43942

# BRAINWARE UNIVERSITY



**Term End Examination 2025-2026**
**Programme – B.Tech.(BT)-2024**
**Course Name – Genetics**
**Course Code - BTB40112**
**( Semester IV )**

**Full Marks : 60** **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

## Group-A

(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Which of the following illustrates an example of allelic interaction?
a) Epistasis b) Complementary gene action
c) Polygenic inheritance d) Incomplete dominance

(ii) Identify the pattern of inheritance suggested by a 1:2:1 phenotypic ratio in the $F_2$ generation.
a) Co-dominance b) Complete dominance
c) Epistasis d) Complementary gene interaction

(iii) Predict the genotype that expresses the co-dominant phenotype in the heterozygous offspring of a cross between red-flowered (RR) and white-flowered (WW) plants.
a) RR b) WW
c) RW d) Rr

(iv) Select which type of selection favors extreme phenotypes.
a) Stabilizing selection b) Directional selection
c) Disruptive selection d) Artificial selection

(v) Identify the main cause of genetic variation.
a) Natural selection b) Mutation and recombination
c) Adaptation d) Competition

(vi) Name the term for loss of genetic variation due to sudden reduction in population size.
a) Founder effect b) Bottleneck effect
c) Mutation d) Selection

(vii) Interpret the role of histone H1 in chromosomal structure.
a) It forms the nucleosome core b) It stabilizes linker DNA between nucleosomes
c) It acetylates histone tails d) It replaces histone H3 during replication

(viii) Explain the role of C-banding in chromosome identification.
a) It stains euchromatic regions b) It highlights constitutive heterochromatin
c) It reveals gene-rich areas d) It stains entire chromosome length uniformly

(ix) Summarize the effect of a frameshift mutation on a gene.
a) It changes one amino acid only b) It has no effect on protein structure

c) It affects only intronic regions
d) It alters the reading frame of codons

(x) Tell the genetic basis of Klinefelter syndrome.

a) Presence of a single X chromosome
b) Loss of Y chromosome
c) Presence of three X chromosomes in females
d) Presence of an extra X chromosome in males

(xi) Apply the concept of linkage to predict the inheritance pattern of two genes located close together on the same chromosome.

a) They assort independently
b) They show complete linkage
c) They segregate randomly
d) They follow cytoplasmic inheritance

(xii) Illustrate the effect of crossing over on linked genes during meiosis.

a) It increases parental combinations only
b) It reduces genetic variation
c) It produces recombinant combinations
d) It prevents segregation

(xiii) Examine the role of synaptonemal complex in crossing over.

a) Prevents chromatid exchange
b) Maintains homologous chromosome pairing
c) Causes chromosome duplication
d) Separates sister chromatids

(xiv) Interpret a pedigree in which an affected mother transmits the disorder to all her children, but affected fathers transmit it to none.

a) Autosomal dominant inheritance
b) X-linked recessive inheritance
c) Mitochondrial inheritance
d) Y-linked inheritance

(xv) Apply pedigree analysis to identify a key feature of multifactorial inheritance.

a) Equal frequency in both sexes in every generation
b) Trait determined by a single gene
c) Increased risk with number of affected relatives
d) Male-to-male transmission is mandatory

## Group-B

(Short Answer Type Questions) 3 x 5=15

2. Write a short note on peripatric and parapatric speciation. (3)
3. Illustrate an X-linked recessive pedigree using its characteristic transmission pattern. (3)
4. Illustrate and explain the role of microRNAs in gene regulation. (3)
5. Indicate the difference between autosomal and sex chromosome aneuploidy. (3)
6. Measure the allele frequencies of the population.In a population of flowers, 16% are red (RR), 48% are pink (Rr), and the rest are white (rr). (3)

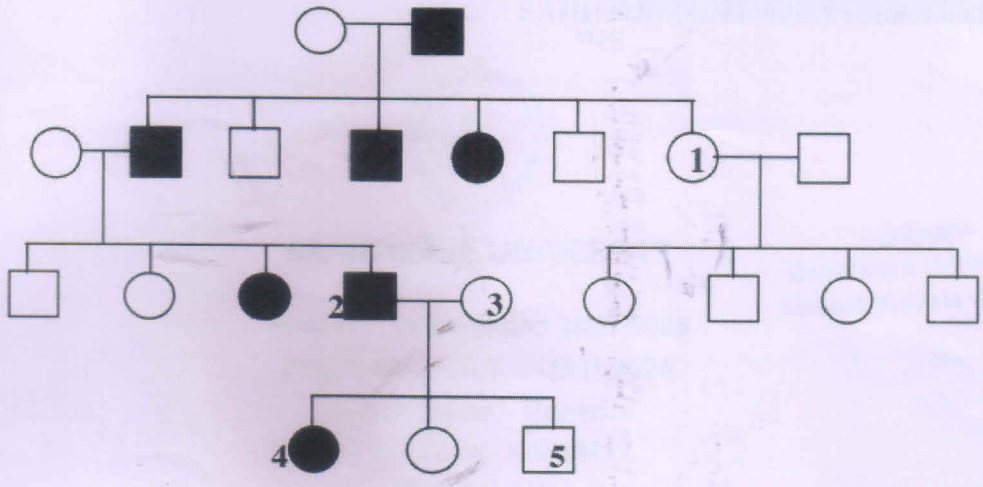
**OR**

Measure the frequency of heterozygotes, if the incidence of phenylketonuria (PKU) is 1 in 10,000 live births and it follows a recessive pattern. (3)

## Group-C

(Long Answer Type Questions) 5 x 6=30

7. Describe the principle of chromosome banding techniques. (5)
8. Analyze the significance of Cot curve analysis in resolving the C-value paradox. (5)
9. Discriminate Turner syndrome and Klinefelter syndrome on the basis of chromosomal constitution and phenotype. (5)
10. Describe the types of natural selection: directional, stabilizing, and disruptive, with examples. (5)
11. Develop a linkage map showing the gene order and the distance between the genes, where a plant heterozygous for three gene pairs CShWx/CShWx was crossed to cshwx/cshwx and the progenies obtained were classified as follows: CShWx – 1200, cshwx – 1160, CshWx – 50, cShwx – 55, CShwx – 82, cshWx – 84, Cshwx – 5, cShWx – 7 (5)
12. Compute the following human pedigrees, the filled symbols represent the affected individuals. You may assume that the disease allele is rare and therefore individuals marrying into the family are unlikely to have defective allele. (5)




i) What is the most likely mode of inheritance for this pedigree?

ii) State the genotypes of individuals from 1 to 5.

iii) If individuals 2 and 3 have another son what are the chances that this son will be affected?

**OR**

Propose a pedigree-based strategy to identify carrier females in X-linked recessive disorders. (5)

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