KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATION, 2024/2025ACADEMIC YEAR
FIRST YEAR, SECOND SEMESTER EXAMINATION
FOR THE DEGREE OF BACHELOR OF SCIENCE
(BUSINESS ADMINISTRATION)

Date: 9th December, 2024
Time: 11.30am – 10.30am

KBA 2106 - MANAGEMENT MATHEMATICS 11

INSTRUCTIONS TO CANDIDATES

ANSWER **QUESTION ONE (COMPULSORY)** AND **ANY OTHER TWO** QUESTIONS

QUESTION ONE (30 MARKS)

a)   Evaluate the following limits
  i) $\lim_{x \to 3} 2x^3 + 3x^2 + 7$

(2 marks)

  ii) $\lim_{x \to 2} \dfrac{x - 4}{x - 2}$

(3 marks)

b)   The demand and supply functions under perfect competition are $y = 16 - x^2$ and $y = 2x^2 + 4$ respectively. Find the market price, consumer's surplus and producer's surplus. x denotes quantity demanded or supplied, y denotes price.

(5 marks)

c)   Given the matrix $A = \begin{pmatrix} 2 & -3 & 6 \\ 3 & 1 & 2 \\ 2 & 3 & 5 \end{pmatrix}$. Find A^T and hence compute $A^T A$

(3 marks)

d)   Suppose the marginal cost of a product is given by $25 + 30x - 9x^2$ and the fixed cost is known to be 55. Find the total cost and the average cost functions.

(4 marks)

e)   A small-scale manufacturer has production facilities for producing two different products. Each product requires three different operations: grinding, assembling and testing each unit of product I requires 15, 20 and 10 minutes to grind, assembling and test respectively; whereas each unit of product II requires 7.5, 40 and 45 minutes for grinding, assembling and testing. The production run calls for at least 7.5 hours of grinding time, at least 20 hours of assembling time, and at least 15 hours of testing time. If each unit of product I costs 60 dollars and each unit of product II costs 90 dollars to manufacture. Develop a linear program that can be used to determine the number of units for each product the firm should produce in order to minimize the costs of operations.

(4 marks)

f)   Given that $y = x^4 - 5x^3 + 3x^2 + 8$, find the third derivative

(4 marks)

g)   At a certain factory, the marginal cost is $3(x - 4)^2$ dollars per unit when the level of production is x units. By how much will the total manufacturing cost increase if the level of production is raised from 6 units to 10 units?

(5 marks)

QUESTION TWO (20 MARKS)

a)   The cost of 3 sheep and 2 goats is sh. 7200. If 4 sheep and a goat costs sh. 7600. If Mary plans to hold a graduation party, find how much it will cost her to buy 2 goats and a sheep using matrix method.

(5 marks)

b)   A company is manufacturing two types of products A and B. Production is limited to 80 units of product A and 60 units of product B. Production of each of these products require 5 units and 6 units of electronic components respectively. The electronic components are supplied by another manufacturer and the supply is limited to 600 units per day. The company has 160 employees, i.e., the labour supply amounts to 160-man days. The production of 1 unit of product A requires 1 man day of labour and the production of 1 unit of product B requires 2-man days of labour. Each unit of these products is sold at a profit of 50 dollars and 80 dollars respectively. Formulate a linear programming problem and use graphical method to determine the number of units of each product so that the profit is maximum.

(6 marks)

c)   North Rift Transport Company estimates its cost function to be $TC = Q^3 + 5Q^2 + 50$ where Q represents the number of passengers transported each day between Kisii and Nairobi. If in a particular day the company transported 100 passengers, find the company's marginal cost for that particular day.

(4 marks)

d)   In a certain tourist hotel there are 2 major dishes beef and fish. The marketing manager is interested in the eating habits of the customers in this hotel. He discovered that of those who ate beef on a particular day 50% do so the following day while the rest change to fish. Of those who eat fish 45% change to beef. If the eating level as at yesterday was 25% for beef and 75% for fish. Assuming that these conditions satisfy Markov conditions, Determine:-
   i)   Transition Matrix   (2 marks)

   ii)   Eating levels at the equilibrium point   (3 marks)

QUESTION THREE (20 MARKS)

a)   If $A = \begin{pmatrix} 7 & -3 & -3 \\ -1 & 1 & 0 \\ -1 & 0 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{pmatrix}$. Find

   i) $A^T + B$

(3 marks)

   ii)   AB

(4 marks)

b)   Evaluate $\int_1^2 (x^9 + 3x^3 + 9x - 7)\, dx$

(4 marks)

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c) Bidco Company Limited manufactures large-scale units. The marginal cost for the company is estimated at Ksh. $(92 - 2y)$ thousands, where y is the number of units of output per week. The fixed costs are Kshs. 800,000. It is also estimated that the marginal revenue is Kshs. $(112 - 2y)$ thousands.

Required; Estimate:
i)   The equation for total cost   (3 marks)
ii) The equation for total revenue   (3 marks)
iii)   Hence establish the break-even situation for the company.
                                                                                                                      (3 marks)

QUESTION FOUR (20 MARKS)

a) Use the matrix method to solve for x, y and z in the following simultaneous linear equations:
$$x + y + 2z = 9$$
$$2x + 4y - 3z = 1$$
$$3x + 6y - 5z = 0$$ (8 marks)

b) Differentiate the function: $y = \frac{x^2 - 5}{3x + 1}$ using the quotient rule.
                                                                                                                      (4 marks)

c) A company produces two types of pens, say, A and B. Pen A is of superior quality, and pen B is of lower quality. Profits of pens A and B are Ksh. 5 and Ksh. 3 respectively. The raw material required for each pen of type A is twice that of the pen of type B. The supply of raw material is sufficient only for 1000 pens of type B. Pen A requires special clips and 400 such clips are available per day. Pen B also requires a particular type of clip and 700 such clips are available per day. Develop a linear programming problem and solve it graphically
                                                                                                                      (8 marks)

QUESTION FIVE (20 MARKS)

a) Find both the derivatives and the integrals of the following functions with respect to x

i) $y = x^5 + 4x^3 + x^2 + 6$ (2 marks)
ii) $y = \sqrt[8]{x^7}\,(x^3 + x + 3)$ (2 marks)

b) Daystar stores want to enclose a rectangular field with a fence for timber storage. They have 500 feet of fencing material and a building is on one side of the field and so won't need any fencing. Determine the dimensions of the field that will enclose the largest area.
                                                                                                                      (6 marks)

c) Find the fourth derivative of the function $y = 5x^6 + 72x^3 - 26x^2 + 4x$
                                                                                                                      (3 marks)

d) Spark Fresh company produces three products every day. Their total production on a certain day is 45 tons. It is found that the production of the third product exceeds the production of the first product by 8 tons while the total combined production of the firsthand third product is twice that of the second product. Determine the production level of each product using matrix method.
                                                                                                                      (7 marks)