Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, Dec 2024

Course: Gene Expression and Transgenics — **Semester : VII**

Program: B.Tech Biotechnology — **Duration : 3 Hours**

Course Code: HSBT4011 — **Max. Marks: 100**

Instructions: Read all questions carefully

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q 1	What is the main purpose of the 5' capping of eukaryotic mRNA? (A) Facilitate ribosome binding for translation (B) Protect mRNA from degradation (C) Aid in mRNA export from the nucleus (D) All of the above	1.5	CO1
Q 2	What is the role of the poly(A) tail in mRNA processing? (A) Promote transcription termination (B) Protect mRNA from degradation (C) Facilitate splicing of introns (D) Translate proteins directly	1.5	CO1
Q 3	Alternative splicing allows for: (A) Different proteins to be produced from the same gene (B) DNA to mutate (C) Termination of transcription (D) Preventing gene expression	1.5	CO1
Q 4	Where does mRNA export primarily occur in eukaryotic cells? (A) Cytoplasm (B) Golgi apparatus (C) Nuclear pore complex (D) Endoplasmic reticulum	1.5	CO1
Q 5	What role does the 5' cap of mRNA play in mRNA export? (A) Facilitates nuclear retention (B) Prevents exonuclease degradation (C) Recruit export factors (D) Inhibits translation initiation	1.5	CO2
Q 6	The exon-junction complex (EJC) is deposited on mRNA during which process? (A) Transcription (B) Splicing (C) Export (D) Translation	1.5	CO2

Q 7	Which of the following is an example of a regulatory protein that inhibits transcription? (A) Activator (B) Enhancer (C) Repressor (D) Promoter	1.5	CO2
Q 8	What role do histone modifications play in eukaryotic gene regulation? (A) They facilitate DNA replication (B) They determine the efficiency of translation (C) They alter chromatin structure to regulate accessibility to DNA (D) They repair damaged DNA	1.5	CO2
Q 9	What is the role of microRNAs (miRNAs) in gene regulation? (A) They code for proteins that regulate transcription (B) They facilitate the elongation phase of transcription (C) They bind to mRNA to inhibit its translation (D) They enhance ribosome binding to mRNA	1.5	CO3
Q 10	Which of the following is **not** an essential feature of a cloning vector? (A) Origin of replication (Ori) (B) Selectable marker (C) Restriction enzyme sites (D) Promoter for protein expression	1.5	CO3
Q 11	Which of the following is an example of an expression vector? (A) pBR322 (B) pUC19 (C) pET28a (D) Lambda phage	1.5	CO3
Q 12	Which feature in an expression vector allows the detection of recombinant protein? (A) Selectable marker (B) Reporter gene (C) Fusion tag (e.g., His-tag) (D) Restriction site	1.5	CO3
Q 13	What is the primary goal of gene therapy? (A) Replace defective cells with healthy ones (B) Introduce new genetic material to correct a genetic disorder (C) Remove damaged DNA from cells (D) Improve the effectiveness of traditional medicines	1.5	CO4
Q 14	In ex vivo gene therapy, how is the treatment typically carried out? (A) Genes are directly injected into the body (B) Genes are delivered via nanoparticles (C) Cells are removed, modified outside the body, and then reintroduced (D) A virus is used to infect the cells directly in the patient	1.5	CO4
Q 15	How does a DNA vaccine stimulate an immune response? (A) By directly injecting antigens into the bloodstream	1.5	CO4

	(B) By enabling the body to produce antigens that trigger immunity (C) By creating antibodies against the plasmid itself (D) By killing the pathogen directly in the body		
Q 16	What is a transgenic animal? (A) An animal that is cloned from another animal (B) An animal that has had a foreign gene deliberately inserted into its genome (C) An animal that is naturally resistant to diseases (D) An animal that has undergone natural selection	1.5	CO4
Q 17	Which technique is commonly used to introduce foreign DNA into a transgenic animal? (A) CRISPR-Cas9 gene editing (B) Microinjection into the pronucleus of a fertilized egg (C) RNA interference (D) Electroporation	1.5	CO5
Q 18	What is the difference between a transgenic mouse and a knockout mouse? (A) Transgenic mice lack certain genes, whereas knockout mice contain extra genes (B) Transgenic mice express a foreign gene, whereas knockout mice have a gene inactivated (C) Transgenic mice are used for drug testing, whereas knockout mice are not (D) Transgenic mice are larger than knockout mice	1.5	CO5
Q 19	What is the central application of synthetic biology? (A) Predicting protein structures (B) Studying genetic variations in populations (C) Engineering new biological systems and functions (D) Understanding natural ecosystems	1.5	CO5
Q 20	Small RNAs regulate gene expression predominantly through: (A) Protein degradation (B) Chromosome replication (C) Post-transcriptional gene silencing (D) DNA amplification	1.5	CO5
Section B (4Qx5M=20 Marks)			
Q 1	Describe the different types of RNA polymerases and their roles.	5	CO1
Q 2	List different types of viral vectors and their applications	5	CO2

Q 3	Differentiate the characteristic features between expression vs cloning vectors.	5	CO3
Q 4	Describe synthetic biology and its applications in brief	5	CO3
Section C (2Qx15M=30 Marks)			
Q 1	A pharmaceutical company is developing conditional knock-out mice for the P53 gene in the liver to study its role in liver cancer suppression. A. Describe the steps in creating the conditional knock-out mice in detail **(10 marks)** B. Explain the advantages and limitations of generating P53 conditional knock-out mice **(5 marks)**	15 (10+5)	CO2
Q 2	A team of researchers is working on engineering *Escherichia coli* to produce bioethanol more efficiently. They aim to redirect the metabolic flux towards ethanol production by overexpressing pyruvate decarboxylase (PDC) and alcohol dehydrogenase (ADH), key enzymes in ethanol biosynthesis. However, this modification led to a bottleneck in glycolysis, causing the accumulation of pyruvate and reduced biomass yield. Additionally, the strain shows sensitivity to high ethanol concentrations, leading to cell death during fermentation. A. Propose a metabolic engineering strategy to address the pyruvate accumulation issue while balancing growth and ethanol production. **(7 marks)** B. What approaches could be employed to enhance the ethanol tolerance of the engineered strain? **(8 marks)**	15 (7+8)	CO5
Section D (2Qx10M=20 Marks)			
Q 1	Explain the steps of mRNA processing in detail with an illustration	10	CO2
Q 2	Explain in detail the process of protein translocation with illustrations.	10	CO4