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MANIPAL INSTITUTE OF TECHNOLOGY

III SEMESTER B.TECH. (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: CELL AND MOLECULAR BIOLOGY [BIO 2101]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

✤ Answer ALL the questions.

✤ Missing data may be suitably assumed.

1A.	 Amazingly, an alien species of cellular organism is found alive in the remains of a meteorite that landed in the Thar desert. As a scientist, you are trying to determine whether this alien life-form uses DNA, protein, or some other type of compound as its hereditary material. a. What kinds of experiments would you propose to determine what the hereditary material is? b. Assuming that the hereditary material turns out to be similar to our DNA, describe the simplest experiments you could run to try to determine if it is double-stranded like our DNA, triple-stranded, or something else. 	4 M
1B.	A scientist uses a molecule of DNA composed of nucleotides containing radioactive sugar molecules as a template for replication and transcription in a nonradioactive environment. What percentage of DNA strands will be radioactive after three DNA replication cycles? What percentage of RNA molecules will be radioactive?	3M
1C.	We have seen that the hydrogen bonds between complementary nucleotides are crucial to the structure of dsDNA because they hold the two strands together. Why couldn't the two strands be effectively linked by covalent bonds? Elaborate.	3M
2A.	Why is proper chromosome condensation important for mitosis? Elaborate on the proteins involved in chromosome condensation.	4M
2B.	If a colony of 1.5 billion (1 billion=10 ⁹) E. Coli cells were infected with a single phage T4, and each lytic replication cycle of the phage produced 200 new phages, how many replication cycles would it take for T4 phages to overwhelm the entire bacterial colony? (Assume for the sake of simplicity that every phage completes its replication cycle in a different cell, and that the bacteria themselves do not reproduce.)	3M
2C.	Microtubules play a major role in the stability of the spindle structure. In what way does the kinetochore microtubules differ from the interpolar microtubules?	3M
3A.	You purify a protein from a plant cell that can act as a potential appetite suppressant. Owing to its possible commercial application you decide to clone the gene, Gene A, that encodes this protein. You isolate this gene from the plant cell, clone it into a plasmid vector and amplify it in the bacterial cells. List three	4M

BIO 2101

Page 1 of 2

	Reg. No.			
MANIPAL INSTITUTE OF TECHNOLOGY				
	features that a plasmid must have to allow the cloning and amplification of Gene A in bacterial cells.			
3B.	Recently it has been found that diseases associated with mitochondrial DNA can be inherited. Why is it difficult to treat diseases arising from faulty mitochondria and what are the ways by which such diseases can be treated?	3M		
3C.	Explain why an insertion of three nucleotides is less likely to result in a deleterious effect than an insertion of a single nucleotide.	3M		
4A.	 The following diagram represents a complex three-dimensional conformation of a micro RNA (miRNA) molecule. Top region 5' 3' Region 2 Bottom region i. Within Region 2, what bonds/interactions are primarily involved in stabilizing the RNA structure? ii. In Region 1, if the sequence of the top region is AUGGCUAA, can you predict the % of bases i.e. %A, %U %C and %G of the bottom region? Explain. iii. In the Region 2, if the sequence of the top region is AUGGCUAA, can you predict the % of bases i.e. %A, %U %C and %G of the bottom region? Explain. 	4M		
4R	Explain.	3M		
4C.	Specific DNA sequences within eukaryotic chromosomes are involved in controlling gene expression. Describe how the following two DNA elements operate and their influence on the transcriptional process. i) enhancer elements and ii) promoters	3M		
5A.	What is the need for post-translational modification of proteins? Elaborate on 3 such modifications.	4M		
5B.	A student claims that nucleotide analogs can be carcinogenic. Another student in the study group insists that nucleotide analogs are sometimes used to treat cancer. Explain why both students are correct.	3М		
5C.	You cultured some cells that thrive at 37°C and exposed them to 45°C for a brief period. You then analyzed the protein content of those cells and found that chaperones were upregulated. What could be the reason for this observation?	3М		