



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/M.Tech (PBIR)/SEM-1/MBT/PHMB/PHMC-103/2012-13**

**2012**

**MOLECULAR BIOLOGY**

*Time Allotted : 3 Hours*

*Full Marks : 70*

*The figures in the margin indicate full marks.*

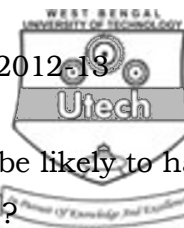
*Candidates are required to give their answers in their own words  
as far as practicable.*

Answer Question No. 1 and any *five* from the rest.

**GROUP – A**

1. Answer the following questions : 5 × 1 = 5

- a) Transcriptional activators, NtrC and MerR work by recruitment rather than by allostery . ( True or False )
- b) Certain sequences, generally short sequences of 20 to 300 bp long, if they are repeated several thousand times, then its  $\text{cot } \frac{1}{2}$  value is very low. ( True or False )
- c) Genes with trinucleotide repeats are not prone to frame shift mutation. ( True or False )
- d) Name the DNA binding motif of the lambda repressor.



- e) Which of the following mutations would be likely to have the largest effect on the protein involved ?
- A missense mutation of the last amino acid of the protein.
  - A nonsense mutation of the 10th amino acid (assuming the protein is more than 100 amino acids long).
  - A single base-pair change in an intron.
  - A single base-pair change after the stop codon.
  - None of these.

### GROUP – B

Answer any *five* from the following.  $5 \times 7 = 35$

- "H bond is important for the specificity of base pairing". Enumerate the statement with special reference to base pair complementarity.
  - What parameters will lower the stability of double-stranded DNA ?
  - Compare and contrast between Type I and Type II topoisomerases (for both prokaryotes and eukaryotes).
- The plasmid pcDNA is a closed circular double-stranded DNA molecule with 5,500 base pairs.  
( Note : Assume that B-DNA has 10 bp/turn. )
    - How many helical turns are there in the relaxed molecule ?
    - What is the linking number of the molecule when it is relaxed B-DNA ?



- b) The said molecule is transferred from aqueous solution to 70 % ethanol. Under these conditions, the structure changes from B form to A-DNA due to the relatively lower water concentration.

( Note : Assume A-DNA has 11 bp/turn )

- i) What is the linking number now ?
  - ii) How many helical turns are there now ?
  - iii) Which molecule ( a or b ) would have the more compact structure ?
- c) What is genomic imprinting and why is it important ?

2 + 3 + 2

4. a) State why eukaryotic chromosomes are replicated exactly once per cell cycle, which is critical for these organisms ?
- b) How the end replication problem is eventually resolved in eukaryotic linear DNA ?
- c) What is the biological importance of negative super-coiling of DNA in cells.

2 + 3 + 2



5. a) What is Ames test and how is it useful to assess mutagenic potential of chemical compounds ?
- b) How would DNA damage be reversed by photoreactivation ?
- c) Induction of an SOS response in bacteria allows an error prone repair. Explain with a suitable example.

2 + 2 + 3

6. a) Does the protein CIII promote lytic or lysogenic growth ? Explain its mechanism of action.
- b) Explain very briefly why the dimeric/tetrameric structure of the repressor crucial in maintaining lysogeny in lambda phage.
- c) How would you map promoter regions on a genomic DNA ?

2 + 2 + 3

7. a) What feature of the Gal4 protein of *S. cerevisiae* has been exploited for using it as a tool to study protein-protein interactions ?
- b) Glucose levels in bacterial cells are regulated by the activity of CAP and repressors. Explain.
- c) If a gene is fused to the araBAD promoter, explain how the expression of the gene can be easily controlled by addition of arabinose.

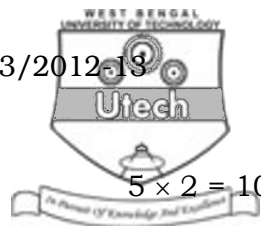
2 + 3 + 2



8. a) Give an example of a negative regulation of gene expression in a bacterial operon.
- b) What are the different types of modifications of the histone N-terminal tails that take place to alter DNA accessibility ? Explain in brief how these modifications are associated in transcriptional silencing.
- c) If the *lacI* gene is deleted, what will be the effect on the lac operon ?
- d) What are miRNAs ? Briefly describe biological significance of such RNAs.
- 1 + 2 + 1 + 3

**GROUP – C**

9. Answer any *five* of the following : 5 × 1 = 5
- a) What is the difference between Group I and Group II introns ?
- b) What is transesterification ?
- c) What is tautomeric shift ?
- d) What is the importance of Shine-Dalgarno sequence ?
- e) What is the consequence of splice-site mutation ?
- f) What is missense mutation ?
- g) How is retrovirus related to cancer ?



10. Answer any *five* of the following :

5 × 2 = 10

- a) How could you detect radiation induced recessive lethal mutation in *Drosophila* ?
- b) Explain the molecular mechanism of mutation, using a base analog as mutagen.
- c) How is oncogene activated in Chronic Myelogenous Leukaemia (CML) ?
- d) What is splicing ? How is polyadenylation occur at 3' end of hn-RNA ?
- e) How is t-RNA activated during protein synthesis ?
- f) What is ribozyme ? Explain the mechanism of self splicing.
- g) Explain the significance of wobble hypothesis.

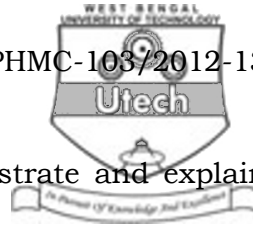
Answer any *two* of the following :

2 × 7  $\frac{1}{2}$  = 15

11. What is transposon ? What are the types of transposon ?

Explain the molecular mechanism of composite transposon in Tn3 element.

12. State the important features of post-transcriptional modifications in rRNA and tRNA.



13. How is codon deciphered by t-RNA ? Illustrate and explain the process of Initiation, Elongation and Termination in protein synthesis.
  14. Explain the mechanism of activation of Retinoblastoma gene.  
How is cell cycle arrested & apoptotic pathways are activated in response to DNA damage ?
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