

LAIKIPIA



UNIVERSITY

UNIVERSITY EXAMINATIONS

FIRST SEMESTER 2025/2026 ACADEMIC YEAR

SECOND YEAR EXAMINATION FOR THE DEGREE
OF SCIENCE IN ECONOMICS & STATISTICS

ECON 214: MATHEMATICS FOR ECONOMIST III

STREAM: *BSC, ECON STAT*

TIME: *2 HRS*

DAY: *TUESDAY [8.30 A.M-10.30 A.M]* **DATE:** *03/02/2026*

THIS QUESTION PAPER CONSISTS OF THREE (3) PAGES

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INSTRUCTIONS:

Answer question ONE and any other TWO QUESTIONS

QUESTION ONE (COMPULSARY) (30 MARKS)

a) Determine the order and degree of the following differential equations

i) $\frac{dy}{dt} + 5t^2 = 12$ (2 Marks)

ii) $\left(\frac{d^2 y}{dt^2}\right)^3 - 6\left(\frac{dy}{dt}\right)^2 + xy$ (2 Marks)

b) Discuss the two subdivisions of integration (5 marks)

c) Compute the integral of the following

i) $\int 2x \ln x$ (6 Marks)

ii) Given that the marginal propensity to consume

$$MPC = 0.15 + \frac{0.2}{\sqrt{Y}}$$

Where Y denotes income. Find the consumption function C and savings function S if consumption is 135 units when Y = 100 money units. (6 Marks)

d) If the marginal revenue function $MR = 15 - 6Q$, determine;

i) The total revenue function TR. (3 marks)

ii) The demand function. (3 marks)

e) Determine the following integral, using the substitution method.

$$\int \frac{6x^2 + 4x + 10}{(x^3 + x^2 + 5x)^3} dx$$
 (3 marks)

QUESTION TWO

a) Solve the following system of equations using the Gaussian elimination method: (8 Marks)

$$4X_1 + 2X_2 + 6X_3 = 50$$

$$8X_1 + 10X_2 + 2X_3 = 74$$

$$6X_1 + 2X_2 + 4X_3 = 46$$

b) The utility function for a student consuming two commodities is given as:

$$U = X_1^2 + X_1X_2 + 3X_3^2$$

The price of X_1 is 7 units and the price of X_2 is 20 units.

i) Determine the quantity of X_1 and X_2 that will maximize utility, and the maximum utility? **(4 marks)**

ii) Verify that the level of utility is indeed maximum? **(2 Marks)**

c) Test the existence of functional dependence between the following paired function;

(i) $Y_1 = 2X_1 + 6X_2$ and $Y_2 = 2X_1^2 + 12X_1X_2 + 18X_2^2$ **(3 marks)**

(ii) $Y_1 = e^{2X_1+3X_2}$ and $Y_2 = 4X_1^2 + 9X_2^2 - 12X_1X_2$ **(3 marks)**

QUESTION THREE

a) Find producers surplus and consumer surplus given the following functions and equilibrium prices (8 marks)

i) $P = 3 + Q^2; P_e = 19$ **(4 Marks)**

ii) $P = 50 - 0.5Q; P_e = 30$ **(4 Marks)**

b) Find the second order total differentials for the following functions

$Z = f(x, y) = x^2y^2$ **(6 marks)**

$Z = f(x, y) = x^3y^3$ **(6 marks)**

QUESTION FOUR

a) Solve for the following:

(i) $dy/dt + 7y = 20$ given $y(0) = 20$ **(3 marks)**

(ii) $y_{t+1} + 5y_t = 25$ given $y(0) = 20$ **(3 marks)**

b) A bank customer borrows Kshs. 15,000. Interest is 9.6% per annum on the outstanding balance. The customer can afford to repay at most Kshs. 400 each month.

i) How long will it take to repay the loan? **(4 marks)**

ii) How much does the customer owe after 1 year? **(4 marks)**

- iii) A car manufacturer's supply and demand functions at time t for a particular car model are

$$Q_{S,t} = 3P_{t-1} - 12$$

$$Q_{D,t} = -4P_t + 28$$

Show that over time, the car's price will converge and give the equilibrium value.

(6 marks)

QUESTION FIVE

- a) A company's marginal cost function is given by $MC = 100 - 2Q + 0.6Q^2$. Calculate the extra cost in increasing production from:
- 5 to 10 units **(3 marks)**
 - 10 to 15 units **(3 marks)**

- b) A model for the population N (in millions) of a certain country over 10 years, from the beginning of the year 2000 until the end of 2010, assumes the population will decrease exponentially and that the rate of decrease is given by;

$$\frac{dN}{dt} = -15e^{-0.5t}$$

where t is the number of years since the beginning of the year 2000.

Required;

- Express N as a function of t , given that at the start of 2000, the population is 100 million. **(4 marks)**
- What will the population be at the end of 2010? **(3 marks)**
- In what year will the population fall to 75 million? **(4 marks)**
- If we assume this model is valid indefinitely, what population is predicted in the long run? **(3 marks)**