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) Which of the following is an example of missense mutation?
(a) Cystic Fibrosis (b) Sickle cell anaemia
(c) Haemophilia (d) Tay Sach's Disease

(ii) A-G change is an example of
(a) tautomerization (b) transition
(c) transversion (d) translocation

(iii) 2n-1 karyotype is an example of
(a) monosomy (b) nullisomy
(c) trisomy (d) tetraploidy.

(iv) Which of the following cancers does not form a solid tumour?
(a) Leukemia (b) Sarcoma
(c) Lymphoma (d) Carcinoma.

(v) Kline felter syndrome is an example of
(a) aneuploidy (b) polyteny
(c) polyploidy (d) monoploidy.

(vi) Hunchback gene in Drosophila helps in
(a) anterior-posterior polarity (b) body segmentation
(c) specification of body structures (d) wing development.

(vii) The transfer of genetic material from one bacterium to another via lytic bacteriophage is called
(a) transformation (b) conjugation
(c) generalized Transduction (d) specialized Transduction.

(viii) In the Hardy-Weinberg equation, 2pq equals the percentage of
(a) homozygous dominant (b) homozygous recessive
(c) heterozygous (d) none of these.

(ix) What is the frequency of the recessive allele in a population of 100 individuals with the following genotypes: 30 BB, 60 Bb, 10 bb?
(a) 0.2 (b) 0.4 (c) 0.6 (d) 0.8.

(x) Chi square is zero when
(a) expected frequency is less than observed frequency
(b) expected frequency is equal to observed frequency
(c) expected frequency is double of observed frequency
(d) expected frequency is greater than observed frequency.

Group – B

2. (a) Discuss the phenomenon of 'Haemolytic Disease of the Newborn'.

(b) What do you mean by complementation analysis? Explain with an example.

(c) Explain the mechanism of extra X chromosome inactivation in mammalian female nuclei.

4 + 4 + 4 = 12

3 (a) Singed bristles (sn), crossveinless wings (cv) and vermilion (v) eye colour are due to recessive mutant alleles of the 3 sex-linked genes in *Drosophila melanogaster*. When a female heterozygous for each of the 3 genes was test-crossed with a singed, crossveinless, vermilion male, the following progeny were obtained:
signed, crossveinless, vermilion – 3
crossveinless, vermilion – 392
vermilion – 34
crossveinless - 61
singed, crossveinless – 32
singed, vermilion - 65
singed – 410
wild type - 3
(i) What is the correct order of the 3 genes on the chromosome?
(ii) What are the genetic map distances between the 3 genes?
(iii) Calculate 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? Explain with logic.

(c) Mention the criteria for sex-linked recessive mode of inheritance.

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

Group – C

4. (a) What do you mean by Missense mutation and Nonsense mutation? Give examples.

(b) Explain how tautomerization leads to anomalous base paring of DNA.

(c) How are Apurinic sites formed?

(2 + 2) + 4 + 4 = 12

5. (a) Explain the phenomenon of frameshift mutation.

(b) What do you mean by Gatekeeper genes and Caretaker genes?

(c) Site an example by which a proto-oncogene can be converted into an oncogene by a point mutation.

4 + (2 + 2) + 4 = 12

Group – D

6. (a) Give a step-by-step description of the generalized transduction in bacteria.

(b) Describe the life cycle of a Lambda Bacteriophage.

(c) In *E. coli* four Hfr strain donate the following genetic markers when in the order donated:

Strain 1	Q	W	D	M	T
Strain 2	A	X	P	T	M
Strain 3	B	N	C	A	X
Strain 4	B	Q	W	D	M

All these Hfr strains are derived from the same F^+ strain. What is the order of these markers on the chromosome of the original F^+?

4 + 4 + 4 = 12

7. (a) Explain with a diagram the process of bacterial recombination.

(b) Briefly explain the process of bacterial Hfr conjugation.

(c) How is telomere shortening related to ageing?

4 + 4 + 4 = 12

Group – E

8. (a) A population of 173 people showed the following blood groups: O 78; A 71; B 17; AB 7. Calculate the gene frequencies of A, B and O.

(b) The mean of 30 values was 150. It was detected on rechecking that the value 165 was wrongly copied as 135 for the computation of the mean. Find the correct mean.

(c) There are 200 rice plants in an experimental plot. The plants range from 28 to 36cm in height, which may be grouped in 5 classes. Example: 28, 30, 32, 34, 36 cm showing distribution frequencies 32, 80, 55, 28 and 5 respectively. Calculate the mean and standard deviation of height of these plants.

4 + 2 + 6 = 12

9. (a) There are two identical boxes containing 4 white and 3 red balls, and 3 white and 7 red balls respectively. A box is chosen at random and a ball is drawn from it. If the ball is white, then what is the probability that it is from the first box?

(b) In a hospital the mortality rate for a disease is 7 in 1000. What is the Poisson probability for just 2 on account of the disease in a group of 400 people? Given $e^{-2.8} = 0.06$.

(c) Compute the variance, SD of the following distribution of inter-orbital width (mm) of a sample of 100 pigeons.

Class interval	11-13	14-16	17-19	20-22	23-25
Frequency	8	20	40	25	7

4 + 4 + 4 = 12