Name : .....

Roll No. : .....

Invigilator's Signature : .....

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

2012
MOLECULER 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 : $5 \times 1 = 5$

   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 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 ?

i) A missense mutation of the last amino acid of the protein.

ii) A nonsense mutation of the 10th amino acid (assuming the protein is more than 100 amino acids long).

iii) A single base-pair change in an intron.

iv) A single base-pair change after the stop codon.

v) None of these.

GROUP – B

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

2. a) "H bond is important for the specifity of base pairing". Enumerate the statement with special reference to base pair complementarity.

b) What parameters will lower the stability of double-stranded DNA ?

c) Compare and contrast between Type I and Type II topoisomerases (for bothy prokaryotes and eukaryotes).

2 + 2 + 3

3. a) 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.)

i) How many helical turns are there in the relaxed molecule ?

ii) 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 : $5 \times 1 = 5$

   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 : $5 \times 2 = 10$

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 : $2 \times 7\frac{1}{2} = 15$

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 ?