B.Tech/M.Tech(Integrated) DEGREE EXAMINATION, NOVEMBER 2023

Third Semester

21BTC206T - GENETICS AND CYTOGENETICS

(For the candidates admitted during the academic year 2022-2023 onwards)

Note:

i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours   **Max. Marks: 75**

PART - A (20 × 1 = 20 Marks)
Answer all Questions

		Marks	BL	CO

1. When a disease is more predominant in a family irrespective of males and females it is said to be   **1   2   1**
   (A) X-linked
   (B) Y-linked
   (C) autosomal dominant
   (D) autosomal recessive

2. What are the possible offspring from blood type A mother and AB father   **1   1   1**
   (A) A, B and AB
   (B) B and AB
   (C) O and AB
   (D) A and O

3. If a daughter of a colour blind person marries a normal man then their progenies will be   **1   4   1**
   (A) Half of their daughters are colour blind
   (B) Half of their sons are colour blind
   (C) All the sons are colour blind
   (D) All the daughters are colour blind

4. Test cross of a plant with yellow round seeds produce 1:1:1:1 ratio of yellow round: yellow wrinkled: green round: green wrinkled progenies. What is the expected genotype of the yellow round parent?   **1   2   1**
   (A) $YYRR$
   (B) $YyRr$
   (C) $YYRr$
   (D) $yyrr$

5. Genes a and b are 10 map units apart. An ab^+ / ab^+ individual was mated with an a^+b / a^+b individual. What gametes can the F_1 produce and in what ratio?   **1   2   2**
   (A) $45a^+b$: $5ab$: $5a^+b^+$: $45ab^+$
   (B) $45a^+b^+$: $5a^+b$: $5ab^+$: $45ab$
   (C) $40a^+b$: $10ab$: $10a^+b^+$: $40ab^+$
   (D) $40a^+b^+$: $10a^+b$: $10ab^+$: $40ab$

6. A heterozygous gray-bodied (b^+), normal winged (vg^+) female fruit fly test crossed with a recessive male gave the following progenies: Gray normal-90, gray vestigial-10, black normal-10, and black vestigial-90. What is the distance between the genes b and vg?   **1   2   2**
   (A) 10 map units
   (B) 20 map units
   (C) 5 map units
   (D) 90 map units

7. The genetic markers present in homologous chromosomes in a heterozygous individual is $X+Z/+Y+$. What is the arrangement of the genes X and Y in the individual?   **1   2   2**
   (A) cis
   (B) trans
   (C) coupling
   (D) different chromosomes

8. In somatic cell hybridization, HAT selection procedure is used to eliminate growth of   **1   1   2**
   (A) Parent cells
   (B) hybrid cells
   (C) synkaryon
   (D) heterokaryon

9. The arrangement of genes in a chromosome is A B C D E ● F G, where ● represents the centromere. What type of chromosome mutation is required to change the arrangement in this chromosome to A E D C B ● F G ?   1   2   3
   (A) Deletion   (B) Inversion
   (C) Translocation   (D) Duplication

10. Some people with Turner syndrome are 45, X/46, XY. The reason for this could be   1   2   3
   (A) Duplication of chromosomes   (B) Mosaicism
   (C) Translocation   (D) Position effect

11. During FISH analysis if a person exhibits two signals on hybridization with a specific probe, then the person is said to be   1   1   3
   (A) monosomic   (B) normal
   (C) trisomic   (D) tetrasomic

12. Exchange of chromatid segments between non-homologous chromosomes is called as   1   1   3
   (A) Deletion   (B) duplication
   (C) inversion   (D) reciprocal translocation

13. A random segment of the donar DNA is transferred to the recipient cells by   1   2   4
   (A) Generalized transducing phage   (B) temperate phage
   (C) Specialized transducing phage   (D) lysogenic phage

14. Integrated state of the F plasmid that increases the frequency of recombination is   1   1   4
   (A) prophage   (B) Hfr
   (C) lysogen   (D) extrachromosomal DNA

15. During transformation, mapping of bacterial genes can be done by evaluating the frequency of   1   2   4
   (A) Co-transformation   (B) co-transduction
   (C) double transformation   (D) lysogen

16. Recombination of the donor DNA with the recipient genome in bacteria occurs during   1   2   4
   (A) Single cross over   (B) Double cross over
   (C) Three cross over   (D) Five cross over

17. If the frequency of the L_M allele is 0.3 in a population, assuming random mating what is the frequency of the heterozygous carriers?   1   2   5
   (A) 0.42   (B) 0.5
   (C) 0.7   (D) 0.23

18. The incidence of recessive albinism is 0.0004 in a human population. What is the frequency of the recessive allele?   1   2   5
   (A) 0.2   (B) 0.02
   (C) 0.4   (D)   0.04

19. The frequency of M, N and MN phenotypes are 53, 4 and 29 in an Indian population. What is the frequency of L_M allele?   1   4   5
   (A) 0.78   (B) 0.22
   (C) 0.39   (D)   0.61

20. A certain gene has three alleles A_1, A_2 and A_3. The frequency of A_1 and A_2 is 0.4 and 0.2 respectively. What is the frequency of $A_2 A_3$ hetrozygotes?   1   2   5
   (A) 0.16   (B) 0.32
   (C) 0.04   (D) 0.14

PART - B (5 × 8 = 40 Marks)
Answer **all** Questions   Marks   BL   CO

21.	(a) Given the genotypes of the parents, what will be the flower colour of the offspring of the following crosses? In sweet peas, genes C or P alone produce white flowers, with the purple color resulting from the presence of both factors. i) What is the expected ratio of the progenies resulting from a cross between cCpp X cCPP? ii) What is the expected ratio of offspring from a recessive backcross with a heterozygous parent (CcPp)?	8	4	1

(OR)

(b) A man and woman marry. They have five children, 2 girls and 3 boys. The mother is a carrier of hemophilia, an X-linked disorder. She passes the gene on to two of the boys who died in childhood and one of the daughters is also a carrier. Both daughters marry men without hemophilia and have 3 children (2 boys and a girl). The carrier daughter has one son with hemophilia who dies. One of the non-carrier daughters son marries a women who is a carrier and they have twin daughter.
i). Create a pedigree for the family.
ii). Determine the genotypes of the family members. List the genotypes of each individual in the pedigree.

22.	(a) Discuss the disadvantages of the two factor cross used in preparation of linkage maps.	8	3	2

(OR)

(b) How would you map genes in humans to its specific linkage group using selection procedure?

23.	(a) Explain the technique that can be used to detect aneuploids in humans in the early embryonic stage?	8	3	3

(OR)

(b) How would you classify mutation that leads to alteration in the arrangement of genes in the chromosomes? Explain.

24.	(a) An F+ strain marked at 10 loci give rise spontaneously to Hfr progeny.For any Hfr strain the order of markers entering early can be determined by interrupted mating experiments. From the following data, for several Hfr strains derived from the same F+, determine the order and distance between the makers in the F+ strain.	8	4	4

1	-A-4min-H-2min-E-5min- R->
2	-D-2min- K-4min-S-3min-R->
3	-K-2min-D-4min-Y-8min-L->
4	-A-1min-L-3min-J-9min-D->
5	-H-4min-A-1min-L-3min-J->

(OR)

(b) How does a lytic phage help in gene transfer in bacteria? Explain its use in gene mapping.

25.	(a) A locus has three alleles A_1, A_2, and A_3 with frequencies of 0.6 for A_1 and 0.3 for A_2. Assuming random mating, what is the expected frequency of all the heterozygotes and homozygotes in the population?	8	3	5

(OR)

(b) How does random genetic drift contribute towards change in allele frequency in a population? Explain its effects.

PART - C (1 × 15 = 15 Marks)
Answer **any 1** Questions

Marks BL CO

26. A cross was made between *scute* or loss of certain thoracic bristles (sc), *echinu* or roughened eye surface (*ec*), *vestigial wing* (vw) female (sc *ec vw/sc ec vw*) flies and wild type males. The F_1 females were test crossed. The progeny are listed as gametic genotypes derived from the heterozygous females

Gametic genotypes	Number
+ + +	169
sc + +	9
+ + vw	1
sc ec vw	172
+ ec vw	10
sc + vw	18
sc ec +	0
+ ec +	21

   Are these genes linked? What is the correct order of the 3 genes on the chromosome? What is the genetic map distance between these three genes? Calculate the coefficient of interference?

27. How is a meroztgote used in mapping of closely related genetic markers in Bacteria?

15   4   2

15   4   4

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