INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
DEPARTMENT OF BIOSCIENCES AND BIOENGINEERING
Genetics (BT 204)
End-Semester Examination

Total Marks: 50

Date: November 22, 2024

NOTE:

- ***Read the questions carefully. All questions are compulsory.***
- **Explain through the crosses, wherever required.**
- **For numerical questions, all steps are to be mentioned resulting into the final answers.**

1. The sex-influenced gene governing the presence of horns in sheep exhibits dominance in males but acts recessively in females. When the Dorset breed (both sexes horned) with genotype ***hh*** is crossed to the Suffolk breed (both sexes hornless) with the genotype **h'h'**, what phenotypic ratios are expected in the F_1 and F_2? **[Marks 4]**

2. If a cross produces an F_1 progeny in the ratio of 3 hen-feathering : 1 cock-feathering and 1/3 of the hen-feathering progeny is males, give the genotypes of the parents. Use the symbols **H** and **h** for feathering type and **Z** and **W** for sex type. **[Marks 4]**

3. Short index finger is a sex influenced trait, i.e., it is dominant in men and recessive in women. A heterozygous man marries a heterozygous long-fingered woman. Determine the phenotypes of their children. Use the symbol **F** and **f** for index finger size and X and Y for sex type. **[Marks 4]**

4. Red-green color blindness is a human X-linked recessive disorder. Jill has normal color vision, but her father is color blind. Jill marries Tom, who also has normal color vision. Jill and Tom have a daughter who has Turner syndrome and is color blind: **[Marks 4]**
   (a) How did the daughter inherit color blindness?
   (b) Did the daughter inherit her X chromosome from mother Jill or from father Tom?

5. Determine the type of sex expression in higher plants against the flowers of different types as mentioned in the table below: **[Marks 0.5×8= 4]**

S.No.	Flowers of different types	S.No.	Flowers of different types
1.	All perfect bisexual flowers	5.	Perfect bisexual and female flowers on the same plant
2.	Separate male and female flowers, but on the same plant	6.	Perfect bisexual, female and male flowers on the same plant
3.	Separate male and female flowers, but on the different plant	7.	Perfect bisexual and male flowers on separate plant
4.	Perfect bisexual and male flowers on the same plant	8.	Perfect bisexual and female flowers on separate plant

6. A series of two-point crosses were carried out among seven loci (a, b, c, d, e, f and g), producing the following recombination frequencies. Using these recombination frequencies, map the seven loci, showing their linkage groups, the order of the loci in each linkage group, and the distances between the loci of each group: **[Marks 4]**

Loci	Recombination frequency (%)	Loci	Recombination frequency (%)	Loci	Recombination frequency (%)	Loci	Recombination frequency (%)
a and b	50	b and c	10	c and d	50	d and f	50
a and c	50	b and d	50	c and e	26	d and g	8
a and d	12	b and e	18	c and f	50	e and f	50
a and e	50	b and f	50	c and g	50	e and g	50
a and f	50	b and g	50	d and e	50	f and g	50
a and g	4						

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7. Determine the sexual phenotypes and ploidy level in *Drosophila* possessing following doses of X-Chromosomes and Sets of Autosomes? **[Marks 1×5= 5]**

S.No.	Number of X-Chromosomes	Sets of Autosomes
(i)	4	4
(ii)	4	3
(iii)	1	4
(iv)	2	4
(v)	3	4

8. An individual heterozygous for a reciprocal translocation possesses the following 4 chromosomes: **[Marks 5]**

(1)	A	B	•	C	D	E	F	G
(2)	A	B	•	C	D	V	W	X
(3)	R	S	•	T	U	E	F	G
(4)	R	S	•	T	U	V	W	X

I. Draw the pairing arrangement of these chromosomes in prophase-I of meiosis.
II. Diagram the different segregation patterns in anaphase-I of meiosis

9. A young couple is planning to have children. Knowing that there have been a substantial number of miscarriages and fertility problems on the husband's side of the family, they see a genetic counsellor. A chromosome analysis revealed that, whereas the women has a normal karyotype, the man possesses only 45 chromosomes and is carrier of Robertsonian translocation between chromosome 22 and 13. **[Marks 4+4]**

(a) List all the different types of gametes that might be produced by the man.
(b) What types of zygotes will develop when each of gametes produced by the man fuses with a normal gamete produced by the women?

10. A wild-type chromosome has the following segments, where • represents the centromere: **[Marks 8]**

A B • C D E F G

What type of Chromosomal Mutations are occurring in each one of the following Chromosomes?

a) A B A B • C D E F G
b) A B • C D E A B F G
c) A B • C F E D G
d) A • C D E F G
e) A B • E D C F G
f) C • B A D E F G
g) A B • C F E D F E D G
h) A B • C D E F C D E F G