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(NEP—2020)

(5th Semester)

ECONOMICS (MAJOR1)

(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. A set which contains no elements is

(a) equal set ( )

(b) universal set ( )

(c) null or empty set ( )

(d) equivalent set ( )

2. Any set containing n number of elements has _____ number of subsets.

(a) $2n^2$ ( )

(b) 2^n ( )

(c) n^2 ( )

(d) None of the above ( )

3. The optimal solution of linear programming is found

(a) outside the feasible region ( )

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

(c) at the origin of the graph ( )

(d) None of the above ( )

4. If $\frac{dy}{dx}>0$, then

(a) the curve rises from left to right ( )

(b) the curve remains stationary ( )

(c) the curve falls from left to right ( )

(d) the curve slopes upward from left to right ( )

5. When Average Cost (AC) is minimum, then

(a) MC is below AC ( )

(b) MC > AC ( )

(c) AC = MC ( )

(d) MC < AC ( )

6. Integration of any marginal revenue function will yield

(a) average revenue function ( )

(b) demand function ( )

(c) slope of the average revenue ( )

(d) total revenue function ( )

7. The integration of the exponential function (e^x) is

(a) e^x ( )

(b) $e^x + C$ ( )

(c) $\frac{e^x}{\log e} + C$ ( )

(d) $e^x \log e$ ( )

8. Column matrices are those that have

(a) one column and any number of rows ( )

(b) equal number of rows and columns ( )

(c) one row and any number of columns ( )

(d) None of the above ( )

9. 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 ( )

10. If

$$A = \begin{bmatrix} 1 & 3 \\ 5 & 2 \end{bmatrix}$$

then the transpose of matrix A' is

(a) $\begin{bmatrix} 1 & 5 \\ 3 & 2 \end{bmatrix}$ ( )

(b) $\begin{bmatrix} 1 & 3 \\ 2 & 5 \end{bmatrix}$ ( )

(c) $\begin{bmatrix} 1 & 2 \\ 5 & 3 \end{bmatrix}$ ( )

(d) $\begin{bmatrix} 1 & 5 \\ 2 & 3 \end{bmatrix}$ ( )

(SECTION : B—SHORT ANSWERS)

(*Marks* : 15)

Answer *five*, taking at least *one* from each Unit : 3×5=15

UNIT—I

1. Distinguish between finite and infinite sets.

2. Write any three assumptions of linear programming problem.

UNIT—II

3. Write the inter-relationship among total, marginal and average revenues.

4. Find the partial derivatives of the following function :

$$Z = 4x^2 + xy - y^2$$

UNIT—III

5. Differentiate between integrand and integral.

6. Define consumer's surplus.

UNIT—IV

7. Distinguish between singular matrix and non-singular matrix.

8. Given that

$$A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \; B = \begin{pmatrix} a & b \\ c & d \end{pmatrix}, \text{ and } C = \begin{pmatrix} 0 & 1 \\ 1 & 1 \end{pmatrix}$$

What are the values of a, b, c and d, if $A + B = C$?

(SECTION : C—DESCRIPTIVE)

(*Marks* : 50)

Answer *five* questions, taking at least *one* from each Unit : 10×5=50

UNIT—I

1. *(a)* Explain Cartesian products with examples. 3

(b) In a group of 60 students, 40 of them take Economics, 35 of them take History and 20 of them take both the subjects. How many students take neither of the two subjects? 3

(c) Verify the associative laws of union and intersection by using the following sets : 4

$$A = \{1, 2, 3, 4\},\ B = \{2, 4, 5, 6\},\ C = \{3, 4, 7, 8\}$$

2. Solve the following linear programming problem by graphical method and indicate the feasible region in the diagram : 8+2=10

Maximize $Z = 3x_1 + 2x_2$

subject to

$$2x_1 + x_2 \leq 5$$
$$x_1 + x_2 \leq 3$$
$$x_1, x_2 \geq 0$$

UNIT—II

3. *(a)* Find the derivatives of the following (any *two*) : 2×2=4

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

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

(iii) $y = (2x^3 + 5x)^6$

(b) Given the demand function $P = 20 - q$. Find the marginal revenue. 2

(c) Describe the necessary and sufficient condition for maximization and minimization. 4

4. *(a)* The total cost of the firm is given by $C = q^3 - 4q^2 + 3q$.

(i) Find at what level of output (q), AC is minimum.

(ii) Verify that at a minimum of average cost, AC = MC. 3+3=6

(b) The average revenue function and the cost function are given by $AR = 10 - 5q$ and $C = q^2 - 3q + 7$ respectively. Find the total revenue function and profit function. 2+2=4

UNIT—III

5. *(a)* Evaluate the following functions (any *three*) : 2×3=6

(i) $\int x^2 \log x \, dx$

(ii) $\int \left(x^3 + \frac{1}{x} - 5e^x \right) dx$

(iii) $\int (5x + 9)^3 \, dx$

(iv) $\int_0^3 (x^2 - 6x + 4) \, dx$

(b) The demand and supply functions are given by $P_d = 16 - x^2$ and $P_s = 4 + x$ respectively. Determine the producer's surplus at equilibrium. 4

6. *(a)* The marginal revenue function is given by $MR = 100 - 5q$. Find the total revenue. 2

(b) The marginal cost function of a firm is given by $MC = 3 + x + x^2$ where x is the output. Find the total cost function of the firm under the assumption that its fixed cost is ₹ 35. 4

(c) Given the demand function $= 85 - 4x - x^2$. What will be the consumer's surplus if P_0 is 64? 4

UNIT—IV

7. (a) Write the properties of determinants. 5

(b) Solve the following equations by using the matrix inverse method : 5

$$9x + y = 13$$
$$8x + 2y = 16$$

8. (a) Solve the following set of equations by Cramer's rule : 6

$$3x + y - z = 5$$
$$x + 4y + 2z = 6$$
$$2x + 3y + z = 4$$

(b) If

$$A = \begin{bmatrix} 2 & 5 \\ 1 & 3 \end{bmatrix}, \; B = \begin{bmatrix} 1 & -1 \\ -1 & 0 \end{bmatrix}$$

find AB and BA. Is $AB = BA$? 4

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