

UGANDAMARTYRS UNIVERSITY  
NKOZI

UNIVERSITY EXAMINATIONS  
SUPPLEMENTARY/SPECIAL EXAMINATIONS

FACULTY OF SCIENCE

DEPARTMENT OF ECONOMICS

Mathematics for Economists  
ECO 2102:

DATE: 6TH AUGUST 2015

TIME: 2:00- 5:00 PM

DURATION: 3HRS

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**Instructions:**

1. Carefully read through ALL the questions before attempting
  2. **ANSWER FOUR (4) Questions ONLY.** (Each question carries equal marks)
  3. No names should be written anywhere on the examination book.
  4. Ensure that your **Reg Number** is indicated on all pages of the examination answer booklet.
  5. Ensure your work is **clear and readable**. Untidy work shall be penalized
  6. Any type of examination Malpractice will lead to automatic disqualification
  7. Do not write anything on the questions paper.
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### QUESTION ONE

- (a) Solve the following system of linear equations using crammers rule

$$2X + Y + Z = 4$$

$$X + Y + 2Z = 4 \quad [10marks]$$

$$4X + 3Y + 4Z = 11$$

- (b) The total cost function of the firm is given by  $TC = 100 + 20Q + 2Q^2$ . Determine the level of output that minimizes the total costs of production [5marks]

- (c) Consider the following reduced-form macroeconomic model:

$$Y = C + I_o + G_o$$

$$C = C_o + b(Y - T) \quad 0 \leq b \leq 1, \quad 0 \leq t \leq 1$$

$$T = tY$$

Find the equilibrium values of the endogenous variables using crammers rule when  $b = 0.75, t = 0.2, C_o = 500, I_o = 400$ , and  $G_o = 600$  [10marks]

### QUESTION TWO

- (a) The demand functions for coffee (subscripted  $x$ ) and tea (subscripted  $y$ ) are inter-connected by the following demand functions:  $Q_x^D = 100 - 15P_x + 2P_y$  and  $Q_y^D = 67 + 3P_x - 3P_y$ . The supply functions for apples andbananas are given by  $Q_x^S = -4 + 25P_x$  and  $Q_y^S = -4 + 7P_y$ .

- (i) State the consumption relationship between the two commodities. (Give a reason for your answer) [5marks]

- (ii) Determine the equilibrium prices ( $\overline{P}_x$  and  $\overline{P}_y$ ) using crammers rule and the respective equilibrium quantities ( $\overline{Q}_x$  and  $\overline{Q}_y$ ) in the market [10marks]

- (b) A whole seller at Nkozi trading center is involved in selling two types of products; Posho (X) and Beans (Y) measured in kilograms. The Profit function of the whole seller is given by

$\pi = 30X - 3X^2 - 2XY + 20Y - 2Y^2 - 10$ . As an expert in mathematics for economists, advise the whole seller on the quantities of Posho and Beans that must be sold in order to maximize profits. Hence determine His maximum profits [10marks]

### QUESTION THREE

- (a) Given the following demand and supply functions:  $Q_d = 128 - 9P$  and  $Q_s = 7P - 32$

Find the equilibrium price and quantity. (8 marks)

- (b) Given that the consumer faces a utility function of the form  $U(X_1, X_2) = x_1x_2$ . Suppose that the consumer's budget constraint is given by  $M = P_1X_1 + P_2X_2$ , find the;

(i) Utility maximizing levels of  $X_1$  and  $X_2$

[10marks]

(ii) Show that the second order condition for utility maximization is satisfied. (7marks)

### QUESTION FOUR

- (a) If the total revenue (TR) and total cost (TC) of the firm are functions of output, show that the firm maximizes profits at a point where  $MC = MR$  [5marks]

- (b) The firm's revenue and cost functions in terms of output are given as  $TR = 600Q - 3Q^2$  and  $TC = 1000 + 100Q + 2Q^2$

(i) Find the output level at which the profits of the firm are maximized [10marks]

(ii) Determine the total revenue and total costs of the firm at the profit maximizing level of output (6marks)

(iii) Compute the profits of the firm at the optimum output level (4 marks)

### QUESTION FIVE

- (a) The Total revenue of a textile firm obtains from selling  $X$  football shirts and  $Y$  cricket jumpers are given by the function  $R(X, Y) = -2X^2 + 6X - 3Y^2 + 6Y + 10XY + 50$ . Find the marginal revenue from selling one extra:

(i) Football shirt when  $X = 4$  and  $Y = 3$  (7marks)

(ii) Cricket jumper when  $X = 4$  and  $Y = 3$  (6marks)

- (b) A laundry firm is involved in the production of two products; Bars of soap ( $X$ ) and Tins of Omo ( $Y$ ). The joint cost function of the firm is in such a way that  $C = 45X^2 + 90XY + 90Y^2$ . Given that the firm has to meet the production quota  $2X + 3Y = 60$ , determine the optimal number of Bars of soap and Tins of Omo that can be produced in order to minimize the production costs. Hence show that the second order condition for cost minimization is satisfied (12 marks)

### **QUESTION SIX**

(a) Discuss the assumptions of the input- Output model (5marks)

(b) Given the following Leontief matrix and final demand vector

$$L = \begin{pmatrix} 0.8 & -0.3 & -0.2 \\ -0.4 & 0.9 & -0.2 \\ -0.1 & -0.3 & 0.8 \end{pmatrix} \quad D = \begin{pmatrix} 10 \\ 5 \\ 6 \end{pmatrix}$$

(i) Obtain the matrix of input coefficients and give the interpretation of the elements in the second column (6marks)

(ii) What happens to the input coefficient matrix if no industry uses its own product as its inputs? (2marks)

(iii) Find the equilibrium output levels for the three industries (7marks)

(iv) Find the total primary input requirements for the three industries (5marks)

**END-GOOD LUCK**