

**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) Sickle cell anaemia is an example of
 (a) Point mutation (b) Missense mutation
 (c) Nonsense mutation (d) Deletion mutation.
- (iii) 2n-2 karyotype is an example of
 (a) Monosomy (b) Nullisomy
 (c) Diploidy (d) Tetraploidy.
- (iv) AB blood group is an example of
 (a) incomplete dominance (b) co-dominance
 (c) lethal alleles (d) mendelian inheritance.
- (v) Down's syndrome is an example of
 (a) aneuploidy (b) polyteny
 (c) polyploidy (d) monoplody.
- (vi) Which one is not an example of tumour suppressor gene?
 (a) p53 (b) Rb (c) INK4 (d) Abl.
- (vii) The transfer of genetic material from one bacterium to another via virus is called
 (a) transformation (b) conjugation
 (c) recombination (d) transduction.

- (viii) 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.
- (ix) Bicoid gene in *Drosophila* helps in
 (a) anterior-posterior polarity (b) body segmentation
 (c) specification of body structures (d) wing development.
- (x) 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.

Group - B

2. (a) What do you mean by Bombay Phenotype?
 (b) What do you mean by sex-limited and sex-influenced inheritance?
 (c) Explain the role of Y chromosome in sex determination in humans.
4 + 4 + 4 = 12
3. (a) The following genes are linked on chromosome 3 of *Drosophila melanogaster*: Black body (*b*), cinnabar eyes (*cn*), vestigial wings (*vg*). A trihybrid cross between a heterozygous female and a homozygous recessive male produced the following 1000 progeny:
 Wild type - 39
 Black, cinnabar - 1
 Black - 416
 Black, cinnabar, vestigial - 48
 Cinnabar - 42
 Black, vestigial - 50
 Cinnabar, vestigial - 402
 Vestigial - 2
 (i) Which are the n.c.o. and d.c.o. classes?
 (ii) Which is the middle gene in the sequence?
 (iii) Find out the map distances between the 3 loci and prepare a linkage map.
- (b) Mention the salient features of mtDNA with a diagram.

- (c) Define (**any three**): Pseudodiploidy, Autopolyploidy, Allopolyploidy, Nullisomy.

$$(2 + 1 + 2) + 4 + 3 = 12$$

Group - C

4. (a) Explain the normal function of Rb gene and state how Rb mutations can cause deregulation of cell cycle.

(b) What do you mean by transition and transversion?

(c) Write short notes on **any one**:

- (i) Tay-Sachs disease
- (ii) Fragile X syndrome
- (iii) Huntington's disease.

$$4 + (2 + 2) + 4 = 12$$

5. (a) Mention the pathways by which a proto-oncogene can be converted into an oncogene.

(b) 'Cancer is a multi-hit, multi-step, multi-mutation process'. Justify the statement.

(c) Write a brief note on Ames test for detection of mutagenesis.

$$4 + 4 + 4 = 12$$

Group - D

6. (a) Give a comparative analysis between Generalized and Specialized transduction.

(b) Describe the life cycle of a T4 Bacteriophage.

(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 following table of results, + = recombination, 0 = no recombination. Construct a topological map for these deletions.

	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) Explain with a diagram the Holliday model of recombination.

(b) Briefly explain the experiment performed by Lederberg and Tatum to establish bacterial conjugation.

(c) Give a short description of Retrotransposons.

$$4 + 4 + 4 = 12$$

Group - E

8. (a) In drosophila 'b' is recessive autosomal mutation that results in black body colour and *vg* is a recessive autosomal mutation results in vestigial wing. Wild type flies have grey bodies and long wings. True breeding black normal (*b/b vg⁺/vg*) flies were crossed with true breeding grey vestigial (*b⁺/b⁺ vg/vg*) male flies. The female is heterozygote in this test cross because in Drosophila no crossing over occurs between homologous pair of chromosome in males. The test cross progeny data were as follows: 283 grey, normal, 1, 294 grey vestigial, 1418 black normal, 241 black vestigial, total 3, 236 flies. Use chi-square test to test the hypothesis that the two genes are unlinked. The table value for 3 *df* at 0.05 level is 7.82.

(b) How many mammalian cells would be killed if an irradiation dose administered to a cell population was sufficient for an average of 5 lethal hits per target, when in fact only 2 hits are needed for lethality? (Given e^{-m} i.e., $e^{-5} = 0.0067$).

$$8 + 4 = 12$$

9. (a) 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.

(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 after 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

Patient	BP- Before	BP- After
6	184	141
7	178	182
8	156	171
9	190	177
10	168	138

- (c) Evaluate the Pearson's measure of skewness on the basis of mean, mode and standard deviation from the following data:

Class interval	69-	76-	83-	90-	97-	104-	111-
[blood glucose]	76	83	90	97	104	111	118
No. of dogs	6	9	8	3	2	1	2

$$3 + 4 + 5 = 12$$