



Name :

Roll No. :

Invigilator's Signature :

CS/MBT, PHMB, PHMC/SEM-1/MBT, PHMB, PHMC-103/2009-10

2009

MOLECULAR BIOLOGY

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

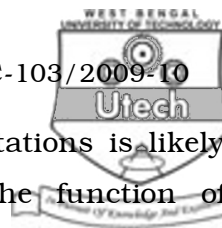
*Candidates are required to give their answers in their own words
as far as practicable.*

Question No. 1 is compulsory and any six from the rest.

GROUP – A

1. Answer any *ten* questions : 10 × 1 = 10

- A) i) Which of the following statements is/are true ?
- a) A chromosome contains many genes.
 - b) DNA replication copies both DNA strands of entire chromosomes.
 - c) Transcription only copies one strand of particular parts of chromosomes.
 - d) All of these.
 - e) None of these.



ii) Which one of the following mutations is likely to have the greatest effect on the function of a protein ?

- a) A missense mutation of the last amino acid of the protein
- b) A nonsense mutation of the 10th amino acid (assuming the protein is more than 100 amino acids long)
- c) A single base-pair change in an intron
- d) A single base-pair change after the stop codon
- e) None of these.

iii) The fact that a specific protein leaves a “footprint” on a DNA molecule is indicative of

- a) lack of interaction between the specific protein and DNA
- b) protection from DNase by the specific protein
- c) binding of the specific protein to all types of DNA
- d) binding of the specific protein to a specific sequence of DNA.

B) Answer the question in *one* sentence each :

iv) Name the tautomeric forms of DNA bases.

C) State whether the following statement is *True* or *False* :



- v) Melting point or T_m is the temperature at which the entire DNA is denatured.

D) Answer the questions in *one* sentence each :

- vi) Name the most abundant protein associated with eukaryotic DNA.
- vii) Exons from different RNA molecules can be fused by which splicing mechanism ?

E) Fill in the blanks :

- viii) Adenylation refers to transfer of while adenylation refers to transfer of

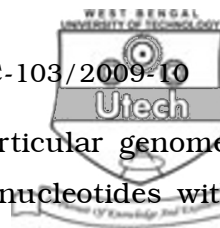
F) Answer the questions in *one* sentence each :

- ix) Name an antitermination factor in lambda phage.
- x) Name a general transcription factor having helicase activity.
- xi) What does the acronym ChIP stands for
- xii) Name the activity encoded by the Lac/gene.

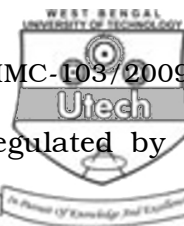
GROUP – B

Answer any six of the following. $6 \times 10 = 60$

2. a) More complex organisms (eukaryotes) have decreased gene density in comparison to prokaryotes. Justify with suitable examples. 2



- b) What is C-value ? C-value for a particular genome is always not equal to the number of nucleotides within the genes. Explain. 2
- c) You are given a temperature-sensitive *E. coli* strain that lacks ligase activity at higher temperature (40°C) but retains it at lower temperature (25°C). If these strains were placed at 40°C what would be the outcome in terms of their DNA replication and survivability ? 2
- d) Explain very briefly how eukaryotic replication is tightly regulated to ensure a single round of replication during each cell cycle. 2
- e) Linear chromosomes require specialized proteins to ensure the completion of replication. Explain how such proteins direct the process. 2
3. a) What are the major strategies for replicating circular DNA ? With the help of diagrams explain any one such strategy. 3
- b) Why do origins of replication tend to be A-T rich ? What is the function of DnaA proteins with respect to bacterial OriC ? 1 + 2
- c) You are studying a protein that you suspect has DNA helicase activity. Describe how you would assay the protein for the activity and show sample positive results. 2
- d) What are the different types of modifications of the histone N-terminal tails that take place to alter DNA accessibility ? 2

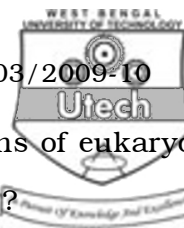


4. a) Glucose levels in bacterial cells are regulated by the activity of CAP and repressors. Explain. 5
- b) If a gene is fused to the araBAD promoter, explain how the expression of the gene can be easily controlled by addition of arabinose. 5

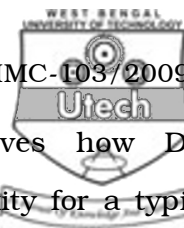
OR

Give an example of a negative regulation of gene expression in a bacterial operon. 5

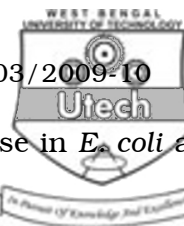
5. a) What are the features of Rho independent termination of transcription ? 2
- b) Define between promoter and enhancer elements. 2
- c) What effect would a mutation in an intron section of a gene have on the expression of the gene ? Explain. 1
- d) How does the inducer galactose enter a cell under conditions when the lac operon is repressed ? 3
- e) What feature of the Gal4 protein of *S. cerevisiae* has been exploited for using it as a tool to study protein-protein interactions ? 2
6. a) If you wished to design an inducible system similar to the *trp* operon in *S. cerevisiae*, would you be successful ? Explain your answer with reasons. 2



- b) How do post-transcriptional modifications of eukaryotic mRNAs help in stabilizing the transcript? 3
- c) Does the protein CIII promote lytic or lysogenic growth? Explain its mechanism of action. 1 + 2
- d) Explain very briefly why the dimeric/tetrameric structure of the repressor crucial in maintaining lysogeny in lambda phage. 2
7. a) Explain why brief digestion of eukaryotic chromatin with micrococcal nuclease gives a DNA ladder of 200 bp, but longer digestion gives 146 bp fragments. 2
- b) Why is it essential for linear eukaryotic DNA molecules to have multiple origins of replication contrary to *E. coli* that has a single origin of replication? 1
- c) List some of the important cellular functions associated with repetitive DNA. 1
- d) Differentiate between spontaneous and induced mutation. 2
- e) Write down the molecular mechanism of mutation by UV radiation. How can this mutation be repaired by excision? 4



8. a) Explain with the help of Cot curves how DNA renaturation is related to DNA complexity for a typical mouse satellite DNA, unique fraction of calf DNA and *E. coli* DNA. 3
- b) What is Ames test ? 1
- c) How does DNA polymerase take part in mutation repair ? 1
- d) Distinguish between transition and transversion mutation. 2
- e) Define a lesion. Give examples of spontaneous and induced mutations (two each). 3
9. a) Outline the process of aminoacyl-*t*RNA formation. 4
- b) What modifications of eukaryotic *m*RNAs facilitate translation ? 2
- c) Why are more than 30 *t*RNAs necessary to translate *m*RNAs when there amino acids incorporated into proteins ? 1
- d) Define and briefly outline the major function of (i) ribosomes and (ii) *P* sites on ribosome. $2 \times 1\frac{1}{2}$



10. a) Explain the phenomenon of SOS response in *E. coli* and the role of key players in the process. 3
- b) Explain the mechanism by which the two-enzyme system recognizes certain mutagens and detoxifies them before they affect the DNA. 2
- c) Explain the means of repair of DNA lesions in presence of light. 2
- d) Describe briefly the signaling mechanism of IL-2-mediated gene expression. 3
11. Write short notes on any *four* of the following : $4 \times 2\frac{1}{2}$
- a) *miRNAs*
- b) RISC
- c) Intergenic suppression
- d) TFIID
- e) Okazaki fragments
- f) Nucleosomes.
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