

UNIVERSITY EXAMINATIONS

FIRST SEMESTER 2025/2026 ACADEMIC YEAR

**FIRST YEAR EXAMINATION FOR THE DEGREES OF
BACHELOR OF SCIENCE (GENERAL) AND BACHELOR
OF EDUCATION (SCIENCE)**

BOT/BOTA 113: GENERAL GENETICS

STREAM: R

TIME: 2 HRS

DAY: MONDAY [11.30 – 13.30 P.M]

DATE: 02/02/2026

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

Answer all questions in section A and any two in section B**SECTION A: (40 MARKS)**

- (i) A gene is best defined as: **(1 Mark)**
- a) A segment of DNA that codes for a protein
 - b) A structure that carries histones
 - c) A pair of homologous chromosomes
 - d) An enzyme involved in replication
- (ii) During DNA replication, the enzyme responsible for unwinding the double helix is: **(1 Mark)**
- a) DNA polymerase
 - b) Ligase
 - c) Helicase
 - d) Primase
- (iii) A heterozygous tall plant (Tt) is crossed with a homozygous recessive (tt). The expected ratio of tall to short offspring is: **(1 Mark)**
- a) 3:1
 - b) 1:1
 - c) 2:1
 - d) 4:0
- (iv) The XY sex-determination system is found in: **(1 Mark)**
- a) Birds
 - b) Mammals
 - c) Bees
 - d) Some reptiles only
- (v) A silent mutation is one that: **(1 Mark)**
- a) Changes the amino acid sequence drastically
 - b) Changes a codon but not the amino acid
 - c) Always leads to disease
 - d) Causes a frameshift

(vi) Crossing over occurs during:

(1 Mark)

- a) Mitosis metaphase
- b) Meiosis II
- c) Meiosis I (prophase I)
- d) DNA replication

(vii) A recombination frequency of 10% between two genes indicates they are:

(1 Mark)

- a) 1 map unit apart
- b) 5 map units apart
- c) 10 map units apart
- d) Unlinked

(viii) The Hardy–Weinberg equation assumes all of the following except:

(1 Mark)

- a) Random mating
- b) No mutation
- c) Large population
- d) High migration rate

(ix) A frameshift mutation is caused by:

(1 Mark)

- a) Substitution
- b) Deletion or insertion not in multiples of three
- c) Silent mutation
- d) Inversion

(x) Chromosomal mutations include all except:

(1 Mark)

- a) Translocations
- b) Inversions
- c) Point mutations
- d) Duplications

QUESTION TWO

Describe the **five** major steps in DNA replication.

(5 Marks)

QUESTION THREE

Work out a cross between **two** heterozygous pea plants ($Yy \times Yy$), and state the genotypic and phenotypic ratios.

(5 Marks)**QUESTION FOUR**

Give **four** differences between mitosis and meiosis.

(4 Marks)**QUESTION FIVE**

a) Briefly describe the **four** types of chromosomes based on the centromere position on the chromosome.

(4 Marks)

b) List any **four** substances or mutagens that can affect the genetic material in a cell.

(2 Marks)**QUESTION SIX**

If you observed 68 yellow and 32 green in a real population of 100, perform a chi-square test to determine if the results deviate significantly from the expected ratio.

(10 Marks)**SECTION B (30 MARKS)****QUESTION SEVEN**

a) Define allele frequency and genotype frequency.

(4 Marks)

b) Explain genetic drift and give an example.

(3 Marks)

c) A population contains 60% A alleles and 40% a alleles.

i. Calculate expected genotype frequencies under Hardy–Weinberg equilibrium.

(4 Marks)

ii. Explain what conditions could disturb these frequencies.

(4 Marks)

QUESTION EIGHT

- a) Differentiate between gene mutations and chromosomal mutations (2 Marks)
- b) Describe the following gene mutations: silent, missense and nonsense (3 Marks)
- c) Using illustrations, describe the various types of structural chromosomal aberrations (10 Marks)

QUESTION NINE

- (a) Perform a dihybrid cross from the P to the F₂ generations in which the two traits show complete dominance. Show gamete types where necessary and in the F₂ summarize your results under columns: Genotypes, genotypic ratios, phenotype and phenotypic ratios. Use your own example with appropriate symbols which must be defined at the start. (9 Marks)
- (b) A plant heterozygous for the independent assorting genes (Aa Bb Cc Dd) is self-pollinated. Determine the expected frequency of the following genotype in the progeny:
- i. aabbccdd
 - ii. aabbCcDd
 - iii. AaBbCcDd
- (6 Marks)