



*(University of Choice)*

**MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY  
(MMUST)**

**UNIVERSITY SPECIAL/SUPPLEMENTARY EXAMINATIONS**

**2021/2022 ACADEMIC YEAR**

**FIRST YEAR EXAMINATIONS**

**FOR THE DEGREE  
OF  
BACHELOR OF EDUCATION ARTS & COMMERCE**

**COURSE CODE:   BCB 102**

**COURSE TITLE:   BUSINESS MATHEMATICS**

**DATE: MONDAY, 25<sup>TH</sup> JULY 2022      TIME: 11:00AM-1:00PM**

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**INSTRUCTIONS TO CANDIDATES**

Answer question **ONE** and any other **TWO** questions

**TIME: 2 HOURS**

MMUST observes **ZERO** tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

### QUESTION ONE (COMPULSORY) (30 MARKS)

- a) The following information is about the raw material requirements to manufacture 3 types of jute bags  $B_1, B_2, B_3$  with 3 qualities of jute  $J_1, J_2, J_3$ . The available raw material is also given determine with these details, how many bags the industry can manufacture (000) units. (8 marks)

Type of jute	Jute bags required			Jute available
	$B_1$	$B_2$	$B_3$	
$J_1$	4	3	5	27
$J_2$	1	6	2	19
$J_3$	3	1	3	15

- b) Total cost of producing  $x$  units in a factory is  $C(x) = 3x^2 + 7x + 12$ . Find the average cost function and marginal cost function and determine AC and MC when  $x = 3$  and 5. (5 marks)
- c) An employee who received fixed annual increments had a final salary of Ksh 9000 p.a. after 10 years. If his total salary was Ksh 65,000 over the 10 years, what was his initial salary? (5 marks)
- d) A firm is considering two separate capital projects with cash flows as follows

Year	0	1	2	3	4	5
Project 1	(80,000)	18,000	20,000	25,000	38,000	45,000
Project 2	(120,000)	30,000	50,000	50,000	50,000	15,000

- i) Using the NPV criterion and a discount rate of 15%, choose the project that is more profitable (5 marks)
- ii) Find the NPVs using a discount rate of 20% and use the results to estimate the IRR for each project. (5 marks)
- iii) Verify that using the IRR criterion, the decision in (i) is reversed and attempt to explain why. (2 marks)

### QUESTION TWO (20 MARKS)

Your company manufactures large scale units. It has been shown that the marginal (or variable) cost, which is the gradient of the total cost curve, is  $(92 - 2x)$  Ksh. thousands, where  $x$  is the number of units of output per annum. The fixed costs are Ksh. 800,000 per annum. It has also been shown that the marginal revenue which is the gradient of the total revenue is  $(112 - 2x)$  Ksh. thousands.

#### Required

- Establish by integration the equation of the total cost curve (3marks)
- Establish by integration the equation of the total revenue curve (3 marks)
- Establish the break even situation for your company (4 marks)
- Determine the number of units of output that would
  - Maximize the total revenue and ( 4 marks)
  - Maximize the total costs, together with the maximum total revenue and total costs (6 marks)

### QUESTION THREE (20 MARKS)

a) A farmer of a large farm of poultry announced that egg production per month follows the equation;

$$w = \frac{3m^3 - m^2}{m^2 + 10}$$

Where  $w$  – Total no of eggs produced per month

$m$  – Amount in kilograms of layers mash feed.

#### Required

Determine the rate of change of  $w$  with respect to  $m$  (i.e. the rate at which the number of eggs per month increase or decrease depending on the rate at which the kilos of layers marsh are increased). (5 marks)

b) The manufacturer of Tamu Soft drinks has been facing stiff competition on its main brand Tamu-cola soda. The management is considering an extensive advertising and rebranding campaign for Tamu-Cola soda. If the current branding remains, the transition matrix of consumer between Tamu-Cola and other brands will be as follows:

		To	
		Tamu-Cola	Others
From	Tamu-Cola	0.85	0.15
	Others	0.25	0.75

The advertising and rebranding campaign is expected to cost Sh.20 million each year. There are 40 million consumers of soft drinks in the market and for each consumer the average profitability is Sh.5 annually.

#### Required:

- The equilibrium state proportion of consumers using Tamu-Cola before the advertising campaign. (5 marks)
- The equilibrium state proportion of consumers using Tamu-Cola after the advertising campaign. (5 marks)
- The expected annual profit increase or decrease after the advertising campaign. Would you recommend the advertising campaign? (5 marks)

### QUESTION FOUR (20 MARKS)

Three clients of safaricom Ltd P, Q and R are direct competitors in the Mpesa business. In the first week of the year P had 300 customers Q had 250 customers and R had 200 customers. During the second week, 60 of the original customers of P transferred to Q and 30 of the original customers of P transferred to R. similarly in the second week 50 of the original customers of Q

transferred to P with no transfers to R and 20 of the original customers of R transferred to P with no transfers to Q.

**Required**

- a) Display in a matrix the pattern of retention and transfers of customers from the first to the second week (4 marks)
- b) Re-express the matrix that you have obtained in part (a) showing the elements as decimal fractions of the original numbers of customers of P, Q and R (2 marks) *Refer to this re expressed matrix as B*
- c) Multiply matrix B by itself to determine the proportions of the original customers that have been retained or transferred to P, Q and R from the second to the third week. (4 marks)
- d) Solve the matrix equation  $(xyz)B = (xyz)$  given that  $x + y + z = 1$  (8 marks)
- e) Interpret the result that you obtain in part (d) in relation to the movement of customers between P, Q and R (2marks)

**QUESTION FIVE (20 MARKS)**

- a) Determine the total demand (X) for the industry 1, 2, 3 given the matrix of technical coefficients (A), Capital and the final demand vector B. (10 marks)

$$A = \begin{matrix} & \begin{matrix} 1 & 2 & 3 \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \end{matrix} & \begin{pmatrix} 0.3 & 0.4 & 0.1 \\ 0.5 & 0.2 & 0.6 \\ 0.1 & 0.3 & 0.1 \end{pmatrix} \end{matrix} \quad B = \begin{pmatrix} 20 \\ 10 \\ 30 \end{pmatrix}$$

- b) Given that  $C=36 + (Q - 8)^2$  where C is the marginal cost of producing Q units and  $R = 100 - 2Q$ , where R is the marginal revenue from selling Q units. You are required to find:
  - i) The profit maximizing output for the firm. (2 marks)
  - ii) Integrate the equation and derive the equations for total cost and total revenue. You may assume that fixed costs and fixed revenue (the constant terms) will be zero. (5 marks)
  - iii) The value of maximum profit. (2 marks)

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