Name:

Enrolment No:

UPES

End Semester Examination, May 2025

Course: Synthetic Biology **Semester: 6**

Program: INT-BMSC-MICROBIOLOGY

Duration: 3 Hours

Course Code: HSMB3018 **Max. Marks: 100**

Instructions: Attempt all the questions

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q 1	**Synthetic promoters are engineered to:** A. Silence gene expression B. Initiate protein degradation C. Initiate transcription at desired levels D. Bind ribosomes	1.5	CO1
Q 2	**Which of the following is true about recombinant DNA technology?** A. Only used for protein folding B. Combines DNA from different species C. Applicable only to prokaryotes D. Doesn't involve cloning	1.5	CO2
Q 3	**Which genome editing tool uses RNA as a guide?** A. Zinc-finger nucleases B. CRISPR-Cas9 C. TALE nucleases D. RNAi	1.5	CO1
Q 4	**Which challenge limits the use of genome editing in clinical therapy?** A. Cost of reagents B. Difficulty in sequencing DNA C. Off-target effects and delivery issues D. Availability of bacterial cultures	1.5	CO3
Q 5	**Which of the following components is essential for CRISPR-based editing?** A. DNA ligase B. Guide RNA C. Antibody D. tRNA	1.5	CO3
Q 6	**Synthetic RNA regulators often act at the level of:** A. DNA replication	1.5	CO5

	B. Spliceosome assembly C. mRNA stability or translation D. Histone modification		
Q 7	**Which of these techniques is used for gene expression control in synthetic biology?** A. Protein crystallization B. qRT-PCR C. Synthetic feedback loops D. SDS-PAGE	**1.5**	**CO5**
Q 8	**A primary purpose of synthetic biology is to:** A. Extract natural products B. Cure viral infections directly C. Create standardized biological parts D. Map protein structures	**1.5**	**CO2**
Q 9	**Which technique is *not* a genome editing method?** A. TALENs B. CRISPR-Cas9 C. Southern blotting D. Zinc-finger nucleases	**1.5**	**CO2**
Q 10	**The term "synthetic biology" is best defined as:** A. Modifying RNA for therapy B. Artificially creating biological components and systems C. Using synthetic drugs for diseases D. Mapping the entire genome	**1.5**	**CO1**
Q 11	**Golden Gate Assembly enables DNA assembly through:** A. Overlapping PCR B. Restriction-ligation using sticky ends C. CRISPR interference D. Protein tagging	**1.5**	**CO1**
Q 12	**Gibson Assembly requires:** A. Restriction enzymes only B. Ligase and exonuclease C. RNA polymerase D. DNA helicase	**1.5**	**CO5**
Q 13	**Which of the following is *not* involved in DNA delivery methods?** A. Lipofection B. Calcium phosphate C. CRISPR array D. Electroporation	**1.5**	**CO4**
Q 14	**A virus can be used as a vector to:** A. Measure pH B. Deliver DNA into host cells C. Sequence proteins D. Amplify mRNA	**1.5**	**CO5**

Q 15	**Which of the following is an advantage of using chemical reagents for DNA delivery?** A. High specificity for proteins B. Strong immune response C. Ease of use and scalability D. Limited cell type targeting	**1.5**	**CO2**
Q 16	**The biological element in a biosensor could be:** A. LED B. DNA, enzyme, or antibody C. Thermometer D. Microchip	**1.5**	**CO2**
Q 17	**In biosensors, the transducer:** A. Generates energy B. Converts a biological response into a measurable signal C. Acts as a biological receptor D. Amplifies RNA	**1.5**	**CO3**
Q 18	**Which type of biosensor is commonly used for glucose detection in diabetes?** A. Optical biosensor B. Piezoelectric biosensor C. Electrochemical biosensor D. Thermal biosensor	**1.5**	**CO3**
Q 19	Synthetic biology-based biosensors are designed to: A. Randomly mutate DNA B. Increase DNA replication C. Detect specific cellular signals or molecules D. Induce mutations	**1.5**	**CO5**
Q 20	**A major application of biosensors in environmental monitoring is:** A. Editing genomes B. Detecting GMOs C. Measuring pollutant levels D. Producing proteins	**1.5**	**CO1**
Section B (4Qx5M=20 Marks)			
Q 1	Propose a method to deliver a synthetic DNA construct into plant cells. Justify your choice of delivery technique and mention the expected challenges.	**5**	**CO3**
Q 2	Imagine you are tasked with designing a biosensor for detecting heavy metals in water. What biological and electronic components would you include, and how would the sensor function?	**5**	**CO4**
Q 3	Describe an ethical dilemma associated with synthetic biology or genome editing in humans. Provide your viewpoint on how it can be addressed.	**5**	**CO5**

Q 4	If a synthetic RNA regulator is used to downregulate a disease-causing gene, what considerations must be made regarding specificity, stability, and delivery?	**5**	**CO2**
Section C **(2Qx15M=30 Marks)**			
Q 1	**You're given a challenge to design a toolkit for synthetic gene construction in a resource-limited lab.** 1. List and justify 3 essential methods/tools you would include (e.g., Gibson assembly, Golden Gate, CRISPR-Cas9). *(7.5 Marks)* 2. Explain how each tool contributes to synthetic biology and why it's suited for a minimal toolkit. *(7.5 Marks)*	**15**	**CO2**
Q 2	**Synthetic biology aims to produce low-cost insulin using genetically engineered microbes.** 1. Outline the steps you would take to design such a system. *(5 Marks)* 2. Describe the gene modification, host selection, protein expression, and downstream purification in brief. *(5 Marks)* 3. Mention any two advantages of this method over traditional insulin production. *(5 Marks)*	**15**	**CO4**
Section D **(2Qx10M=20 Marks)**			
Q 1	**You discover a microorganism with an unknown gene circuit that turns it fluorescent only at night.** 1. Propose a hypothesis about how this system might work. *(5 Marks)* 2. How could synthetic biology help you rewire or mimic this behaviour in another organism? *(5 Marks)*	**10**	**CO5**
Q 2	**If CRISPR were a word processor, what kind of "editing tools" does it offer compared to traditional methods?** Use this metaphor to compare CRISPR with older genome editing tools (like ZFNs and TALENs), and explain why CRISPR became so popular.	**10**	**CO2**