



# MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF ARTS

EES 100: MATHEMATICS FOR ECONOMISTS 1

DATE: 17/6/2021

TIME: 2.00-4.00 PM

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## INSTRUCTIONS:

- (i) Answer question one (Compulsory) and any other two questions
- (ii) Do not write on the question paper
- (iii) Show your workings clearly

## QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Explain the difference between the following terms as used in Economics
  - i. Univariate function and Multivariate function (2 marks)
  - ii. Local maxima and Global maxima (2 marks)
- b) The demand and supply functions for a good are  $P = 50 - 2Q$  and  $P = 14 + 4Q$  respectively. Calculate the equilibrium price and quantity (3 marks)
- c) Analyze the continuity of the following
  - i.  $y = \frac{x^2+3x+6}{x-2}$  at  $x = 3$  Given that  $0 \leq x \leq 6$  (2 marks)
  - ii.  $y = \frac{x^2-4}{x-2}$  at  $x = 2$  Given that  $0 \leq x \leq 4$  (2 marks)
- d) Compute the first derivatives of the following functions and state the rule(s) used in each Problem
  - i.  $y = (17 + x^2 + 3x^4)^8$  (2 marks)
  - ii.  $z = (3y^2 - \frac{1}{y^3})^4(4y^5 + 6)$  (3 marks)

e) Given the following production function:

$$Q = 40K^{0.5} L^{0.75}$$

- i. Compute the MPL and APL and compare their magnitudes (2 marks)
  - ii. Compute the MPK and APK and compare their magnitudes (2 marks)
  - iii. Determine the nature of the Marginal Products (2 marks)
- f) A study of consumers in Machakos University was conducted about their preference for three products: X, Y and Z. The following results were obtained:
- 51 consumers preferred product X
  - 49 consumers preferred product Y
  - 60 consumers preferred product Z
  - 34 consumers were indifferent between product X and Y
  - 32 consumers were indifferent between product Y and Z
  - 34 consumers were indifferent between product X and Z
  - 24 consumers were indifferent between all the three products
  - 3 consumers did not prefer any of the three products

**Required:**

- i. Present the problem in a Venn diagram (2 marks)
- ii. How many consumers were sampled for the study? (2 marks)
- iii. How many preferred product Y and/ or Z? (2 marks)
- iv. How many preferred exactly two products? (2 marks)

## QUESTION TWO (20 MARKS)

a) Given the following Univariate demand function  $Q_a = 425 + 0.75P_b$  where  $Q_a$  is quantity demanded for commodity  $a$  and  $P_b$  is the price of commodity  $b$ . Where  $P_b = 100$

**Required**

- i. Is the demand for good  $a$  elastic, inelastic or of unit elasticity with respect to the price of good  $b$ ? *Prove your answer.* (4 marks)
- ii. Are the two commodities related? Prove your answer. (4 marks)
- iii. What happens to  $Q_a$  if  $P_b$  changes by 10 percent? (2 marks)

b) A firm has the following the following demand function  $Q = 10 - \frac{1}{2}P$

The average variable cost function is given by  $AVC = 20 - 8Q + Q^2$

Further investigations have revealed that the firms fixed cost is 2

Find

- i. The level of output that will maximize the firm's total revenue (3 marks)
- ii. The level of output that will minimize the firm's total costs (3 marks)
- iii. The level of output that will maximize the firm's profits (4 marks)

**QUESTION THREE (20 MARKS)**

- a) A sample space **S** is given as {1,2,3,4,5,6,7,8,9,10}. Three events in this sample space are **A** = {2,4,6,8,10}, **B** = {1,2,3,4,5}, **C** = {4,5,6,8,9}

Find the members of the sets,

- i.  $(A \cap B) \cup C$  (3 marks)
  - ii.  $A \cap (B \cup C)$  (3 marks)
- b) A firm has the following total cost and total revenue functions

$$TC = \frac{1}{3}Q^3 - 9Q^2 + 200Q + 5050 \text{ and } TR = Q(120 - 10Q)$$

Deduce the equations for the following functions (4 marks)

- i. Marginal cost
  - ii. Marginal revenue
  - iii. Average cost
  - iv. Average revenue
- c) Express the following as a single logarithm (4 marks)

$$3\log_7 x + \log_7(x + 1) - 2\log_7(x + 2)$$

- d) Expand the following using the binomial formula (6 marks)
- $$(a + b)^7$$

**QUESTION FOUR (20 MARKS)**

- a) Given the following function

$$y = 3x^3 - 36x^2 + 135x - 13$$

**Required:**

- i. The critical values of x and the stationary values of y (4 marks)
  - ii. Do the critical values of x yield a maximum or minimum (3 marks)
  - iii. Find the value of x at the point of inflexion. (3 marks)
- b) You are given the following information about the commodity and money market of a closed economy without government

***The commodity market***

Consumption function:  $C = 50 + \frac{2}{5}Y$

Investment function:  $I = 790 - 21r$

***The money market***

Precautionary and transactions demand for money;  $Md^T = \frac{1}{6}Y$

Speculative demand for money:  $Md^S = 1200 - 18r$

Money supply:  $M_s = 1250$

Find the equilibrium  $Y$  and  $r$  in the two markets (10 marks)

**QUESTION FIVE (20 MARKS)**

a) Distinguish the following numbers according to whether they are rational or irrational. Where appropriate, state the periodicity of the decimals of the number in question. (6 marks)

i. 3.4178641786417...

ii. 5.1137654028493680

iii. 1.2543125431254

iv. 4.234198462816422

b) The utility function of a consumer is given by:

$$U = Q_1^2 + 5Q_1Q_2 - Q_2^3$$

i. Determine the marginal utility of good 1 and good 2. (4 marks)

ii. Find out if the utility function displays decreasing or increasing marginal utility with respect to  $Q_1$  and  $Q_2$ . (4 marks)

c) Consider a system of two linear simultaneous equations

$$2x - 3y = 8$$

$$3x + 4y = -5$$

Solve for the values of  $x$  and  $y$  using the graphical method (6 marks)