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) 2n-1 karyotype is an example of
(a) Aneupolidy (b) Nullisomy
(c) Diploidy (d) Tetraploidy.

(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) An interaction between non-allelic genes in which an allele at one locus prevents expression of an allele at another locus, but not vice versa, is called
(a) collaboration (b) complementation
(c) epistasis (d) modification.

(vi) In a Robertsonian translocation, fusion occurs at
(a) Telomere (b) Centromere
(c) Histone (d) end of long arm.

(vii) _____ refers to the study of events which are going to happen or not.
(a) probability (b) correlation
(c) regression (d) Chi square analysis.

(viii) The_____ is the average evaluated after applying weights to the item as judged by their relative importance.
(a) weighted arithmetic (b) median
(c) mode (d) standard deviation.

(ix) 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.

(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) Discuss the phenomenon of co-dominance with an example.

(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) 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_1 are wild type for all three characters. The test cross of an F_1 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.

   (c) 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) Write a brief note on *Hfr* conjugation with illustrations.

   (b) Describe the genetic control of body segmentation in *Drosophila*.

   (c) Write a short description on the pattern of homeotic gene expression in *Drosophila*.

4 + 4 + 4 = 12

Group – E

8. (a) Prove that allele frequency remains constant throughout generations.

(b) What are the assumptions of Hardy-Weinberg theory for an ideal population?

(c) 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

4 + 2 + 6 = 12

9. (a) Calculate the mean, median, S.D. and variance of the following data.

Height in inches	95-105	105-115	115-125	125-135	135-145
No. of children	19	23	36	70	52

(b) In the evening primrose pure red flowered plants were crossed with white flowered plants, F_1 are all pink coloured. Inbred F1 plants produced 113 red, 242 pink and 129 white flowered plants. This phenotypic ratio also seems to be genotypic ratio of the F_2 of a Mendelian monohybrid cross involving a gene responsible for flower pigmentation. Analyse the result with suitable statistical test. Given that x^2 value for 2 *df* at 0.05 is 5.99.

8 + 4 = 12

Department & Section	Submission Link
BT	https://classroom.google.com/c/MTI3ODc0NTU0MzA1/a/MjcNDc3NDQwMjU1/details