MOLECULAR BIOLOGY
(BIOT 2203)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) Discontinuous replication in lagging strand is a result of which property of DNA?
(a) Complementary bases, (c) Antiparallel nucleotide strands
(b) Charged phosphate group, (d) Five-carbon sugar.

(ii) All of the following are examples of housekeeping genes except _____
(a) beta galactosidase (b) ribosomal protein genes
(c) RNA polymerase (d) rRNA genes

(iii) Which type of replication requires a break in the nucleotide strand to get started?
(a) Theta replication (b) Linear eukaryotic replication,
(c) Rolling-circle replication (d) All of the above.

(iv) Match the antibiotics in Group-I with the targets of Group –II

Group-I	Group-II
P. Nalidixic acid	1. RNA polymerase-II
Q. α-amanitin	2. Bind at A site of ribosome
R. Puromycin	3. DNA gyrase
S. Rifampicin	4. RNA polymerase.

(a) P-1, Q-4, R-3, S-2. (b) P-3, Q-1, R-4, S-2.
(c) P-3, Q-1, R-2, S-4. (d) P-1, Q-3, R-2, S-4

(v) For the *E. coli* genotype $I^+P^+O^cZ^+Y^+A^+$, the expression of β-galactosidase will be:
(a) inducible (b) constitutive
(c) absent (d) lethal

(vi) Topoisomerase II favors transcriptional chain elongation because:
(a) It is a DNA gyrase (b) It favors DNA supercoiling
(c) It favors DNA unwinding (d) It has exonuclease activity

(vii) In humans, the enzyme having reverse transcriptase activity is:
(a) Ribonuclease P (b) Ribonuclease D
(c) Cre-Recombinase (d) Telomerase

(viii) Ribozyme is
(a) Ribosomal RNA (b) Catalytic RNA
(c) Type of lysozyme (d) RNA polymerase

(ix) Which of the following is mismatched?
(a) Type II topoisomerases**:** introduces breakages into both strands of the double helix
(b) Displacement replication**:** D-loop
(c) Linking number: the number of times one strand crosses the other in a linear molecule
(d) DNA gyrase **:** introduction of extra turns into DNA molecules

(x) For their efficient translation, eubacterial mRNAs possess a Shine-Dalgarno sequence for its recognition by an anti-Shine-Dalgarno sequence (ASD) present in
(a) 5S rRNA (b) 23S rRNA
(c) 16S rRNA (d) any of them

Group – B

2. (a) Write the name of experiment which shows that DNA replication is bidirectional and describe design, results and interpretation of the experiment with labeled diagram.

(b) Write the mechanism of reaction of the following with condition and labelled diagram**:**
(i) DNA helicase, (ii) DNA gyrase, (iii) T4 DNA Ligase.

(c) Draw a replication bubble of a molecule DNA undergoing eukaryotic linear replication. On your drawing, identify (i) origin, (ii) polarity (5' and 3' ends) of all template strands and newly synthesized strands, (iii) leading and lagging strands, (iv) Okazaki fragments, (v) location of primers and (vi) position of MCM protein, Topoisomerase, Pol α, pol δ, Pol ε, PCNA and RepA.

(1 + 4) + 3 + 4 = 12

3. (a) Write the names of different classes of transposon. Describe the mechanism of transposition of gene by cut & paste mechanism, with a diagram.

(b) What are the differences between Reverse transcriptase and RdRP. What is the physiological role of these two enzymes?

(c) Describe the mechanism of DNA damage occurs by UV radiation and describe the mechanism of repair of that DNA damage by light dependent DNA repair system, with diagram.

(d) If *E.coli* bacterium completely replicates its circular chromosome by theta replication in 40 minutes, how many Okazaki fragments will be produced during replication of *E.coli* DNA?

(1 + 3) + (1 + 2) + (1.5 × 2) + 2 = 12

Group – C

4. Following is a DNA segment:

+1

5' CATACATGGTATAATGACGTTACCC**G**ACATAGCTACGATGACGATA 3'
3' GTATGTACCATATT ACTGCAATGGGCTGT ATCGATGCTACTGC TAT 5'

(i) Write down the sequence of sense RNA strand produced from this.
(ii) Why it is called the "sense" strand?
(iii) Is it a prokaryotic or eukaryotic DNA? Explain.
(iv) Name the two DNA strands and explain their meaning.
(v) If this DNA segment ends with following sequence:
5' GCCGCCAGUUCCGCUGGCGGCAUUUUUUUUU 3',
Then, what will be the termination mechanism? Explain.
(vi) Name the symmetry found here.

(2 × 6) = 12

5. (a) What are the differences between prokaryotic and eukaryotic core promoter elements?

(b) Describe molecular mechanism of 3' polyadenylation of eukaryotic mRNA.

(c) Mention the mechanism of transcription inhibition by the following: Rifampicin, α-amanitin, isoquinoline sulfonamide.

4 + 4 + 4 = 12

Group – D

6. (a) What is ORF? Where it is present? Where it starts and ends? How ribosome starts translation from the start codon?

(b) What are isoaccepting tRNAs? What is meant by Glu-$tRNA^{Glu}$ and Glu-$tRNA^{Gln}$ and where are they found? Can they be interconverted?

(c) How chloramphenicol inhibits prokaryotic translation?

(1 + 1 + 1 + 1) + (2 + 2) + 4=12

7. (a) What are the common post-translational modifications of eukaryotic proteins?

(b) Mention the role of different translational factors in prokaryotic translation initiation.

(c) Where it differs from eukaryote?

3 + (4 + 3) + 2 = 12

Group – E

8. (a) Show the growth pattern of wild type *E.coli* in the normal medium with the presence of following things, with graphical diagram: (i) only glucose, (ii) only lactose, (iii) both glucose and lactose. What you can conclude from these graphs about gene regulation in *E.coli*?

   (b) Draw a labelled diagram of the structure of *lac* operon**.** In the *lac* operon, explain the probable effect on gene expression due to the presence of the following:
   (i) Mutations in the lac operator
   (ii) Mutations in the lacI gene
   (iii) Mutations in the promoter.

   (c) Write the β-galctosidase enzyme reaction and it assay principle.

(1 × 4) + 4 + 4 = 12

9. (a) Explain the mechanism of gene regulation in eukaryote by a water soluble hormone, with a labled diagram.

   (b) Explain the mechanism of antitermination in Phage lambda, with a labled diagram.

   (c) Draw a diagram showing all the regulatory and structural elements of a eukaryotic gene.

   (d) (i) If 80% of the *E.coli* chromosome codes for specific proteins of average MW 70,000, how many protein can be made?
   (ii) Molecular weight of a prokaryotic double stranded DNA molecule is 6×10^6. If a polypeptide chain contains 2,000 amino acid residues, calculate the number of such polypeptide chains that can be synthesised from the above DNA.

3 + 3 + 3 + (1.5 × 2) = 12

Department & Section	Submission Link
BT	https://classroom.google.com/w/MTE4OTEzNTU3NzMx/tc/MjI2NDA1NzA2NjQw