JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNIVERSITY EXAMINATIONS

RESITS FOR THE 2019/2020 ACADEMIC YEAR

RESIT EXAMINATION FOR SECOND YEAR SECOND SEMESTER THE DEGREE OF BACHELOR OF SCIENCE (BIOLOGICAL SCIENCES)

COURSE CODE: SB1 3226 / SZL 408

COURSE TITLE: Population Genetics

DATE **TIME**

DURATION: 2 HOURS

INSTRUCTIONS:

1. **This paper contains two sections (A and B)**
2. **Answer ALL questions in Section A and any Two (2) questions in Section B**
3. **Write ALL answers in the booklet provided**
4. **You may use illustrations in your answers as you deem necessary**

SECTION A: ANSWER ALL QUESTIONS (30 MARKS)

1. Define the following terms: (3 marks)
   a. Genetic locus
   b. Gene pool
   c. Allele
2. Outline assumptions of the Hardy-Weinberg law (3 marks)
3. In a population that has been mating randomly for many generations, two phenotypes are segregating; one is due to a dominant allele *G*, the other to a recessive allele *g*. The frequencies of the dominant and recessive phenotypes are 0.7975 and 0.2025, respectively.
   a. Estimate the frequencies of the dominant and recessive alleles. (1.5 marks)
   b. Estimate the frequency f the heterozygous genotype. (1.5 marks)
4. The A–B–O blood types are determined by three alleles *IA*, *IB*, and *i*. Use a table to summarize the blood types, the genotypes coding for each type and their respective allelic frequencies. (3 marks)
5. Explain why the heterozygote frequency does not exceed 0.5 in any population. (3 marks)
6. Suppose that the alleles of the *T* gene are selectively neutral. In a population of 50 individuals, currently, 34 are heterozygotes. Predict the frequency of heterozygotes in this population 10 generations in the future. Assume that the population size is constant and that mating is completely random.
7.
   a. Define inbreeding coefficient (1 mark)
   b. Explain how inbreeding affects genotypic frequencies (2 marks)
8. Describe the patterns of geographic variation among populations (3 marks)
9. Distinguish between gametic and zygotic selection mechanisms. (3 marks)
10. Explain why the observed phenotypic frequencies of sex-linked traits vary between males and females.

SECTION B: ANSWER ANY TWO QUESTIONS (40 MARKS)

11.
   a. Derive the formulae for calculating allelic frequencies based on the number of genotypes for a locus with three alleles (6 marks)
   b. Alcohol is a common substance in rotting fruit, where fruit fly larvae grow and develop; larvae use the enzyme alcohol dehydrogenase (ADH) to detoxify the effects of this alcohol. In some fruitfly populations, two alleles are present at the locus than encodes ADH: *ADH*F, which encodes a form of the enzyme that migrates rapidly (fast) on an electrophoretic gel; and *ADH*S, which encodes a form of the enzyme that migrates slowly on an electrophoretic gel. Female fruit flies with different *ADH* genotypes produce the following numbers of offspring when alcohol is present:

Genotype	**Mean number of offspring**
$ADH^{F}ADH^{F}$	120

$ADH^{F}ADH^{S}$	60
$ADH^{S}ADH^{S}$	30

i. Calculate the relative fitnesses of females having these genotypes. (6 marks)

ii. If a population of fruit flies has an initial frequency of ADH^{F} equal to 0.2, what will be the frequency in the next generation when alcohol is present? (8 marks)

12. Discuss the factors that alter allelic frequencies in a population. (3 marks)

13.

a. Explain the tenets of ecological genetics (4 marks)

b. Discuss the key stages of plant invasions citing the adaptive evolutionary processes that operate in each stage. (12 marks)

c. Describe an example of an invasive plant species in Kenya. (4 marks)

14. In an isolated population, the number of people with the A, B and O blood groups are, 2382, 3968, and 9252 respectively. If the genotypes of the A–B–O blood type gene are in Hardy–Weinberg proportions, calculate genotypic frequencies for all the possible genotypes? (20 marks)