

**2024**  
(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*

*Simple calculator can be used in this paper*

**( SECTION : A—OBJECTIVE )**

*( Marks : 10 )*

Tick (✓) the correct answer in the brackets provided :

1×10=10

1. Non-algebraic functions are also called

- (a) exponential functions ( )
- (b) cubic functions ( )
- (c) transcendental functions ( )
- (d) constant functions ( )

2. A set which contains all the elements in question is

(a) null or empty set ( )

(b) equivalent set ( )

(c) equal set ( )

(d) universal set ( )

3.  $\frac{d^2y}{d^2x} < 0$  means that

(a) the slope of curve tends to increase ( )

(b) the slope of curve tends to decrease ( )

(c) the value of function tends to increase ( )

(d) the value of function tends to decrease ( )

4. The partial derivative of  $z = 2x^2 + xy - y^2$  with respect to  $x$  is

(a)  $4x + y$  ( )

(b)  $4x + x$  ( )

(c)  $2x + y - 2y$  ( )

(d)  $2x + x - y$  ( )

5. If the marginal cost function of a firm is  $MC = 6x^2 + 2x$ , where  $x$  is output, the total cost function will be

(a)  $2x^3 + 2x^2 + c$  ( )

(b)  $2x^3 + x^2$  ( )

(c)  $12x + 2$  ( )

(d)  $3x^2 + 2x$  ( )

6. \_\_\_\_ has a numerical value independent of the constant  $C$ .

(a) An indefinite integral ( )

(b) A definite integral ( )

(c) A constant integral ( )

(d) None of the above ( )

7. A square matrix  $A$  is singular, if

(a)  $|A| \neq 0$  ( )

(b)  $|A| > 0$  ( )

(c)  $|A| < 0$  ( )

(d)  $|A| = 0$  ( )

8. Transpose of transpose of a matrix  $(A')'$  is

(a) the original matrix ( )

(b) zero ( )

(c) one ( )

(d) infinity ( )

9. In linear programming problem, the optimal solution should be

(a) basic but not feasible ( )

(b) feasible but not basic ( )

(c) basic as well as feasible ( )

(d) neither basic nor feasible ( )

10. Multiple optimal solutions arise in linear programming problem in case where the

(a) constraint functions have different slopes ( )

(b) objective and constraint functions have equal slope ( )

(c) objective and constraint functions have unequal slope ( )

(d) two or more constraint lines are intersecting each other ( )

**( SECTION : B—SHORT ANSWERS )**

( Marks : 15 )

Answer the following :

3×5=15

**UNIT—I**

1. Explain Cartesian product with suitable example.

**OR**

2. Define null and universal sets.

**UNIT—II**

3. What are the first-order and second-order conditions for optimization?

**OR**

4. Mention the relationship between average and marginal cost curves.

**UNIT—III**

5. Define producer's surplus.

**OR**

6. If  $MR = 20 - 2q$ , find the total revenue when  $q = 5$ .

**UNIT—IV**

7. Define rank of a matrix.

**OR**

8. Explain transpose of a matrix.

UNIT—V

9. Explain basic and feasible solutions.

OR

10. Formulate the dual problem of the following LPP :

Maximize  $Z = 10x + 5y$   
subject to

$$x - 5y \leq 9$$

$$4x + y \leq 7$$

$$x, y \geq 0$$

( SECTION : C—DESCRIPTIVE )

( Marks : 50 )

Answer the following :

10×5=50

UNIT—I

1. (a) Distinguish between disjoint and overlapping sets with example. 4  
(b) Enumerate all the proper subsets of a set  $A = \{a, b, c\}$ . 2  
(c) Verify the distributive law of union by using the following sets : 4

$$A = \{1, 3, 4\}, B = \{3, 4, 7\} \text{ and } C = \{4, 5, 8\}$$

OR

2. (a) Distinguish between dependent and independent variables. 2  
(b) If the supply and demand functions for a commodity are  $q_s = 20p + 8$  and  $q_d = 4p + 20$  respectively, find the equilibrium price and equilibrium quantity. 4  
(c) In a certain examination, 53 percent students passed in Economics, 61 percent in Politics, 60 percent in History, 24 percent in Economics and Politics, 35 percent in Politics and History, 27 percent in Economics and History and 5 percent passed in none of these subjects. How many students passed in all the three subjects? 4

UNIT—II

3. (a) Find the derivatives of  $y = (3x + 5)(2x + 3y)$ . 3  
 (b) Determine whether the function  $y = 3x^2 - x + 1$  is maximum or minimum. 4  
 (c) The total revenue ( $R$ ) and total cost ( $C$ ) functions of a firm are given by  $R = 30Q - Q^2$  and  $C = 20 + 4Q$  respectively, where  $Q$  is the output. Find the equilibrium output of the firm. 3

**OR**

4. (a) Find the elasticity of demand for the demand function  $q = 25 - 4p + p^2$ , where  $p = 5$  and interpret the result. 3+1=4  
 (b) The total cost function is given by  $C = Q^3 - 2Q^2 + 2Q$ .  
 (i) Find MC function.  
 (ii) Verify that at a minimum of average cost,  $AC = MC$ . 1+5=6

UNIT—III

5. (a) Evaluate the following (any two) : 2×2=4  
 (i)  $\int 3x(x^2 + 2x + 1) dx$   
 (ii)  $\int x \log x dx$   
 (iii)  $\int (x^2 + 2e^x + \frac{1}{x}) dx$   
 (iv)  $\int_0^2 (3x^2 + 2x + 5) dx$   
 (b) Define consumer's surplus. Find the consumer's surplus for the demand function  $p = 36 - x^2$ , when equilibrium  $p = ₹ 5$ . 2+4=6

**OR**

6. (a) The marginal revenue function of a firm is given by  $MR = 200 - 6q$ , where  $q$  is the output. Find the total revenue, when  $q = 3$ . 4  
 (b) The demand and supply laws are given by  $p_d = 16 - x^2$  and  $p_s = 4 + x$  respectively. Determine the producer's surplus under pure completion. 4  
 (c) The marginal cost function of a firm is  $MC = 100 - 4q$ . Find the total cost function and the average function. 2

UNIT—IV

7. (a) What is an idempotent matrix? 2

(b) Given :

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

Find (i)  $2A - B$  and (ii)  $AB$ . 2+2=4

(c) Write the basic properties of determinants. 4

**OR**

8. (a) Obtain the inverse of the matrix

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

3

(b) Solve the following equations by Cramer's rule : 7

$$2x + 3y + 4z = 29$$

$$3x + 2y + 5z = 32$$

$$5x + y + 2z = 25$$

UNIT—V

9. Solve the following LPP by graphical method and indicate the feasible region in the diagram : 8+2=10

Minimize  $Z = 2x + 3y$

subject to

$$x + y \geq 6$$

$$2x + y \geq 7$$

$$x + 4y \geq 0$$

$$x, y \geq 0$$

**OR**

10. Discuss the various basic assumptions for the application of linear programming problem. 10

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