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| **Name:**<br>**Enrolment No:** | |

**UPES**
**End Semester Examination, May 2024**

**Course: Biotechnology**
**Semester : VI**
**Program: Int BMSC Microbiology-VI** **Duration : 3 Hours**
**Course Code: HSBT3001** **Max. Marks: 100**

**Instructions: Attempt all questions as per instructions given in each section.**

| S. No. | Section A<br>Short answer questions/ MCQ/T&F<br>(20Qx1.5M= 30 Marks) | Marks | COs |
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| **Q 1** | In recombinant DNA technology, the purpose of the polylinker region (multiple cloning site) in a cloning vector is to:<br>A) Enhance transcription of inserted genes<br>B) Facilitate insertion of DNA fragments at multiple sites<br>C) Initiate replication of the vector in the host cell<br>D) Increase stability of the vector in the host cell | **1.5** | **CO2** |
| **Q2** | Which of the following events marks a significant milestone in the history of genetic engineering?<br>A) Discovery of the structure of DNA by Watson and Crick<br>B) Development of the polymerase chain reaction (PCR) by Kary Mullis<br>C) Cloning of the first mammal, Dolly the sheep<br>D) Introduction of CRISPR-Cas9 technology for genome editing | **1.5** | **CO1** |
| **Q3** | The development of insulin-producing bacteria using recombinant DNA technology marked a breakthrough in:<br>A) Agricultural biotechnology<br>B) Medical biotechnology<br>C) Environmental biotechnology<br>D) Industrial biotechnology | **1.5** | **CO5** |
| **Q4** | Which of the following is an example of a commonly used cloning vector derived from a bacteriophage?<br>A) Plasmid<br>B) Cosmid<br>C) YAC (Yeast Artificial Chromosome)<br>D) BAC (Bacterial Artificial Chromosome) | **1.5** | **CO2** |
| **Q5** | The process of creating recombinant DNA molecules involves:<br>A) Synthesizing new DNA strands from scratch | **1.5** | **CO3** |

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| | B) Cutting DNA fragments using Type II restriction enzymes and ligating them into vectors<br>C) Amplifying DNA sequences using PCR<br>D) Identifying genetic mutations in DNA sequences | | |
| **Q6** | The main advantage of real-time PCR over conventional PCR is:<br>A) Higher specificity<br>B) Higher sensitivity<br>C) Faster amplification<br>D) Real-time monitoring of DNA amplification | **1.5** | **CO4** |
| **Q7** | Which of the following is an example of a commonly used expression vector system?<br>A) pUC19<br>B) pET system<br>C) Cosmid<br>D) YAC (Yeast Artificial Chromosome) | **1.5** | **CO2** |
| **Q8** | The purpose of gel electrophoresis in molecular cloning is to:<br>A) Amplify DNA fragments<br>B) Separate DNA fragments based on size<br>C) Insert DNA fragments into plasmids<br>D) Identify restriction enzyme recognition sites | **1.5** | **CO3** |
| **Q9** | Which of the following is NOT a step in the Sanger sequencing method?<br>A) PCR amplification<br>B) DNA denaturation<br>C) Incorporation of dideoxynucleotides<br>D) Gel electrophoresis | **1.5** | **CO4** |
| **Q10** | Which of the following is NOT a commonly used NGS platform?<br>A) Illumina<br>B) Pacific Biosciences (PacBio)<br>C) Sanger Sequencing<br>D) Oxford Nanopore Technologies | **1.5** | **CO5** |
| **Q11** | In the context of molecular cloning, PCR (Polymerase Chain Reaction) is primarily used for:<br>A) Amplifying DNA sequences<br>B) Inserting DNA fragments into plasmids<br>C) Identifying restriction enzyme recognition sites<br>D) Selecting transformed bacterial colonies | **1.5** | **CO4** |
| **Q12** | Which of the following techniques relies on the ability of Type II restriction enzymes to cut DNA at specific sites?<br>A) Southern blotting<br>B) Polymerase Chain Reaction (PCR)<br>C) Gel electrophoresis<br>D) CRISPR-Cas9 gene editing | **1.5** | **CO3** |
| **Q13** | The technique of blue-white screening is commonly used in molecular cloning to: | **1.5** | **CO2** |

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| | A) Identify bacterial colonies containing recombinant plasmids<br>B) Determine the size of DNA fragments<br>C) Amplify specific DNA sequences<br>D) Detect restriction enzyme activity | | |
| **Q14** | The purpose of the denaturation step in PCR is to:<br>A) Anneal primers to the DNA template<br>B) Extend the DNA strands<br>C) Separate the DNA strands<br>D) Introduce mutations into the DNA sequence | **1.5** | **CO3** |
| **Q15** | Why does Bt brinjal not affect the human gut?<br>A) It contains genes that specifically target human gut cells.<br>B) Its proteins are broken down by digestive enzymes before reaching the gut.<br>C) Humans lack the receptors targeted by Bt proteins.<br>D) Bt brinjal is not consumed by humans. | **1.5** | **CO5** |
| **Q16** | In NGS, DNA fragments are typically sequenced in:<br>A) Parallel<br>B) Series<br>C) Isolation<br>D) Conjunction | **1.5** | **CO4** |
| **Q17** | Which of the following is NOT a step in Southern blotting?<br>a) Gel electrophoresis<br>b) Hybridization<br>c) DNA amplification<br>d) DNA transfer | **1.5** | **CO3** |
| **Q18** | Who is commonly referred to as the "father of biology"?<br>a) Charles Darwin<br>b) Aristotle<br>c) Gregor Mendel<br>d) Louis Pasteur | **1.5** | **CO1** |
| **Q19** | Recombinant DNA technology is used in the production of vaccines by:<br>A) Inserting viral genes into bacterial cells<br>B) Generating synthetic viruses<br>C) Culturing live viruses in host animals<br>D) Inserting viral antigens into expression vectors | **1.5** | **CO5** |
| **Q20** | The development of genetically modified bacteria to produce insulin is an example of:<br>A) Gene therapy<br>B) Pharmaceutical biotechnology<br>C) Environmental bioremediation<br>D) Industrial enzyme production | **1.5** | **CO4** |
| **Section B<br>(4Qx5M=20 Marks)** | | | |
| **Q 1** | Describe and draw the basic principle of the biolistic method. | **5** | **CO2** |

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| **Q2** | Create and label the key steps in the schematic of a Southern blotting procedure. | **5** | **CO3** |
| **Q3** | Justify the significance of the ampicillin resistance gene in pUC19 vector in your own words? | **5** | **CO1** |
| **Q4** | Summaries the primary purpose of agarose gel electrophoresis in molecular biology? | **5** | **CO4** |
| | **Section C**<br>**(2Qx15M=30 Marks)** | | |
| **Q 1** | Agrobacterium tumefaciens is a soil bacterium capable of transferring a segment of its Ti (tumor-inducing) plasmid, known as T-DNA (transfer DNA), into the genome of a plant host, resulting in the formation of crown gall tumors. This natural genetic transformation ability has been harnessed as a powerful tool in plant biotechnology for the genetic modification of various plant species.<br>(a) Explain the process of Agrobacterium-mediated gene transfer in plants.<br>(b) Draw the schematics representation of Ti plasmid.<br>c) Applications of *Agrobacterium* - mediated gene delivery. (5+5+5) | **15** | **CO3+2** |
| **Q2** | A laboratory is tasked with sequencing a bacterial genome to study its genetic makeup and potential virulence factors.<br>a) Outline the workflow and steps involved in using Sanger sequencing for this project.<br>b) Explain chain termination reaction<br>c) Differentiate Sanger with Next generation sequencing. (5+5+5) | **15** | **CO4+5** |
| | **Section D**<br>**(2Qx10M=20 Marks)** | | |
| **Q 1** | Differentiate between RT-PCR versus Real-Time PCR (draw flowcharts). 5+5 | **10** | **CO2+4** |
| **Q2** | You are leading a research project aiming to clone a gene of interest for studying its function in a model organism. Outline the step-by-step procedure you would follow to clone the gene using molecular cloning techniques. | **10** | **CO1+2** |