

2024

( May/June )

ECONOMICS

( Honours )

( Mathematics for Economists )

Marks : 75

Time : 3 hours

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

Answer **one** question from each Unit

**UNIT—I**

1. (a) State and prove the distributive laws of set operations by using the following sets :

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$$A = \{b, c, e, f\}; B = \{a, c, d, g\}; C = \{a, b, d, e\}$$

- (b) Find the Cartesian products of the following sets ;

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$$A = \{2, 5, 7\}; B = \{4, 6\}$$

- (c) Write notes on any three of the following :  $3 \times 3 = 9$

- (i) Slope of a function
- (ii) Homogeneous function
- (iii) Power set
- (iv) Venn diagram

2. (a) Find the equation of a straight line which passes through the points (3, -2) and (-1, 4). Also write down the gradient of the line.  $4 + 1 = 5$

- (b) The demand and supply functions are

$$Q_s = 2P - 4, Q_d = 56 - 3P$$

Determine the equilibrium price and quantity.  $3 + 2 = 5$

- (c) Determine the degree of homogeneity of the following functions :  $2 + 3 = 5$

(i)  $f(L, K) = AL^a K^{1-a}$

(ii)  $f(x, y) = [ax^{-2} + by^{-2}]^{\frac{1}{2}}$

## UNIT-II

3. (a) If  $A = \begin{bmatrix} 1 & 0 & -2 \\ 2 & -1 & 3 \\ 0 & 4 & 1 \end{bmatrix}$ , find  $A^2 - 6A + 8I$ . 6

- (b) Find  $C_1, C_2, C_3$  if  $\begin{bmatrix} 7 \\ 3 \\ 5 \end{bmatrix} - \begin{bmatrix} C_1 \\ C_2 \\ C_3 \end{bmatrix} = \begin{bmatrix} 4 \\ 6 \\ 2 \end{bmatrix}$ . 3

- (c) If

$$A = \begin{bmatrix} 2 & -1 & 1 \\ 0 & 3 & -2 \\ 1 & 0 & -3 \end{bmatrix}, B = \begin{bmatrix} 1 & 0 & 1 \\ 3 & -1 & 2 \\ -2 & 3 & 0 \end{bmatrix}$$

prove that  $(AB)^T = B^T \cdot A^T$ . 6

4. (a) Solve the following equations by matrix inversion method : 9

$$x + y - z = 4$$

$$3x - 4z = 5$$

$$4x - 5y = 2$$

- (b) Write notes on any two of the following :  $3 \times 2 = 6$

(i) Transpose of a matrix

(ii) Inverse of a matrix

(iii) Cramer's rule

(iv) Leontief input-output model

## UNIT—III

5. (a) Explain the concepts of limit and continuity with suitable examples.  $2+2=4$

- (b) Evaluate the following limits (any two) :  $3 \times 2 = 6$

(i)  $\lim_{x \rightarrow 0} \frac{e^x - 1}{x}$

(ii)  $\lim_{x \rightarrow 0} \frac{(x+h)^3 - h^3}{3x}$

(iii)  $\lim_{x \rightarrow 0} \frac{\sqrt{a+x} - \sqrt{a-x}}{3x}$

- (c) Find the values of  $x$  for which the following functions are discontinuous :  $2+2+1=5$

(i)  $f(x) = \frac{3x+7}{x^2-5x+6}$

(ii)  $f(x) = \frac{x^2-6x+1}{3x^2-12}$

(iii)  $f(x) = \frac{4x-5}{3x-8}$

6. (a) Find  $\frac{dy}{dx}$  of the following functions (any three) :  $3 \times 3 = 9$

(i)  $x^3 - 3x^2y + y^3 = 10$

(ii)  $y = x^{-6}(x^2 - 4x + 5)$

(iii)  $y = (x+1)^x$

(iv)  $y = e^{x^3 - \sqrt{5-x} + 1}$

(v)  $f(x) = \frac{ax^2 - bx + c}{x^{-3}}$

- (b) Find the second-order partial derivatives of the following function : 3

$$z = 7x^3y^2 - 5x^2y^3$$

- (c) If  $u = \sqrt{x^2 + y^2}$ , find  $du$  where  $du$  is the total differential of  $u$ . 3

## UNIT—IV

7. (a) Discuss the various steps involved in finding the maxima/minima of the function  $y = f(x)$ . 5

- (b) The demand function and cost function of a firm are  $q = 10 - P$  and  $C = \frac{q^2}{4}$  respectively. Find the level of output ( $q$ ) where profit is maximum. Also write down the value of maximum profit.  $4+1=5$

- (c) The total cost function of a firm is  $C = 34q - 9q^2 + q^3$ . At what level of output ( $q$ ), marginal cost is minimum? Also write down the minimum value of marginal cost. 4+1=5

8. (a) Determine the maximum/minimum values of the following function : 5

$$y = \frac{1}{3}x^3 - 3x^2 + 8x + 10$$

- (b) The demand function is given by  $q = 200 - P^2$ . Find the price elasticity of demand if the price was ₹ 5. Also interpret the result. 3+1=4

- (c) The total revenue function of a firm is given by  $R = q^3 - 2q^2 + 6q$ . Obtain the slopes of AR-curve and MR-curve when  $q = 3$ . Also find the value of output ( $q$ ) where the two slopes are equal. 2+2+2=6

### UNIT—V

9. (a) Evaluate the following integrals (any three) : 3×3=9

(i)  $\int (x+1)^2 dx$

(ii)  $\int \frac{4x-5}{2x^2-5x+1} dx$

(iii)  $\int_1^2 (x^3 + 5)^2 3x^2 dx$

(iv)  $\int 8e^{2x+3} dx$

- (b) The demand function is  $P = \sqrt{9-x}$  and the units of demand is 5. Find the consumer's surplus. 6

10. (a) Evaluate  $\int_{-2}^2 (x^2 - 4x + 5) dx$ . 3

- (b) In a competitive market, the equilibrium price is 40 and the supply function is  $P = 0.2Q + 20$ . Find the producer surplus. 6

- (c) Write notes on any two of the following : 3×2=6

(i) Consumer's surplus

(ii) Producer's surplus

(iii) Integration

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