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

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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the function that converts a number to an integer. | | CO1 | U | 1 |
| 2. | Predict the output of the following statement:  print(len({1,2,3,2}) | | CO1 | U | 1 |
| 3. | Identify the method that checks if a string contains only of digits. | | CO2 | U | 1 |
| 4. | Predict the output for the following code:  print(“Hello, {}!”.format(“Ann”)) | | CO2 | U | 1 |
| 5. | Determine the output for the following code:  x=[10,20,30,40,50]  x. insert(2,25)  print(x) | | CO3 | U | 1 |
| 6. | Name the method that is used to remove an element from a list by value. | | CO3 | R | 1 |
| 7. | List any two benefits of tuple. | | CO4 | R | 1 |
| 8. | Predict the output for the following code:  a=(1,2,3,4,5)  print(min(a)) | | CO4 | U | 1 |
| 9. | Predict the output for the following code:  x=5  while x>0:  print(x, end=” ”)  x=x-2 | | CO5 | U | 1 |
| 10. | Enumerate any three built-in modules in python. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write a python program to check whether a given number is positive or not. | | CO1 | A | 3 |
| 12. | Differentiate split() and join() methods in strings. | | CO2 | U | 3 |
| 13. | Write a python program to sort elements in a given list. | | CO3 | A | 3 |
| 14. | Compare min() and max() methods in tuples. | | CO4 | U | 3 |
| 15. | Explain the use of pass statement in python. | | CO5 | U | 3 |
| 16. | State the use of Seq() in python. | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the arithmetic and conditional operators in python. | CO1 | U | 7 |
|  | b. | Write a python program to find the factorial of a number. | CO1 | A | 5 |
|  |  |  |  |  |  |
| 18. | a. | Explain the following string methods with suitable example.   1. find() 2. count() 3. strip() 4. replace() | CO2 | U | 6 |
|  | b. | Write a python program to count the occurrences of a substring in a string. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Describe any 6 list methods with suitable examples for each. | CO3 | U | 6 |
|  | b. | Write a python program to get the frequency of the elements in a list. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 20. |  | Write a python code to perform the following operations using the following tuples: a=(1,2,3,4) b=(5,6,7,8,5)   1. Concatenate the two tuples 2. Append the elements of tuple ‘b’ twice 3. Find the max element in the tuple 4. Find the number of occurrences of a particular element in the tuples 5. Add an element to a tuple. 6. Print the elements one by one from the tuple using a loop. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 21. | a. | Explain for loop and while loop with suitable example. | CO5 | U | 6 |
|  | b. | Write a python program to find the sum of the digits of a number. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the various operations that can be performed on list. | CO3 | U | 6 |
|  | b. | Write a Python program to remove duplicate elements in a list. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Write a Python program to find the second most repeated word in a string. | CO2 | A | 6 |
|  | b. | Explain the various jump statements in python with suitable example. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the bio-python modules and its features. | CO6 | U | 6 |
|  | b. | Describe the various sequence operations in bio python packages. | CO6 | U | 6 |

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

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name any one chemical bond, which contributes to the stability of DNA structure. | | CO1 | R | 1 |
| 2. | Sketch the Haworth projection of glucose molecule. | | CO2 | A | 1 |
| 3. | Recognize and write the difference in the structure between starch and glycogen. | | CO2 | R | 1 |
| 4. | Cite the reason for the solid nature of saturated fatty acids. | | CO2 | U | 1 |
| 5. | Select one negatively charged amino acid among the standard amino acids. | | CO3 | E | 1 |
| 6. | State an amino acid that is responsible for UV absorption property of proteins. | | CO3 | R | 1 |
| 7. | Cite an example for glycoprotein. | | CO4 | U | 1 |
| 8. | Define Tm of DNA. | | CO5 | R | 1 |
| 9. | Compare and contrast the roles of Vitamin K and E in blood coagulation. | | CO6 | An | 1 |
| 10. | State the Vitamin, which is named as yellow enzyme. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | List the biological buffer systems. | | CO1 | R | 3 |
| 12. | Illustrate diagrammatically the mutarotation of a sugar. | | CO2 | A | 3 |
| 13. | Relate the desaturase enzymes of human with essential fatty acids. | | CO3 | U | 3 |
| 14. | Define isoelectric pH and give its significance. | | CO5 | R | 3 |
| 15. | Describe the Chargaff’s rules for the composition of DNA. | | CO2 | An | 3 |
| 16. | Associate any three cationic macro elements with their biological significance. | | 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. |  | Enumerate the chemical properties of water. | CO1 | R | 12 |
|  |  |  |  |  |  |
| 18. | a. | Classify lipids types with the general structure. | CO2 | R | 6 |
|  | b. | Analyze and write the significance of each class of lipids with an example. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Evaluate the different conformations of protein with suitable example. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 20. | a. | Explain the properties of nucleic acids and their uses. | CO5 | A | 6 |
|  | b. | Illustrate the structures of different types of RNAs. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Explain the biological significance of Vitamin D. | CO6 | U | 6 |
|  | b. | Differentiate the nutraceuticals from dietary supplements with examples. | CO6 | U | 6 |
|  |  |  |  |  |  |
| 22. |  | Distinguish the structural composition between the proteoglycan and glycoprotein. Give their biological significance with examples. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe the isomers of monosaccharides with suitable examples. | CO3 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the dietary source, functions and deficiency symptoms of Vitamin E. | CO6 | An | 12 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| **CO1** | Evaluate the impact of chemical bonding on properties of biomolecules |
| **CO2** | Analyse the structures and functions of biomolecules. |
| **CO3** | Illustrate the significance of biomolecules in living cells. |
| **CO4** | Design the glycoconjugate based biomaterials for various applications |
| **CO5** | Develop biomolecules-based products in biotechnology industries |
| **CO6** | Analyse the clinical and biological significance of biomolecules in disorders to find solutions |

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Mention a double membrane bound organelle in animals. | | CO1 | U | 1 |
| 2. | Name the organelle that functions as the protein synthetic machinery. | | CO1 | R | 1 |
| 3. | DNA Polymerase is targeted to ……….. | | CO2 | R | 1 |
| 4. | State the basic condition required for the diffusion of solute. | | CO2 | R | 1 |
| 5. | Identify the protein that is primarily responsible for microtubule formation. | | CO3 | U | 1 |
| 6. | Mention the motile appendage that is responsible for bacterial locomotion. | | CO3 | R | 1 |
| 7. | Mention any one protein component of ECM. | | CO4 | U | 1 |
| 8. | List the major secondary messangers. | | CO4 | R | 1 |
| 9. | Describe CDK’s. | | CO5 | U | 1 |
| 10. | Define stem cells. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate prokaryotic and eukaryotic cells. | | CO1 | An | 3 |
| 12. | Illustrate the opening and closing of voltage gated channels. | | CO2 | U | 3 |
| 13. | Analyze the role of epithelial-mesenchymal transition (EMT) in cancer metastasis. | | CO3 | An | 3 |
| 14. | What are signaling molecules? Mention their functions. | | CO4 | U | 3 |
| 15. | Analyze the fate of cells when apoptosis is inhibited. | | CO5 | An | 3 |
| 16. | Explain the principle of FACS. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Describe the Fluid Mosaic Model of membranes. | CO1 | U | 8 |
|  | b. | Outline the biological functions of membrane. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate and explain the working of sodium potassium pump | CO2 | U | 8 |
|  | b. | Give a brief account on the Components and Functions of endomembrane system. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Schematically represent and discuss the mechanism of signal transduction by G-protein coupled receptor. | CO3 | U | 8 |
|  | b. | Describe the coordinated interaction between actin and myosin during muscle contraction. | CO3 | U | 4 |
|  |  |  |  |  |  |
| 20. | a. | Elaborate an essay on different modes of signal transduction. | CO4 | U | 6 |
|  | b. | Depict and describe types of Cell-cell interactions. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Analyze the regulation of cell cycle by cell cycle check points. | CO5 | An | 8 |
|  | b. | Explain the hall marks of cancer cells. | CO5 | U | 4 |
|  |  |  |  |  |  |
| 22. | a. | Principle and applications of Fluorescence Microscopy. | CO6 | A | 6 |
|  | b. | Discuss the therapeutic applications of stem cells. | CO6 | A | 6 |
|  |  |  |  |  |  |
| 23. |  | Elaborate in detail about the SARS-CoV-2 virus entry into an animal cell by endocytosis. | CO4 | U | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Elaborate an essay on the therapeutic potential of stem cells. | CO6 | A | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Exhibit a knowledge base in cell structure, organelles and their functions |
| **CO2** | Outline the process that control cell cycle, and cell deat |
| **CO3** | Relate how cell movement and cell to cell communication occur and discuss mechanisms of signal transduction |
| **CO4** | Link the rapid advances in cell and molecular biology to a better understanding of disease including cancer |
| **CO5** | Evaluate and apply knowledge of recent techniques in cellular biology |
| **CO6** | Crtique and professionally present literature articles in cell and molecular biology |

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List the key components of an aseptic fermentation system. | | CO1 | R | 1 |
| 2. | Write the significance of GILSP. | | CO1 | A | 1 |
| 3. | For optimizing carbon, vitamin and nitrogen of four concentrations each using the classical method, calculate the number of experiments to be performed. | | CO2 | E | 1 |
| 4. | Define the role of metabolic regulators. | | CO2 | R | 1 |
| 5. | 1. Calculate the productivity of a fermentation process if the total biomass produced is 50 g/L in 48 hr. Express your answer in g/L/hr. | | CO3 | E | 1 |
| 6. | 1. The initial number of microbes present in 3 liters of medium is 25×10¹⁵ cells/mL. Calculate the Del Factor for sterilization. | | CO3 | E | 1 |
| 7. | Cite two techniques for preserving microbial cultures at reduced temperature. | | CO4 | U | 1 |
| 8. | List out any two gas flow measuring devices. | | CO5 | R | 1 |
| 9. | What is an inline sensor? Give example. | | CO5 | U | 1 |
| 10. | Air is passed at a rate of 2.5 m³/sec for 250 sec through a depth filter. If the microbial load in air is 5 × 10³ cells per m³, calculate the initial number of microbes present in the air before filtration. | | CO6 | E | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Sketch the basic configuration of a fermenter. | | CO1 | R | 3 |
| 12. | Infer on the role of chelators in medium formulation with an example. | | CO2 | U | 3 |
| 13. | 1. The Del Factor for heating and cooling is 2.5 and 1.3, respectively. The initial number of microbes before sterilization is 2.6 × 10¹⁶. If the death rate constant k= 2.54 min−1, calculate the holding time at sterilization temperature. | | CO3 | E | 3 |
| 14. | Identify a protocol for the long-term preservation of an industrially important microbe. | | CO4 | U | 3 |
| 15. | Illustrate the effects of inadequate dissolved oxygen levels on microbial growth. | | CO5 | U | 3 |
| 16. | Differentiate between absolute filtration and depth filtration for liquid media sterilization. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q.No. 17 to 23, Q.No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the fermentation process with a flow diagram. | CO1 | U | 6 |
|  | b. | Differentiate between various sampling techniques used in industrial fermentation and justify their suitability. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. |  | Explain the nutrient requirements for the industrial production of penicillin and add a note on non-nutritional media supplement. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | A bioprocess engineer is optimizing the composition of a fermentation medium to maximize protease production. The study involves eleven factors Where D1, D2and D3 are Dummy variables, the results of the 12-run Plackett-Burman experiment are given in the table below:   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Trial** | **Nit** | **Car** | **Vit** | **Min** | **D1** | **AF** | **Mn** | **Che** | **Fe** | **D2** | **D3** | | **∑(H)** | 20.1 | 27.1 | 3.1 | 2.2 | 3.7 | 1.5 | 12 | 9.5 | 6.4 | 2.1 | 2.7 | | **∑(L)** | 11.2 | 12.1 | 1.2 | 1.5 | 3.5 | 0.7 | 11.3 | 8.5 | 4.2 | 2.3 | 2.9 |  1. Calculate the effect of each factor 2. Identify the most significant factors influencing the yield. 3. Plot a bar graph to visualize the effect of each variable on yield. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | A fermentation process requires a 8 liters batch of complex medium to be steam sterilized at 121 °C. Assuming that the medium before sterilization contains 7.5xl011 bacterial spores of *Bacillus stearothermophilus* per ml and the probability of non-sterility after sterilization is 1 in 1000, Determine the holding time at 121°C and ▼holding. The time of heating from 100°C to 121°C is 12 min and the time of cooling from 121°C to 102°C is 15 min. Assume that the spore death below 100°C is insignificant. The value of ▼table=12.55, A=9.5x1037min-1, E=283000 J/mol and R=8.314 J/(mol K). | CO3 | E | 12 |
|  |  |  |  |  |  |
| 21. | a. | Derive the expression for thermal death kinetics of microbes in medium sterilization. | CO3 | A | 6 |
|  | b. | The same degree of sterilization is obtained if, one medium is sterilized at 800C for 40min and the next medium is sterilized at 1000C for 20 min. Which one is found to be the best method? Why? | CO3 | A | 6 |
|  |  |  |  |  |  |
| 22. |  | Describe the process of primary screening of industrially important microbes and explain various methods of preservation of industrially important microbes. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Analyze and write the significance of pressure, temperature, dissolved oxygen measurement and control in a fermentation process. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Air is sterilized through a depth filter and sent at a flow rate of 14 m³/min for a fermentation process lasting 45 min, with a linear velocity of 0.17 m/min. The rate constant for microbial removal is 1.55 m-1.  Calculate:   1. Initial number of microorganisms present in air before sterilization. 2. Radius of the filter. 3. Length of the filter. 4. Cross-sectional area of the filter. 5. X₉₀ (Depth required for 90% microbial removal).   Efficiency of filtration in removing airborne microbes. | CO6 | E | 12 |

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

|  |  |
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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 the fermentation process |
| CO3 | Analyze the kinetics of the sterilization process |
| CO4 | Apply knowledge on isolation and storage of industrially important microbes |
| CO5 | Analyze parameters to control during the fermentation process |
| CO6 | Evaluate the process of sterilization by filtration |

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

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

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define transformation in the context of bacterial recombination. | | CO1 | R | 1 |
| 2. | Describe the role of DNA polymerase in bacterial replication. | | CO1 | U | 1 |
| 3. | Compare D-loop replication and rolling circle replication. | | CO2 | U | 1 |
| 4. | Elucidate the role of RNA replicase in RNA viruses. | | CO2 | A | 1 |
| 5. | Classify DNA repair systems based on their function. | | CO3 | U | 1 |
| 6. | Relate the concept of telomere shortening in cellular aging. | | CO3 | A | 1 |
| 7. | List the post-transcriptional modifications in eukaryotes. | | CO4 | R | 1 |
| 8. | List the stop codons in the genetic code. | | CO4 | R | 1 |
| 9. | Compare the role of rRNA, mRNA, and tRNA in translation. | | CO5 | An | 1 |
| 10. | State the inducer in the lac operon. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate the molecular structure of RNA and highlight its differences from DNA. | | CO1 | A | 3 |
| 12. | Describe the Rolling circle mode of Replication. | | CO2 | A | 3 |
| 13. | Define telomere replication and its significance in eukaryotic cells. | | CO3 | R | 3 |
| 14. | Compare transcription termination in prokaryotes and eukaryotes. | | CO4 | An | 3 |
| 15. | Cite the importance of the wobble hypothesis in translation. | | CO5 | U | 3 |
| 16. | Compare the role of cis and trans elements in eukaryotic gene regulation. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Describe the role of transformation, transduction, and conjugation in bacterial evolution. | CO1 | R | 6 |
|  | b. | Summarize the molecular structures and functions of DNA and RNA. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the Meselson-Stahl experiment and its contribution to understanding DNA replication. | CO2 | U | 6 |
|  | b. | Describe the replication processes of the leading and lagging strands, including the role of DNA polymerase. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Assess the significance of enzymes like helicase, ligase, and DNA polymerase in DNA replication. | CO2 | E | 6 |
|  | b. | Summarize the role of different DNA repair systems in maintaining genome stability. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. |  | Illustrate the process of replication in eukaryotes with a diagram, showing how it differs from prokaryotic replication. Include the role of telomeres and telomerase. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate the process of transcription in prokaryotes with a labeled diagram, including initiation, elongation, and termination. | CO4 | A | 6 |
|  | b. | Summarize the process of post-transcriptional modifications, focusing on RNA splicing and RNA editing. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the steps involved in translation in prokaryotes, naming the key enzymes and factors required. | CO4 | R | 6 |
|  | b. | Describe the process of translation in prokaryotes with a labeled diagram, showing initiation, elongation, and termination. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 23. | a. | Summarize the posttranslational modifications that occur in proteins and highlight their significance. | CO5 | U | 6 |
|  | b. | Illustrate the role of chromatin remodeling in eukaryotic gene regulation. | CO5 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the mechanism of gene regulation in the *lac* and *trp* operons, focusing the presence and absence of lactose and tryptophan respectively. | CO6 | A | 12 |

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

|  |  |
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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 4. Distinguish the process of replication, transcription and translation of prokaryotes and eukaryotes |
| **CO4** | Appraise the post-synthesis modifications for transcription and translation |
| **CO5** | Comprehend the role of genetic code, chromatin, operons and cis/trans elements in gene regulation |
| **CO6** | Recall the fundamental concepts of the prokaryotic and eukaryotic genome organization, its replication and gene expression |

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Cite the role of molecular scissors in genetic engineering. | | CO1 | U | 1 |
| 2. | Recall the laboratory method used to detect specific protein molecules among a mixture of proteins. | | CO2 | R | 1 |
| 3. | Name the function of a resistance marker in a plasmid. | | CO3 | R | 1 |
| 4. | Identify the type of hybrid plasmid that contains a Lambda phage cos sequence. | | CO3 | R | 1 |
| 5. | Identify the key difference between PCR and Reverse PCR. | | CO4 | U | 1 |
| 6. | List the step in which the primer binds to the denatured strand of DNA during PCR. | | CO4 | R | 1 |
| 7. | Infer on the transduction that occurs in bacteria and the agent responsible for it. | | CO5 | U | 1 |
| 8. | Name the chemical used to prepare competent cells for the heat-shock method of bacterial transformation. | | CO5 | R | 1 |
| 9. | Interpret the significance of biosafety containment levels when working with viruses like SARS-CoV-2. | | CO6 | U | 1 |
| 10. | Identify the committee responsible for reviewing research using Animals in a research/educational institute. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze in brief the three blotting techniques and write the molecules, which they detect. | | CO1 | An | 3 |
| 12. | Explain the properties that make a vector ideal for genetic engineering applications. | | CO2 | U | 3 |
| 13. | Describe the principle of PCR. | | CO3 | R | 3 |
| 14. | Explain the concept of a genomic library and its applications in biotechnology. | | CO4 | U | 3 |
| 15. | Differentiate between a genetically modified organism (GMO) from a naturally occurring organism. | | CO5 | An | 3 |
| 16. | Explain the full form of RDAC and its role in biological research. | | 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 types and functions of restriction enzymes. | CO1 | U | 12 |
|  |  |  |  |  |  |
| 18. |  | Describe the principle and process of Southern hybridization and its significance in molecular biology. | CO2 | R | 12 |
|  |  |  |  |  |  |
| 19. |  | Illustrate the technique of Real-time PCR along with its various applications in molecular diagnostics and research. | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Elucidate the key steps involved to clone the genome of a newly emerged RNA virus for sequencing. | CO4 | E | 6 |
|  | b. | Evaluate the impact of genome cloning and sequencing on epidemic control and virology research with relevant examples. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. |  | Evaluate the ethical issues in Biology and Biotechnology with respect to their impact on society, research, and healthcare. | CO5 | E | 12 |
|  |  |  |  |  |  |
| 22. | a. | Analyze the principle of Blue-White selection and its significance in molecular cloning. | CO2 | An | 6 |
|  | b. | Explain the role of alpha-complementation in Blue-White selection and how it differentiates recombinant and non-recombinant colonies. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 23. |  | Analyze the applications of RFLP and RAPD, comparing their advantages and limitations in genetic analysis. | CO4 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Describe the different levels of containment and their significance in biosafety. | CO6 | U | 6 |
|  | b. | Explain the role of the Institutional Biosafety Committee (IBSC) in regulating and monitoring biological research. | CO6 | U | 6 |

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

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

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name a chemical method used for cell lysis involving saponification of membrane lipids. | | CO1 | R | 1 |
| 2. | Name an enzyme relevant to fungal biomass processing. | | CO1 | U | 1 |
| 3. | Name the SI unit of specific cake resistance in the filtration process. | | CO2 | U | 1 |
| 4. | List the factors affecting the sedimentation velocity of cells under gravity. | | CO2 | R | 1 |
| 5. | Distinguish between chemisorption and physisorption process. | | CO3 | U | 1 |
| 6. | List the preferred solvent characteristics for liquid-liquid extraction. | | CO3 | R | 1 |
| 7. | Explain the mechanism involved in protein precipitation using ammonium sulfate. | | CO4 | U | 1 |
| 8. | Name the surface functional group required for Reversed Phase chromatography | | CO4 | R | 1 |
| 9. | State the charge on the resin used in anion exchange chromatography. | | CO5 | R | 1 |
| 10. | Define homogeneous crystallization. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate the working principle of high-pressure homogenization. | | CO1 | U | 3 |
| 12. | Examine the importance of sigma factor in the centrifuge scaleup process. | | CO2 | A | 3 |
| 13. | Deduce the expression to calculate product recovery in repeated batch extraction. | | CO3 | An | 3 |
| 14. | Explain the salting-in and salting-out phenomenon in protein precipitation. | | CO4 | U | 3 |
| 15. | Analyze the factors influencing the performance of Bioaffinity chromatography. | | CO5 | An | 3 |
| 16. | Illustrate the relationship between crystal growth and degree of supersaturation. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the applicability of different chemical methods of cell lysis. | CO1 | An | 6 |
|  | b. | Illustrate the difference between Gram-positive and Gram-negative bacterial cell wall structure and its implication on cell lysis. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Deduce constant pressure batch filtration rate expression applying Darcy’s law. | CO2 | A | 6 |
|  | b. | Deduce the expression relating cell sedimentation velocity under gravity in fermentation broth considering viscous drag on a particle. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | A tubular bowl centrifuge operating at 5000 rpm can process fermentation broth at a rate of 10 L/min. Evaluate the expected capacity if both viscosity and rpm of the centrifuge are doubled while particle size is reduced to half of the original. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. | a. | Illustrate the procedure to identify the correct isotherm expression from the batch adsorption study data set for Ce and Qe. | CO4 | A | 6 |
|  | b. | The addition of 10 g charcoal into 10 L fermentation broth containing 20 mg/L of antibiotic results in 50% product recovery. However, the addition of 20 g of charcoal results in 80% recovery. Estimate maximum adsorption capacity, if adsorption follows Langmuir isotherm. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. |  | Deduce mathematical expression to calculate recovery in multi-stage counter-current extraction process while appropriately labeling the stage diagram. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. | a. | Illustrate the use of Cohn equation to calculate the expected amount of protein to precipitate due to a change in ionic strength. | CO5 | A | 6 |
|  | b. | Interpret the mechanism involved in organic solvent-based protein precipitation. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the change in LLE recovery for weakly ionizable organics with a change in fermentation broth. | CO4 | U | 6 |
|  | b. | Illustrate the steps involved in the continuous rotary filtration process. | CO4 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the different stages for nucleation and crystal growth considering the relevant rate expression and supersaturation zones. | CO6 | An | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Apply methods for cell disruption in bioproduct recovery. |
| **CO2** | Solve challenges associated with solid-liquid separation after fermentation. |
| **CO3** | Analyse product recovery in isolation techniques. |
| **CO4** | Assess the performance of different extraction and adsorption techniques. |
| **CO5** | Examine various purification strategies for bioproducts. |
| **CO6** | Evaluate various techniques for bioproduct formulation |

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Mention the datatype contained in nucleic acid sequence databases. | | CO1 | U | 1 |
| 2. | Give an example of a secondary database. | | CO1 | U | 1 |
| 3. | State the significance of biological databases. | | CO2 | R | 1 |
| 4. | Describe the function of primary sequence databases. | | CO2 | R | 1 |
| 5. | Classify the type of analysis used in gene expression studies. | | CO3 | U | 1 |
| 6. | Define proteomics. | | CO3 | R | 1 |
| 7. | List two genomics databases based on their function or type. | | CO4 | R | 1 |
| 8. | Explain the purpose of comparative genomics. | | CO4 | U | 1 |
| 9. | Illustrate the importance of target identification in drug discovery. | | CO5 | U | 1 |
| 10. | Name a distance-based tree reconstruction method. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare the main difference between a primary and a secondary biological database. | | CO1 | U | 3 |
| 12. | State how data of 3D structure is stored in structure files. | | CO2 | A | 3 |
| 13. | Explain the concept of local alignment in sequence analysis. | | CO3 | U | 3 |
| 14. | Describe the use of ExPASy tools in protein sequence analysis. | | CO4 | U | 3 |
| 15. | Explain how proteomics databases are used to identify disease specific proteins. | | CO5 | A | 3 |
| 16. | Differentiate between distance-based and character-based methods in tree reconstruction. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Analyze the two distinct tools employed for data submission to the GenBank database with their relative advantages and limitations. | CO1 | A | 6 |
|  | b. | Explain the concept of Bioinformatics, their importance and diverse applications in the field of biology. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the purpose of "FUNCTION" and "SEQUENCE" sections in a Swiss-Prot (UniProt) entry focusing on the type of information each section provides. | CO2 | U | 4 |
|  | b. | Using the information below, construct a GenBank flat file entry. Follow GenBank file format conventions and ensure all information is properly structured and formatted.  **Gene Information:** • **Organism**: *Escherichia coli* (strain K-12) • **Gene**: *LacZ* (Beta-galactosidase) • **Accession Number**: MN987654 • **Sequence Length**: 654 bp • **Molecule Type**: DNA • **Strand**: Double-stranded • **Function**: Hydrolyzes lactose into glucose and galactose. • **Keywords**: Beta-galactosidase, lactose metabolism, operon • **Authors**: Johnson, T., and Smith, L. • **Title of Study**: "Regulation of *LacZ* expression in *Escherichia coli* K-12" • **Publication**: Journal of Microbial Genetics, 2022, Volume 85, Pages 45-59 • **Gene Location**: Start at 50 bp, end at 703 bp • **Sample Sequence (partial)**: ATGAAACGCTGGGACATGGCGATTGACGACAGGCTTGACGCGGA TTGCGCGAAGTGACTGAGCAGCTTGAGCGTGACGCGTGAAGGAG CTTGAAGTGAGCGTGAAGGTGACGTAGCTGAGGCGTGAAGTGG | CO2 | C | 8 |
|  |  |  |  |  |  |
| 19. | a. | Design a dot plot matrix to compare the following two nucleotide sequences:  Sequence X: ATGCGTACGTTAGC  Sequence Y: TGCGTACGTGAC  Show each step of the construction, including how you align the sequences, choose the window size, and mark matching bases.  Explain the patterns within dot plot that reveals similarities and differences.  If Sequence X had a few insertions and deletions, how would the dot plot change, illustrate the impact of these changes on the matrix. | CO3 | C | 6 |
|  | b. | Evaluate the gap penalty of the following two DNA sequences with gaps:  **Sequence A:** AC-TGGA-TC  **Sequence B:** ACTT-GAATC  Note that each gap incurs a penalty of -1.5 points | CO3 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | Construct a simple BLOSUM-like matrix for the following set of short amino acid sequences. Show all steps in the calculation, including the identification of amino acid pairs, calculation of frequencies, and log-odds score calculation. Explain how the resulting scores in the matrix are interpreted in terms of sequence similarity.  **Sequences:**   * Sequence 1: ALMA * Sequence 2: ALMA * Sequence 3: ALMA * Sequence 4: ALLA  1. Calculate the log-odds score for each amino acid pair using a log base 2 and a scaling factor of 1. Present the calculated log-odds scores in a matrix format. Explain how the scores in the resulting matrix are interpreted in terms of amino acid substitution preferences and sequence similarity. | CO4 | C | 6 |
|  | b. | Explain the functionalities of Clustal Omega available at EMBL-EBI. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate the role of energy minimization techniques in protein structure prediction and refinement. | CO5 | A | 6 |
|  | b. | Critically analyze the application of molecular dynamics simulations and molecular docking simulations in predicting the drug binding affinity. Compare how these approaches aid in identifying lead compounds and optimizing drug-target interactions. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | The following represents an alignment of two DNA sequences:  Sequence A: ATGCGTACGTTA  Sequence B: ATGCGTA-GTA  Calculate the percentage identity for this sequence alignment. Show all steps in the calculation.  Explain the concept of percentage identity in sequence alignments. Differentiate between identical positions, mismatches, and gaps, and describe how these factors influence the final score and its interpretation. | CO3 | E | 6 |
|  | b. | Two homologous genes are sequenced in two related species, A and B. The genes show 12 nucleotide differences between the species. If the estimated mutation rate for these genes is 3 x 10^-8 mutations per site per year, and assuming a strict molecular clock, estimate the time of divergence between species A and B. | CO3 | E | 6 |
|  |  |  |  |  |  |
| 23. | a. | The following distance matrix represents genetic distances between four species:   | **Species** | **Species X** | **Species Y** | **Species Z** | **Species W** | | --- | --- | --- | --- | --- | | **Species X** | 0 | 4 | 6 | 8 | | **Species Y** | 4 | 0 | 5 | 7 | | **Species Z** | 6 | 5 | 0 | 3 | | **Species W** | 8 | 7 | 3 | 0 |   (a) Using the UPGMA method, construct a phylogenetic tree for these four species. Show each step of the clustering process, including the recalculation of the distance matrix after each cluster is formed. (b) Based on the UPGMA tree, discuss the evolutionary relationship between the species and the significance of the branch lengths. | CO6 | C | 6 |
|  | b. | You are given the following distance matrix for four species:   | **Species** | **Species X** | **Species Y** | **Species Z** | **Species W** | | --- | --- | --- | --- | --- | | **Species X** | 0 | 6 | 8 | 10 | | **Species Y** | 6 | 0 | 7 | 9 | | **Species Z** | 8 | 7 | 0 | 4 | | **Species W** | 10 | 9 | 4 | 0 |   Using the Neighbor Joining (NJ) method, construct a phylogenetic tree for these four species. Show the calculation of the corrected distance matrix and the steps for identifying the closest pair of species at each iteration.  After constructing the tree, describe the evolutionary relationships between these species and the significance of the branch lengths in the tree. | CO6 | C | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Apply the Needleman-Wunsch algorithm to align the following sequences with a match score of +2, a mismatch penalty of -1, and a gap penalty of -2:  **Sequence 1:** AGCTAC  **Sequence 2:** AGTACC   1. Construct the scoring matrix for these sequences using the given scoring scheme. 2. Perform the traceback to determine the optimal global alignment.   Present the final alignment, justify the placement of any gaps, and explain how the resulting alignment score reflects sequence similarity and potential evolutionary connections between the sequences. | CO6 | C | 12 |

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

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

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the role of telomerase in cell longevity. | | CO1 | R | 1 |
| 2. | Write the primary purpose of stem cell technology. | | CO1 | A | 1 |
| 3. | State the purpose of a laminar airflow hood in cell culture. | | CO2 | U | 1 |
| 4. | Name one common disinfectant used to clean surfaces in a cell culture lab. | | CO2 | R | 1 |
| 5. | Explain totipotency. | | CO3 | U | 1 |
| 6. | Name the scientist who discovered induced pluripotent stem cells (iPSCs). | | CO3 | R | 1 |
| 7. | List any one storage method used for banking of stem cells. | | CO4 | R | 1 |
| 8. | Expand FDA. | | CO4 | R | 1 |
| 9. | Differentiate between symmetric and asymmetric cell division in stem cells. | | CO5 | U | 1 |
| 10. | State one major ethical concern in stem cell technology. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the differences between primary and secondary cell cultures. | | CO1 | An | 3 |
| 12. | Explain the importance of proper hand hygiene and personal protective equipment (PPE) in a cell culture lab. | | CO2 | U | 3 |
| 13. | Compare and contrast embryonic stem cells (ESCs) and induced pluripotent stem cells (iPSCs) based on their origin, ethical considerations, and potential applications. | | CO3 | An | 3 |
| 14. | Explain the three criteria for Mesenchymal Stem Cells (MSCs) as per the International Society of Cellular Therapy. | | CO4 | U | 3 |
| 15. | Examine the role of stem cells in cardiac disease repair. | | CO5 | U | 3 |
| 16. | Explain three major ethical concerns associated with stem cell 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. |  | Analyze the role of Hayflick limit and telomerase in cellular aging and their implications for regenerative medicine. | CO1 | An | 12 |
|  |  |  |  |  |  |
| 18. |  | Explain the key principles of aseptic technique in cell culture and the importance of maintaining contamination-free conditions. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 19. |  | Evaluate the differences between totipotent, pluripotent, multipotent, and unipotent stem cells. | CO3 | E | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the role of transcription factors (i) MyoD (ii) ASCII in transdifferentiation | CO4 | U | 12 |
|  |  |  |  |  |  |
| 21. |  | Analyze the role of different stem cell types in Parkinson’s disease treatment. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Analyze the applications and benefits of stem cell technology in the cosmetics industry, and its impact on skincare and anti-aging treatments. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | Critically analyze the ethical, legal, and social implications of human cloning. | CO6 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the major ethical, social, and regulatory challenges associated with stem cell technology. | CO6 | An | 12 |

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

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

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Write the highest level of biosafety in genetically modified microorganism. | | CO1 | A | 1 |
| 2. | Define Biohazards. | | CO1 | R | 1 |
| 3. | Write the role of Genetic Engineering Approval Committee (GEAC). | | CO2 | A | 1 |
| 4. | State the need for GMO in Agriculture sector. | | CO2 | R | 1 |
| 5. | Define Trademarks. | | CO3 | R | 1 |
| 6. | Write the significance of Budapest treaty. | | CO3 | A | 1 |
| 7. | List the significance of patent law in biotechnology inventions. | | CO4 | R | 1 |
| 8. | State the significance of patent licensing. | | CO5 | R | 1 |
| 9. | Define Bioethics. | | CO6 | R | 1 |
| 10. | Write one ethical issue in organ transplantation in humans. | | CO5 | A | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the historical background of biosafety. | | CO1 | An | 3 |
| 12. | Illustrate the role of Institutional Biosafety Committee. | | CO2 | An | 3 |
| 13. | Explain the salient features of copyrights with examples. | | CO3 | U | 3 |
| 14. | Analyze the patentable subjects in biotechnology. | | CO3 | An | 3 |
| 15. | Explain the role of Blue Cross in India. | | CO4 | U | 3 |
| 16. | Illustrate the bioethical issues of transgenic research in biotechnology. | | CO6 | A | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Explain the containment requirements and different levels of biosafety of genetically modified microorganisms with suitable examples. | CO1 | A | 8 |
|  | b. | Discuss the different types of Biosafety cabinets available and its role in protecting Personel and Environment. | CO1 | U | 4 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the operation of biosafety guidelines and regulations of government of India. | CO2 | A | 8 |
|  | b. | Describe the biosafety issues of genetically modified foods with suitable examples. | CO2 | U | 4 |
|  |  |  |  |  |  |
| 19. | a. | Define Patent. | CO4 | R | 2 |
|  | b. | Explain the strategies adapted by government of India for protection of traditional knowledge and geographical indications with suitable examples. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 20. | a. | List the organizations established by government of India for biotechnology patents. | CO3 | R | 2 |
|  | b. | Illustrate the steps involved in patent filing and granting procedures in biotechnological innovations. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 21. |  | Describe the International and National agreements and treaties of IPR and its significance in protection of biotechnological innovations. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 22. |  | Illustrate the ethical implications of human cloning designer babies and biowarfare with suitable case study. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Explain the ethical limits of animal research in biotechnology. | CO5 | An | 6 |
|  | b. | Illustrate the frame work of ethical decision making in transgenic research. | CO5 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Explain the ICMR guidelines and importance of health care resources in organ transplantation in humans in India. | CO6 | An | 12 |

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

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

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the role of trypsin in cell culture. | | CO1 | U | 1 |
| 2. | Name one common type of microbial contamination in cell culture. | | CO1 | R | 1 |
| 3. | Name one assay method used to measure cell proliferation. | | CO2 | R | 1 |
| 4. | List one marker associated with stem cell differentiation. | | CO2 | R | 1 |
| 5. | Describe the role of scaffolds in tissue engineering. | | CO3 | U | 1 |
| 6. | Give an example of a synthetic biomaterial used in tissue engineering. | | CO3 | U | 1 |
| 7. | State the purpose of 3D cell culture in tissue engineering. | | CO4 | U | 1 |
| 8. | List one source of mesenchymal stem cells. | | CO4 | R | 1 |
| 9. | Describe the purpose of electrospinning in tissue engineering. | | CO5 | U | 1 |
| 10. | List one regulatory body other than the FDA involved in tissue engineering product approval. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate between primary and secondary cell cultures. | | CO1 | An | 3 |
| 12. | Describe the importance of morphological assessment in cell characterization. | | CO2 | U | 3 |
| 13. | Analyze the properties of silk biomaterials that make them suitable for tissue regeneration. | | CO3 | An | 3 |
| 14. | Describe the significance of 3D cell culture models in mimicking the *in vivo* environment. | | CO4 | U | 3 |
| 15. | **Analyze** the current scope of tissue engineering in *in-vitro* drug testing. | | CO5 | An | 3 |
| 16. | **Explain** the importance of FDA regulations in the approval of tissue-engineered products. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. |  | **Evaluate** the essential components of cell culture media and their specific roles in supporting cell growth. | CO1 | E | 12 |
|  |  |  |  |  |  |
| 18. |  | **Evaluate** the techniques used for chromosome analysis in tissue culture. | CO2 | E | 12 |
|  |  |  |  |  |  |
| 19. |  | **Analyze** the process of tissue engineering in skin and liver regeneration in the context of biomaterials, cells, and strategies used. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. |  | Evaluate the effectiveness of cell transplantation therapies in musculoskeletal and liver tissue engineering. | CO4 | E | 12 |
|  |  |  |  |  |  |
| 21. |  | Explain the different scaffold fabrication methods used in tissue engineering. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 22. |  | Compare and contrast the tissue engineering applications of epithelial, mesenchymal, neuroectodermal, and hematopoietic cells. | CO4 | An | 12 |
|  |  |  |  |  |  |
| 23. |  | **Analyze** the different types of microbial contamination in cell culture, and the preventive strategies employed in maintaining sterile conditions. | CO1 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the regulatory and ethical considerations in tissue engineering and their impact on research practices and clinical applications. | CO6 | An | 12 |

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

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

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

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| --- | --- | --- | --- |
| **Course Code** | **20BT2060** | **Duration** | **3hrs** |
| **Course Title** | **DEVELOPMENTAL BIOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define Mosaic Theory. | | CO1 | R | 1 |
| 2. | Explain the role of Gurken protein in drosophila development. | | CO1 | U | 1 |
| 3. | Name the growth factor involved in limb development in human embryos. | | CO2 | R | 1 |
| 4. | Explain Capacitation. | | CO2 | U | 1 |
| 5. | List the proteins involved in differentiation of trophoblast or ICM. | | CO3 | R | 1 |
| 6. | Write the role of zona pellucida in mammalian fertilization. | | CO4 | A | 1 |
| 7. | Explain the function of prolactin in mammals. | | CO4 | U | 1 |
| 8. | Define genetic heterogenicity. | | CO5 | R | 1 |
| 9. | Write the functions of mosaic Pleiotrophy. | | CO5 | A | 1 |
| 10. | Justify the role of bisphenol A in human embryo development. | | CO6 | E | 1 |
|  | | | | | |
| 11. | Explain holometabolous development in Drosophila. | | CO1 | U | 3 |
| 12. | Analyze species-species recognition in fertilization. | | CO2 | An | 3 |
| 13. | Describe Thanotophoric Dysplasia with examples. | | CO3 | U | 3 |
| 14. | Write the importance of compaction in development biology. | | CO4 | A | 3 |
| 15. | Illustrate oestrogen regulation in human fertilization. | | CO5 | U | 3 |
| 16. | Critically analyze the meiotic defects caused in mouse oocyte during cell division. | | 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. | Discuss anterior-posterior polarity in the oocyte of drosophila. | CO1 | U | 6 |
|  | b. | Create germline chimeras by interchanging pole cells and germ cell precursors. | CO1 | C | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the hypothetical model for mammalian sperm capacitation. | CO2 | U | 6 |
|  | b. | Illustrate the induction process of mouse acrosome reaction by ZP3. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Analyze the key steps involved in activation of mammalian eggs. | CO3 | An | 6 |
|  | b. | Describe Jak Stat pathway with suitable illustrations. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Explain the pathway of blastomere to become trophoblast and inner cell mass layers. | CO3 | An | 6 |
|  | b. | Describe the process of human monozygotic twinning in context to extra embryonic membranes. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | Illustrate the derivation of tissues in human and rhesus monkey and the process of tissue formation in early mammalian embryo. | CO4 | A | 12 |
|  |  |  |  |  |  |
| 22. |  | Describe the process of *In vitro* fertilization and embryo transfer methods. | CO4 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Analyze the methods used in genetic diagnosis and screening in early embryonic development. | CO5 | An | 6 |
|  | b. | Justify the ethical issues involved in *In vitro* embryo development with suitable examples. | CO6 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate the environmental assaults caused during human embryo development. | CO6 | A | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Apply the knowledge in basic embryonic development in Drosophila. |
| **CO2** | Relate the role of genes and its expression during the process of the development of organs. |
| **CO3** | Analyze the role of hormones involved during embryonic development. |
| **CO4** | Assess the process of gastrulation for organ development. |
| **CO5** | Evaluate the importance of gene expression in embryonic development. |
| **CO6** | Analyze the impact of environmental teratogens and on human embryo development. |

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | List the use of density gradient centrifugation in cell separation. | | CO1 | R | 1 |
| 2. | List anyone cell bank in India and state its significance. | | CO1 | R | 1 |
| 3. | Differentiate between suspension cultures and adherence cultures. | | CO2 | U | 1 |
| 4. | Name one vaccine that is commercially produced using mammalian cell culture. | | CO2 | R | 1 |
| 5. | State the advantage of using 3D cell cultures over traditional 2D cultures in tissue engineering. | | CO3 | R | 1 |
| 6. | Name the type of tissue that is commonly engineered using biodegradable polymer scaffolds. | | CO3 | R | 1 |
| 7. | Explain the significance of lignocellulose bioconversion in nutritional biotechnology. | | CO4 | U | 1 |
| 8. | Fermentation process improves the nutritional properties of meat –Justify. | | CO4 | U | 1 |
| 9. | Analyze the primary purpose of *in vitro* fertilization (IVF) in animal biotechnology. | | CO5 | An | 1 |
| 10. | Justify the role of artificial intelligence in livestock monitoring. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Compare the key differences between primary cell culture and cell lines. | | CO1 | An | 3 |
| 12. | Describe the production of vaccines using cell culture technology. | | CO2 | U | 3 |
| 13. | Analyze the factors influencing the success of 3D cell culture. | | CO3 | An | 3 |
| 14. | Examine the importance of genetic manipulation of microbes to improve health. | | CO4 | U | 3 |
| 15. | Illustrate the role of artificial insemination in animal breeding programs. | | CO5 | An | 3 |
| 16. | Explain the role of molecular diagnosis in detecting animal diseases. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Describe the working principle and steps involved in fluorescent-activated cell sorting (FACS). | CO1 | U | 6 |
|  | b. | Analyze the role of chromosomal analysis in cell characterization. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the advantages of continuous flow culture in large-scale production. | CO2 | U | 6 |
|  | b. | Examine the role of cell culture in enzyme and hormone production. | CO3 | A | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain the importance of scaffold design in tissue engineering. | CO3 | An | 6 |
|  | b. | Evaluate the role of biomaterials in organ regeneration. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 20. | a. | Describe the process of lignocellulose bioconversion in dietary fiber production. | CO4 | U | 6 |
|  | b. | Genetic engineering improves microbial fermentation in food biotechnology-Justify with suitable examples. | CO5 | U | 6 |
|  |  |  |  |  |  |
| 21. | a. | Describe the process of germ cell line manipulation in reproductive biotechnology. | CO5 | U | 6 |
|  | b. | Explain the techniques used in preimplantation genetic diagnosis. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 22. | a. | Describe the strategies used to develop transgenic animal in biomedical research. | CO3 | U | 6 |
|  | b. | Explain the applications of artificial intelligence in animal health monitoring. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 23. | a. | Explain the role of marker-assisted selection in livestock breeding. | CO3 | A | 6 |
|  | b. | Examine the importance of stem cells in generating transgenic animals. | CO2 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Analyze the various advancements in micromanipulation technologies in embryo engineering. | CO6 | An | 12 |

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

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

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Appraise the role of rDNA technology in developing transgenic plants for high yield, stress tolerance, value addition and pharmaceutical uses. | CO1 | An | 16 |
|  |  |  |  |  |  |
| 2. | a. | Classify the types of vectors. Give example for each class. | CO2 | A | 8 |
|  | b. | Compare and contrast between the two common screening methods used in cloning. | CO2 | A | 8 |
|  |  |  |  |  |  |
| 3. | a. | Sketch a flow chart for the industrial production and recovery of human insulin. | CO3 | A | 8 |
|  | b. | Illustrate the steps involved in the amplification of nucleic acids by PCR. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 4. | a. | List the strategies used for developing draught resistant crops. Outline any TWO draught resistant crops. | CO6 | U | 8 |
|  | b. | Illustrate with diagram how the CRISPR/Cas systems can be utilized on the development of virus-resistant transgenic crops with examples. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 5. | a. | Describe any EIGHT genetically modified animals developed along with their commercial applications. | CO5 | U | 8 |
|  | b. | Explain how the transgenic hypoallergenic cows are developed and used to solve the cow milk protein allergy of infants. | CO5 | An | 8 |
|  |  |  |  |  |  |
| 6. | a. | Interpret the steps involved in the generation of genomic library with diagram. | CO2 | E | 8 |
|  | b. | Evaluate the hybridization techniques used for screening the cloned genes. | CO2 | E | 8 |
|  |  |  |  |  |  |
| 7. | a. | Write the principle, technique and applications of qPCR. | CO1 | An | 8 |
|  | b. | Illustrate the steps of pyrosequencing method used in Next Generation Sequencing. | CO1 | An | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Highlight the therapeutic uses of hGH. Explain its industrial production process. | CO6 | U | 10 |
|  | b. | Relate any TEN therapeutic enzymes with the disorders for which it is used. | CO6 | An | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Implement the genetic engineering concepts in recombinant technology. |
| CO2 | Apply genetic engineering tools for the development of recombinant products |
| CO3 | Develop techniques for genetic manipulation of microbes. |
| CO4 | Formulate gene manipulation techniques for crop improvement. |
| CO5 | Develop gene manipulation techniques for transgenic animals. |
| CO6 | Assess the ethical and societal impacts of genetic engineering and recombinant protein technologies |

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. |  | Explain the structure and functions of primary lymphoid organs with an example. | CO1 | U | 16 |
|  |  |  |  |  |  |
| 2. |  | Describe various types of immune cells. Describe the process of differentiation of immune cells in the bone marrow. | CO2 | R | 4+12 |
|  |  |  |  |  |  |
| 3. |  | Illustrate with sketches the structure and function of the classes of immunoglobulins. | CO3 | U | 16 |
|  |  |  |  |  |  |
| 4. |  | Describe various types of autoimmunity with suitable examples. | CO4 | R | 16 |
|  |  |  |  |  |  |
| 5. | a. | Describe how chimeric antibodies are produced. | CO5 | U | 6 |
|  | b. | Compare and contrast chimeric antibodies with humanized antibodies. | CO5 | An | 8 |
|  |  |  |  |  |  |
| 6. |  | Explain the process involved in the production of Monoclonal Antibodies. State a few application of MAB’s. | CO6 | U | 12+4 |
|  |  |  |  |  |  |
| 7. |  | Analyze the importance of cytokines, their classes, functions and their mode of action. | CO3 | R | 16 |
|  |  |  |  |  |  |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Evaluate various vaccines approaches for SARS CoV2. | CO6 | U | 20 |

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

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

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the structure, function and commercial significance of secondary metabolite flavonoids with suitable examples. | CO1 | A | 10 |
|  | b. | Analyze the functions and biological activities of plant secondary metabolite with examples. | CO1 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Illustrate the MEP pathway of biosynthesis and functions of terpenoids in plants with a neat diagram. | CO2 | U | 15 |
|  | b. | Write the mechanism of exchange of intermediates between biochemical pathways in plants. | CO2 | A | 5 |
|  |  |  |  |  |  |
| 3. |  | Evaluate the concept of genetic regulation of key enzymes in plants with suitable examples. | CO3 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the process of commercial production of plant secondary metabolite Taxol. | CO4 | U | 15 |
|  | b. | Write the role of endophytes in plant secondary metabolite production. | CO4 | A | 5 |
|  |  |  |  |  |  |
| 5. |  | Write the method of cloning and characterization of enzymes in Shikimate pathway with a sketch. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Explain the process of metabolic engineering of Yeast for production alkaloids and its significance in commercial production. | CO2 | A | 20 |
|  |  |  |  |  |  |
| 7. | a. | Write the parameters of solubility in preformulation of drugs. | CO3 | U | 5 |
|  | b. | Illustrate the properties and selection criteria for various excipients in preformulation studies. | CO3 | U | 15 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Evaluate various excipients used in pharmaceutical dosage forms. | CO6 | E | 10 |
|  | b. | Explain the process of formulation development in inhalation dosage form. | CO6 | U | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. |  | Illustrate the process of formulation, production and evaluation of dry syrups. | CO6 | E | 20 |

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

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

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Name a large-scale experimental tool used to study transcriptomics. | | CO1 | R | 1 |
| 2. | List two outcomes of functional genomics. | | CO1 | R | 1 |
| 3. | State the role of feedback inhibition in primary metabolite biosynthesis. | | CO2 | R | 1 |
| 4. | Name a technique that is used to isolate auxotrophic mutants. | | CO2 | R | 1 |
| 5. | Illustrate the relation between Elemental matrix and Stoichiometric matrix if the reaction is mass balanced. | | CO3 | U | 1 |
| 6. | Justify the purpose of using isotopic labeling in 13C-MFA. | | CO3 | U | 1 |
| 7. | Explain the goal of Metabolic Control Analysis. | | CO4 | U | 1 |
| 8. | Identify the system parameters and system variables for the simple pathway with net flux of j . | | CO4 | U | 1 |
| 9. | List three types of reactions that occur in biotransformation. | | CO5 | R | 1 |
| 10. | Illustrate the advantage of replacing phosphotransferase system with non-phosphotransferase system in cells. | | CO6 | An | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Explain the key metabolic control differences between prokaryotes and eukaryotes. | | CO1 | U | 3 |
| 12. | Determine the role of sequential feedback control mechanism in the accumulation of intermediates in a biosynthetic pathway. | | CO2 | A | 3 |
| 13. | Construct the stoichiometric matrix for the following reaction map. | | CO3 | A | 3 |
| 14. | Differentiate between control and regulation in metabolism with suitable example. | | CO4 | U | 3 |
| 15. | Describe the characteristics of sequential bioconversion. | | CO5 | U | 3 |
| 16. | In the production of biofuel using microbial hosts, toxicity to microbial cells is a major challenge. Recommend a viable solution to address this issue. | | CO6 | An | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Classify metabolic reactions on the basis of their primary function in the overall cell synthesis process. | CO1 | U | 6 |
|  | b. | Evaluate the importance of proton symport in maintaining the intracellular pH of a cell. | CO1 | E | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the principle behind Davis technique in isolating auxotrophic mutants. | CO2 | A | 6 |
|  | b. | Explain cooperative repression and feedback inhibition in the purine nucleotide pathway of *Bacillus subtilis*, focusing on the contribution of AMP and GMP in the regulation of inosine production. | CO2 | An | 6 |
|  |  |  |  |  |  |
| 19. |  | Determine the equation (matrix form) relating the flux, substrates, products and intermediates for the simplified metabolic pathway for aromatic amino acid synthesis by *S. cerevisiae* as shown below | CO3 | A | 12 |
|  |  |  |  |  |  |
| 20. | a. | Compare the choice of flux control coefficients (FCCs) and concentration control coefficients (CCCs) in MCA. | CO4 | An | 6 |
|  | b. | Explain the importance of connectivity theorem in understanding metabolic flux control. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 21. |  | **Compare** different methods used to enhance the conversion of insoluble substances in bioconversion. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the experiment using 13C-MFA to investigate the metabolic pathways in a microbial fermentation process. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 23. |  | Explain the role of auxotrophic mutants in improving microbial biosynthesis and their contribution to the accumulation of metabolic intermediates and end products in unbranched and branched biosynthetic pathways. | CO2 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Evaluate the metabolic engineering strategies used for the overproduction of alcohol in industrial biotechnology. | CO6 | E | 12 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Apply the principles of metabolic engineering to assess cellular function and characterize metabolites. |
| **CO2** | Analyse the regulation of metabolic pathways and their influence on the production of primary and secondary metabolites. |
| **CO3** | Formulate experimental methods to assess metabolic flux analysis. |
| **CO4** | Assess the flux distribution within a metabolic network using Metabolic Control Analysis. |
| **CO5** | Implement the principles of bioconversion to produce industrially important products. |
| **CO6** | Develop industrially important products by applying the principles of metabolic engineering |

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

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| **Course Code** | **22BT2076** | **Duration** | **3hrs** |
| **Course Title** | **DATA ANALYSIS AND SIMULATIONS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify the difference between nominal and ordinal attributes. | | CO1 | R | 1 |
| 2. | Infer the data proportion to be present inside the box for a good box-plot diagram. | | CO1 | U | 1 |
| 3. | Indicate the expected range of pair-wise correlation coefficient for a data set. | | CO2 | U | 1 |
| 4. | Identify the condition that necessitates the use of a paired t-test for analysis. | | CO2 | U | 1 |
| 5. | Name a regression-based strategy for missing value imputation. | | CO3 | R | 1 |
| 6. | Define the IQR of a data set. | | CO3 | R | 1 |
| 7. | Name an algorithm adopted to select a predictor set as a candidate for node splitting. | | CO4 | R | 1 |
| 8. | Associate data transformation in *purelin* activation function in Artificial Neuronal Network model. | | CO5 | R | 1 |
| 9. | Infer the situation for the adoption of LOO cross-validation for machine learning. | | CO6 | U | 1 |
| 10. | Explain the modality to measure the generalization capability of Machine Learning models. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Illustrate position of mean, median, and mode in distribution for positively and negatively skewed data sets. | | CO1 | A | 3 |
| 12. | Explain the different data-normalization strategies adopted in Machine Learning. | | CO2 | U | 3 |
| 13. | Illustrate the differences between *k*-mean and hierarchical clustering. | | CO3 | U | 3 |
| 14. | Enumerate the advantage of Ensemble models in data analysis. | | CO4 | U | 3 |
| 15. | Illustrate the role of different activation functions in ANN architecture. | | CO5 | U | 3 |
| 16. | Explain the requirements and strategies to optimize the generalization capability of Machine Learning models. | | 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. | Determine the steps involved in the construction of a box plot (box whisker) from a synthetic data set. | CO1 | A | 6 |
|  | b. | Appraise different steps and the strategies in preprocessing of data sets for Machine Learning model development. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. | a. | Interpret the significance of mean, median, mode, and standard deviation to analyze the underlying data distribution or anomaly. | CO2 | U | 6 |
|  | b. | Employ the statistical tests relevant to compare outcomes from different levels for one or more factors. | CO2 | A | 6 |
|  |  |  |  |  |  |
| 19. |  | Distinguish between classification and clustering algorithms for categorical outcomes. Organize the steps involved in *k*-mean clustering for a data set. | CO3 | An | 12 |
|  |  |  |  |  |  |
| 20. | a. | Recommend decision split on categorical predictors adopting the Gini impurity index. | CO4 | An | 6 |
|  | b. | Evaluate the utility of logistic regression for classification problems. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. |  | Illustrate the architecture multi-layer perceptron in the regression model. Explain the information flow in input-hidden-output layers combined with activation. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Explain the basic architecture of the convolutional neural network, pooling layer, and fully connected layer architecture with an appropriate diagram. | CO5 | U | 12 |
|  |  |  |  |  |  |
| 23. | a. | Examine the algorithms used to remove outliers, and perform normalization in data analysis. | CO1 | An | 6 |
|  | b. | Describe the significance of PCA on multivariate data regression. | CO1 | An | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Illustrate different cross-validation schemes and the strategies adopted to evaluate the quality of Machine Learning model performance. | CO6 | U | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Analyse correlation among data sets through data visualization. |
| **CO2** | Apply relevant statistical analysis to real-time data. |
| **CO3** | Analyse associations, or causal structures from data sets. |
| **CO4** | Develop machine learning models relevant to healthcare and biological data. |
| **CO5** | Implement ANN-based models to get insight into biological data. |
| **CO6** | Evaluate the quality of developed machine learning models. |

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

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| **Course Code** | **22BT2081** | **Duration** | **3hrs** |
| **Course Title** | **RATIONAL DRUG DISCOVERY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Define a therapeutic drug. | | CO1 | R | 1 |
| 2. | Predict the outcome if a drug has poor bioavailability. | | CO1 | R | 1 |
| 3. | List the key advantages of HTS in drug discovery. | | CO2 | R | 1 |
| 4. | List two challenges in validating a novel drug target. | | CO2 | R | 1 |
| 5. | Which type of interaction would dominate between a positively charged drug and a negatively charged receptor. | | CO3 | A | 1 |
| 6. | List the phases of clinical trials. | | CO3 | A | 1 |
| 7. | Identify ONE ethical principle that governs clinical trials. | | CO4 | R | 1 |
| 8. | Write the purpose of a regulatory review in the NDA process. | | CO4 | R | 1 |
| 9. | Name THREE forms of IPR protection. | | CO5 | R | 1 |
| 10. | What is the significance of the TRIPS agreement? | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Write the importance of dose-response relationships in understanding drug action. | | CO1 | U | 3 |
| 12. | Explain the significance of natural products as a source for lead compounds in drug discovery using two examples. | | CO2 | U | 3 |
| 13. | Illustrate the role of hydrogen bonding in drug-receptor interactions and its effect on drug efficacy. | | CO3 | An | 3 |
| 14. | Propose a strategy to test a drug formulation for enhanced bioavailability in the preclinical phase. | | CO4 | A | 3 |
| 15. | Outline the process of NDA submission, and explain how it differs from an IND application. | | CO5 | A | 3 |
| 16. | What is Intellectual Property Rights (IPR), and why is it important in drug discovery and development? | | CO6 | R | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Compare the pharmacokinetics of a lipophilic drug with a hydrophilic drug. | CO1 | An | 6 |
|  | b. | List the different routes of drug administration and classify them based on their applications. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Critically assess the relevance of Lipinski’s Rule of FIVE in modern drug discovery, especially for biologics and advanced therapies. | CO1 | An | 6 |
|  | b. | Judge the importance of understanding dose-response relationships in determining the therapeutic index of a drug. | CO1 | E | 6 |
|  |  |  |  |  |  |
| 19. |  | Define drug discovery and list the key stages involved in the drug discovery and development process. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 20. |  | Explain the importance of combinatorial chemistry and CADD in drug discovery. | CO2 | U | 12 |
|  |  |  |  |  |  |
| 21. | a. | Illustrate with examples how covalent bonding in drug-receptor interactions leads to long-lasting effects compared to non-covalent interactions. | CO3 | A | 6 |
|  | b. | Define the following types of interactions in drug molecules and provide one example for each: covalent interactions, hydrogen bonding, van der Waals interactions, and ion-dipole interactions. | CO3 | R | 6 |
|  |  |  |  |  |  |
| 22. | a. | Describe the components of Good Clinical Practice (GCP) guidelines and explain their role in ensuring ethical clinical trials. | CO4 | U | 6 |
|  | b. | Define pharmacokinetics and pharmacodynamics. Describe their importance in preclinical testing of new drugs. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 23. |  | Analyze the differences and similarities between the US FDA’s regulatory pathways for new drug approval and the CDSCO’s approval process in India. | CO5 | An | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Explain the significance of the Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement in global trade. | CO6 | U | 6 |
|  | b. | Using the TRIPS framework, explain how developing countries can balance the need for patent protection with access to affordable medicines. | CO6 | U | 6 |

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

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

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

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| **Course Code** | **22BT2086** | **Duration** | **3hrs** |
| **Course Title** | **MOLECULAR PHARMACEUTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Identify ONE ideal characteristic of targeted drug therapy. | | CO1 | R | 1 |
| 2. | State why poor solubility is a challenge in oral drug delivery systems. | | CO1 | U | 1 |
| 3. | Identify any ONE parameter which is involved in characterization and evaluation of  Nanoparticles. | | CO2 | R | 1 |
| 4. | Infer why liposomes are considered effective carriers in drug delivery. | | CO2 | U | 1 |
| 5. | Outline the structure of microspheres. | | CO3 | U | 1 |
| 6. | Compare monoclonal antibodies with polyclonal antibodies. | | CO3 | U | 1 |
| 7. | Name the most commonly used devices for generation of aerosol. | | CO4 | R | 1 |
| 8. | State the molecular components that direct contact with brain and CSF. | | CO4 | R | 1 |
| 9. | Identify ONE role of Antisense molecules. | | CO5 | R | 1 |
| 10. | Write the TWO types of reversible enzyme inhibition. | | CO6 | R | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Sketch the pinocytosis process with neat diagram. | | CO1 | A | 3 |
| 12. | Illustrate the key components of blood-brain barrier system. | | CO2 | U | 3 |
| 13. | Examine the cross-sectional features of microspheres with neat sketch. | | CO3 | An | 3 |
| 14. | Explain the function of the main components of metered-dose inhalers. | | CO4 | U | 3 |
| 15. | Describe the importance of viruses in gene transfer. | | CO5 | An | 3 |
| 16. | Illustrate the enzyme kinetics with neat diagram. | | CO6 | U | 3 |
| **PART – C (6 X 12 = 72 MARKS)**  **(Answer any five Questions from Q. No. 17 to 23, Q. No. 24 is Compulsory)** | | | | | |
| 17. | a. | Demonstrate how different tumor-targeting strategies improve drug delivery in cancer therapy. | CO1 | A | 6 |
|  | b. | Compare different strategies for drug delivery to the brain in terms of efficiency and challenges. | CO1 | An | 6 |
|  |  |  |  |  |  |
| 18. | a. | Describe the role of nanoparticles in targeted drug delivery systems. How do nanoparticles improve the efficacy and reduce side effects of drugs. | CO2 | E | 6 |
|  | b. | Evaluate the characteristic feature of liposomes. Highlight their role in drug delivery. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. |  | Illustrate different techniques for the preparations of microcapsules. | CO3 | U | 12 |
|  |  |  |  |  |  |
| 20. | a. | Summarize different aerosol devices which is involved in drug therapy. | CO4 | U | 6 |
|  | b. | Describe how *in vitro* and *in vivo* evaluation techniques are applied to test the efficiency of intranasal drug formulations. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. |  | Write the concepts of biodistribution and pharmacokinetics. Describe the key factors affecting drug biodistribution and the significance of pharmacokinetic parameters in drug design and development. | CO5 | An | 12 |
|  |  |  |  |  |  |
| 22. |  | Describe the production process and applications of monoclonal antibodies with neat illustration. | CO3 | R | 12 |
|  |  |  |  |  |  |
| 23. |  | Describe the process of SELEX (Systematic Evolution of Ligands by EXponential enrichment) for developing aptamers. Highlight its application in targeted drug delivery and disease treatment. | CO5 | A | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Differentiate between competitive and non-competitive enzyme inhibition. Provide a detailed explanation of allosteric inhibition and its significance in biochemical regulation. | CO6 | An | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Implement the knowledge on Drug delivery systems and understanding. |
| **CO2** | Assess the characterization and preparation of various drug targeting methods with liabilities. |
| **CO3** | Analyze the enterprise-wide information assets in support of various pharmaceutical micro capsules and spears. |
| **CO4** | Evaluate the concepts of nasal drug delivery systems and physiological mechanism. |
| **CO5** | Evaluate the Bimolecular based drug delivery methods and function. |
| **CO6** | Implement the functional principle of enzyme inhibitors. |

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

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

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Write the significance of genome organization. | | CO1 | U | 1 |
| 2. | Define the function of Real-Time PCR. | | CO1 | R | 1 |
| 3. | Identify ONE gene editing technique used for site-specific recombination. | | CO2 | R | 1 |
| 4. | State the function of guide RNA in CRISPR. | | CO2 | R | 1 |
| 5. | Differentiate miRNA and siRNA. | | CO3 | U | 1 |
| 6. | Cite the role of shRNA in gene therapy. | | CO3 | R | 1 |
| 7. | Identify a disease where *ex vivo* gene editing therapy is used. | | CO4 | U | 1 |
| 8. | State how CRISPR/Cas9 helps in cancer research. | | CO4 | R | 1 |
| 9. | Define "CRISPR babies". | | CO5 | R | 1 |
| 10. | Write ONE ethical concern related to genome editing. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Examine *ex vivo* and *in vivo* gene editing strategies. | | CO1 | An | 3 |
| 12. | Explain how Phi31 integrase functions in site-specific recombination. | | CO2 | U | 3 |
| 13. | Describe the role of non-coding RNAs in gene therapy. | | CO3 | U | 3 |
| 14. | Infer how CRISPR is used for genetic screening in cancer cells. | | CO4 | U | 3 |
| 15. | Identify the importance of WHO recommendations on genome editing. | | CO5 | A | 3 |
| 16. | Discuss the major challenges in translating gene editing to clinical applications. | | 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. | Identify the structure and function of the human genome. | CO1 | R | 6 |
|  | b. | Classify different types of genetic variations and their analysis methods. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 18. | a. | Illustrate the working mechanism of the Cre-Lox recombination system. | CO2 | U | 6 |
|  | b. | Differentiate ZFN, TALEN, and CRISPR/Cas9 genome editing techniques. | CO2 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Explain how CRISPR knock-out experiments are designed and validated. | CO3 | A | 6 |
|  | b. | Describe CRISPR knock-in strategies for inserting or mutating DNA sequences. | CO3 | R | 6 |
|  |  |  |  |  |  |
| 20. | a. | Examine the role of small RNAs in gene silencing. | CO4 | R | 6 |
|  | b. | Determine how siRNA can be used for therapeutic gene regulation. | CO4 | A | 6 |
|  |  |  |  |  |  |
| 21. | a. | Assess how CRISPR/Cas9 technology is applied in brain disease treatment. | CO5 | E | 6 |
|  | b. | Sketch gene editing approaches for hematologic disorders. | CO5 | A | 6 |
|  |  |  |  |  |  |
| 22. | a. | Appraise the major limitations of gene editing tools. | CO3 | A | 6 |
|  | b. | Examine potential risks associated with CRISPR in human applications. | CO3 | R | 6 |
|  |  |  |  |  |  |
| 23. | a. | Interpret the concept of "CRISPR babies" and its ethical implications. | CO4 | A | 6 |
|  | b. | Evaluate the regulatory challenges of clinical gene editing. | CO4 | E | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Analyze the impact of artificial intelligence in gene editing advancements. | CO6 | An | 6 |
|  | b. | Assess the future applications of CRISPR in personalized medicine. | CO6 | E | 6 |

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

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

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

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| --- | --- | --- | --- |
| **Course Code** | **23BT2004** | **Duration** | **3hrs** |
| **Course Title** | **ARTIFICIAL INTELLIGENCE IN HEALTHCARE AND BIOSCIENCES** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | Write the primary goal of Artificial Intelligence in healthcare. | | CO1 | U | 1 |
| 2. | Define computational models of intelligence. | | CO1 | R | 1 |
| 3. | Name TWO key libraries used for data handling in Python. | | CO2 | R | 1 |
| 4. | Cite the primary purpose of Pandas Data Frames. | | CO2 | U | 1 |
| 5. | Differentiate the Bayesian Machine Learning from other ML models. | | CO3 | U | 1 |
| 6. | List TWO applications of AI in medical biosensors. | | CO3 | R | 1 |
| 7. | List TWO key challenges in applying AI to healthcare. | | CO4 | R | 1 |
| 8. | Infer ONE advantage from a cluster of models of AI in drug discovery. | | CO4 | An | 1 |
| 9. | Cite the role of AI in analyzing microbial communities. | | CO5 | An | 1 |
| 10. | Represent the significance of transcriptomics in AI-based biosciences. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Analyze the main ethical issues associated with AI applications. | | CO1 | An | 3 |
| 12. | Write the importance of Matplotlib in AI-powered data visualization. | | CO2 | U | 3 |
| 13. | Explain how machine learning improves biosensor technology. | | CO3 | An | 3 |
| 14. | Describe the key metrics used to evaluate ML models in healthcare. | | CO4 | U | 3 |
| 15. | Explain how convolutional neural networks aid in digital pathology. | | CO5 | An | 3 |
| 16. | Focus on the challenges in applying AI to biomedical research. | | 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. | Recognize the impact of AI on the healthcare and pharmaceutical industries. | CO1 | R | 6 |
|  | b. | Explain ethical concerns related to AI, including bias and job displacement. | CO2 | R | 6 |
|  |  |  |  |  |  |
| 18. | a. | Explain the significance of data preprocessing in AI-based healthcare applications. | CO2 | U | 6 |
|  | b. | Describe the role of Pandas in AI-driven medical analytics. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 19. | a. | Discuss the role of biosensors in medical data collection. | CO3 | U | 6 |
|  | b. | Explain the use of NumPy as a model in predicting health conditions. | CO4 | U | 6 |
|  |  |  |  |  |  |
| 20. | a. | Articulate how machine learning is applied to detection of Brain tumour. | CO4 | A | 6 |
|  | b. | Appraise the importance of model evaluation metrics in medical AI applications. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 21. | a. | Analyze how AI-driven risk assessment aids in personalized medicine. | CO5 | An | 6 |
|  | b. | Assess how Power Bi works in evaluating medical data and its role in protein folding and drug development. | CO5 | E | 6 |
|  |  |  |  |  |  |
| 22. | a. | Analyze AI-based methods used in transcriptomics and proteomics. | CO4 | An | 6 |
|  | b. | Assess the impact of AI in large genome sequence data analysis. | CO5 | E | 6 |
|  |  |  |  |  |  |
| 23. | a. | Discuss the successes and limitations of AI in biomedical research. | CO4 | R | 6 |
|  | b. | Explain how convolutional neural networks contribute to diagnostic medicine. | CO4 | U | 6 |
| **COMPULSORY QUESTION** | | | | | |
| 24. |  | Appraise the role of AI in ecological and evolutionary biology and the current trends for Biosciences. | CO6 | E | 12 |

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

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|  | **COURSE OUTCOMES** |
| **CO1** | Exhibit the core elements of AI and ML |
| **CO2** | Evaluate the Programming and Descriptive Statistics and carry out Statistical Analysis |
| **CO3** | Restate basics and applications of AI and ML |
| **CO4** | Evaluate the AI data mining technologies and their application in healthcare and Biosciences |
| **CO5** | Evaluate Ethical framework of AI when applied in medicine. |
| **CO6** | Effectively communicate and disseminate knowledge in any science or engineering domain in the context of computing, systems, and/or biomedical applications. |

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

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| **Course Code** | **23BT2011** | **Duration** | **3hrs** |
| **Course Title** | **ENTREPRENEURSHIP PRODUCT DEVELOPMENT** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (10 X 1 = 10 MARKS)** | | | | | |
| 1. | State the primary difference between an entrepreneur and a manager. | | CO1 | R | 1 |
| 2. | Write the concept of entrepreneurship. | | CO1 | U | 1 |
| 3. | Name ONE government procedure that an entrepreneur must comply with when starting a business. | | CO2 | R | 1 |
| 4. | List TWO key components of environmental scanning. | | CO2 | R | 1 |
| 5. | Abbreviate SIDBI. | | CO3 | R | 1 |
| 6. | Name TWO financial institutions that provide funding for new businesses. | | CO3 | R | 1 |
| 7. | Define the term "tax concessions" in the context of entrepreneurship. | | CO4 | R | 1 |
| 8. | Distinguish between incentives and subsidies. | | CO4 | U | 1 |
| 9. | State the purpose of the MSME Act. | | CO5 | U | 1 |
| 10. | Infer role of government policy for small scale enterprises. | | CO6 | U | 1 |
| **PART – B (6 X 3 = 18 MARKS)** | | | | | |
| 11. | Differentiate an innovative entrepreneur from an imitative entrepreneur. | | CO1 | An | 3 |
| 12. | Explain the process by which a business idea evolves from an identified problem or opportunity. | | CO2 | U | 3 |
| 13. | Illustrate the role of technical feasibility in business planning. | | CO3 | An | 3 |
| 14. | Distinguish between export-oriented units and regular domestic businesses. | | CO4 | U | 3 |
| 15. | Analyze the role of District Industries Centers in promoting entrepreneurship. | | CO5 | An | 3 |
| 16. | Describe the three symptoms of sickness in a small-scale business. | | 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. | Apply the concept of tourism entrepreneurship to design a sustainable tourism business model in your area of interest. | CO1 | A | 6 |
|  | b. | Explain the role of women entrepreneurship in fostering economic development in emerging economies. | CO1 | A | 6 |
|  |  |  |  |  |  |
| 18. |  | Analyze the effectiveness of different environmental scanning techniques (SWOT analysis, PESTLE, or Porter’s Five Forces) in identifying business opportunities. | CO2 | An | 12 |
|  |  |  |  |  |  |
| 19. | a. | Describe the importance of personnel and management feasibility in determining the long-term success of a business. | CO3 | A | 6 |
|  | b. | Analyze the challenges of a business might face in securing venture capital funding, especially in the early stages. | CO3 | An | 6 |
|  |  |  |  |  |  |
| 20. | a. | Compare the fiscal and tax concessions available to export-oriented units with those available to domestic businesses. | CO4 | An | 6 |
|  | b. | Evaluate the impact of central and state government support on an entrepreneur's decision to establish a business in a rural versus an urban area. | CO4 | E | 6 |
|  |  |  |  |  |  |
| 21. | a. | Analyze the role of Small Industries Service Institute (SISI) and District Industrial Centre (DIC) in fostering entrepreneurship. | CO5 | An | 6 |
|  | b. | Critically analyze the benefits of the Carry on Business (COB) license for businesses in the context of legal and regulatory compliance. | CO5 | An | 6 |
|  |  |  |  |  |  |
| 22. | a. | Explain the key components of financial feasibility and their interrelationship in a business plan. | CO3 | U | 6 |
|  | b. | Explain the importance of an entrepreneur’s ability to adapt to market changes, using examples from successful or failed businesses. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 23. |  | Evaluate how environmental scanning can help identify market trends, customer behavior, and potential risks for a new business venture. | CO2 | E | 12 |
| **COMPULSORY QUESTION** | | | | | |
| 24. | a. | Illustrate the potential impact of government policy on the survival and growth of small-scale enterprises. | CO6 | E | 6 |
|  | b. | Summarize the corrective measures that have been taken by small businesses in India that faced financial distress. | CO6 | E | 6 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| **CO1** | Analyse the requirements of an entrepreneurial endeavour |
| **CO2** | Examine critical factors involved in real case studies |
| **CO3** | Design product concepts, design and prototype fabrication |
| **CO4** | Apply lean start-up techniques in development of business idea. |
| **CO5** | Analyse go-to -market strategy required for a start-up |
| **CO6** | Evaluate the action plan for successful entrepreneurial career |

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

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| --- | --- | --- | --- |
| **Course Code** | **24BT3002** | **Duration** | **3hrs** |
| **Course Title** | **BIOPROCESS MODELLING AND SIMULATION** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Analyze the connectivity between experimental data, dynamic model ODEs, and optimization scheme in parameter estimation exercise using appropriate schematic. | CO1 | An | 8 |
|  | b. | Differentiate between Static, dynamic, first-principle, and black box models. | CO1 | An | 8 |
|  |  |  |  |  |  |
| 2. |  | Illustrate the strategies adopted in *k*-fold and LOO cross-validation schemes to test the generalization capability of the model. Explain the scheme with an appropriate diagram or pseudo-code | CO2 | A | 16 |
|  |  |  |  |  |  |
| 3. |  | Develop a bioprocess model for acetic acid production from glucose, growth-associated CO2 production, and atmospheric exchange. Additionally assume acetic acid dissociation and DIC equilibrium. | CO3 | C | 16 |
|  |  |  |  |  |  |
| 4. | a. | Write the differential expressions for the bioprocess kinetic model considering microbial growth, consumption of C and N substrate, and product formation. | CO4 | U | 8 |
|  | b. | Differentiate between diauxic growth, and double Monod growth kinetics adopted in bioprocess modeling. | CO4 | U | 8 |
|  |  |  |  |  |  |
| 5. | a. | Illustrate the use of MLR algorithm to model bioprocess data from a 2-level factorial design experiment. Consider the scenario of an over-determined system. | CO5 | A | 8 |
|  | b. | Develop a single hidden layer 3-4-1 ANN architecture and illustrate the feed-forward calculation step for prediction. | CO5 | A | 8 |
|  |  |  |  |  |  |
| 6. | a. | Explain the steps involved in the calculation of the regression coefficient from the experimental and modeled response. | CO1 | An | 8 |
|  | b. | Illustrate the strategies involved (preferably a flow chart) in the estimation of the boot-strapped confidence interval of dynamic model parameters. | CO1 | An | 8 |
|  |  |  |  |  |  |
| 7. |  | Evaluate the Euler method of numerical integration of bioprocess for two-time steps. Consider , µm=0.2 h-1, Ks=20 g l-1, Yx/s=0.5 g g-1, X0=2 g l-1, S0=30 g l-1. Explain the relevance of the RK4 algorithm in numerical integration. | CO3 | E | 16 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. |  | Develop a mathematical model for ethanol production from corn-starch hydrolysis by a microbial consortium, one is hydrolyzing the substrate and the other one is ethanol fermentation. A high concentration of ethanol is toxic to both microbial species. | CO6 | C | 20 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Analyse different components and their inter-relationship in bioprocess modeling. |
| CO2 | Evaluate model quality in terms of sensitivity, external validation, and generalization capability. |
| CO3 | Develop dynamic bioprocess models from experimental data. |
| CO4 | Design parametric models based on process kinetics, mass transfer, and related data |
| CO5 | Formulate appropriate machine learning models depending on data availability for modeling and simulation process. |
| CO6 | Formulate simplification strategies to simulate bioprocess models. |

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

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| **Course Code** | **24BT3009** | **Duration** | **3hrs** |
| **Course Title** | **BIOETHICS AND BIOSAFETY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Design the steps in the handling and disposal of hazardous biological agents. | CO1 | C | 10 |
|  | b. | Explain the ethical, legal and socioeconomic implications of gene therapy. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 2. | a. | Define IPR. Explain its types. | CO2 | A | 6 |
|  | b. | Elaborate the process of patent filing procedure and the precautions to be followed. | CO2 | R | 10 |
|  |  |  |  |  |  |
| 3. | a. | Discuss the biosafety guidelines and regulations for release of genetically engineered microorganisms. | CO3 | U | 8 |
|  | b. | Sketch the ethical implications of GM crops and the biosafety assessment procedure followed for transgenic food crops. | CO3 | A | 8 |
|  |  |  |  |  |  |
| 4. | a. | Depict the ethical issues associated with stem cell research. | CO4 | A | 8 |
|  | b. | Compare and contrast Gene Editing and Genome Engineering. | CO4 | An | 8 |
|  |  |  |  |  |  |
| 5. | a. | Define xenotransplantation. Briefly explain about its ethical implications. | CO5 | E | 8 |
|  | b. | Describe the organ transplantation in human beings. | CO5 | U | 8 |
|  |  |  |  |  |  |
| 6. | a. | Explain the DBT - rDNA safety guidelines for research involving recombinant DNA. | CO6 | U | 8 |
|  | b. | Sketch the recent advances involving CRISPR-Cas9. | CO6 | A | 8 |
|  |  |  |  |  |  |
| 7. | a. | Narrate the ethical implications of organ culture. | CO5 | E | 8 |
|  | b. | Explain Organoid and Tissue-on-a-Chip Technologies. | CO4 | R | 8 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Discuss the regulatory affairs involving transgenics- plants, animals. | CO6 | U | 10 |
|  | b. | Summarize the working of international harmonization. | CO6 | C | 10 |

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

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|  | **COURSE OUTCOMES** |
| CO1 | Analyse different rDNA technologies of transgenic in animals, humans, and microorganisms |
| CO2 | Apply the various biosafety regulations in transgenics |
| CO3 | Illustrate IPR and patent procedures |
| CO4 | Assess various techniques of genome, stem cells, and organ research in humans |
| CO5 | Justify modern rDNA research and its ethical procedures |
| CO6 | Analyse ethical, legal, and social-economic impacts of rDNA technology |

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

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| **Course Code** | **24BT3012** | **Duration** | **3hrs** |
| **Course Title** | **STEM CELL THERAPEUTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (5 X 16 = 80 MARKS)**  **(Answer any five from the following)** | | | | | |
| 1. | a. | Analyze the pros and cons of Animal Cell Culture. | CO1 | An | 10 |
|  | b. | Explain Confluency, Hayflick’s limit and Trypan blue staining. | CO1 | U | 6 |
|  |  |  |  |  |  |
| 2. | a. | List the major types of stem cells and define each briefly. | CO2 | R | 8 |
|  | b. | Explain the significance of symmetry in stem cell division and how it influences cell fate. | CO2 | U | 8 |
|  |  |  |  |  |  |
| 3. |  | Apply your understanding of induced pluripotent stem cells (iPSCs) to explain how they can be used in regenerative medicine. | CO2 | A | 16 |
|  |  |  |  |  |  |
| 4. | a. | Define a stem cell niche and name two conserved components commonly found in niches across organisms. | CO3 | R | 10 |
|  | b. | Describe the process of isolating stem cells from umbilical cord blood. | CO3 | U | 6 |
|  |  |  |  |  |  |
| 5. |  | Describe how stem cell therapy is being applied in the treatment of autoimmune diseases. | CO4 | U | 16 |
|  |  |  |  |  |  |
| 6. |  | Explain how stem cells are used in the field of vascular biology. | CO4 | A | 16 |
|  |  |  |  |  |  |
| 7. | a. | Demonstrate how 3D culture systems can be used to improve organoid development for disease modeling. | CO5 | A | 10 |
|  | b. | List the different types of scaffolds used in 3D stem cell culture and their basic characteristics. | CO5 | R | 6 |
| **PART – B (1 X 20 = 20 MARKS) [Compulsory Question]** | | | | | |
| 8. | a. | Explain the ethical, legal, and religio-spiritual concerns surrounding the use of stem cells in treating infertility and human cloning. | CO6 | U | 10 |
|  | b. | Evaluate the potential benefits and drawbacks of using stem cell therapy for degenerative diseases and infertility. | CO6 | E | 10 |

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

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

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

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| --- | --- | --- | --- |
| **Course Code** | **24BT3016** | **Duration** | **3hrs** |
| **Course Title** | **PLANT SECONDARY METABOLITES AND PHARMACEUTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Enumerate the main classes of plant secondary metabolites and describe their functional roles in plant defense, growth, and industrial applications. | CO1 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Evaluate the benefits and potential limitations of using non-pathogenic bacteria in sustainable agriculture. | CO1 | E | 10 |
|  | b. | Explain the strategies for enhancing pest resistance in agriculture based on herbivore-induced volatiles in plants. | CO1 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Describe the Shikimate pathway involved in the biosynthesis of alkaloids in plants. | CO2 | An | 10 |
|  | b. | Illustrate the impact of compartmentalization on cellular metabolism with suitable examples. | CO2 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Analyze the use of callus cultures, cell suspension cultures, and hairy root cultures in *in vitro* production of plant secondary metabolites in modern biotechnology. | CO3 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Explain the role of gene cloning and characterization in enhancing the production of secondary metabolites under *in vitro* conditions. | CO4 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the role of solubility and partition coefficient in predicting the bioavailability of a drug with suitable examples. | CO5 | A | 10 |
|  | b. | Justify the selection of suitable excipients for an oral tablet formulation based on their functional properties. | CO5 | A | 10 |
|  |  |  |  |  |  |
| 7. |  | Explain the role of viscosity promoters in liquid and semi-solid dosage forms, with their effects on formulation stability. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Evaluate the economic and technological feasibility of using plant tissue culture versus chemical synthesis for the production of Taxol. | CO4 | E | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | **Explain** the formulation and manufacturing steps involved in the production of tablets. | CO6 | U | 10 |
|  | b. | **Illustrate** the role of polymers in modifying the release profile of capsules in controlled drug delivery. | CO6 | A | 10 |

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

|  |  |
| --- | --- |
|  | **COURSE OUTCOMES** |
| CO1 | Compare 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 | Categorize the pharmaceutical procedures for preformulation studies |
| CO6 | Examine the development of formulation and dosage forms |

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

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| --- | --- | --- | --- |
| **Course Code** | **24BT3021** | **Duration** | **3hrs** |
| **Course Title** | **BIOPROCESS AND DOWNSTREAM PROCESSING** | **Max. Marks** | **100** |

|  |  |  |  |  |  |
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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Explain the basic configuration of fermentor and the chronological development of the fermentation industry with major products produced, strains used and process control. | CO1 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 2. |  | A bioprocess engineer is optimizing the composition of a fermentation medium to maximize laccase production. The study involves eleven factors Where D1, D2and D3 are Dummy variables, the results of the 12-run Plackett-Burman experiment are given in the table below:   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Trial** | **Car** | **Vit** | **Nit** | **Min** | **D1** | **AF** | **D2** | **Che** | **Fe** | **D3** | **Mn** | | ∑(H) | 15.1 | 8.2 | 13.5 | 8.1 | 1.5 | 1.1 | 1.9 | 2.5 | 3.5 | 1.2 | 6.3 | | ∑(L) | 6.2 | 2.0 | 4.1 | 3.3 | 1.2 | 0.1 | 0.9 | 1.2 | 3.2 | 1.1 | 4.1 |  1. Calculate the effect of each factor 2. Identify the most significant factors influencing the yield. 3. Plot a bar graph to visualize the effect of each variable on yield. | CO2 | E | 20 |
|  |  |  |  |  |  |
| 3. |  | Describe the process of screening industrially important microbes from the environment? Explain various primary screening methods involved in the isolation of microbes. | CO3 | U | 20 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Evaluate the significance of growth kinetics equation. Write all the alternative forms of Monod equation. | CO4 | An | 10 |
|  | b. | Derive the speciality of Leude-King Piret's equation for product formation. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. |  | The production of Penicillin was carried out in a batch reactor and the following data were obtained.   |  |  |  |  | | --- | --- | --- | --- | | **Time (hr)** | **Glucose conc. (g/l)** | **Biomass conc. (g/l)** | **Penicillin conc.**  **(g/l)** | | 0 | 120 | 0.75 | 0 | | 10 | 106 | 2.5 | 2.5 | | 20 | 93 | 3.2 | 3.8 | | 30 | 76 | 6.7 | 6.9 | | 40 | 62 | 12.1 | 8.4 | | 50 | 45 | 16.8 | 12.7 | | 60 | 30 | 25.7 | 14.9 |   Determine,   1. Net-specific growth rate. 2. Specific growth rate @40hrs. 3. Biomass yield coefficient. 4. Product yield coefficient. 5. Doubling time. 6. Max cell concentration if 50 g/l of biomass is used as inoculum. | CO4 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 6. |  | Explain various methods of solid liquid separation techniques by filtration and centrifugation with examples. | CO5 | U | 20 |
|  |  |  |  |  |  |
| 7. |  | Describe the working principle and applications of the following in about 500 words:   1. Electro dialysis 2. Isoelectric focusing | CO5 | R | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Describe the principle and working of gel filtration chromatography and write about the determination of the molecular weight of purified enzymes. | CO6 | U | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Explain in detail the principle of drying and working of a drier with a neat diagram in about 800 words. | CO6 | U | 10 |
|  | b. | Write the principle of lyophilization and its application in drug industry. | CO6 | U | 10 |

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

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

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

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| --- | --- | --- | --- |
| **Course Code** | **24BT3025** | **Duration** | **3hrs** |
| **Course Title** | **INDUSTRIAL BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Explain the principles of fermentation, comparing bacterial, fungal, and yeast-based fermentation processes. | CO1 | U | 10 |
|  | b. | Classify upstream and downstream processing in industrial biotechnology and explain their importance in large-scale bioproduct manufacturing. | CO1 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the biosynthetic pathway and industrial fermentation process of microbial production of beta-lactam antibiotics. | CO2 | A | 10 |
|  | b. | Illustrate the importance of selection of microorganisms, fermentation conditions, and factors affecting yield in microbial production of ethanol with suitable examples. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the significance of primary and secondary metabolites in industrial biotechnology with necessary examples. | CO3 | U | 10 |
|  | b. | Explain the upstream, fermentation and downstream process of industrial bacitracin production and its application. | CO3 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the production and application of nisin as a biopreservative in the food industry. | CO3 | A | 10 |
|  | b. | Explain the microbial fermentation of biopolymer xanthan gum and its applications in industrial biotechnology. | CO4 | A | 10 |
|  |  |  |  |  |  |
| 5. | a. | Explain the steps involved in production monoclonal antibodies and its applications in healthcare. | CO5 | A | 10 |
|  | b. | Write the upstream and downstream process of industrial production of Vitamin B12. | CO5 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Analyze the parameters of fermentation, and downstream processing techniques involved in industrial production of lactic acid. | CO1 | An | 10 |
|  | b. | Explain the various immobilization techniques used for microbial lipases and their advantages in industrial applications. | CO3 | A | 10 |
|  |  |  |  |  |  |
| 7. | a. | Explain the industrial production of steroid hormones, focusing on testosterone synthesis using microbial biotransformation. | CO5 | U | 10 |
|  | b. | Discuss the production of bioflavor compounds like vanilla using microbial fermentation and biotransformation techniques. | CO4 | A | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Illustrate the method of in vitro production of Taxol using plant cell cultures and its significance. | CO6 | A | 10 |
|  | b. | Analyze the different methods of production of biofertilizers, and its significance in sustainable agriculture. | CO5 | An | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Discuss the principles and applications of microbial enhanced oil recovery (MEOR), highlighting its benefits and challenges in petroleum extraction. | CO6 | E | 10 |
|  | b. | Discuss the various techniques used in the large-scale production of single-cell protein (SCP) and its applications in food and feed industries. | CO6 | E | 10 |

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

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

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

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| **Course Code** | **24BT3029** | **Duration** | **3hrs** |
| **Course Title** | **ALGAE BIOTECHNOLOGY** | **Max. Marks** | **100** |

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| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. | a. | Compare the methods of micropipette and centrifuge washing techniques for isolation of pure culture algae and state its advantages and potential limitations. | CO1 | U | 12 |
|  | b. | Explain the significance of growth phases of an algae and how these phases are used to optimize the harvesting times for maximum biomass production. | CO1 | U | 08 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Compare the use of Fog’s Medium, Bold’s Basal Medium and Walne Medium in culturing marine algae and its significance with suitable examples. | CO2 | An | 10 |
|  | b. | Evaluate the role of raceway ponds in the commercial production of algae with suitable illustrations. | CO2 | An | 10 |
|  |  |  |  |  |  |
| 3. | a. | Illustrate the role of microalgae in removing excess nutrients and contaminants from wastewater and the key factors influencing their efficiency. | CO3 | U | 10 |
|  | b. | Explain the role played by algae in reducing atmospheric CO2 with suitable illustrations. | CO3 | U | 10 |
|  |  | **(OR)** |  |  |  |
| 4. | a. | Explain the commercial production of Single Cell Protein and its potential use as a sustainable source of protein in functional foods. | CO4 | An | 10 |
|  | b. | Compare the methods of production of biodiesel and biomethanol using microalgae and state its pros and cons. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 5. | a. | Analyze the role of Gas Chromatography-Mass Spectrometry in identifying fatty acids in algal extracts. | CO5 | An | 10 |
|  | b. | Evaluate the significant role of different algal metabolites in phyco-medicine with suitable examples. | CO5 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Explain the role of Poly Unsaturated Fatty Acids (omega-3 and omega-6 fatty acids) extracted from microalgae in functional foods. | CO4 | U | 10 |
|  | b. | Analyze the physical and biological methods used in processing microalgae biomass into biodiesel. | CO4 | An | 10 |
|  |  |  |  |  |  |
| 7. | a. | Evaluate the role and applications of Astaxanthin produced by algae in pharma, and food industries. | CO3 | An | 10 |
|  | b. | Analyze the potential of phycobiliproteins derived from algae in biotechnological applications. | CO3 | An | 10 |
|  |  | **(OR)** |  |  |  |
| 8. | a. | Explain the basic principles of nuclear genome analysis in algae and its significance in cellular functions. | CO6 | A | 10 |
|  | b. | Explain how phylogenetic tree aid to understand the relationship between various genera of algae. | CO6 | A | 10 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Justify the use of *Chlamydomonas reinhardtii* as a model organism for algal genomics. | CO6 | E | 10 |
|  | b. | Evaluate the importance of biomarkers in algal genomics in the context of algal growth, productivity and resistance to environmental stresses in *Chlamydomonas*. | CO6 | E | 10 |

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

|  |  |
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|  | **COURSE OUTCOMES** |
| CO1 | Classify algae and their culture techniques |
| CO2 | Summarize the nutritional requirements of algae |
| CO3 | Outline the industrial application of algae |
| CO4 | Assess value addition to microalgae |
| CO5 | Investigate on products from algae through technological interventions |
| CO6 | Illustrate algal characterization using various molecular tools |

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

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| --- | --- | --- | --- |
| **Course Code** | **24BT3031** | **Duration** | **3hrs** |
| **Course Title** | **TISSUE ENGINEERING AND STEM CELL THERAPEUTICS** | **Max. Marks** | **100** |

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| **Q. No.** | **Questions** | | **CO** | **BL** | **M** |
| **PART – A (4 X 20 = 80 MARKS)**  **(Answer all the Questions)** | | | | | |
| 1. |  | Evaluate the advantages and disadvantages of cell culture techniques and their clinical applications, providing examples of primary and secondary cultures. | CO1 | E | 20 |
|  |  | **(OR)** |  |  |  |
| 2. | a. | Explain the significance of extracellular matrix (ECM) in tissue engineering, including the process of tissue decellularization and its applications. | CO2 | A | 10 |
|  | b. | Analyze the structural and functional differences among spheroids, organoids, and assembloids in 3D cell culture. | CO2 | A | 10 |
|  |  |  |  |  |  |
| 3. |  | Explain the process of cartilage repair and skin tissue engineering, highlighting their applications in regenerative medicine. | CO3 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 4. |  | Illustrate the types of stem cells, their characteristics, functions, and medical applications. | CO4 | An | 20 |
|  |  |  |  |  |  |
| 5. |  | Explain the stem cell niche, its influencing factors, conserved components, and the role of transit-amplifying cells in differentiation. | CO5 | A | 20 |
|  |  | **(OR)** |  |  |  |
| 6. | a. | Evaluate the standard operating procedure (SOP) for maintaining aseptic conditions in a cell culture laboratory. | CO1 | E | 10 |
|  | b. | Justify the importance of proper lab equipment and etiquette in ensuring successful cell culture experiments. | CO1 | E | 10 |
|  |  |  |  |  |  |
| 7. |  | Analyze the key biomaterials and techniques used in tissue engineering of bone and facial reconstruction. | CO3 | An | 20 |
|  |  | **(OR)** |  |  |  |
| 8. |  | Explain the significance of informed consent and donor privacy policies in stem cell research, highlighting the legal and ethical considerations involved. | CO6 | A | 20 |
| **COMPULSORY QUESTION** | | | | | |
| 9. | a. | Analyze the principles of equitable access and resource allocation in stem cell treatments and possible solutions in global healthcare systems. | CO6 | An | 10 |
|  | b. | Infer the significance of data protection in stem cell research with examples of its impact on trust and integrity. | CO6 | An | 10 |

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

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