2021

MOLECULAR BIOLOGY & BIOTECHNOLOGY
[HONOURS]
Paper : IV

Full Marks : 75   Time : 4 Hours

The figures in the right-hand margin indicate marks.
Candidates are required to give their answers in
their own words as far as practicable.

Write the answers to Questions of each Unit in separate books.

Answer all the questions.

UNIT–I

(Marks : 40)

1. Answer any **two** questions: 1×2=2

   i)   Monosomy in human beings is encountered in _____ syndrome.

   ii) Cruciform pairing is a diagnostic feature of translocation heterozygote – **True** / **False**.

   iii) Anticipation phenomenon is often observed in diseases caused due to triple repeat expansions– **True** / **False**.

2. Distinguish between (any **two**):   2×2=4

   i)   Homoplasmy and Heteroplasmy (w.r.t mitochondrial DNA)

   ii) Test cross and Back cross.

   iii) Aneuploidy and polyploidy

3. Answer any **four**:   6×4=24

   i) a) How many Barr bodies might be found in the nuclei of human cells with Karyotype XY, XX, XXY, XYY.

       b) Name an alkaloid that interferes with spindle fibre assembly.

       c) Distinguish between Reciprocal Translocation and Robertsonian Translocation.   2+1+3=6

   ii) In a particular monohybrid cross between purple and white flowers, flowers obtained in F1 are all purple. On seeing F1, 105 purple and 45 white flowers are obtained in F2. Hypothesize on the nature of inheritance of flower colour, supporting your inference by chi-square statistic. Given : 5% critical value for 1 degre of freedom is 3.841.   6

   iii) a) What are pseudoautosomal genes?

        b) Suppose that a mutation occurred in the SRY gene on human Y chromosome,

knocking out its ability to produce TDF. Predict the sexual phenotype of an individual who carried this mutation and a normal X-chromosome.   1+5=6

iv) In a certain population, the number of individuals born with cystic fibrosis (CF), an autosomal recessive disease, is 1 in 2500. Assuming Hardy-Weinberg equilibrium for this trait.

   a) Estimate the frequencies for normal and CF alleles.

   b) Compute the genotypic frequencies for homozygous normal, heterozygous normal and homozygous affected individuals.   3+3=6

v) Flower colour in Snapdragon shows incomplete dominance. Red (WW) and white (ww) true breeding varieties, when crossed, produces all pink flowers in F1 generation.

   a) Compute the genotypic and phenotypic ratio that might be obtained in F2 when the F1 hybrids are intercrossed.

   b) If the total number of F2 individuals obtained is 300, estimate the expected number of plants in each phenotypic class.   3+3=6

vi) a) Translate the mRNA

   $5' - (+1) AUG - UCC - ACA - UGG - 3'$

   into its corresponding polypeptide.

   b) If there is $A \rightarrow G$ base change at position 7, identify the kind of mutation in terms of nucleotide and amino acid substitution.

   c) If a $G \rightarrow A$ change occurs at position 12, what might be the outcome?

   [Given codon UGG-Trp, ACA-Thr, UCC-Ser, AUG-Net, GCA-Ala, UGA-X]
                                    2+2+2=6

4. Answer any **one**:   10×1=10

   i) a) Give a brief description of the Multiplicative and Additive rules of Probability.

      b) For the hypothetical cross Aa×Aa, Estimate the chance of a zygote being Aa heterozygote, by applying the above rules.   5+5=10

ii) Given below is the data on height of plants grown under normal light condition. Calculate the arithmetic (a) mean and (b) median.

Height (mm)	410-419	420-429	430-439	440-449	450-459	460-469	470-479
No. of plants	14	20	42	54	45	18	07

6+4=10

UNIT–II

(Marks : 35)

5. Answer any **three** questions: 1×3=3

a) Define Shine-Dalgarno sequence.

b) What do you mean by attenuation?

c) What is Wobble hypothesis?

d) What is Tm?

e) Which enzyme is involved in proof reading activity during prokaryotic DNA replication?

6. Answer any **two** questions: 2×2=4

a) Write the significance of sigma(σ) factor.

b) What are the differences between B-DNA and Z-DNA?

c) Briefly describe the non-ambiguous nature of genetic code.

7. Answer any **three** questions: 6×3=18

a) What is operon? Briefly mention different components of a typical operon. Define inducible and repressible operon. 1+3+1+1

b) Why nucleic acid is called polyanionic? Distinguish between nucleoside and nucleotide. What do you mean by siRNA and miRNA? 2+2+2

c) Describe Avery Mcleod Macarthy's experiment to prove that DNA is the genetic material. 6

d) What is non-sense codon? Briefly describe the deciflerance of genetic code. 1+5

e) Define 'TATA-Box'. Describe the termination of RNA synthesis in prokaryotes. 1+5

8. Answer any **one** question: 10×1=10

a) How can you prove that DNA replication is semiconservative? Briefly describe different enzymes required for DNA replication. 4+6

b) Define central degma. How does a polypeptide chain synthesize in bacteria? 2+8