THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

MAY – JULY 2019 TRIMESTER

FACULTY OF COMMERCE

DEPARTMENT OF ACCOUNTING AND FINANCE

SPECIAL / SUPPLEMENTARY EXAMINATION

CMS 121: BUSINESS MATHEMATICS

Date: JULY 2019	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any other TWO Questions	

Q1. a) Describe briefly, with appropriate examples how you can apply the following mathematical tools/techniques in business decision making or analysis:

- **i.** Sets **(2 marks)**
- **ii.** Functions **(2 marks)**
- **iii.** Differential Calculus **(2 marks)**

b) Prior to admitting students to a Bachelor of Commerce degree programme in the Eldoret Campus of Catholic University, the director of the campus analyses the grades they obtained in mathematics, English, and commerce subjects in the Kenya Certificate of Education (KCSE) exam done in high school.
From the list of 250 applicants, the director finds the following:

104 applicants had passed in mathematics.
123 applicants had passed in commerce.
117 applicants had passed in English.
20 applicants had passed in all the three subjects.
28 applicants had passed in mathematics and commerce.
39 applicants had passed in English and commerce
All applicants had passed at least in one subject.

Required:

i. Draw a Venn diagram that aptly captures the above information for all the possible distinct sets **(8 marks)**

ii. If the director decided to admit those students who had passed in mathematics and at least one other subject, how many students did he admit? **(2 marks)**

iii. The students who had passed in one and only one subject were to be offered the option of a bridging course of one year before being admitted into the degree program. What is the total number of students who got the offer? **(2 marks)**

c) i Differentiate (i.e. find $\frac{dy}{dx}$) of the following function: $y = 8\sqrt{x}$.

(2 marks)

ii Using differential calculus techniquedetermine the slope of the curve $y = 16x^{\frac{3}{2}}$ at the point (4, 128). **(3 marks)**

d) Determine the turning point(s) or rest point(s) on the curve of the following function and the nature of the turning point(s) , i.e whether maximum or minimum on the curve of $y = \frac{1}{3}x^3 - x^2 - 8x$ (NB. Differential calculus and/or the concept of the second derivative can be of help) **(6 marks).**

Q2. a) Given that the market (equilibrium) price is K£5 and occurs when 14,000 units of a certain commodity are produced. And given that at a price of £1, no units are manufactured and at a price of £19, no units will be purchased. By determining two sets of points that lie on the linear supply and linear demand functions of this commodity, formulate the supply and demand equations for the commodity.

(10 marks)

b) A major bank offers a credit card which can be used domestically and internationally. Data gathered over time indicate that the collection percentage for credit issued in any month is an exponential function of the time since the credit was issued. Specifically, the function approximating the relationship is:

$$p = f(t) = 0.9\left(1 - e^{-0.09t}\right) \text{ for } t \geq 0$$

Required:

i. Use the exponential function to determine the collection percentage that would be expected after 4 months. **(2 marks)**

ii. What value does p approach when t increases without bound (i.e limitlessly or takes on a very large value)? Demonstrate the approximate value using the exponential function above. **(3 marks)**

c) The following are the revenue and cost functions for a company that manufactures and sells computer compact discs (CDs). x isin millions of CDs and $p(x)$ and $c(x)$ are in millions of shillings.

$$R(x) = 75x - 3x^2$$

$$C(x) = 125 + 16x$$

Required:

Determine the breakeven point(s) of this business **(5 marks)**

Q3. a) Consider a product with the following data:

Price per unit =Shs 250

Variable cost = shs 150

Fixed cost = shs 1,000,000

Required:

i. After how many units of production and sale will profit be realized on this product? i.e the point of sale beyond which the product starts making a profit or the breakeven point. **(4 marks)**

ii. What is the profit that is realized with a sale of 15,000 units? **(1mark)**

iii. What are the sales units required to make a profit of shs 2,000,000? **(2 marks)**

. b) Given that the demand function, $D = f(x)$, is quadratic, i.e takes on the form of $D = ax^2 + bx + c$, where D is quantity demanded at a given price, x, and that three points that lie on the quadratic demand curve are $(D = 5, x = 5{,}000)$, $(D = 20, x = 2{,}000)$, and $(D = 35, x = 800)$. Find the equation of the quadratic demand function $D = ax^2 + bx + c$, by determining the values of the constants a, b and c in the equation. {Hint: formulate a system of linear equations by substituting each of the three points in the functional form $D = ax^2 + bx + c$ and simultaneously solve for the resulting system of 3 linear equations to obtain the constant values of a, b, and c. E.g. taking, for instance, point $(D = 5, x = 5{,}000)$

and inserting in $D = ax^2 + bx + c$, one of the three equations is :

$5,000 = a(5^2) + b(5) + c$ or written alternatively as $25a + 5b + c = 5,000$ }

(14 marks)

Q4. A company manufactures and sells x mobile phones per week. If the weekly cost and price-demand (demand function) equations are:

$$C = 5000 + 2x$$
$$P = 10 - 0.001x$$

where C and P are in thousands of shillings and x is in thousands of units.

Required:

i. Find the marginal cost function and interpret it . **(3 marks)**

ii. Find the revenue function, R ,as a function of x, given that: $revenue = price$ times $quantity$ or P X x. **(3 marks)**

iii. Find the profit function. How many units need to be produced and sold to maximize profit? Also determine the price per unit (phone) that gives the highest profit. **(6 marks)**

iv. Using differential calculus and the revenue function, determine the level of production where revenue is at a maximum. **(3 marks)**

v. You have heard your friend from the Economics discipline stating that “At a profit maximizing level, marginal revenue (MR) = marginal cost(MC).”. Is this statement true or false? Demonstrate your answer using information from this manufacturing company. **(5 marks)**

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