Name:

Enrolment No:

UPES

End Semester Examination, December 2024

Course: Recombinant DNA Technology and OMICS **Semester: Vth**

Program: B.Sc. Microbiology **Duration: 3 hours**

Course Code: HSMB3001 **Max. Marks : 100**

Instructions: Read and attempt all questions carefully.

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q1.	Redundancy of the genetic code protect against mutations - A. By allowing only one codon per amino acid. B. By ensuring synonymous codons encode the same amino acid. C. By eliminating all stop codons. D. By preventing insertion or deletion mutations.	**1.5**	**CO1**
Q2.	In Molecular biology, Southern blotting is used - A. To sequence DNA fragments B. To detect specific DNA sequences in a mixture C. To analyze protein expression D. To amplify RNA molecules	**1.5**	**CO1**
Q3.	Elucidate the fundamental principle of Sanger sequencing? A. Use of radioactive isotopes to tag DNA strands B. Chain termination using dideoxynucleotides (ddNTPs) C. DNA fragmentation and mass spectrometry D. Detection of DNA via fluorescence markers only	**1.5**	**CO3**
Q4.	Adjuvants in vaccines are used - A. To preserve the vaccine for a longer duration B. To enhance the immune response to the antigen C. To reduce the number of doses required D. To prevent allergic reactions to vaccine components	**1.5**	**CO1**
Q5.	Cloning a tyrosinase gene in *E. coli* led to the final production of A. Melanin B. Albumin C. Insulin D. Indigo	**1.5**	**CO1**
Q6.	Identify the malfunctioning pathway associated with insulin resistance.	**1.5**	**CO3**

	A. Impaired GLUT4 translocation due to defective insulin receptor signaling B. Overactivation of glycogen synthase in liver cells C. Increased beta-cell secretion of insulin D. Impaired breakdown of glycogen		
Q7.	Recognize Insulin's active form stored in pancreatic beta cells. A. Monomeric insulin B. Hexameric insulin with zinc ions C. Dimeric insulin D. Proinsulin	**1.5**	**CO1**
Q8.	Select the organism used for recombinant hepatitis B vaccine production. A. Escherichia coli B. Saccharomyces cerevisiae C. Bacillus subtilis D. Pseudomonas fluorescens	**1.5**	**CO1**
Q9.	A researcher wants to incorporate an ncAA at a specific site in a protein. List the steps. A. Mutate the target codon to a stop codon (e.g., UAG) and use an orthogonal tRNA-aaRS pair specific to the ncAA. B. Modify the ribosome to recognize all codons as ncAAs. C. Randomly incorporate ncAAs during translation. D. Use chemical synthesis to add the ncAA post-translationally.	**1.5**	**CO4**
Q10.	Identify the factors responsible for the increased mutation rate in error-prone PCR. A. High magnesium ion concentration B. Use of a high-fidelity DNA polymerase C. Optimal buffer conditions for DNA polymerase D. Lower temperature for denaturation	**1.5**	**CO1**
Q11.	List the advantage of computational protein design in protein engineering. A. It eliminates the need for experimental validation. B. It predicts protein structures and functions with high accuracy. C. It reduces the complexity of protein folding. D. It directly modifies protein sequences without DNA manipulation.	**1.5**	**CO2**
Q12.	Elucidate the primary role of the ligand in a riboswitch mechanism. A. It acts as an enzyme. B. It triggers a conformational change in the riboswitch RNA. C. It binds to DNA to enhance transcription. D. It degrades the riboswitch RNA.	**1.5**	**CO3**

Q13.	Point out the statement that best explains the role riboswitches affect translation initiation? A. They degrade the mRNA. B. They mask or unmask the Shine-Dalgarno sequence. C. They alter ribosomal structure. D. They prevent RNA polymerase binding.	**1.5**	**CO1**
Q14.	Explain the role of the spray needle in ESI-MS. A. To fragment the sample into ions. B. To create charged droplets through high-voltage application. C. To separate ions by their mass-to-charge ratio. D. To collect the ions for analysis.	**1.5**	**CO4**
Q15.	A sample contains peptides with different masses. After MALDI-TOF analysis, you observe peaks at 1000 Da and 2000 Da. Identify the peptide ion that would reach the detector first. A. 1000 Da B. 2000 Da C. Both will arrive simultaneously D. Cannot determine without more information	**1.5**	**CO2**
Q16.	Identify the role of matrix responsible for influencing the ionization process in MALDI. A. It only determines the wavelength of the laser. B. It has no role in ionization; it only protects the sample. C. It absorbs the laser energy and facilitates proton transfer to the analyte. D. It influences only the resolution of the spectrum.	**1.5**	**CO3**
Q17.	Di-sulphide bond is formed in – A. Prosulin B. Metasulin C. Proinsulin D. Preproinsulin	**1.5**	**CO1**
Q18.	Select the critical ethical concern related to genetic code expansion. A. The environmental impact of ncAAs. B. The potential transfer of orthogonal systems to native organisms. C. The inability to synthesize orthogonal ribosomes. The inability to replicate ncAA-incorporated proteins in natural systems.	**1.5**	**CO3**
Q19.	A scientist argues that PACE is more efficient than traditional directed evolution methods. Identify the statement in support of this claim. A. PACE automates the generation and screening of mutants.	**1.5**	**CO2**

	B. PACE eliminates the need for host cells during evolution. C. PACE introduces no genetic mutations. D. PACE does not rely on phage replication.		
Q20.	Identify example of a live attenuated vaccine. A. Polio vaccine (Salk) B. Measles, Mumps, Rubella (MMR) vaccine C. Hepatitis B vaccine D. Tetanus toxoid	**1.5**	**CO1**
	Section B **(4Qx5M=20 Marks)**		
Q1.	List out the differences in the chemical and electroporation-based transformation of DNA.	**5**	**CO1**
Q2.	Elaborate the role of growth hormone in the body and draw a schematic for its production using rDNA technology.	**5**	**CO4**
Q3.	Discuss a technique to identify molecular markers in a genetic study.	**5**	**CO3**
Q4.	Explain Antisense technology and discuss its therapeutic applications.	**5**	**CO3**
	Section C **(2Qx15M=30 Marks)**		
Q1.	Elaborate on Nextgen Sequencing. Discuss nanopore sequencing and its applications.	**15**	**CO4**
Q2.	Describe vaccines and discuss their role in immunity. Explain any three vaccine design strategies. Additionally, clarify the need the requirement for multiple doses or booster in some vaccinations.	**15**	**CO4**
	Section D **(2Qx10M=20 Marks)**		
Q1.	Describe the mechanism of action of insulin and explain a methodology for insulin production in *E. coli* using rDNA technology.	**10**	**CO 3**
Q2.	Define stable cells? Describe the process for generating a stable cell line.	**10**	**CO 3**