

2020

ECONOMICS

(Major)

Course : 401

(Mathematics for Economics)

Full Marks : 80
Pass Marks : 32/24

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Answer/Choose the correct option of the following : 1×8=8
- (a) A set containing no element is called
- (i) singleton set
 - (ii) disjoint set
 - (iii) null set
 - (iv) None of the above
- (b) What is a finite set?

(c) Define norm of a matrix.

(d) $\frac{d}{dx} e^{-x} = ?$

(e) A consumer has a total utility function $U = U(x) = ax^b$, what will be his marginal utility function?

(f) $\int x dx = ?$

(i) $x^2 + c$

(ii) $\frac{1}{x} x^2 + c$

(iii) $x + c$

(iv) None of the above

(g) Define consumer surplus.

(h) $y = a_0 + a_1x + a_2x^2 + a_3x^3$ is a form of

(i) constant function

(ii) polynomial function

(iii) exponential function

(iv) None of the above

2. Answer any *four* of the following : 4×4=16

(a) Define the following : 1×4=4

(i) Square matrix

(ii) Scalar matrix

(iii) Diagonal matrix

(iv) Symmetric matrix

(b) Write two assumptions and two limitations of input-output analysis. 4

(c) Given the total cost function

$$C = 100 + 50q - 10q^2 + \frac{1}{3}q^3$$

Find—

(i) the marginal cost function;

(ii) output at which marginal cost is equal to average variable cost. 2+2=4

(d) What are the conditions of maxima and minima with more than one variable for both unconstrained and constrained cases. 4

- (e) The marginal revenue and marginal cost functions of a firm are given as

$$MR = 25 - \frac{1}{2}Q$$

$$MC = 0.2Q^2 - \frac{1}{3}Q + 2$$

and the total fixed cost is 10. Find out total profit when the firm produces and sells 10 units of output.

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3. (a) (i) Discuss the following set operations with Venn diagram :

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Union of sets, Intersections of sets, Complementation of a set and Difference of sets

- (ii) If $A = \{2, 1, 0\}$, $B = \{4, 3, 2\}$ and $C = \{5, 4, 2\}$ then show that

$$A - (B \cup C) = (A - B) \cap (A - C)$$

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Or

- (b) (i) Prepare a brief note on different forms of functions and their graph.
- (ii) If $A = \{3, 4, 5\}$, find $P(A)$ and obtain $|P(A)|$.
4. (a) (i) Solve the following market model using Cramer's rule :

8

3

8

$$Q_d = Q_s$$

$$Q_d = 50 - 2P$$

$$Q_s = -10 + 3P$$

- (ii) Evaluate the following determinant : 2

$$\begin{vmatrix} 1 & 1 & 3 \\ 2 & -2 & 1 \\ 1 & 0 & -2 \end{vmatrix}$$

- (iii) Define rank of a matrix. 1

Or

- (b) (i) Given

$$A = \begin{bmatrix} 2 & 1 & 5 \\ 4 & 0 & 2 \\ 3 & 1 & 1 \end{bmatrix} \text{ and } B = \begin{bmatrix} 4 & 2 & 2 \\ 1 & 3 & 2 \\ 5 & 1 & 1 \end{bmatrix}$$

Show that

$$(A+B)' = A' + B' \text{ and } (AB)' = B'A' \\ 3+3=6$$

- (ii) If

$$A = \begin{bmatrix} 2 & 1 \\ 4 & 3 \end{bmatrix} \text{ and } B = \frac{1}{2} \begin{bmatrix} 3 & -1 \\ -4 & 2 \end{bmatrix}$$

then prove that $A^{-1} = B$. 5

5. (a) Prove that the production function of the type $Q = AL^\alpha K^\beta$ satisfies the Euler's theorem for $\alpha + \beta = 1$, where L is the unit of labour employed and K is the unit of capital used and A , α , β are the parameters and positive. 12

Or

- (b) A monopolist has the following total revenue (R) and total cost (C) functions :

$$R = 30q - q^2$$

$$C = q^3 - 15q^2 + 10q + 100$$

Find—

- (i) profit maximizing output;
 (ii) maximum profit;
 (iii) equilibrium price;
 (iv) point elasticity of demand at equilibrium level of output.

$$3+3+3+3=12$$

6. (a) (i) Evaluate : 5

$$\int \frac{4x^3 + 2}{(4x^4 + 8x)^5} dx$$

- (ii) Given the marginal cost function $MC = 3Q^2 - 4Q + 6$ and total fixed cost 8. Will the average cost minimum when $Q = 2$? 6

Or

- (b) (i) If the marginal revenue function for output q is given by $MR = \frac{6}{(q+2)^2 + 5}$, find the total revenue function. 4

- (ii) Find out the Producer's surplus when the supply function is $Q = \sqrt{-4 + 4P}$ and market price is 10. 7

7. (a) (i) Solve : 4

$$\frac{dy}{dx} + 2x = 0 \text{ given } y(0) = 5$$

- (ii) Analyze the following market model for stability : 7

$$Q_d = 14 - 3P$$

$$Q_s = -10 + 2P$$

$$\frac{dP}{dt} = 4(Q_d - Q_s)$$

Or

- (b) (i) Solve the difference equation $y_{t+1} - y_t = 10$ and $y_0 = 5$. 4

- (ii) In a Cobweb model

$$Q_{dt} = a - bP_t \quad (a, b > 0)$$

$$Q_{st} = -c + dP_{t-1} \quad (c, d > 0)$$

$$Q_{dt} = Q_{st}$$

Obtain the time path of P_t and analyze the condition for its convergence. 7
