TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MOLECULAR BIOLOGY AND FORENSIC TECHNOLOGY

AFR 4402: FORENSIC MOLECULAR BIOLOGY EXAM I

END OF SEMESTER EXAMINATION

SERIES: DEC 2024

TIME: 2 HOURS

DATE: Pick Date DEC 2024

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question ONE

a) Describe the anatomy of a gene (4 Marks)

b) Highlight the properties of ideal molecular marker to be used in forensics (6 Marks)

c) Describe the basis of DNA profiling (4 Marks)

d) Describe the steps in DNA sample processing for forensic investigation (6 Marks)

e) Describe the hierarchy of gene organization (6 Marks)

f) Explain the applications of DNA in forensics (4 Marks)

Question TWO

a) Describe the history of human genome project (3 Marks)

b) Explain the benefits of human genome project (10 Marks)

c) Describe the differences between nuclear genome and mitochondrial genome in human (7 Marks)

Question THREE

a) In an experiment, *Escherichia coli* cells were grown for many generations in a medium in which the only available source of nitrogen was heavy isotope ^{15}N. They were then transferred to a medium containing light isotope 14N as the only source of nitrogen. What was the distribution of ^{15}N and ^{14}N in the DNA of the *Escherichia coli* that were grown for one generation, two generations and three generations in the ^{14}N containing medium assuming that the DNA replication was to be conservative, semiconservative and dispersive (10 Marks)

b) Three babies were mixed up in a hospital. In establishing their maternity and paternity, blood typing was performed for both the three parents and babies and the results were presented in the table below

Couple #	I	II	III
Blood group	A and A	A and B	B and O
Babe #	1	2	3
Blood group	B	O	AB

i) Describe the principle of blood typing in determining the identity of the three mixed babies (2 Marks)

ii) After consideration of the data in the table above, match the correct baby with their parents (3 Marks)

iii) In the two couples, both women had blood group A and the babies were one girl with blood group O rhesus factor (Rh) positive and two sons with blood group B rhesus factor negative (Rh). Rhesus factor positive is a simple dorminant trait over rhesus factor negative. Using symbols AA, BB, AB, RR, Rr and rr to represent the genotypes and A, B, AB and O to represent the phenotypes, what is the possible genotypes and phenotypes of the sons, mothers and fathers in terms of rhesus factors (Rh) and blood groups? (5 Marks)

Question FOUR

A family of a certain couple composed of seven children, two son and five daughters had a conflict regarding the sons' paternity status. They consulted a genetic counsellor who advised them to established the paternity of the sons using Y-STR loci which was preferential chosen by the family instead of mtDNA loci

(a) Explain the reason why the family did not choose mtDNA in establishment of the paternity of the two sons (2 Marks)

a) Explain why Y-STR testing was chosen in paternity testing by the family (2 Marks)

b) Explain why Y-STR testing was helpful in the analysis of paternity within the family (2 Marks)

c) Highlight the advantages of Y-STR loci in forensic DNA testing (9 Marks)

d) State the limitations of Y-STR testing in analysis of paternity (5 Marks)

Question FIVE

(a) Outline the applications of DNA in forensics (3 Marks)

(b) Describe DNA reporting terminologies that are used in forensic DNA testing (17 Marks)