The Open University of Sri Lanka
Faculty of Natural Sciences
B.Sc/ B. Ed Degree Programme

Department	: Botany
Level	: Level 4
Name of the Examination	: Final Examination
Course Title and Code	: Genetics and Evolution BYU4301/BYE4301
Academic Year	: 2024/2025
Date	: 11.12.2024
Time	: 1.30 to 3.30 pm
Duration	: 2 hrs

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **six (06)** questions in **four (04)** pages.
3. Answer any **four (04)** questions **selecting at least one (01) from each part.** All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. Draw fully labelled diagrams where necessary
6. Involvement in any activity that is considered as an exam offense will lead to punishment
7. Use blue or black ink to answer the questions.
8. Clearly state your index number in your answer script

Answers to the questions in Part A and Part B should be written in separate answer books

PART A

1. A) Sex-linked genes are located on a sex chromosome.

   i) In humans, X-linked recessive traits are more prevalent among males than females. Explain your answer. (25 marks)

   ii) Give a comparison of sex-linked, sex-limited, and sex-influenced traits. (30 marks)

   B) In *Drosophila* white eye is an X-linked recessive trait, and ebony body is an autosomal recessive trait. A homozygous, white-eyed female homozygous for body colour is crossed with homozygous ebony male with white eyes.

   i) What phenotypic ratios do you expect in the F_1 generation? (15 marks)

   ii) What phenotypic ratios do you expect in the F_2 generation? (15 marks)

   iii) If the initial cross was reversed: ebony female x white-eyed male, what phenotypic ratio do you expect in the F_2 generation? (15 marks)

2.

   A) Cell division is the process by which new cells are formed for growth, repair, and replacement in the body. The three unique types of cell divisions are Mitosis, Meiosis and Binary fission.

   i) How are Mendel's rules of segregation and independent assortment related to mitosis and meiosis? (15 marks)

   ii) Describe the behavior of chromosomes in the phases of meiosis. (15 marks)

   iii) Outline how the process of meiosis can lead to Down's syndrome. (20 marks)

   B) The function of chromosomes is to carry the basic genetic material – DNA, which provides genetic information for various cellular functions. These functions are essential for growth, survival, and reproduction of organisms.

i) Distinguish between

a) chromosomes and chromatids. (10 marks)

b) sister and non-sister chromatids. (10 marks)

c) homologous and nonhomologous chromosomes. (10 marks)

ii) A hypothetical organism has six chromosomes (2n = 6).
How many different combinations of maternal and paternal chromosomes can appear in the gametes? (20 marks)

3.

A) Epistasis is the functional interaction between different genes (non-alleles).

i) Explain the difference between dominance and epistasis. (10 marks)

ii) Why did none of the pairs of genes studied by Mendel show epistasis? (10 marks)

iii) Two independently assorting genes determine the petal colour in a plant species. When a homozygous strain of a red-petal flower plant was crossed with a homozygous strain of white-petal flower plant, the F_1 progeny had only purple flowers.
Selfing the F_1 produced an F_2 progeny plants are obtained as follows.

Purple flowers	85
Red flowers	30
White flowers	35

a) What phenotypic ratio is approximated by the F_2? (15 marks)

b) What kind of interaction is present between the expression of the two genes determining the petal colour? (15 marks)

B) Heritability of a trait is a measure of its genetic variation.

i) Explain the advantage of estimating the heritability value of a trait of interest when breeding a new crop variety. (15 marks)

ii) What is the relationship between heritability of a trait and the environment? (15 marks)

iii) Two homozygous tomato varieties (T1 and T2) were crossed to produce F_1 hybrids. The average phenotypic variance in yield of the three populations P_1, P_2 and F_1, was 12.20. The variance of F_2 was 22.20.
Calculate the heritability of yield in the F_2 population. (20 marks)

PART B

4.

a. What is meant by evolution of organisms? (05 marks)

b. Briefly describe the differences between macroevolution and micro evolution. (10 marks)

c. Giving suitable examples discuss the evidence for macroevolution. (85 marks)

5.

a. Define a species according to Biological species concept. (05 marks)

b. Distinguish between gene pool and gene flow of a population. (15 marks)

c. With reference to suitable examples, explain how reproductive isolating mechanisms restrict gene flow between closely related species (80 marks)

6. Write short notes on any three of the following

a. Evolution of mammals

b. Hardy Weinberg law

c. Neanderthal Man

d. Origin of earth

e. Evolutionary links (each 33 marks)