2025

(CBCS)

(5th Semester)

ECONOMICS

SEVENTH PAPER

(Quantitative Techniques—I)

Full Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions

(SECTION : A—OBJECTIVE)

(*Marks* : 10)

Tick (✓) the correct answer in the brackets provided : 1×10=10

1. Variable that assumes value only within a countable range is termed as

(a) discrete variable ( )

(b) continuous variable ( )

(c) exogenous variable ( )

(d) endogenous variable ( )

2. A quadratic function may be used to describe

(a) average fixed cost ( )

(b) cost function ( )

(c) trade cycle ( )

(d) None of the above ( )

3. The first-order derivative refers to

(a) the absolute surplus value of the function ( )

(b) the relative value of the function ( )

(c) the slope of the curve ( )

(d) the absolute value of the function ( )

4. When average cost (AC) rises, then

(a) MC < AC ( )

(b) MC = AC ( )

(c) MC > AC ( )

(d) TC = AC ( )

5. The integration of any given marginal cost function will yield

(a) total cost function ( )

(b) average cost function ( )

(c) demand function ( )

(d) slope of the average curve ( )

6. _____ has a numerical value independent of the constant *C*.

(a) An indefinite integral ( )

(b) A definite integral ( )

(c) Constant integral ( )

(d) None of the above ( )

7. For any square matrix to be inversible, the matrix must be a/an

(a) symmetric matrix ( )

(b) idempotent matrix ( )

(c) singular matrix ( )

(d) non-singular matrix ( )

8. A special type of matrix in which there is only one row or one column is a/an

(a) vector ( )

(b) identity matrix ( )

(c) singular matrix ( )

(d) non-singular matrix ( )

9. Every linear programming problem in its standard form involves

(a) objective function, structural constraints and negativity constraints ( )

(b) objective function, structural constraints and non-negativity constraints ( )

(c) non-linear function, structural constraints and negativity constraints ( )

(d) non-linear function, structural constraints and non-negativity constraints ( )

10. The solution to a linear programming problem will occur

(a) inside the feasible region ( )

(b) outside the feasible region ( )

(c) at the corner point of the feasible region ( )

(d) None of the above ( )

(SECTION : B—SHORT ANSWERS)

(*Marks* : 15)

Write short notes on/Answer the following : 3×5=15

UNIT—I

1. Difference between equal sets and equivalent sets

OR

2. Enumerate all the subsets of the set $\{a, b, c, d\}$.

UNIT—II

3. Concept of differentiability of a function

OR

4. Relationship between average revenue and marginal revenue

UNIT—III

5. Distinction between integrand and integral

OR

6. Find $\int\left(3e^x + \frac{4}{x}\right)dx$; $(x>0)$.

UNIT—IV

7. Diagonal matrix and identity matrix

OR

8. Transpose of a matrix

UNIT—V

9. Assumptions of linear programming problem

OR

10. Dual of general linear programming problem

(SECTION : C—DESCRIPTIVE)

(*Marks* : 50)

Answer the following : 10×5=50

UNIT—I

1. *(a)* Distinguish between finite and infinite sets. 3

(b) Find the Cartesian products $S_1 \times S_2$ and $S_2 \times S_3$ from the following sets : 3

$$S_1 = \{7, 8, 9\};\ S_2 = \{a, b\};\ S_3 = \{y, z\}$$

(c) Verify the associative law of union and intersection using the sets given below : 4

$$A = \{4, 5, 6\};\ B = \{3, 4, 6, 7\};\ C = \{2, 3, 6\}$$

OR

2. *(a)* Explain dependent and independent variables. 3

(b) If $A = \{2, 4, 6\}$ and $B = \{1, 3, 7\}$, find $A - B$ and $B - A$. 3

(c) In a class of 70 students, 20 students take Economics, 25 students take Education and 10 students take both. Find the number of students taking neither of the two subjects. 4

UNIT—II

3. *(a)* Find $\frac{dy}{dx}$ of the following (any *two*) : 2×2=4

(i) $y = 7x^3 + 5x^5 - 3x^6 + 8$

(ii) $y = (2x + 4)(3x^2 + 1)$

(iii) $y = (3 + 2x^2)^3$

(b) Given $y = -2x^2 + 3x - 1$, determine whether the function has a maximum or minimum. 3

(c) The total cost function of a firm is $C = 2Q^3 - 16Q^2 + 50Q$. Show that at the minimum of average cost, MC = AC. 3

OR

4. *(a)* Find the partial derivatives of the following : 2+2=4

(i) $Z = 2x^2 + 5x^2y + xy^2 + y^2$

(ii) $Z = \frac{5x+3}{y-2}$

(b) A firm has a demand and total cost function given by the respective equations

$$P = 300 - Q \text{ and } TC = 800 + 2Q$$

Find the quantity at which profit is maximized. 6

UNIT—III

5. *(a)* Evaluate the following (any *two*) : 2½×2=5

(i) $\int \frac{4x}{x^2+1} dx$

(ii) $\int x \log x \, dx; \; (x > 0)$

(iii) $\int_1^3 3\sqrt{x} \, dx$

(b) A market has the following demand and supply functions :

$$P_d = 18 - 2x - x^2 \quad \text{[demand function]}$$

$$P_s = 2x - 3 \quad \text{[supply function]}$$

Find the producer's surplus at equilibrium. 5

OR

6. *(a)* The marginal cost function of a firm is given by $MC = 25 + 30Q - 9Q^2$ and the fixed cost is 55. Find the total cost and average cost functions. 2+2=4

(b) Suppose the demand for a product is given by $P = 25 - Q^2$. Find the consumer's surplus if *(i)* $P = ₹9$ and *(ii)* $Q = 3$ units. 3+3=6

UNIT—IV

7. *(a)* How is an idempotent matrix different from the standard symmetric matrix? Give examples. 4

(b) Find the inverse of the following matrix : 6

$$A = \begin{bmatrix} 4 & -2 & 1 \\ 7 & 3 & 0 \\ 2 & 0 & 1 \end{bmatrix}$$

OR

8. *(a)* Write the various properties of transpose of a determinant. 4

(b) Solve the following system of equations : 6

$$4x_1 + x_2 - 5x_3 = 8$$
$$-2x_1 + 3x_2 + x_3 = 12$$
$$3x_1 - x_2 + 4x_3 = 5$$

UNIT—V

9. Define linear programming. What are the various procedures involved in the formulation of linear programming problem? 3+7=10

OR

10. Using graphical method, solve the following linear programming problem and indicate the feasible region in the diagram : 10

Maximize $Z = 60x_1 + 16x_2$

subject to

$$12x_1 + 16x_2 \leq 120$$
$$8x_1 + 8x_2 \leq 80$$
$$x_1, x_2 \geq 0$$

★★★