

END TERM EXAMINATION

FIRST SEMESTER [BA (ECONOMICS)] FEBRUARY 2023

Paper Code: BAECO-105

Subject: Mathematics for Economics-I

Time: 3 Hours

Maximum Marks: 75

Note: Attempt any five questions. Internal choice is indicated.

Q1. Answer any five parts:

(3x5=15)

- (a) Show that $\lim_{x \rightarrow 0} [(a+x)^{1/2} - a^{1/2}] / x = 1 / [2(a)^{1/2}]$
- (b) For any two sets A and B, prove that $A \cap (A' \cup B) = A \cap B$
- (c) The cost of producing x units of a commodity is given by the formula $C(x) = p + qx^2$. Find $C'(x)$. What is its economic implication.
- (d) Decide where the function is convex and determine possible inflection points:
 $f(x) = x / (1+x^2)$
- (e) Determine the rank of the following matrix for all values of k.

$$A = \begin{bmatrix} 5-k & 2 & 1 \\ 2 & 1-k & 0 \\ 1 & 0 & 1-k \end{bmatrix}$$

- (f) Suppose $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$. Show that $A^2 = (a+d)A - (ad-bc)I_2$

Q2. The inverse demand function for a firm is given as follows:

(15)

$$P = \begin{cases} 10 - ax & \text{when } 0 \leq x \leq 2 \\ 12 - 3x & \text{when } 2 < x \leq 4 \end{cases}$$

$$TR = P \cdot X$$

$$MR = \text{derivative of } TR$$

- (a) Find the value of 'a' if the demand function is known to be constant.
- (b) Find Total Revenue Function and the level of output at which it is maximum.
- (c) Find Marginal Revenue as a function of x. Is it continuous everywhere? Show it on the graph. Find x where $MR = 0$.

OR

- Q3. (a) Show that the function $y = 2x^3 - 3x^2 + 5x - 10$ is convex from below when $x > 1/2$ and concave from below when $x < 1/2$. What happens when $x = 1/2$? Draw an approximate curve to support your answer. (5)
- (b) If $p = a - bx$ is the inverse demand function, show that elasticity of demand is different at different points on the demand curve. At what price the demand is unitary elastic? (5)
- (c) Examine the concavity / convexity of the production function $Y = AK^a$, defined for all $K \geq 0$, where $A > 0$ and $a > 0$. (5)

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BAECO-105

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- Q4. (a) The demand curve of a monopolist is given by $p = (100 - x) / 4$. (8)
- Find Total Revenue and Marginal Revenue Functions.
 - Find Marginal Revenue when $x = 0$ and $x = 18$.
 - Find elasticity of demand at $x = 18$ and verify the relation $MR = AR (1 - 1/e)$, where e denotes elasticity of demand, MR denotes Marginal Revenue and AR denotes Average revenue.
- (b) Total Cost of a manufacturer is $C = 5000 + 1000q - 500q^2 + (2/3)q^3$ (7)
- Find Marginal Cost Function.
 - Find the expression for the slope of Marginal Cost Function.
 - Find Average Total Cost Function.
 - At what value of q does $MC = AVC$.

OR

- Q5. (a) Let f be defined for all x by $f(x) = x^3 + (3/2)x^2 - 6x + 10$ (10)
- Find the points c where $f'(c) = 0$ and determine the intervals where the function increases.
 - Find the inflection points for f .
- (b) Find if $\sim A \wedge B \rightarrow \sim (A \vee B)$ is a tautology or not. (5)
- Q6. (a) For what values of α and β , the following system has a unique, no or several solutions: (10)
- $$\begin{array}{ll} \text{(i) } 2x + 3y = 7 & \text{(ii) } 3x - (\alpha + 1)y = 2\beta - 1 \\ 2\alpha x + (\alpha + \beta)y = 28 & 5x - (1 - 2\alpha)y = 3\beta \end{array}$$
- (b) Find the value(s) of x so that the following set of vectors is linearly independent: (5)

$$v_1 = \begin{pmatrix} 0 \\ 3 \\ 4 \end{pmatrix} \quad v_2 = \begin{pmatrix} 8 \\ x \\ 0 \end{pmatrix} \quad v_3 = \begin{pmatrix} 6 \\ 0 \\ -2 \end{pmatrix}$$

OR

- Q7. Following is the Keynesian Model for a two sector economy: (15)
- $$\begin{array}{ll} Y = C + I & \\ C = a + bY & (a > 0; 0 < b < 1) \\ I = \alpha - \beta r & (\alpha > 0; \beta > 0) \\ M_d = M_s & \\ M_d = \lambda Y - \delta r & (0 < \lambda < 1; \delta > 0) \\ M_s = M_0 & \end{array}$$
- Write down the equation of IS and LM curves.
 - Find the equilibrium values of Y and r using Cramers' rule.
 - Take $a = 500$, $b = 0.8$, $\alpha = 2000$, $\beta = 0.4$, $\lambda = 0.5$, $\delta = 50$, $M_0 = 5230$ and find equilibrium values of Y and r .