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University of Ruhuna Faculty of Technology
Bachelor of Biosystems Technology Honours Degree
Level 1 (Semester II) Examination, November/December 2025
Academic year 2023/2024

Course Unit: BST1251 Fundamentals of Genetics (Theory)- Repeat Duration: 1.5 hours

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Directions to Candidates

- Answer **ONLY THREE (03)** questions.
- Use a given booklet for answering the questions.
- Begin each answer on a new page

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1. Genes, alleles, and inheritance patterns play a crucial role in determining how organisms appear and function.
 - a) Define the terms "allele" and "incomplete dominance." **(10 marks)**
 - b) Write down the Mendel's Law of Segregation. **(20 marks)**
 - c) Illustrate a cross between two snapdragon plants with incomplete dominance for flower color (red, white, and pink), including the genotypic and phenotypic ratios of the offspring. **(30 marks)**
 - d) Illustrate with a Punnett square of a dihybrid cross between two pea plants heterozygous for plant height (tall vs. dwarf) and seed color (yellow vs. green), showing the expected genotypic and phenotypic ratios of the offspring **(40 marks)**

2. Apply your understanding of mutations and genetic disorders to answer the following questions.
- a) What is gene mutation? Mention **one (01)** cause of gene mutations. **(10 marks)**
- b) State the difference between Mendelian and non-Mendelian disorders. **(20 marks)**
- c) Briefly describe the autosomal recessive disorders and give **one (01)** example **(30 marks)**
- d) Briefly describe the following topics. **(40 marks)**

- i. Karyotype
- ii. Down Syndrome

3. The expression of traits in living organisms is controlled by genes but is also strongly influenced by mutations and environmental factors.
- a) Define gene, genotype, and phenotype, and give **one (01)** example for each term. **(30 marks)**
- b) The table below shows grain yield (t ha^{-1}) of three rice varieties tested in two environments.

Variety	Environment 1	Environment 2
V1	4.0	4.2
V2	3.5	5.0
V3	4.3	4.1

- i) From this data, identify the most stable variety across environments by giving reasons. **(20 marks)**
 - ii) Which variety shows the strongest $G \times E$ interaction? Explain briefly. **(20 marks)**
- c) Briefly Explain why understanding $G \times E$ interaction is important in plant breeding and variety recommendation. **(30 marks)**

4. During meiosis, crossing over and genetic linkage play an important role in producing variation and in mapping genes on chromosomes.

a) What is crossing over? Explain during which stage of meiosis it occurs, and describe why it is important in inheritance. **(30 marks)**

b) Briefly explain how the offspring ratios in a test cross differ for,

i) linked genes

ii) genes that assort independently. **(30 marks)**

c) In a cross between two genes A and B, the total offspring are counted as follows:

Parental types = 820

Recombinant types = 180

i) Calculate the recombination frequency between A and B. **(15 marks)**

ii) Express this distance in map units / centimorgans (cM). **(15 marks)**

iii) Explain whether the genes are tightly linked or loosely linked, and give a reason for your answer. **(10 marks)**