# 2023-24

***Time - 3 hours***

***Full Marks - 60***

*Answer **all groups** as per instructions.*
*Figures in the right hand margin indicate marks.*
*Candidates are required to answer*
*in their own words as far as practicable.*
*Draw labelled diagrams wherever necessary.*

## GROUP - A

1. Fill in the blanks. (all) [1 × 8

(a) In Mendelian genetics, the allele that is not expressed in a heterozygous individual is called _____.

(b) When two genes are located close to each other on the same chromosome and tend to be inherited together, they are said to be in _____.

(c) A point mutation that changes a single nucleotide base pair to another, such as the substitution of adenine (A) with cytosine (C), is known as a _____ mutation.

(d) A chromosomal aberration where a segment of one chromosome breakes off and attaches to a different chromosome is called _____.

(e) In Drosophila, the sex determination system is based on the number of _____ chromosomes.

(f) Extra-chromosomal inheritance refers to the inheritance of genetic traits that are not associated with the _____.

(g) The process of genetic exchange in bacteria where genetic material is transferred from one bacterium to another through direct cell-to-cell contact is called _____.

(h) Transposons, also known as 'jumping genes', are genetic elements that have the ability to move within a genome. In maize, _____ elements are an example of 'mobile' transposons.

## GROUP - B

2. Answer any eight of the following within two or three sentences each. [1½ × 8

(a) How do Mendel's principles of segregation and independent asortment apply to the inheritance of two different traits in pea plants ?

(b) What is genetic linkage and how is recombination frequency used to assess gene distance on a chromosome ?

(c) What are the different types of gene mutations and how do they result in genetic variation ? Provide examples.





(d) Compare sex determination mechanisms in Drosophila and humans.

(e) Explain extra-chromosomal inheritance and provide examples of traits inherited this way.

(f) Compare bacterial genetic exchange mechanisms (conjugation, transformation, transduction) and their importance in evolution.

(g) Analyze the significance of transposons in generating genetic variability and provide examples of their role in evolution.

(h) How do chromosomal aberrations like translocations affect genetic material and phenotypic traits in organisms ?

(i) What is recombination frequency and how is it calculated in a two-factor cross ?

(j) Analyze the cytological and molecular mechanisms of crossing over during meiosis, including the role of recombination models.

## GROUP - C

3. Answer any eight of the following within 75 words each. [2 × 8

(a) Explain the significance of two-factor and three-factor crosses in genetics.

(b) Analyze the concept of interference and coincidence in genetic recombination.

(c) Analyze the purpose and applications of somatic cell hybridization in genetics research.

(d) Explain the CLB method for detecting mutations.

(e) Analyze the attached X method for detecting mutations.

(f) Analyze the criteria used to identify extrachromosomal inheritance in genetic traits.

(g) Analyze the genetic basis of antibiotic resistance in Chlamydomonas.

(h) Explain how mitochondrial mutations occur in Saccharomyces.

(i) Analyze the cocept of infective heredity in Paramecium.

(j) Analyze the genetic concept of maternal effects.

## GROUP - D

4. Answer any four of the following within 500 words each. [6 × 4

(a) Explain polygenic inheritance with suitable examples. How does the cumulative effect of multiple genes contribute to the observed range of phenotypes for a particular trait ?

(b) Define recombination frequency as a measure of linkage intensity. How is recombination frequency calculated and what does it indicate about the physical distance between genes on a chromosome ?





(c) Describe the classification of gene mutations. Provide examples for different types of gene mutations, such as point mutations, insertions and deletions.

(d) Explain the classification of chromosomal aberrations and provide figures for each type.

(e) Explain the criteria for extrachromosomal inheritance. Provide examples of antibiotic resitance in Chlamydomonas and maternal effects.

(f) Describe the processes of conjugation, transformation and transduction in bacterial recombination. How do these mechanisms enable genetic exchange between bacterial cells ?

(g) Define transposons and their role as 'jumping genes'. Provide examples of Ac-Ds elements in maize and P elements in Drosophila.