5. | Define incineration. | | CO3 | R | | 1 |
| 6. | List two examples of biofuels produced from biomass. | | CO3 | U | | 1 |
| 7. | Define brown grease. | | CO4 | R | | 1 |
| 8. | List the side product produced along with biodiesel during trans esterification reaction. | | CO4 | A | | 1 |
| 9. | Give example of a compostable waste. | | CO5 | U | | 1 |
| 10. | Enumerate the amount of crude oil imported in India. | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Explain energy crops with an example. | | CO1 | | U | 3 |
| 12. | Write down the steps in anaerobic digestion. | | CO2 | | A | 3 |
| 13. | Define gasification. | | CO3 | | R | 3 |
| 14. | Explain saponification reaction and why it is carried out? | | CO4 | | U | 3 |
| 15. | Explain landfill method of waste disposal. | | CO5 | | U | 3 |
| 16. | Give an example for a funding agency that promotes biofuel research and production in India. | | 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. | Classify biofuels based on technology maturity. | CO1 | | U | 6 |
|  | b. | Classify biofuels based on physical state. | CO1 | | U | 6 |
| 18. | a. | Explain the process of ethanol synthesis from  i) Sugars,  ii) Starch. | CO2 | | A | 6 |
|  | b. | Explain the process of ethanol synthesis from iii) lignocellulosic biomass. | CO2 | | A | 6 |
| 19. | a. | Define combustion and explain the types of combustion mixture. | CO3 | | R | 4 |
|  | b. | Define Pyrolysis and explain the types of pyrolysis. | CO3 | | R | 8 |
| 20. | a. | List any four raw materials used for production of biodiesel. | CO4 | | R | 4 |
|  | b. | Explain the steps for production of biodiesel from a waste cooling oil with 15% free fatty acid (FFA). | CO4 | | U | 8 |
| 21. | a. | Explain landfill method of waste disposal. | CO5 | | U | 6 |
|  | b. | Explain the incineration method of waste disposal. What are the disadvantages of incineration? | CO5 | | U | 6 |
| 22. |  | Explain the proximate and ultimate methods for biomass characterization. | CO1 | | An | 12 |
| 23. |  | Explain in detail, the steps involved in anaerobic digestion process. | CO2 | | A | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Explain the steps and interventions taken up by the government towards biofuel in India. | CO6 | | An | 12 |

|  | **COURSE OUTCOMES** |
| --- | --- |
| CO1 | Understand the fundamental concepts of energy. |
| CO2 | Relate the principles underlying the design and operation of biomass to energy. |
| CO3 | Identify the bioconversion techniques and limitations in Biomass processing. |
| CO4 | Compare Biomass conversion processes. |
| CO5 | Analyze research issues in biodiesel production. |
| CO6 | Measure the Environmental impacts of biofuels and legislation. |

| **Assessment Pattern as per Bloom’s Level** | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 1 | 16 | - | 12 | - | - | 29 |
| CO2 | 2 | - | 27 | - | - | - | 29 |
| CO3 | 1 | 16 | - | - | - | - | 17 |
| CO4 | 5 | 11 | 1 | - | - | - | 17 |
| CO5 | 16 | - | - | - | - | - | 16 |
| CO6 | 1 | 3 |  | 12 | - | - | 16 |
|  | | | | | | | **124** |



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| **Course Code** | **20BT2056** | **Duration** | **3hrs** |
| **Course Name** | **ENTREPRENEURSHIP FOR BIOENGINEERS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | |
| 1. | Distinguish between entrepreneur and enterprise. | CO1 | An | 1 |
| 2. | Write the role of District Industrial Corporation. | CO2 | A | 1 |
| 3. | Define market survey. | CO2 | R | 1 |
| 4. | Recall the key areas of biotechnology. | CO3 | R | 1 |
| 5. | State the major roles of tiny units. | CO3 | R | 1 |
| 6. | Define ‘Acid Test’. | CO4 | U | 1 |
| 7. | State the importance of venture capitals. | CO4 | R | 1 |
| 8. | Assess the key factors influencing the mobility of entrepreneur. | CO5 | An | 1 |
| 9. | Expand ‘SISI’ | CO4 | U | 1 |
| 10. | Write the policy for subsidies. | CO6 | A | 1 |

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| **PART – B (6 X 3 = 18 MARKS)** | | | | |
| 11. | Differentiate: creativity, innovation and entrepreneurship. | CO1 | An | 3 |
| 12. | Assess the paradox of entrepreneurship. | CO2 | An | 3 |
| 13. | Illustrate the five essential elements for growing a biotechnology cluster in a region. | CO3 | A | 3 |
| 14. | You won a lemonade stand. It costs you Rs.1.50 to make a cup of lemonade. You sell your lemonade for Rs.5.00. It costs you Rs.5,000 to rent for the space of your lemonade stand. How many cups do you have to sell to breakeven? | CO4 | E | 3 |
| 15. | Write a note on ‘e-commerce’. | CO5 | A | 3 |
| 16. | Determine the importance of International collaborations. | CO6 | A | 3 |

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| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.no 17 to 23)** | | | | | |
| 17. |  | Describe the types of Entrepreneurs with suitable factors. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Critique on SWOT analysis in business plan preparation. | CO2 | E | 4 |
|  | b. | Explain the four major startup Silicon Valley interventions implemented in India. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 19. | a. | Articulate case studies on start-up village in Kerala. | CO2 | E | 6 |
|  | b. | Appraise different forms of Intellectual Property rights for the protection of bio-based products. | CO6 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | Examine the stages involved in entrepreneurship sickness. | CO3 | A | 6 |
|  | b. | Criticize the government measures to combat industrial sickness. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 21. | a. | Evaluate the funding opportunities to establish Technology Business Incubator in institutions. | CO5 | E | 8 |
|  | b. | Analyze the market feasibility of the bio-based products. | CO5 | An | 4 |
|  |  |  |  |  |  |
| 22. |  | Construct the flow sheet of breakeven analysis and ratio analysis for financial interpretation. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 23. |  | Prepare the concept proposal with the aspect of idea, prototype, product development and commercialization. | CO6 | C | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Discuss the role and different government schemes for supporting entrepreneurship in Biotechnology. | CO5 | A | 12 |

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|  | **COURSE OUTCOMES** |
| CO1 | Understand the 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 | Transform research based ideas into feasibility business plans and IPR. |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | 12 | - | 4 | - | - | 16 |
| CO2 | 1 | 8 | 1 | 3 | 10 | - | 23 |
| CO3 | 2 | - | 9 | - | 6 | - | 17 |
| CO4 | 1 | 2 | - | - | 15 |  | 18 |
| CO5 | - | - | 15 | 1 | 4 | 8 | 28 |
| CO6 | - | - | 4 | - | 6 | 12 | 22 |
|  | | | | | | | **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** | | **Course Outcome** | **Bloom’s Level** | | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | | |
| 1. | \_\_\_\_\_\_\_\_\_\_ is a framework for providing converged voice and data on a 4G Long-Term Evolution (LTE) network. | | CO1 | U | | 1 |
| 2. | \_\_\_\_\_\_\_\_ is the identifying signature of a particular tag under the scan of the reader. | | CO1 | R | | 1 |
| 3. | Define Actuator. | | CO2 | R | | 1 |
| 4. | What is an Analog Sensor? | | CO2 | R | | 1 |
| 5. | Name an app, that can be used to get the market price of crops in the markets within 50 km of the device’s location capture by GPS. It can also get price of any market and any crop without using GPS location. | | CO3 | U | | 1 |
| 6. | \_\_\_\_\_\_\_\_ is one of the few food tech startups, that combines drone scouting and multi-sensor analysis to predict crop health for longevity that have literally made their mark in the field. | | CO3 | R | | 1 |
| 7. | In 1988, Intermec Corporation created the first 2D barcode, they called it \_\_\_\_\_\_\_\_\_\_. | | CO4 | U | | 1 |
| 8. | \_\_\_\_\_\_\_\_\_ barcodes look like QR codes with a finder icon in the middle and the icon is uniquely generated for each code, and it helps the barcode scanner decode the surrounding squares | | CO4 | R | | 1 |
| 9. | Write a note on the RF Bluetooth technology. | | CO5 | U | | 1 |
| 10. | List two examples of IoT in laboratory automation. | | CO6 | R | | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | | |
| 11. | Infer the Technology Challenges in IoT implementation. | | CO1 | | An | 3 |
| 12. | Differentiate Scalar and Vector sensors. | | CO2 | | U | 3 |
| 13. | Interpret the importance of Smart Agriculture IoT Stick. | | CO3 | | An | 3 |
| 14. | Indicate the working of RFID tags. | | CO4 | | U | 3 |
| 15. | Differentiate the technology between RF Vs Bluetooth. | | CO5 | | An | 3 |
| 16. | Express the various Device management challenges in IoT. | | 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 IoTas a trending technology. | CO1 | | U | 6 |
|  | b. | Classify the 6 levels of Automation levels in driverless cars laid down by the traffic safety administration in the USA. | CO1 | | U | 6 |
| 18. | a. | Explain the evolution of Internet which enabled IoT. | CO2 | | A | 6 |
|  | b. | Appraise the significance of Solar Photovoltaic Cells and their types. | CO2 | | An | 6 |
| 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. |  | Debate the importance of Cloud servers in today’s IoT scenario. | CO5 | | E | 12 |
| 22. | a. | Articulate the various technologies in Autonomous seeding system where IoT is used. | CO3 | | A | 06 |
|  | b. | Justify the Central Government of India initiative for farmers who are unable to buy the various sensors used in Agriculture. | CO3 | | E | 06 |
| 23. |  | Summarize the regulations for GDP and GMP laid down by the pharmaceutical industry with respect to IoT. | CO4 | | An | 12 |
| **COMPULSORY QUESTION** | | | | | | |
| 24. |  | Survey the challenges in terms of Network integrity in R&D Laboratories with respect to Data. | CO6 | | An | 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 Level** | | | | | | | |
| **CO / P** | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| **CO1** | 01 | 13 | - | 03 | - | - | 17 |
| **CO2** | 02 | 03 | 06 | 06 | - | - | 17 |
| **CO3** | 01 | 01 | 06 | 03 | 18 | - | 29 |
| **CO4** | 01 | 04 | - | 24 | - | - | 29 |
| **CO5** | - | 01 | - | 03 | 12 | - | 16 |
| **CO6** | 01 | 03 | - | 12 | - | - | 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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define an explant. | | CO1 | R | 1 |
| 2. | List the characteristics of haploid plants. | | CO1 | R | 1 |
| 3. | Recall the importance of microcarriers. | | CO2 | R | 1 |
| 4. | Define site directed integration of transgene. | | CO2 | U | 1 |
| 5. | Recall the size of Ti plasmid. | | CO3 | R | 1 |
| 6. | List the NIF genes for Nitrogen fixation in legumes. | | CO3 | R | 1 |
| 7. | Cite one example of a drug produced through plant cell suspension culture. | | CO4 | U | 1 |
| 8. | Define immobilization of enzymes. | | CO4 | R | 1 |
| 9. | Recall one abiotic stress factor in plants. | | CO5 | R | 1 |
| 10. | Infer the advantage of reusable bioreactors in plant cell suspension. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the significance of anther culture. | | CO1 | An | 3 |
| 12. | Interpret the significance of chloroplast transformation. | | CO2 | A | 3 |
| 13. | Recall the importance of co-integrative vector in plant genetic transformation. | | CO3 | R | 3 |
| 14. | State the elicitors used for *in vitro* drug enhancement in plant cell suspension culture. | | CO4 | R | 3 |
| 15. | Write the steps involved in commercial seed production. | | CO5 | A | 3 |
| 16. | Discuss the role of IPC in plant bioreactors. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No 17 to 23, Q.No 24 is Compulsory)** | | | | | |
| 17. |  | Explain the different stages of micro propagation and its significance with diagram. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the protocol for biolistic method of gene transfer in plants with diagram. | CO2 | An | 6 |
|  | b. | Analyze the role of virulence genes in Agrobacterium mediated gene transfer. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. | a. | Analyze the molecular mechanism involved in Nitrogen fixation in legumes. | CO3 | An | 7 |
|  | b. | Illustrate the steps involved in plant gene transfer using binary vector. | CO3 | An | 5 |
|  |  |  |  |  |  |
| 20. |  | Evaluate the process of *in vitro* production of secondary metabolites using hairy root culture. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | Describe the natural disease resistance mechanism exhibited by plants against biotic stress. | CO5 | R | 12 |
|  |  |  |  |  |  |
| 22. |  | Summarize the process adapted in cultivar release and commercial seed production in India. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the different selectable markers used in plant genetic transformation for development of transgenic crops. | CO3 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Elaborate on the different types of bioreactors for *in vitro* production of pharmaceutical drugs through root culture. | CO6 | E | 12 |

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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 Level** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 2 | 12 |  | 3 |  |  | 17 |
| CO2 | 1 | 1 | 3 | 12 |  |  | 17 |
| CO3 | 5 |  | 12 | 12 |  |  | 29 |
| CO4 | 4 | 1 |  |  | 12 |  | 17 |
| CO5 | 13 |  | 3 |  | 12 |  | 28 |
| CO6 |  | 4 |  |  | 12 |  | 16 |
|  | | | | | | | **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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Recall the blood group glycan with illustrative diagrams. | CO1 | R | 8 |
|  | b. | Show the interactions of lectins with different glycoconjugates. | CO1 | R | 8 |
|  |  |  |  |  |  |
| 2. |  | Summarize the role of enzyme markers in various disease diagnosis. | CO2 | U | 16 |
|  |  |  |  |  |  |
| 3. | a. | Explain the methods used for antibody engineering. | CO3 | U | 8 |
|  | b. | Infer on abzyme and its applications. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 4. |  | Appraise the development of structured lipids and criticize on their applications as food and nutraceuticals. | CO4 | E | 16 |
|  |  |  |  |  |  |
| 5. | a. | Analyze the applications of enzyme based biosensors. | CO5 | An | 8 |
|  | b. | Examine the applications of enzymes in pharmaceutical industries. | CO5 | An | 8 |
|  |  |  |  |  |  |
| 6. | a. | Illustrate the structure – function relationship in any one protein. | CO4 | U | 8 |
|  | b. | Outline the role of biopolymer scaffold in tissue engineering. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 7. | a. | Explain the therapeutic applications of nucleic acid probe. | CO6 | E | 8 |
|  | b. | Criticize on the current status of gene therapy. | CO6 | E | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. |  | Analyze the role of biopolymer in bioremediation and add a note on novel applications of liposomes in nano-biotechnology. | CO6 | An | 20 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 16 |  |  |  |  |  | 16 |
| CO2 |  | 16 |  |  |  |  | 16 |
| CO3 |  | 16 |  |  |  |  | 16 |
| CO4 |  | 16 |  |  | 16 |  | 32 |
| 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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Recall the various applications of recombinant products with suitable examples. | CO1 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Outline the tools used in genetic engineering to clone and express the gene of interest. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. | a. | Classify the PCR techniques used in genetic manipulation and explain any two types in detail. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Illustrate the steps of pyrosequencing method. | CO4 | U | 10 |
|  | b. | Infer of Next Generation Sequencing methods. | CO4 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Examine the steps involved in generation of genomic library. | CO5 | An | 10 |
|  | b. | List out the applications of genomic and cDNA libraries. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Analyze the different methods used for transferring recombinant DNA into target cell. | CO1 | An | 20 |
|  |  |  |  |  |  |
| 7. | a. | Evaluate the various gene editing tools used in genetic manipulation for commercial purpose. | CO5 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Appraise the techniques used for the production of plantibodies and edible vaccines for therapy. | CO6 | E | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Analyze the genetic manipulation techniques employed for the production of insulin and growth hormone for therapeutic use. | CO6 | An | 20 |

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|  | **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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 20 |  |  | 20 |  |  | 40 |
| CO2 |  | 20 |  |  |  |  | 20 |
| CO3 |  |  |  | 20 |  |  | 20 |
| CO4 |  | 20 |  |  |  |  | 20 |
| CO5 |  |  |  | 20 | 20 |  | 40 |
| CO6 |  |  |  | 20 | 20 |  | 40 |
|  | | | | | | | **180** |

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| **Course Code** | **20BT3003** | **Duration** | **3hrs** |
| **Course Name** | **BIOPROCESS MODELLING AND SIMULATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Infer the implications of modelling and simulation in a bioprocess system. | CO1 | C | 6 |
|  | b. | Construct a flow-chart depicting the different stages in the modelling procedure. | CO1 | C | 10 |
|  |  |  |  |  |  |
| 2. | a. | Differentiate modelling and simulation strategies based on information required in each step of the exercise. | CO2 | An | 6 |
|  | b. | Distinguish between the key steps involved in the calculation of confidence interval in bootstrap parameter estimation. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain the steps involved in solving a system of ODEs using Matlab Solver using an appropriate flowchart, if necessary. | CO3 | An | 10 |
|  | b. | Appraise the utility of the Runge-Kutta method in formulating numerical solutions of differential equations. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 4. | a. | Formulate the mathematical approach to estimate the sensitivity of dynamic model parameters in bioprocess. Infer the utility of such sensitivity analysis. | CO4 | C | 10 |
|  | b. | In the modelling of a bioprocess using a guess parameter, the following observations are made for experimental and modelled data.  Expt. X (g/L) 0.10 0.20 0.30 0.40  Model X (g/L) 0.12 0.25 0.28 0.45  Estimate the SSE and R2 for the given data set. | CO4 | C | 6 |
|  |  |  |  |  |  |
| 5. | a. | Discuss the parameter identifiability problem in modelling. How can we improve/simplify the parameter identification exercise? | CO5 | U | 10 |
|  | b. | Describe the mathematical model variants you may opt to use to represent diauxic growth or dual substrate growth. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 6. |  | Compile the different microbiological steps involved in the anaerobic digestion of insoluble substrate into methane.Also, develop a simplified dynamic model to represent the bioprocess. | CO6 | C | 10 |
|  |  | Justify the use of the logistic growth model in bioprocess and any modifications pertaining to the same. | CO6 | C | 6 |
|  |  |  |  |  |  |
| 7. |  | Acetic acid bacteria aerobically convert ethanol to acetic acid and CO2. Construct mass balance, and charge balance equations assuming carbonate chemistry, biomass, substrate, product and CO2 exchange. | CO1 | A | 10 |
|  | b. | *E. coli* culture is growing on glucose producing an engineered protein. Articulate differential equations representing mass balance equations for the same. | CO1 | A | 6 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Connect bioprocess steps in modelling simultaneous saccharification and fermentation of cellulose to bioethanol. | CO6 | An | 10 |
|  | b. | Differentiate between available kinetic models that projects substrate and product inhibition in bioprocess. | CO6 | An | 10 |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 0 | 0 | 16 | 0 | 0 | 16 | 32 |
| CO2 | 0 | 0 | 0 | 16 | 0 | 0 | 16 |
| CO3 | 0 | 0 | 0 | 16 | 0 | 0 | 16 |
| CO4 | 0 | 0 | 0 | 0 | 0 | 16 | 16 |
| CO5 | 0 | 16 | 0 | 0 | 0 | 0 | 16 |
| CO6 | 0 | 0 | 0 | 20 | 0 | 16 | 36 |
|  | | | | | | | **132** |



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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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Distinguish competitive from non-competitive enzyme inhibitions and its importance. | CO1 | U | 8 |
|  | b. | Describe biological catalysis and its classification. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Describe Monod changeuxwyman model. | CO2 | U | 8 |
|  | b. | Interpret the structure of enzyme using X-ray crystallography. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the kinetics of immobilized enzyme. | CO3 | U | 8 |
|  | b. | Explain the classification of carriers and mention one example. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 4. | a. | Explain the extraction and purification of Cellulase enzyme. | CO5 | U | 8 |
|  | b. | Explain the analysis of diffusional effects in porous supports. | CO3 | U | 8 |
|  |  |  |  |  |  |
| 5. | a. | Explain with neat diagram the various models of enzyme action on substrate. | CO5 | U | 8 |
|  | b. | Describe in detail about the synthesis of catalytic antibodies with an example. | CO5 | R | 8 |
|  |  |  |  |  |  |
| 6. | a. | Explain Pyruvate adolase and its uses. | CO6 | U | 8 |
|  | b. | Explain the production of catalytic antibodies. | CO6 | U | 8 |
|  |  |  |  |  |  |
| 7. | a. | Describe the kinetics of multi substrate enzyme reactions. | CO6 | R | 8 |
|  | b. | Explain the method to increase the substrate specificity. | CO6 | U | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Explain the design of one enzyme electrode. | CO4 | U | 10 |
|  | b. | Discuss the application of enzymes in medicine. | CO4 | U | 10 |

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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 enzyme. |
| 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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | 16 | - | - | - | - | 16 |
| CO2 | - | 24 | - | - | - | - | 24 |
| CO3 | - | 16 | - | - | - | - | 16 |
| CO4 | - | 20 | - | - | - | - | 20 |
| CO5 | 8 | 16 | - | - | - | - | 24 |
| CO6 | 8 | 24 | - | - | - | - | 32 |
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| **Course Code** | **20BT3009** | **Duration** | **3hrs** |
| **Course Name** | **MICROBIAL BIOTECHNOLOGY** | **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. | Articulate different approaches for strain improvement in industrial biotechnology. | CO1 | A | 10 |
|  | b. | Examine the techniques involved in screening of antibiotic producing microorganisms. | CO1 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Describe the working principle of 2D gel electrophoresis and their application. | CO2 | U | 12 |
|  | b. | Explain the objectives of metagenomics and their diversified applications. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 3. | a. | Appraise the production of any one important recombinant vaccine using rDNA technology. State their merits and demerits. | CO3 | An | 10 |
|  | b. | With the help of any TWO suitable examples, demonstrate how microorganisms transform steroids. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Discuss the importance of Vesicular-arbuscular mycorrhiza (VAM) fungi in agriculture. Distinguish between ecto and endomycorrhiza. | CO4 | An | 10 |
|  | b. | Quorum sensing causes some pathogens to express virulence factors that promote infection of gram positive and gram negative bacteria-Critically discuss with suitable examples. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Examine the production of bacteriocin using suitable lactic acid bacteria. Add a note on their applications in food industry. | CO5 | A | 10 |
|  | b. | Discuss food preservation by high temperatures. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Articulate the working of MALDI instrument and their applications in biology. | CO2 | A | 12 |
|  | b. | Describe the methods to construct phylogenetic tree to understand the evolution of microbes. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 7. | a. | Appraise the mechanism of bacteriophage in control of multi drug resistant/pathogenic bacteria. | CO4 | An | 10 |
|  | b. | Discuss about staphylococcal food intoxication. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the production process of penicillin acylase using suitable microorganism. Add a note on their stability and formulation. | CO6 | C | 10 |
|  | b. | Illustrate the industrial production of antibiotics with one example. | CO6 | A | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Appraise the production of Biofuel from algae to overcome the energy crisis. | CO6 | E | 10 |
|  | b. | Microbial fuel cells are considered as source of sustainable energy- Discuss. | CO6 | U | 10 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | - | 20 | - | - | - | 20 |
| CO2 | - | 28 | 12 | - | - | - | 40 |
| CO3 | - | 10 | - | 10 | - | - | 20 |
| CO4 | - | - | - | 30 | - | - | 30 |
| CO5 | - | 20 | 10 | - | - | - | 30 |
| CO6 | - | 10 | 10 | - | 10 | 10 | 40 |
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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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Discuss the various types of Plant tissue culture techniques. | CO1 | U | 10 |
|  | b. | Review on the current scenario of Biotech industries. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Describe the role of microbe in biofertilizers. | CO2 | R | 20 |
|  |  |  |  |  |  |
| 3. |  | Explain the mechanism of action of rhizobacteria in agriculture. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Summarize on Genetically engineered microbes (GEMs) with examples. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 5. |  | Illustrate the role of Biotechnology for natural, artificial flavor and fragrance production. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Enumerate on the principles and methods of food preservation. | CO4 | R | 20 |
|  |  |  |  |  |  |
| 7. |  | Sketch on Food borne infections and intoxication. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Articulate on Plant derived Biotechnological Products with relevant examples. | CO6 | A | 20 |
| **PART – B(1 X 20= 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Explain the immobilization of microbial and cultured plant cells. | CO6 | U | 20 |

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

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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 | 20 |  |  |  | 60 |
| CO5 |  | 20 | 20 |  |  |  | 40 |
| CO6 |  | 20 |  |  |  |  | 20 |
|  | | | | | | | **180** |

Graphical user interface, application

Description automatically generated with medium confidence

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| **Course Code** | **20BT3012** | **Duration** | **3hrs** |
| **Course Name** | **BIOETHICS AND BIOSAFETY** | **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. |  | Illustrate the National and International level biosafety regulations in recombinant DNA research with suitable examples. | CO1 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Discuss the good manufacturing practices to be adapted by an industry involved in production of enzymes using GMO. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Define IPR. Summarize the different types of intellectual property rights with suitable examples. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Illustrate the importance of IPR in the current scenario of rDNA research in Biotechnology with necessary examples | CO3 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Explain the various biosafety assessment procedures of GM foodswith case studies of relevance. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Justify the use of animals for research in biotechnology and ethics in animal cloning with suitable case studies. | CO4 | E | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain the ethics involved in xenotransplantation in modern day research with relevant examples. | CO4 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Discuss on biodiversity, plant breeder’s rights and its legal implications with suitable examples. | CO6 | U | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Analyze the rDNA guidelines of department of biotechnology for microorganisms with suitable examples. | CO6 | An | 20 |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(5 X 16= 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Define computational biology. Describe the structural and functional processing characterization of DNA. | CO1 | R | 8 |
|  | b. | Summarize the computational operations and Step involve in DNA computing techniques. | CO1 | U | 8 |
|  |  |  |  |  |  |
| 2. | a. | Briefly explain the technological concept of Adelman experiment for DNA biomolecular computing. | CO1 | U | 8 |
|  | b. | Describe the importance of RNA secondary structure, write a detail note on covariance models and Application of RNA fold. | CO1 | R | 8 |
|  |  |  |  |  |  |
| 3. | a. | Outline the steps used to find RNA structure folding by Nussinov algorithms. | CO2 | R | 8 |
|  | b. | What is force field? Describe briefly about the classical mechanics in force field. | CO2 | R | 8 |
|  |  |  |  |  |  |
| 4. | a. | Illustrate the force field mechanism model Types of Potentials. | CO3 | R | 9 |
|  | b. | Describe the principal mechanism of The Morse Potential and Harmonic Oscillator Model for Molecular simulations. | CO3 | U | 7 |
|  |  |  |  |  |  |
| 5. | a. | Explain the principal analysis of predicted dynamics simulation structure of molecule with various functions. | CO3 | R | 8 |
|  | b. | What is force field? Describe briefly about the classical mechanics in force field. | CO4 | A | 8 |
|  |  |  |  |  |  |
| 6. | a. | Explain the principle and methodology involved in detail study of molecular mechanics. | CO4 | R | 9 |
|  | b. | What is energy potential, Classify the types of potential in molecular mechanics. | CO4 | U | 7 |
|  |  |  |  |  |  |
| 7. | a. | Explain in detail about the implementation and Importance of a data warehousing. | CO5 | U | 8 |
|  | b. | Define data warehouse. Draw the architecture of data warehouse and explain the three tiers in detail. | CO5 | A | 8 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Explain briefly about the systems biology networks and basics of computer networks. | CO6 | R | 10 |
|  | b. | Elaborate the various properties and types of Networks with respective functional characterization. | 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 | 16 |  |  |  |  | 32 |
| CO2 | 16 |  |  |  |  |  | 16 |
| CO3 | 17 | 7 |  |  |  |  | 24 |
| CO4 | 17 | 7 | 8 |  |  |  | 24 |
| CO5 | 8 |  | 8 |  |  |  | 16 |
| CO6 | 10 | 10 |  |  |  |  | 20 |
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| **Course Code** | **20BT3021** | **Duration** | **3hrs** |
| **Course Name** | **DRUG DESIGN AND DISCOVERY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Appraise the various stages of drug discovery and development. | CO1 | E | 12 |
|  | b. | Comment on Drug repurposing. Summarize the significant challenges and opportunities in drug repurposing. | CO1 | U | 8 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Illustrate the different approaches in lead discovery prior to drug discovery. | CO2 | U | 10 |
|  | b. | Classify receptors. Explain the various theories and forces involved in drug receptor interaction. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Explain about the identification of a pharmacophore in computer aided drug design. | CO3 | An | 10 |
|  | b. | Appraise various approaches used in rational drug design. | CO3 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the protocol to file a patent. Enlist the basic characteristics to make a patent novel. | CO4 | U | 12 |
|  | b. | Describe World Intellectual Property Organization (WIPO) and its role in economic development. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 5. | a. | Examine the various stages involved in FDA’s new drug approval process. | CO5 | A | 10 |
|  | b. | Analyze the philosophy of cGMP and its relevance to globalized pharmaceutical industry. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Pharmacodynamics refers to the relationship between drug concentration at the site of action and the resulting effect-Discuss. | CO2 | An | 10 |
|  | b. | Explain various routes of administration with their advantages and disadvantages. Add a note on novel drug delivery system. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Appraise the importance of prediction and analysis of ADME properties in drug design. | CO3 | An | 10 |
|  | b. | Explain the following: (i) Combinatorial chemistry (ii) High throughput screening. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Examine the various steps involved in carrying out a clinical trial. | CO6 | A | 10 |
|  | b. | Describe the current principles of Good Clinical Practices guidelines. | CO6 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 9. | a. | Illustrate about acute, chronic toxicity studies. | CO6 | An | 12 |
|  | b. | Appraise the mechanism, test system of chemical carcinogenesis. | CO6 | E | 8 |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | 20 | - | - | 10 | - | 30 |
| CO2 | - | 10 | - | 20 | - | - | 30 |
| CO3 | - | 10 | - | 20 | 10 | - | 40 |
| CO4 | - | 20 | - | - | - | - | 20 |
| CO5 | - | - | 10 | 10 | - | - | 20 |
| CO6 | - | 10 | 10 | 12 | 8 | - | 40 |
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| **Course Code** | **20BT3027** | **Duration** | **3hrs** |
| **Course Name** | **NANOBIOTECHNOLOGY** | **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. | Explain in detail the concept of quantum dots and dendrimers. | CO1 | U | 10 |
|  | b. | Explain the process of lithography. Compare hard and soft lithography. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the principle and working of Raman spectroscopy for the evaluation of properties of nanomaterials and nanostructures. | CO2 | E | 10 |
|  | b. | Explain UV and FTIR analysis of nanoparticles and their significance. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Discuss about targeted drug delivery using nanoparticles. | CO3 | U | 12 |
|  | b. | Explain Nanorobots and their application in medicine. | CO3 | U | 8 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Illustrate on different Nanodevices used for drug delivery system. | CO4 | A | 10 |
|  | b. | Appraise various types of nano sensors on the basis of electronic, magnetic and mechanical. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the operations of MEMS cantilevers. | CO5 | U | 10 |
|  | b. | Nanotechnology on a chip- a new paradigm shift- Explain with suitable examples. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain in detail size and surface, morphological analysis of nanostructures using SEM. | CO2 | U | 10 |
|  | b. | Discuss the applications of [nanoparticles](https://www.sciencedirect.com/topics/chemistry/nanoparticle) designed for [oral drug delivery](https://www.sciencedirect.com/topics/chemistry/oral-drug-delivery) systems for peptide-based pharmaceuticals. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Appraise the function and application of DNA based nanostructures. | CO4 | An | 10 |
|  | b. | Discuss the concept and applications of biomaterial-based nanocircuitry with examples. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Assess the toxicity of nanoparticles using suitable *in vitro* methods. | CO6 | E | 10 |
|  | b. | Critically review the toxic effects of nanoparticles and the mechanisms by which toxicity is induced. | CO6 | E | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe the steps involved in the synthesis of nanoparticles by making use of Bacteria. Add a note on their applications. | CO6 | U | 15 |
|  | b. | Comment on Nano-Ethics. Explain with suitable examples. | CO6 | U | 5 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | 20 | - | - | - | - | 20 |
| CO2 | - | 10 | - | 10 | 10 | - | 30 |
| CO3 | - | 30 | - | - | - | - | 30 |
| CO4 | - | - | 20 | 20 | - | - | 40 |
| CO5 | - | 10 | - | 10 | - | - | 20 |
| CO6 | - | 20 | - | - | 20 | - | 40 |
|  | | | | | | | **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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Describe the pathologic characteristics of cancer cells and the various histologic stages of cancer development. | CO1 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Analyze the alterations in signaling pathways of different growth factorsleading to cancer. | CO2 | An | 10 |
|  | b. | Illustrate the cancer cells mimicking immune cells for metastasis. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. |  | Justify that the signaling molecules of mitogen induced oncogenic Ras pathway aresignal targets for cancer detection and therapy. | CO3 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Discuss about the early diagnostic methods available for various cancer types. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 5. |  | Criticize on the various immunodiagnostic techniques used for cancer marker detection. | CO4 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Evaluate the common types of adjuvant therapy given for cancer patients and comment on their challenges. | CO5 | E | 20 |
|  |  |  |  |  |  |
| 7. |  | Analyze the challenges of gene therapy and criticize on the immunotherapy with examples. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Evaluate the various risk factors of cancer and criticize the role of food and lifestyle in cancer prevention. | CO6 | E | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Analyze the measures of post treatment recurrence prevention and add a note on the herbal remedies for cancer. | CO6 | An | 20 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 20 |  |  |  |  |  | 20 |
| CO2 |  |  |  | 20 |  |  | 20 |
| CO3 |  |  |  |  | 20 |  | 20 |
| CO4 |  | 20 |  |  | 20 |  | 40 |
| CO5 |  |  |  | 20 | 20 |  | 40 |
| CO6 |  |  |  | 20 | 20 |  | 40 |
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Graphical user interface, application

Description automatically generated with medium confidence

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

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| **Q. No.** | **Questions** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Summarize the detrimental effects and mitigation of water pollution. | CO1 | An | 10 |
|  | b. | Articulate the transformation mechanism and importance of carbon and nitrogen cycle in soil by microorganisms. | CO1 | A | 6 |
| 2. | a. | Lichens – A Pollution Indicator. Justify the importance. | CO2 | E | 7 |
|  | b. | Describe the different approaches for strain improvement in environmental management. | CO2 | U | 9 |
| 3. | a. | Assess the characteristics of the pharmaceutical industry effluent and explain the different process steps in the treatment of the pharmaceutical industry effluent. | CO3 | An | 10 |
|  | b. | Illustrate the process involved in the aerated Lagoons for waste water treatment. | CO3 | A | 6 |
| 4. |  | Summarize the methods to eliminate the gaseous and volatile organic contaminants using pollution controlling devices. | CO4 | E | 16 |
| 5. | a. | Write the types of bioremediation. Discuss the role of microorganisms *in situ* bioremediation in detail. | CO5 | A | 10 |
|  | b. | Critique the different methods to manage medical waste and solid waste. | CO2 | E | 6 |
| 6. |  | Interpret how the modern techniques are advanced for the identification of microbial genes than conventional techniques in bioremediation. | CO5 | A | 16 |
| 7. | a. | Appraise different process steps involved in the bioleaching of heavy metals with equations. | CO6 | An | 10 |
|  | b. | Validate the production process and extraction of biosurfactants. | CO6 | C | 6 |
| **PART – B (1 X 20 = 20 MARKS)**  **(Compulsory Question)** | | | | | |
| 8. | a. | Comment on biosensor. Explain the role of biosensors in environmental monitoring. | CO4 | U | 14 |
|  | b. | Summarize the application of white rot fungi in bioremediation. | CO3 | E | 6 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | - | 6 | 10 | - | - | 16 |
| CO2 | - | 9 | - | - | 13 | - | 22 |
| CO3 | - | - | 6 | 10 | 6 | - | 22 |
| CO4 | - | 14 | - | - | 16 | - | 30 |
| CO5 | - | - | 26 | - | - | - | 26 |
| CO6 | - | - | - | 10 | - | 6 | 16 |
|  | | | | | | | **132** |



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| **Course Code** | **20BT3051** | **Duration** | **3hrs** |
| **Course Name** | **BIOCHEMISTRY** | **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. |  | Explain the Embden Meyerhof pathway with suitable structures. | CO1 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Classify mono. oligo and polysaccharides with examples. | CO2 | AN | 20 |
|  |  |  |  |  |  |
| 3. |  | Discuss the excretion of toxic substance from your body with suitable reactions. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Enumerate on classification and properties of lipids. | CO4 | R | 20 |
|  |  |  |  |  |  |
| 5. |  | Illustrate the structure of RNA with a suitable diagram. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Describe the Structure of proteins with examples. | CO1 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Explain the classification of water soluble vitamins. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Classify fat soluble vitamins with suitable structures and examples. | CO3 | AN | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Summarize the classification of minerals with examples. | CO6 | U | 20 |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 20 | 20 |  |  |  | 40 |
| CO2 |  |  |  | 20 |  |  | 20 |
| CO3 |  | 20 |  | 20 |  |  | 40 |
| CO4 | 20 |  |  |  |  |  | 20 |
| CO5 |  | 20 | 20 |  |  |  | 40 |
| CO6 |  | 20 |  |  |  |  | 20 |
|  | | | | | | | **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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Narrate major Plant Secondary Metabolites, its types and specific functions. | CO1 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Illustrate the role of different secondary metabolites for chemical defense mechanism in plants with examples | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Explain the process of Hairy root culture and its advantages with diagrams. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Evaluate the process of Crosstalk and Elicitor induced hypersensitivity responses. | CO4 | E | 20 |
|  |  |  |  |  |  |
| 5. |  | Classify the details of various excipients as pharmaceutical ingredients with its type and examples. | CO5 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Narrate the major terpenoids and their importance in plants. | CO1 | U | 10 |
|  | b. | Narrate the technicalities of bioreactor in plant secondary metabolite production. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 7. |  | Evaluate the significance of endophytes in production of unique secondary metabolites. | CO4 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Analyze the preparation of Capsules. | CO6 | An | 10 |
|  | b. | Illustrate the powder dosage form with its classification. | CO6 | U | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Elaborate the monophasic liquid formulation, its type and considerations in manufacture. | CO6 | U | 20 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 20 | 10 |  |  |  |  | 30 |
| CO2 |  | 20 |  |  |  |  | 20 |
| CO3 |  | 30 |  |  |  |  | 30 |
| CO4 |  |  |  |  | 40 |  | 40 |
| CO5 |  | 20 |  |  |  |  | 20 |
| CO6 |  | 30 |  | 10 |  |  | 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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Discuss the impact of 16S rRNA gene sequence analysis for identification of bacteria with suitable examples. | CO1 | U | 10 |
|  | b. | Explain Bergey’s manual of bacterial classification. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Appraise the principle of autoclave, hot air oven and filtration with a neat diagram. Add a note on their applications. | CO2 | E | 10 |
|  | b. | Quorum sensing causes some pathogens to express virulence factors that promote infection of gram positive and gram negative bacteria-Discuss. | CO2 | E | 10 |
|  |  |  |  |  |  |
| 3. | a. | Appraise the structure, transmission, pathogenesis and symptoms of H1NI virus. | CO3 | E | 10 |
|  | b. | Summarize the mode of action of some major antimicrobial agents with a neat diagram. | CO3 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Genetic analysis and mapping in bacteria and bacteriophages-Discuss with suitable diagrams. | CO4 | An | 10 |
|  | b. | Examine the usefulness of tetrad analysis in gene mapping. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Appraise the structural organization and mechanism of transposition of prokaryotic transposons. | CO5 | E | 10 |
|  | b. | Examine the mechanism and applications of RNA silencing. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Discuss the importance of Vesicular-arbuscular mycorrhiza (VAM) fungi in agriculture. Distinguish between ecto and endomycorrhiza. | CO3 | U | 12 |
|  | b. | Describe the morphology, structure and functions of prokaryotic cell. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 7. | a. | Examine how glucose is utilized via TCA cycle. | CO2 | An | 10 |
|  | b. | Describe the process of methanogenesis with suitable examples. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | 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: 5BU, 2AP, NTG and Hydroxylamine. | CO6 | U | 10 |
|  | b. | With labeled diagram, explain Missense, Nonsense, Frame shift mutations and add a note on their function. | CO6 | U | 10 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 20 |  |  |  |  | 20 |
| CO2 |  | 18 |  | 10 | 20 |  | 48 |
| CO3 |  | 12 |  |  | 20 |  | 32 |
| CO4 |  |  | 10 | 10 |  |  | 20 |
| CO5 |  |  | 10 |  | 10 |  | 20 |
| CO6 |  | 40 |  |  |  |  | 40 |
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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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | What is Animal Biotechnology? Describe its applications. | CO1 | R | 10 |
|  | b. | Discuss the nature of livestock in the Indian animal population. | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Explain the process of super ovulation technique in animals. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Illustrate the advances in *invitro* fertilization employing animal models. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Analyze the importance of embryo splitting procedures in animal biotechnology. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | What is cryopreservation? Analyze the principles and methodology behind cryopreservation techniques. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Articulate the importance of transgenic technology and transgenic animal models. | CO6 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Sketch the different DNA based techniques for detecting meat adulteration. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Highlight the importance of germplasm preservation in animal biotechnology. | CO6 | A | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Illustrate with neat diagrams the importance of ELISA techniques for Antigen Antibody interactions. | CO6 | An | 10 |
|  | b. | Sketch the importance of RIA assays for detection of Antigen Antibody reactants. | CO6 | A | 10 |

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

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 20 | - | - | - | - | - | 20 |
| CO2 | - | 20 | - | - | - | - | 20 |
| CO3 | - | - | 20 | - | - | - | 20 |
| CO4 | - | - | - | 20 | - | - | 20 |
| CO5 | - | - | 40 | 20 | - | - | 40 |
| CO6 | - | 20 | 30 | 10 | - | - | 60 |
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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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Highlight the requirements for conducting a through literature review on a topic in scientific research. | CO1 | E | 10 |
|  | b. | Illustrate the strategies you adopt to perform an advanced literature search in Scopus and the steps to refine the results from the same. | CO1 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | List out the different segments included in formulating a research article. Highlight the specific purposes of those components. | CO2 | An | 10 |
|  | b. | List out the components required in articulating the “Introduction” section justifying the need for selected research. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Appraise the different forms of misconduct and unethical practices observed in research and reporting. What could be the possible implications? | CO3 | An | 10 |
|  | b. | Highlight the different forms of authorship issues that may arise in scientific publication. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Compose different strategies one would adopt to choose the right journal for a manuscript. | CO4 | An | 10 |
|  | b. | Illustrate the different forms of the peer-review process and workflow in scientific publication. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Assume the probability of being hypertensive is 10% and 20% for male and female populations. Estimate the probability that two randomly chosen male-female pairs both would be hypertensive. | CO5 | U | 5 |
|  | b. | You are taking out two balls from a bag originally containing 7 red and 5 green balls. Estimate the probability that both the balls would be of the same colour. | CO5 | U | 5 |
|  | c. | Suppose the mean body temperature is normally distributed with a mean of 98°F and a standard deviation of 2°F.  Estimate the probability of a randomly chosen individual would have a body temperature >99°F, and a percentage of the population having a body temperature between 96°F and 97°F | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Serum cholesterol is an important risk factor for coronary disease. We can show that serum cholesterol is approximately normally distributed, with a mean of 219 mg/dL and a standard deviation of 50 mg/dL. The clinically desirable range for cholesterol is < 200 mg/dL. Estimate the proportion of people who have (i) clinically desirable levels of cholesterol, and (ii) those with >250 mg/dL | CO6 | E | 10 |
|  | b. | The BMI of randomly chosen 10 individuals is 18, 22, 25, 24, 23, 22, 20, 21, 22, 26. Estimate the mean BMI of the population based on the sample data and *t* statistics at 90% confidence level. | CO6 | E | 10 |
|  |  |  |  |  |  |
| 7. | a. | The mean birthweight () is found to be 115 oz with a sample standard deviation (s) of 24 oz. Use a one-sample *t*-test for the hypothesis H0: μ = 120 vs. H1: μ < 120, using a significance level of 0.05. | CO2 | An | 10 |
|  | b. | The systolic blood pressure of a woman with or without oral contraceptive (OC) is given below. Test hypothesis H0: OC intake increases systolic blood pressure, at a 90% confidence level.   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Case | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | SBP - OC | 115 | 112 | 107 | 119 | 115 | 138 | 126 | 105 | 104 | | SBP + OC | 128 | 115 | 106 | 128 | 122 | 145 | 132 | 109 | 102 | | CO2 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Specific growth rate of microorganism at two different temperatures are shown below. Test the hypothesis that the growth ratesare not different at the two temperatures, at a 90% confidence level.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | μ@30°C | 0.12 | 0.15 | 0.14 | 0.13 | 0.12 | 0.14 | 0.15 | 0.13 | | μ@40°C | 0.18 | 0.17 | 0.16 | 0.20 | 0.18 | 0.19 | 0.17 | 0.16 | | CO4 | U | 10 |
|  | b. | Identify the appropriate test for the following situation  (i) differentiate between two anti-hypertensive drugs  (ii) confidence interval of the mean for population age  (iii) compare two biofuel variants for fuel efficiency  (iv) compare two countries on mean annual temperature | CO4 | An | 10 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | The reducing sugar concentration and absorbance in the DNS method are given below. Establish the *regression equation* for the analytical method and the corresponding regression coefficient.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | OD (*x*) | 0.08 | 0.12 | 0.14 | 0.18 | 0.22 | 0.26 | 0.30 | 0.32 | | Conc. (g/l) | 1.00 | 1.20 | 1.40 | 1.60 | 1.80 | 2.00 | 2.20 | 2.40 | | CO6 | E | 20 |

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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 parametric and non-parametric approach in statistical package, office tools. |
| CO4 | Analyze the need of literature, experimental data, and supporting information in realm of research publication. |
| CO5 | Practice good-research and publication ethics. |
| CO6 | Understand the need of statistical analysis pertinent to their experimental data . |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 0 | 0 | 0 | 0 | 20 | 0 | 20 |
| CO2 | 0 | 0 | 0 | 40 | 0 | 0 | 40 |
| CO3 | 0 | 0 | 0 | 20 | 0 | 0 | 20 |
| CO4 | 0 | 10 | 0 | 30 | 0 | 0 | 40 |
| CO5 | 0 | 10 | 0 | 10 | 0 | 0 | 20 |
| CO6 | 0 | 0 | 0 | 0 | 40 | 0 | 40 |
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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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Examine the parameters to be monitored and controlled in Fermentation processes. | CO1 | R | 10 |
|  | b. | Classify the Range of Fermentation processes with examples | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Evaluate the basic configuration of fermenter. | CO1 | An | 10 |
|  | b. | Analyze the general requirements of fermentation processes. | CO1 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Summarize the isolation methods utilizing selection of the desired characteristic for the industrially important microbes. | CO3 | U | 10 |
|  | b. | Analyze the different factors to be considered for obtaining suitable inoculum for industrial fermentations. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Examine the screening method employed for the isolated industrially important microbes. | CO3 | U | 10 |
|  | b. | Illustrate the procedure for the development of inocula for bacterial process. | CO3 | U | 10 |
|  |  |  |  |  |  |
| 5. | a. | Compare the physical and chemical-enzymatic methods of cell lysis, while referring their benefits and limitations. | CO5 | A | 10 |
|  | b. | Assess the process details and performance of mechanical disruption of cells in bead mill, high-pressure homogenizer, ultrasonic treatments depending on cell types. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Classify the microbial products. | CO4 | A | 6 |
|  | b. | Describe the different methods in the quantification of cell mass. | CO4 | U | 14 |
|  |  |  |  |  |  |
| 7. | a. | Assess the oxygen requirements in the media. | CO2 | An | 10 |
|  | b. | Compare the different Carbon sources used in medium formulation and illustrate the factors for choosing the carbon source. | CO2 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Elaborate the structural and operational differences between different membranes modules used in membrane separation. | CO5 | U | 8 |
|  | b. | Explain the utility of microfiltration and ultrafiltration membrane in downstream processing also highlighting their associated limitations. | CO5 | U | 12 |
| **PART – B(1 X 20= 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe the principles and application of size exclusion chromatography in downstream processing. | CO6 | R | 10 |
|  | b. | Explain the basic theory of crystallization and its application in purification of bioproducts. | CO6 | U | 10 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 10 | 10 |  | 20 |  |  | 40 |
| CO2 |  |  | 10 | 10 |  |  | 20 |
| CO3 |  | 20 | 10 | 10 |  |  | 40 |
| CO4 |  | 14 | 6 |  |  |  | 20 |
| CO5 |  | 20 | 10 | 10 |  |  | 40 |
| CO6 | 10 | 10 |  |  |  |  | 20 |
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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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Categorize the basic elements of extracellular and intracellular cell signaling systems. | CO1 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Interpret the molecular methods for detection and characterization of microorganisms. | CO2 | A | 20 |
|  |  |  |  |  |  |
| 3. | a. | Debate the Primer and Probe design with the help of RTPrimerDB as a tool in molecular medicine. | CO3 | E | 10 |
|  | b. | Justify the integration of Molecular epidemiology as an innovative laboratory method for molecular diagnostics. | CO3 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Appraise the evolution of bio banking as a bio repository to support contemporary research like genomics and personalized medicine. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 5. | a. | Explain the screening and diagnosis of Duchenne muscular Dystrophy (Creatine phosphokinase-CPK). | CO5 | An | 10 |
|  | b. | Assess the Endocrine disorders related to thyroid and reproduction. | CO5 | E | 10 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Correlate the methods of collection, transport, and processing of clinical samples with precision for diagnosis. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Subdivide the pathogenesis of various Inborn errors of metabolism with appropriate examples. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Illustrate the importance of the immune system with respect to molecular diagnostics and treatment. | CO6 | An | 20 |
| **PART – B(1 X 20= 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Classify the different levels of Biosafety, Containment and Future  Trends with respect to diagnostics. | CO6 | An | 10 |
|  | b. | Determine the types of Immunoassays used in diagnostics. | CO6 | A | 10 |

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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 | Remember | Understand | Apply | Analyze | Evaluate | Create | Total |
| CO1 | - | - | - | 20 | - | - | 20 |
| CO2 | - | - | 20 | - | - | - | 20 |
| CO3 | - | - | - | - | 20 | - | 20 |
| CO4 | - | - | - | 60 | - | - | 60 |
| CO5 | - | - | - | 10 | 10 | - | 20 |
| CO6 | - | - | 10 | 30 | - | - | 40 |
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| **Course Code** | **20BT3062** | **Duration** | **3hrs** |
| **Course Name** | **INDUSTRIAL BIOTECHNOLOGY** | **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. | Discuss the history of biotechnology and future perspectives. | CO1 | R | 10 |
|  | b. | Discuss on the history of reactors and microscopes. | CO1 | R | 10 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Elaborate on the industrial production of Nisin. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Analyze the importance of modelling and simulation in Bioprocessing. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Summarize Upstream and Downstream processing involved in bioreactor engineering. | CO4 | U | 20 |
|  |  |  |  |  |  |
| 5. |  | Describe the process involved in the scale up strategy of Beer production. | CO5 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Describe the industrial production of Riboflavin. | CO6 | An | 20 |
|  |  |  |  |  |  |
| 7. |  | Elaborate on the industrial bioprocessing of Lysine. | CO4 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Describe the large-scale production of Biofertilizers. | CO5 | A | 20 |
| **PART – B(1 X 20= 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Describe the bioreactor. Mention its significance with a neat sketch. | CO6 | An | 20 |

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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 Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 20 | - | - | - | - | - | 20 |
| CO2 | - | 20 | - | - | -- | - | 20 |
| CO3 | - | - | - | 20 | - | - | 20 |
| CO4 | - | 20 | - | - | 20 | - | 40 |
| CO5 | 20 | - | 20 | - | - | - | 40 |
| CO6 | - | - | - | 40 | - | - | 40 |
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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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A(4 X 20= 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Define Biotransformation. | CO1 | R | 3 |
|  | b. | Explain briefly the new drug discovery protocols in pharmaceutical industry. | CO1 | R | 17 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Briefly explain the drug pharmacodynamic properties analysis and characterization. | CO1 | R | 12 |
|  | b. | Define and describe  i. First pass metabolism  ii. Drug incompatibility  iii. Bioavailability. | CO1 | A | 8 |
|  |  |  |  |  |  |
| 3. | a. | Elaborate the routes of drug administration in human body with example. | CO2 | R | 10 |
|  | b. | Discuss in brief parenteral drug manufacturing process and testing procedure. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the criteria for manufacturing good quality soft gelatin formulation. | CO3 | R | 12 |
|  | b. | Discuss in brief the physiochemical test for evaluation of soft gelatin capsule. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 5. | a. | Describe the types of semisolid formulation bases. | CO4 | R | 10 |
|  | b. | Discuss in brief manufacturing of iodine ointment. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain in detail the analytical methods and tests for various drugs and pharmaceuticals. | CO5 | U | 10 |
|  | b. | Briefly describe the standard of hygiene and good manufacturing practice implies on pharmaceutical industries. | CO5 | R | 10 |
|  |  |  |  |  |  |
| 7. | a. | Give an example of a lubricant, a preservative used in solutions, an enteric coating material, and surfactant. | CO5 | R | 10 |
|  | b. | Write a detailed note on Classification of liquid orals using suitable samples. | CO6 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Write on the mechanism of action, antibacterial activity, adverse reaction and therapeutic uses of the following antibiotics. Tetracycline, streptomycin, penicillin. | CO6 | U | 20 |
| **PART – A(1 X 20= 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain the various types, applications and advantages of tablet coating. | CO4 | R | 10 |
|  | b. | Write about tablets under the following heads.  i. Dry granulation  ii. Wet granulation. | CO4 | U | 10 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 32 |  | 8 |  |  |  | 40 |
| CO2 | 20 |  |  |  |  |  | 20 |
| CO3 | 12 |  | 8 |  |  |  | 20 |
| CO4 | 20 | 10 | 10 |  |  |  | 40 |
| CO5 | 10 | 20 |  |  |  |  | 30 |
| CO6 |  | 30 |  |  |  |  | 30 |
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| **Course Code** | **20BT3065** | **Duration** | **3hrs** |
| **Course Name** | **NGS DATA ANALYSIS** | **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. | | Describe the structure of UNIX operating System with necessary illustrations. | CO1 | R | 10 |
|  | b. | | Explain Vi editor and loop control structures with examples. | CO1 | U | 10 |
|  |  | | **(OR)** |  |  |  |
| 2. |  | | Discuss about processes, process scheduling, process priorities in the UNIX system administration. | CO1 | U | 20 |
|  |  | |  |  |  |  |
| 3. | a. | | Interpret on base calling, FASTQ file format, and base quality score in NGS data analysis. | CO2 | An | 10 |
|  | b. | | Sketch the importance of gene array and biochips in genome sequencing. | CO3 | A | 10 |
|  |  | | **(OR)** |  |  |  |
| 4. |  | | Summarize the methods involved in Ion tolerant semi-conductor and shortgun sequencing with error rate analysis. | CO4 | E | 20 |
|  |  | |  |  |  |  |
| 5. |  | | Discuss genotyping and genome variation in genome resequencing. | CO3 | U | 20 |
|  |  | | **(OR)** |  |  |  |
| 6. |  | | Describe in detail the transcriptomics by RNA Sequencing and RNA Sequence data analysis. | CO5 | R | 20 |
|  |  | |  |  |  |  |
| 7. |  | | Interpret on environmental genome analysis for identification of pathogenic bacteria for pneumonia from postmortem lung tissue. | CO6 | An | 20 |
|  |  | | **(OR)** |  |  |  |
| 8. | a. | | Explain the importance of changing land scape in NGS. | CO5 | An | 10 |
|  | b. | | Appraise the role of high throughput sequencing in data analysis. | CO6 | An | 10 |
| **PART – B (1 X 20= 20 MARKS)**  **COMPULSORY QUESTION** | | | | | | |
| 9. |  | | Describe mapping of Protein-DNA interactions with ChIP -Seq. | CO6 | R | 20 |
|  | | | | | | |
|  | | **COURSE OUTCOMES** | | | | |
| CO1 | | Summarize the applications of the different NGS technologies, including the weakness and  strengths of the approaches. | | | | |
| CO2 | | Demonstrate the steps involved in a general NGS data analysis. | | | | |
| CO3 | | Record key theoretical concepts of alignment and de novo assembly. | | | | |
| CO4 | | Synthesize and formulate a project and relevant question within the field. | | | | |
| CO5 | | Illustrate the basics of NGS data analysis. | | | | |
| CO6 | | Infer analytical and reflective skills in analyzing results from individual steps and the final. | | | | |

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| **Assessment Pattern as per Bloom’s Taxonomy** | | | | | | | |
| CO / P | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | 10 | 30 |  |  |  |  | 40 |
| CO2 |  |  |  | 10 |  |  | 10 |
| CO3 |  | 20 | 10 |  |  |  | 30 |
| CO4 |  |  |  |  | 20 |  | 20 |
| CO5 | 20 |  |  | 10 |  |  | 30 |
| CO6 | 20 |  |  | 30 |  |  | 50 |
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| **Course Code** | **20BT3066** | **Duration** | **3hrs** |
| **Course Name** | **ALGAE BIOTECHNOLOGY** | **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. | Demonstrate the scope and application of algal biotechnology with appropriate examples. | CO1 | A | 8 |
|  | b. | Examine the steps involved in scale up of algal culture by citing any TWO economically important algal species. | CO1 | An | 12 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Modification of media is necessary for enhancing the growth and yield of economically viable products from algae-Justify. | CO2 | E | 12 |
|  | b. | Comment on the industrial importance of algae. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the production process of single cell protein using suitable algae. Add a note on their merits and demerits. | CO3 | A | 12 |
|  | b. | Examine the significance of some important algal species in food supplement industries. | CO3 | An | 8 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Discuss the importance of algal based pigments with suitable examples. | CO4 | U | 10 |
|  | b. | Employ Fourier transform infrared (FT-IR) spectroscopy to determine the microalgal compositions. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Fatty acid composition as biomarkers of freshwater microalgae-Discuss. | CO5 | U | 10 |
|  | b. | Algae as resources for production of biofuel-Discuss. | CO5 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Critically analyze the different types of culture media employed for the cultivation of algae. | CO1 | An | 10 |
|  | b. | Explain the importance of temperature, pH, light and salt in culturing algae cells. | CO1 | U | 10 |
|  |  |  |  |  |  |
| 7. | a. | Develop an effective and eco-friendly algal technology for the removal of dye from industrial waste water. | CO3 | C | 10 |
|  | b. | Examine the biotechnological importance of algal biofilms in environment, industry, agriculture, and health care sectors. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Describe the molecular techniques used for the identification of algae. | CO6 | U | 12 |
|  | b. | Outline the challenges and applications of algal genomics. | CO6 | U | 8 |
| **PART – B(1 X 20= 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Describe a suitable and efficient DNA extraction method that is applicable to different types of marine algae. | CO6 | U | 10 |
|  | b. | Identify the algal strains from marine sea water by PCR based methods. | CO6 | An | 10 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | 10 | 8 | 22 | - | - | 40 |
| CO2 | - | 8 | - | - | 12 | - | 20 |
| CO3 | - | - | 12 | 18 | - | 10 | 40 |
| CO4 | - | 10 | 10 | - | - | - | 20 |
| CO5 | - | 20 | - | - | - | - | 20 |
| CO6 | - | 30 | - | 10 | - | - | 40 |
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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** | | **Course Outcome** | **Bloom’s Level** | **Marks** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | | |
| 1. | a. | | Explain in detail on the functional and structural characteristics of cell and tissue. | CO1 | An | 20 |
|  |  | | **(OR)** |  |  |  |
| 2. | a. | | Differentiate various types of bones and detail on the features and functions of bones in axial skeletal system | CO2 | An | 20 |
|  |  | |  |  |  |  |
| 3. | a. | | Explain on the following:   1. Body fluids 2. Composition and functions of blood 3. Blood grouping 4. Transfusion | CO3 | A | 20 |
|  |  | | **(OR)** |  |  |  |
| 4. | a. | | Classify peripheral nervous system and explain the structure and function of sympathetic and parasympathetic nervous system in detail. | CO4 | An | 20 |
|  |  | |  |  |  |  |
| 5. | a. | | Write the anatomy and working of heart with a neat sketch. | CO5 | C | 10 |
|  | b. | | Explain the structure and function of artery, vein and capillaries | CO5 | An | 10 |
|  |  | | **(OR)** |  |  |  |
| 6. | a. | | Illustrate the importance of cardiac cycle and sketch on the working of electrocardiogram and disorders of heart. | CO4 | A | 20 |
|  |  | |  |  |  |  |
| 7. | a. | | Assess the components of a balanced diet and elaborate on deficiency disorders of various nutrients, disease prevention and treatment methods. | CO6 | E | 20 |
|  |  | | **(OR)** |  |  |  |
| 8. | a. | | Explain in detail about various emergency treatment of shock, snakebite,poisoning, burns and fractures with case studies. | CO6 | An | 20 |
| **COMPULSORY QUESTION** | | | | | | |
| 9. | a. | | Summarize on the causes, modes of transmission and prevention measures of the following communicable diseases,   1. Chicken pox 2. Malaria 3. Poliomycetes 4. Rabies | CO6 | E | 20 |

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|  | **COURSE OUTCOMESd** |
| 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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 | - | - | - | 20 | - | - | 20 |
| CO2 | - | - | - | 20 | - | - | 20 |
| CO3 | - | - | 20 | - | - | - | 20 |
| CO4 | - | - | 20 | 20 | - | - | 40 |
| CO5 | - | - | - | 10 | - | 10 | 20 |
| CO6 | - | - | - | 20 | 40 | - | 60 |
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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. |  | Give a detailed account on the history of vaccination. | CO1 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | Discuss the Epidemiology and Pathophysiology of Diptheria. | CO2 | U | 20 |
|  |  |  |  |  |  |
| 3. |  | Describe antigen processing and presentation and indicate the steps which are significant to vaccine designing. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Describe the types of vaccines. | CO3 | E | 20 |
|  |  |  |  |  |  |
| 5. |  | Discuss Adjuvants, their types and function. | CO4 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Discuss attenuation and inactivation and the various modes and chemicals used. | CO4 | R | 20 |
|  |  |  |  |  |  |
| 7. |  | Elaborate on the various modes of vaccine delivery stating their advantages and disadvantages. | CO5 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Discuss storage and handling of vaccines.Write a note on the assessment of vaccine safety. | CO6 | E | 20 |
| **PART – B (1 X 20 = 20 MARKS)**  **COMPULSORY QUESTION** | | | | | |
| 9. |  | Analyze the different types of vaccines for COVID-19. | CO6 | An | 20 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **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** | **20BT3031** | **Duration** | **3hrs** |
| **Course Name** | **ADVANCED ENVIRONMENTAL BIOTECHNOLOGY** | **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. | | Define pollution. Classify the major causes of air pollution that leads to global warming and green house gas effects. | CO1 | An | 10 |
|  | b. | | Describe the role of microorganisms in biogeochemical cycle with suitable examples. | CO1 | U | 10 |
|  |  | | **(OR)** |  |  |  |
| 2. | a. | | Articulate different approaches for strain improvement in environmental management. | CO2 | A | 10 |
|  | b. | | Analyze the role of pollution indicators in air quality monitoring. | CO2 | An | 10 |
|  |  | |  |  |  |  |
| 3. | a. | | Define eutrophication. Write the importance to remove inorganic nitrogen and phosphate from wastewater with suitable treatment process. | CO3 | A | 12 |
|  | b. | | Name the pollutants from leather and dye industrial effluents and their impacts in environment. | CO3 | R | 8 |
|  |  | | **(OR)** |  |  |  |
| 4. | a. | | Summarize the methods to eliminate the gaseous and volatile organic contaminants using pollution controlling devices. | CO4 | E | 16 |
|  | b. | | List the harmful effects due to disposal of industrial wastes without adequate treatment. | CO4 | R | 4 |
|  |  | |  |  |  |  |
| 5. | a. | | Explain the recalcitrant compound degradation pattern and how the hydrocarbon products are degraded? | CO5 | A | 14 |
|  | b. | | Summarize the treatment methods of waste water by lagoons. | CO3 | A | 6 |
|  |  | | **(OR)** |  |  |  |
| 6. | a. | | Anticipate the production process of biodegradable plastics using biopolymers. | CO6 | C | 10 |
|  | b. | | Explain the stages of fermentation process in bioethanol production. | CO6 | A | 10 |
|  |  | |  |  |  |  |
| 7. | a. | | Appraise the structural and catabolic diversity approach for the identification of metagenomes in environmental niche for bioremediation. | CO5 | E | 16 |
|  | b. | | Draw the flow diagram of biodiesel production. | CO6 | E | 4 |
|  |  | | **(OR)** |  |  |  |
| 8. | a. | | Define bioleaching. Illustrate bioleaching process with suitable examples. | CO4 | A | 14 |
|  | b. | | Write a note on Vermicomposting. | CO6 | A | 6 |
| **PART – B(1 X 20= 20 MARKS)**  **COMPULSORY QUESTION** | | | | | | |
| 9. | a. | Comment on Quorum sensing. Explain the role of Quorum sensing in environmental monitoring. | | CO4 | A | 14 |
|  | b. | Write the uses of xylanase in paper production. | | CO6 | C | 6 |

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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 | **Remember** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Create** | **Total** |
| CO1 |  | 10 |  | 10 |  |  | 20 |
| CO2 |  |  | 10 | 10 |  |  | 20 |
| CO3 | 8 |  | 18 |  |  |  | 26 |
| CO4 | 4 |  | 28 |  | 16 |  | 48 |
| CO5 |  |  | 14 |  | 16 |  | 30 |
| CO6 |  |  | 16 |  | 4 | 16 | 36 |
|  | | | | | | | **180** |