Register Number:……..…

**M.TECH DEGREE EXAMINATIONS: NOV/DEC 2024**

(Regulation 2018)

Third Semester

**BIOTECHNOLOGY**

P18BTE0004**:** Molecular Diagnostics & Therapeautics

**COURSE OUTCOMES**

**CO1:** Comprehend mutations and abnormalities in chromosome and be able to understand genetic disorder

**CO2:** Diagnostic methods on gene editing tools

**CO3:** Learn the production of recombinant products and their significance in therapy

**CO4:** Illustrate the strategies of immunotherapy using monoclonal antibodies and vaccines

**CO5:** Understand the mechanism of Clinical Diagnostic tools

**Time: Three Hours** **Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. Arrange the following stages in the progression of Cystic Fibrosis (CF) from gene mutation to clinical symptoms: CO1 [$K_3$]

   i) Chloride ion transport disruption

   ii) Mutation in the CFTR gene

   iii) Thickening of mucus in respiratory and digestive tracts

   iv) Chronic respiratory infections

   a) ii → iii → i → iv b) ii → i → iii → iv

   c) i → ii → iv → iii d) iv → iii → i → ii

2. Which genetic disorder is characterized by the presence of an extra chromosome 21? CO1 [$K_2$]

   a) Turner syndrome b) Cystic fibrosis

   c) Down syndrome d) Klinefelter syndrome

3. What technique uses fluorescent probes to identify specific DNA sequences on chromosomes? CO2 [$K_2$]

   a) PCR b) CRISPR

   c) FISH d) SNP analysis

4. Match each recombinant protein with its primary therapeutic application: CO3 [$K_3$]

| List I | List II |
|---|---|
| A. Erythropoietin | i. Thrombosis treatment |
| B. Recombinant human growth hormone | ii. Diabetes management |
| C. Insulin analogs | iii. Anemia treatment |
| D. Streptokinase | iv. Growth deficiency |

a) A-iii, B-iv, C-ii, D-i
b) A-i, B-iii, C-iv, D-ii
c) A-iv, B-i, C-iii, D-ii
d) A-ii, B-i, C-iii, D-iv

5. Which of the following is NOT a commonly used system for recombinant protein production? CO3 [$K_3$]
   a) Bacterial cells
   b) Viral vectors
   c) Yeast cells
   d) Mammalian cells

6. Which therapeutic method uses antibodies that bind specifically to cancer cells? CO4 [$K_2$]
   a) Interferon therapy
   b) Monoclonal antibody therapy
   c) CRISPR
   d) RNA interference

7. Assertion (A): Monoclonal antibodies are used in cancer immunotherapy to specifically target cancer cells without affecting normal cells. CO4 [$K_3$]
   Reason (R): Monoclonal antibodies are designed to recognize and bind to specific antigens present on the surface of cancer cells.
   a) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A).
   b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
   c) Assertion (A) is true, but Reason (R) is false.
   d) Assertion (A) is false, but Reason (R) is true.

8. Which tool is primarily used to measure chemical biopotentials in diagnostics? CO5 [$K_2$]
   a) Transducers
   b) Biosensors
   c) MRI
   d) CT scan

9. Which of the following clinical diagnostic tools are commonly used for imaging soft tissues in the human body? CO5 [$K_3$]
   i. Magnetic Resonance Imaging (MRI)
   ii. X-ray radiography
   iii. Ultrasound
   iv. Computed Tomography (CT)

a) i, iv b) i, iii, iv

c) ii, iv d) i, ii

10. What type of vaccine is produced using recombinant DNA technology? CO4 [$K_2$]

a) Live attenuated vaccines b) Inactivated vaccines

c) Recombinant vaccines d) Toxoid vaccines

**PART B (10 x 2 = 20 Marks)**

11. Describe the mechanism of a point mutation and give an example of a disease caused by it. CO1 [$K_2$]
12. What causes Klinefelter syndrome CO1 [$K_2$]
13. What is the clinical significance of Quantitative PCR. CO2 [$K_2$]
14. Discuss the advantages and limitations of using FISH as a diagnostic tool. CO2 [$K_3$]
15. What are the function of Zinc Finger Nucleases (ZFNs) in gene editing. CO2 [$K_2$]
16. List the key steps involved in producing recombinant erythropoietin? (no details required) CO3 [$K_2$]
17. Explain the role of monoclonal antibodies in cancer therapy. CO4 [$K_2$]
18. Describe the function of cytokines in immunotherapy. CO4 [$K_2$]
19. Describe the principle of x -ray radiography CO5 [$K_2$]
20. How CT and MRI scan principle differs CO5 [$K_3$]

**PART C (6 x 5 = 30 Marks)**

21. Discuss any ONE Trinucleotide Repeat Disorders - detailing how repeat expansion affects gene expression and leads to genetic disorders CO1 [$K_2$]

22. Discuss the applications and limitations of CRISPR-Cas9 in gene editing. CO2 [$K_2$]

23. Describe the process of producing recombinant human insulin. CO3 [$K_2$]

24. Discuss the mechanisms by which therapeutic monoclonal antibodies target cancer cells CO4 [$K_2$]

25. Discuss the Principle and applications of Piezoelectric transducer CO5 [$K_2$]

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|---|---|---|---|
| 26. | Draw the generalized block diagram of a biomedical instrument | CO5 | [$K_2$] |

**Answer any FOUR Questions**
**PART D (4 x 10 = 40 Marks)**

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|---|---|---|---|
| 27. | Describe the mechanisms and genetic basis of Down syndrome and Turner syndrome. | CO1 | [$K_2$] |
| 28. | Compare and contrast TALENs and CRISPR as gene-editing tools, including their mechanisms, specificity, and efficiency. | CO2 | [$K_2$] |
| 29. | Explain how therapeutic monoclonal antibodies are developed and discuss two examples in detail, including their mechanisms and clinical uses | CO4 | [$K_2$] |
| 30. | Discuss the production, mechanisms, and clinical applications of recombinant growth hormone. | CO3 | [$K_2$] |
| 31. | Explain the role of computed tomography (CT) in clinical diagnostics. Discuss how it differs from MRI and X-ray radiography | CO5 | [$K_2$] |

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