CHUKA   **UNIVERSITY**

UNIVERSITY SUPPLEMENTARY/SPECIAL EXAMINATIONS.

FIRST YEAR EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF COMMERCE, BACHELOR OF PURCHASING AND SUPPLIES AND BACHELOR OF PROCUREMETN AND LOGISTICS MANAGEMENT

BCOM 162/BCOM/BBAM 171: BUSINESS MATHEMATICS II

STREAMS: BSc. BCOM & BBAM Y1S2   **TIME: 2 HOURS**

DAY/DATE: THURSDAY 26/07/2018   **11.30 A.M - 1.30 P.M**

INSTRUCTIONS:
- Answer **Question ONE and any other TWO Questions**
- Do not write anything on the Question paper.

QUESTION ONE [30 MARKS]
(a) Explain the meaning of the following probability terms
   (i) Mutually exclusive events   [2 Marks]
   (ii) Independent events   [2 Marks]
   (iii)   Equally likely events   [2 Marks]

(b) Given function $y = 120X - X^2 + 0.02X^3$

Evaluate
   (i) $\dfrac{d^2 y}{dX.^2}$ [2 Marks]

   (ii) $\displaystyle\int_0^3 y\, dX$ [3 Marks]

(c) A firm considers production of either product A, B or C to be strategies while the likely demands for the products are considered as states of nature. The payoffs (Sh.000) associated with the products are given in the table below:

Demand	Strategies		
	A	B	C
High	700	500	300

| Moderate | 300 | 450 | 300 |
| Low | 150 | 0 | 300 |

Use the table to determine the best production strategy using the following criteria
   (i) Maximum   [2 Marks]

   (ii) Hurwicz (Take $\propto 0.75¿$ [2 Marks]

   (iii)   Laplace   [2
      Marks]

   (iv)Suppose the states of nature are believed to occur with probabilities 0.3, 0.5 and 0.2
      for Low, Medium and High respectively, which product should the firm produce?
                                                                       [2 Marks]

(d) An electronic manufacturer has two lines A and B assembling identical electronic units. 5% of the units assembled on line A and 10% of those assembled on line B are defective. All defective units must be reworked at a significant increase in cost. During the last eight-hour shift, line A produced 200 units while the line B produced 300 units. One unit is selected at random from the 500 units produced.

   (i) If it is found to be defective, find the probability that it was assembled on line. [3 Marks]

   (ii) Find the probability that the unit is defective given that it was assembled on line B.
                                                                       [2 Marks]

(e) Use matrix algebra to solve the following system of simultaneous equations.

$$x+2y+z=8$$
$$2x+3y+2z=14$$
$$3x+2y+2z=13$$ [6 Marks]

QUESTION TWO: [20 MARKS]
(a) Explain the meaning of decision theory and describe the decision making environments.
                                                                     [6 Marks]

(b) The total profit (p) per acre on a wheat farm, has been found to be related to the expenditure per acres for (a) Labour and (b) soil improvement. If X represents the shilling per acre spent on labour and Y represents the shilling per acre spent of soil improvement:
$$P=48X\,60Y+10XY-10X^2-6Y^2$$

Required:
   (i) $\partial P/\partial \dfrac{X \wedge \partial P}{\partial Y}$ [2 Marks]

(ii) What are the values of X and Y that maximize profits?   [3 Marks]

(c) The following system of equation represents the inter-sector demand and final demand or three sectors in an economy that has three industries, T1, T2 and T3. The industries have the following technology matrix

$$A = \begin{bmatrix} 0.2 & 0.2 & 0.1 \\ 0.2 & 0.4 & 0.1 \\ 0.1 & 0.2 & 0.3 \end{bmatrix}$$

And D$= \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix}$. If the gross production matrix X$= \begin{pmatrix} 40 \\ 45 \\ 50 \end{pmatrix}$ where d_1, d_2 and d_3 are the final demands in metric tonnes from sector 1, 2 and 3 respectively.

Required:
(i) Explain the meaning of closed Leontief mode.   [1 Mark]
(ii) Determine the Leontief inverse matrix $(1-A)^{-1}$ [4 Marks]
(iii)   Solve for D (final demand) column vector in the matrix equation $X - AX = D$. [4 Marks]

QUESTION THREE [20 MARKS]

(a) Find the derivative of the function $y = \dfrac{2x^4 - x^3 + 7}{1 + x^2}$ [3 Marks]

(b) A firm has analyzed their operating conditions, prices and costs and has developed he following functions: Revenue: $R = 400Q - 4Q^2$ and Marginal Cost: $\dfrac{dC}{dQ} = 2Q + 10$ where Q is the number of units sold. The firm will incur a total cost Kshs.30 when three is zero production. The firm wishes to maximize profit. Assume that all output produced is sold.
   (i) What quantity should be sold?   [3Marks]
   (ii) What will be the amount of maximum profit?   [2 Marks]

(c) The following system of equations represents the inter-sector dem and final demand of two sectors in a given economy.
$0.4\,X_1 + 0.2\,X_2 + 10 = X_1$

$0.3\,X_1 + 0.1\,X_2 + 12 = X_2$

Where X_1 and X_2 are outputs in metric tonnes of sector 1 and 2 respectively while d_1 and d_2 are the final demands in metric tonnes from sector 1 and 2 respectively.

Required:

(i) Determine the technology coefficients matrix and surplus matrix. [2 Marks]
(ii) Determine the gross production matrix. [4 Marks]

(d) A Company produces three products X, Y and Z using raw materials A, B and C. one unit of X requires 1, 2 and 3 units of A, B and C respectively. One unit of Y requires 2, 3 and 2 units of A, B and C respectively and one unit of Z requires 1, 2, and 2 units of A, B and C respectively. The number of units available for raw materials A, B and C are 8, 14 and 13 units respectively. Using matrix method, find how many units of each product to produce in order to utilize completely the available resources. [6 Marks]

QUESTION FOUR [20 MARKS]
(a) Explain the difference between open and closed Leontief model. [2 Marks]

(b) A retailer of motorized bicycles has examined cost data and has determined an average cost function which expresses the annual cost of purchasing, owning, and maintaining inventory as a function of the size (number of units) of each order it places for the bicycles. The average cost of function is,

$$AC = f(q) = \frac{4,860}{q} + 15q + 750,000$$

Where AC equals average annual inventory cost, stated in dollars and q equals the number of motorcycles ordered each time the retailer replenishes the supply.

(i) Determine the order size, which minimizes annual inventory cost. [2 Marks]
(ii) Determine the Total Cost Function. [2 Marks]
(iii)   What is the minimum total annual inventory cost expected to equal? [2 Marks]

(c) Kaanwa Agro Mills Ltd (KAM) is considering whether to enter a very competitive market for manufacturing of animal feeds. In case KAM decides to enter this market, it must either install a new high technology equipment or pay overtime wages to the entire staff. In either case, market entry could result in;
(i) High sales
(ii) Medium sales
(iii)   Low sales
(iv) No sales

The management of KAM has estimated that if they enter the market there is a 60% chance of their shareholders approving the installation of the new equipment (this means that there is a 40% chance of using overtime). A random analysis of the current market structure reveals that KAM has a 40% chance of achieving high sales, a 30a% chance of achieving medium sales, a 20% chance of achieving low sales and a 10% chance of achieving no sales.

Financial analysis of KAM indicates that a high level of sales will yield Kshs.1,000,000 profits; medium level of sales will result in a Kshs.600,000 profit, low level of sales will result in a Kshs.200000 profit and a no sales level will cost KAM a loss of Kshs.500,000. Entering the market will require a cash outlay of either Kshs.300,000 to purchase and install the new equipment or Kshs.100,000 for overtime expenses, should the second option be selected. A decision not to enter the market will add zero extra profit to the firm which is currently Kshs.250,000. (Assume that all costs and revenues have been discounted to their present values).

(a) Construct a decision tree for the problem showing clearly the courses of action.

(b) By applying an appropriate decision criterion, recommend whether or not KAM should enter the market. [12 Marks]
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