

- (b) Describe the genetic control of anterior-posterior pattern formation in *Drosophila*.
- (c) Discuss the role of pair-rule genes in body segmentation of *Drosophila*.  
4 + 4 + 4 = 12

**Group – E**

- 8. (a) What are the assumptions of Hardy-Weinberg theory for an ideal population?
- (b) Write the theorems of probability.
- (c) If two parents, both heterozygous carriers of the autosomal recessive gene causing cystic fibrosis have five children, what is the probability that three will be normal?

4 + 2 + 6 = 12

- 9. (a) The following blood types are obtained from a sample of 205 Indians: M 123, MN 72 and N 10. Calculate the gene frequency of M and N.
- (b) Ten patients with high blood pressure participated in a study to evaluate the effectiveness of the drug 'X' in reducing their blood pressure. The accompanying table gives blood pressure measurements taken before and two weeks of treatment with 'X'. Calculate the value of SD of the change in blood pressure.

Patient	BP-Before	BP-After
1	172	159
2	186	157
3	170	163
4	205	207
5	174	164
6	184	141
7	178	182
8	156	171
9	190	177
10	168	138

- (c) Two hundred families with three children in a population from a village are sampled at random. How many families do we expect to have (i) no girls (ii) one girl (iii) two girls ? Assume sex ratio to be 1:1.

4 + 4 + 4 = 12

**GENETICS  
(BIOT 3101)**

**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) Lyon Hypothesis refers to
    - (a) Polyploidy
    - (b) X chromosome inactivation
    - (c) Epistasis
    - (d) Linkage.
  - (ii) Crossing over in diploid organisms is responsible for
    - (a) Dominance of genes
    - (b) Segregation of alleles
    - (c) Recombination between linked genes
    - (d) Linkage between genes.
  - (iii) If an autosomal recessive disorder which shows Hardy-Weinberg equilibrium has an incidence of 1 in 6400 then the frequency of carriers is approximately \_\_\_\_
    - (a) 1/20
    - (b) 1/40
    - (c) 1/80
    - (d) 1/160.
  - (iv) Which of the following is an example of monosomy?
    - (a) 46, XX
    - (b) 47, XXX
    - (c) 47, XYY
    - (d) 45, X.
  - (v) Cancer of B lymphocytes is called
    - (a) Sarcoma
    - (b) Melanoma
    - (c) Myeloma
    - (d) Carcinoma.
  - (vi) In a Robertsonian translocation, fusion occurs at
    - (a) telomere
    - (b) centromere
    - (c) histone
    - (d) end of long arm.
  - (vii) In a family, father is having a disease and mother is normal. The disease is inherited to daughters only and not to sons. The mode of inheritance is
    - (a) Sex-linked dominant
    - (b) Sex-linked recessive
    - (c) Autosomal dominant
    - (d) Autosomal recessive.

- (viii) Standard deviation is the square of
  - (a) mode
  - (b) standard error
  - (c) regression
  - (d) variance.
- (ix) Chi square test measures the
  - (a) degree of deviation of observed result from expected
  - (b) closeness of observed and expected frequency
  - (c) population variance and sample variance
  - (d) all of the above.
- (x) ..... is a collection of statistical models used to analyze the differences among group means and their associated procedures.
  - (a) Anova
  - (b) T test
  - (c) Chi-square analysis
  - (d) F test

**Group - B**

- 2. (a) Red eye is the normal eye colour in *Drosophila*, and white eye is an x-linked recessive mutation. Design a cross between a red eyed female and a white eyed male and show the F<sub>2</sub> off springs. What will be the results of the cross if the parental sexes are reversed?
  - (b) Explain how tautomerization leads to anomalous base pairing of DNA.
  - (c) How are Apurinic sites formed?
- (3 + 3) + 3 + 3 = 12**
- 3. (a) Three of the many recessive mutations in *Drosophila melanogaster* that affect body colour, wing shape or bristle morphology are black (b), body versus grey in wild type, dumpy (dp), obliquely truncated wing versus long wing in the wild type, and hooked (hk) bristles at the tip versus not hooked in the wild type. From a cross of a dumpy female with a black and hooked male, all the F<sub>1</sub> are wild type for all three characters. The test cross of an F<sub>1</sub> female with a dumpy, black, hooked male gave the following results:
 

wild type - 169	black - 19
black hooked - 301	dumpy hooked - 21
hooked - 8	hooked dumpy black - 172
dumpy black - 6	dumpy - 304

    - (i) Find out the correct order of the three genes.
    - (ii) Construct a linkage map of the linkage group that these three genes occupy showing the map distances between the genes.
    - (iii) Determine the coefficient of coincidence.
  - (b) A normal woman, whose father had Haemophilia, married a normal man. What is the chance of Haemophilia in their children?

- (c) Explain with a diagram the salient features of a Lampbrush chromosome.
 

**(2 + 2 + 2) + 3 + 3 = 12**

**Group - C**

- 4. (a) What are tumour markers? Mention their applications.
- (b) How did Bishop and Varmus experimentally prove the cellular origin of oncogenes?
- (c) 'p53 has dual roles in cell cycle and apoptosis'- explain the statement with reasons.
 

**(2 + 2) + 4 + 4 = 12**
- 5. (a) Explain how Philadelphia chromosome acts as a marker of chronic myelocytic leukemia.
- (b) Write a brief note on Trinucleotide repeat disorders.
- (b) What do you mean by missense and nonsense mutations?
 

**4 + 4 + (2 + 2) = 12**

**Group - D**

- 6. (a) Give an illustrated flowchart of the process of generalized transduction.
- (b) Describe the different stages in the life cycle of any animal virus.
- (c) Seven deletion mutants within the A cistron of the rII region of phage T4 were tested in all pairwise combinations for wild type recombinants. In the adjacent table of results, + = recombination, 0 = no recombination. Construct a topological map for these mutants.

	1	2	3	4	5	6	7
1	0	+	0	0	+	0	0
2		0	0	0	+	+	0
3			0	0	+	+	0
4				0	+	0	0
5					0	0	0
6						0	0
7							0

**4 + 4 + 4 = 12**

- 7. (a) Design an experiment to show that variations in bacterial phenotypes are due to pre-existing mutations and not due to physiological changes induced by environmental conditions.