Name: **Enrolment No:**	

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	Which enzyme adds the 5' cap to the eukaryotic pre-mRNA? (A) Poly(A) polymerase (B) Guanylyltransferase (C) RNA polymerase (D) Spliceosome	1.5	CO1
Q 2	The spliceosome, a complex responsible for splicing, is primarily made up of which components? (A) DNA and proteins (B) tRNA and proteins (C) snRNA and proteins (D) rRNA and proteins	1.5	CO1
Q 3	What happens to the excised introns during splicing? (A) They are translated into proteins (B) They form lariats and are degraded (C) They remain in the cytoplasm (D) They are incorporated back into the genome	1.5	CO1
Q 4	Which RNA modification is critical for mRNA export? (A) Polyadenylation (B) 5' capping (C) Splicing (D) All of the above	1.5	CO1
Q 5	Which of the following occurs if mRNA export is impaired? (A) Cytoplasmic accumulation of mRNA (B) Enhanced translation (C) Nuclear retention of mRNA (D) Increased mRNA stability	1.5	CO2
Q 6	What is the primary function of a promoter in gene expression? (A) To terminate transcription (B) To enhance translation efficiency (C) To bind RNA polymerase and initiate transcription (D) To stabilize mRNA	1.5	CO2
Q 7	In the lac operon, what molecule acts as the inducer? (A) Glucose (B) Lactose (C) RNA polymerase (D) ATP	1.5	CO2

Q 8	What happens when methyl groups are added to DNA? (A) Transcription is usually activated (B) Transcription is usually repressed (C) Translation becomes more efficient (D) RNA degradation is inhibited	1.5	CO2
Q 9	Which of the following is true about enhancer sequences? (A) They are located only upstream of the gene they regulate (B) They can function at variable distances from the gene (C) They are involved in translation initiation (D) They bind directly to RNA polymerase	1.5	CO3
Q 10	What is the role of a selectable marker in a vector? (A) To insert the desired DNA sequence (B) To select cells that have taken up the vector (C) To facilitate transcription of the gene (D) To inhibit unwanted DNA replication	1.5	CO3
Q 11	In inducible expression systems, the lac operon is often regulated by which molecule? (A) IPTG (B) Glucose (C) X-gal (D) Arabinose	1.5	CO3
Q 12	Which of the following is **not** a commonly used tag for protein purification in expression systems? (A) His-tag (B) GST-tag (C) Myc-tag (D) T7-tag	1.5	CO3
Q 13	What is the main advantage of using adeno-associated viruses (AAV) as vectors in gene therapy? (A) High efficiency in integrating into the host genome (B) Ability to infect a wide range of cell types without causing disease (C) Capability to deliver large genetic payloads (D) Rapid replication in host cells	1.5	CO4
Q 14	What is one of the major challenges associated with gene therapy? (A) The inability to target specific cells (B) Potential immune responses to vectors (C) High cost of genetic engineering (D) Limited efficacy in laboratory experiments	1.5	CO4
Q 15	Which of the following is a potential risk associated with DNA vaccines? (A) Integration of the DNA into the host genome (B) Complete failure to produce an immune response (C) Risk of causing the disease being vaccinated against (D) Limited use in humans	1.5	CO4

Q 16	What is the primary purpose of creating knockout mice? (A) To generate animals resistant to infections (B) To study the function of a specific gene by disabling it (C) To produce animals with enhanced physical abilities (D) To increase the lifespan of laboratory animals	1.5	CO4
Q 17	Knockout mice are created by disrupting genes using which of the following techniques? (A) RNA interference (B) Site-specific homologous recombination (C) Protein overexpression (D) Random mutagenesis	1.5	CO5
Q 18	What is a conditional knockout mouse? (A) A mouse in which a gene is only partially disabled (B) A mouse in which a gene is deleted in a specific tissue or developmental stage (C) A mouse in which a gene is overexpressed (D) A mouse in which all genes are inactivated	1.5	CO5
Q 19	What does the term "epigenomics" refer to? (A) Studying variations in gene sequences (B) Exploring proteins expressed by a genome (C) Examining genome-wide modifications affecting gene expression without altering DNA sequence (D) Synthesizing artificial DNA sequences	1.5	CO5
Q 20	Piwi-interacting RNAs (piRNAs) are primarily involved in: (A) Translational repression in somatic cells (B) Silencing transposable elements in germ cells (C) RNA editing in the cytoplasm (D) Enhancing ribosome assembly	1.5	CO5
Section B (4Qx5M=20 Marks)			
Q 1	Explain in brief the different levels of gene expression regulation	5	CO1
Q 2	Explain metabolic engineering and list its applications.	5	CO2
Q 3	Explain Genomics & proteomics and their applications	5	CO3
Q 4	Explain human gene therapy and the methods employed in it	5	CO1

Section C **(2Qx15M=30 Marks)**			
Q 1	A team of researchers intends to develop a transgenic mouse model by introducing the human insulin gene into the genome. This model aims to study the regulation of insulin production and its role in diabetes. A. Explain the process of generating transgenic mice and the techniques commonly used to introduce foreign genes. **(10 Marks)** B. Propose strategies to minimize unintended effects during the development of transgenic models. **(5 Marks)**	15 (10+5)	CO2
Q 2	A research team has developed a synthetic biology-based therapeutic that uses engineered T-cells to treat cancer. The synthetic T-cells are programmed to specifically recognize cancer markers, release anti-tumor agents, and self-destruct after their mission to prevent adverse effects. A. Explain how would you develop engineered T-cells and the method you employ in detail. **(10 Marks)** B. What are the pros and cons of engineered T-cells and how would you avoid adverse effects? **(5 Marks)**	15 (10+5)	CO3
Section D **(2Qx10M=20 Marks)**			
Q 1	Explain the steps of mRNA export in detail with an illustration	10	CO4
Q 2	Explain the process of miRNA-mediated gene regulation with an illustration	10	CO5