MACHAKOS UNIVERSITY

University Examinations for 2024/2025 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES
DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR FIRST SEMESTER EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE IN AGRICULTURAL EDUCATION AND EXTENSION

KCU 101: FUNDAMENTALS OF MATHEMATICS

DATE: 20TH JANUARY, 2025 **TIME: 8.30 AM – 10.30 AM**

INSTRUCTIONS:
*Answer question **ONE (Compulsory)** and **any other TWO** questions*

QUESTION ONE (30 MARKS)

a) Find the values of y which satisfy the inequality, $2y-16 \geq 17y+5$ (2 marks)

b) Evaluate;

i) $\int_0^1 (9x-5)^6 \, dx$ (3 marks)

ii) $\frac{d}{dx}(2\cos 4x)$ (2 marks)

c) Resolve the partial fraction $\frac{4(x-4)}{x^2-2x-3}$ (3 marks)

d) Solve the equation $2x^2 - x^2 + 3x - 54 = 0$ (3 marks)

e) Transpose the formula $\frac{p}{q} = \sqrt{\frac{a+2b}{a-2b}}$ to make p the subject of the formula (5 marks)

f) If $x = \log_9 5$ and $y = \log_3 5$ find y in terms of x (5 marks)

g) Find the function of which the following is the derived function

$$\frac{2}{x} + \frac{5}{x^3} - \frac{7}{x^4}$$ (4 marks)

h) A bag contains 5 red balls, 6 blue balls and 4 black balls. Three balls are drawn in turn from the bag without replacement. Find the probability of drawing a red ball, blue and a black call in that order. (3 marks)

QUESTION TWO (20 MARKS)

a) The demand for farm tools in a given store is, on average, five times a day and the demand Follows the Poisson distribution. How many of these tools should be kept in the store so that the probability of there being an available tool is greater than 10 %. (5 marks)

Body weight (kg)	30-40	40-50	50-60	60-70	70-80
No. of lambs	12	26	34	20	8

b) The following shows the distribution of body weights of lambs at the first lactations.

Determine;

i) Arithmetic Mean (3 marks)
ii) Geometric Mean (3 marks)
iii) Harmonic Mean (3 marks)
iv) Standard deviation (4 marks)
v) Coefficient of variation (2 marks)

QUESTION THREE (20 MARKS)

a) Evaluate the following integrals;
   i) $\int \frac{x^2+7x+10}{x+5}dx$ (5 marks)
   ii) $\int e^{3x-2}dx$ (5 marks)
b) Differentiate the following;
   i) x^2e^{2x} (6 marks)
   ii) $(2x-1)^2$ (4 marks)

QUESTION FOUR (20 MARKS)

a) Among 60 students in a class, 26 got A in CAT 1 and 21 got an A in CAT 2. If 17 students did not get an A in either CAT, how many students got A in both examination? (5 marks)
b) Given the conditional proposition $p \rightarrow q$, use truth table to determine which of $q \rightarrow p$, $\sim p \rightarrow \sim q$ and $\sim q \rightarrow \sim p$ is logically equivalent to $p \rightarrow q$ (5 marks)
c) Let $U = \{1,2,3,4,5,6,7,8,9\}$, $A = \{1,2,3,4\}$, $B = \{2,4,5,7\}$ and $C = \{3,4,5,6\}$. Find;
   i. $(A \cap C)^c$ (2 marks)
   ii. $(A \cap B)^c$ (2 marks)
   iii. $(A \cup C)^c$ (2 marks)
   iv. $(B - C)^c$ (2 marks)

v. $A \cup B \cup C$ (2 marks)

QUESTION FIVE (20 MARKS)

a) Given the matrix $B = \begin{bmatrix} 1 & 1 & 1 \\ 2 & -3 & 2 \\ -4 & 2 & 1 \end{bmatrix}$, use cofactor method to compute B^{-1}, the inverse of B and hence determine the solution of the system,

$$\begin{aligned} x + y + z &= 12 \\ 2x - 3y + 2z &= 4 \\ -4x + 2y + z &= 1 \end{aligned}$$ (8 marks)

b) The velocity of a moving point changes according to the equation $v = \left(3t^2 + 2t + 1\right) m/s$. Find the path covered by the point during ten seconds from the start. (4 marks)

c) The probability of a component failing in one year due to excessive temperature is $\frac{1}{20}$, due to excessive vibration is $\frac{1}{25}$ and due to excessive humidity is $\frac{1}{50}$. Determine the probabilities that during one –year period a component:

i) Fails due to excessive vibration
ii) Fails due to excessive vibration or excessive humidity, and
iii) Will not fail because of both excessive temperature and excessive humidity

(6 marks)

d) Express $-3 < 1 - 2x \leq 3$ (2 marks)