

2022

ECONOMICS — HONOURS

Paper : CC-2

(Mathematical Methods for Economics - I)

Full Marks : 65

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*

Section - A

1. Answer *any ten* questions :

2×10

- (a) If the set $A = \{1, 2, 3, 4\}$, then what is the number of non-empty subsets of A ?
- (b) How many elements are there in set $S = \{x : x \text{ is a real number and } x^2 + 1 = 0\}$?
- (c) Find the range and domain of $y = \sqrt{x^2 + 4}$.
- (d) Find the marginal and average functions for the following total function.

$$Q = aL + bL^2 + cL^3$$
- (e) Find $\lim_{x \rightarrow 0} \frac{\sin 5x}{3x}$.
- (f) If $y = 10\sqrt[5]{x^3} - \sqrt{x^7} + 6\sqrt[3]{x^8} - 3$, find $\frac{dy}{dx}$.
- (g) Evaluate $f(x) = \int (e^x - 1)e^x dx$
- (h) Consider the demand curve $q = 20 - 3p$. What is the elasticity of demand when price equals $\frac{10}{3}$?
- (i) Sketch the graph of $y = x^2 - 2x - 1$, $x > 0$.
- (j) Determine the value of k for which $f(x)$ is continuous at $x = 3$, where

$$f(x) = \begin{cases} \frac{(x+3)^2 - 36}{x-3}, & x \neq 3 \\ k, & x = 3 \end{cases}$$

- (k) Does the following function have a point of inflexion?

$$y = f(x) = \frac{1}{2}e^{-\frac{1}{2}x}$$

Please Turn Over

- (l) What is an idempotent matrix?
- (m) Find the inverse of the matrix $\begin{bmatrix} 2 & 0 \\ 0 & 0 \end{bmatrix}$.
- (n) Find the eigenvalues of $A = \begin{bmatrix} 2 & 3 \\ -4 & 10 \end{bmatrix}$.
- (o) What is a two-person zero sum game?

Section - B

Answer *any three* questions.

2. Given a 4×4 matrix $B = [b_{ij}]$, write out all the principal minors, and identify the leading principal minors. 3+2
3. Find the saddle point of the game following dominant strategy : 2+3

Strategies \downarrow	Player B					
		B ₁	B ₂	B ₃	B ₄	B ₄
Player A	A ₁	2	4	3	8	5
	A ₂	4	5	2	6	7
	A ₃	7	6	8	7	6
	A ₄	3	1	7	4	2

4. "Null set (ϕ) is the complement of the universal set (U); again ϕ is a subset of U ." Is not it paradoxical? How do you resolve this paradox? 2+3
5. Find the solution of the equation system using Cramer's rule : 5
- $$7x_1 - x_2 - x_3 = 0$$
- $$10x_1 - 2x_2 + x_3 = 8$$
- $$6x_1 + 3x_2 - 2x_3 = 7$$
6. A smart watch manufacturer sells his product in a competitive market at ₹ 1200. If his cost function is $C = 1000 + 10Q^2$, find his profit maximising output. 5

Section - C

Answer *any three* questions.

7. Consider the following Leontief System where the input-output coefficient matrix is :

$$\begin{bmatrix} 0.3 & 0.7 & 0.1 \\ 0.8 & 0.1 & 0.2 \\ 0.1 & 0.3 & 0.1 \end{bmatrix}$$

- (a) Check whether the system satisfies the Hawkins-Simon conditions.

(3)

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(b) Consider the following game :

		Player I		
		L	C	R
Player 2	T	7,6	5,8	0,0
	M	5,8	7,6	1,1
	B	0,0	1,1	4,4

Is there any dominant strategy for each player? Is there any pure strategy Nash equilibrium?

6+(2+2)

8. (a) Evaluate $\int x\sqrt{x+3} dx$

(b) The marginal revenue of a company is given by $MR = 100 + 20Q + 3Q^2$, where Q is the quantity of output sold. Find the total revenue function if at $Q = 2$, total revenue is 260. 5+5

9. Prove or disprove the following statements :

5+5

(a) Any concave (convex) function, say $f(x)$, is quasi-concave (quasi-convex), but the converse is not true.

(b) If $f(x)$ is a linear function, then it is quasi-concave as well as quasi-convex.

10. (a) Classify the stationary values of the function

$$y = f(x) = x^3 - 3x^2 + 5$$

as local maximum, local minimum and inflexional values.

(b) Find the point price elasticity of supply from the supply function $Q = P^2 + 7P$, and determine whether the supply is elastic at $P = 2$. (2×3)+(2+2)

11. (a) Determine the values of constants a, b, c such that the function

$$f(x, y) = ax^2y + bxy + 2xy^2 + c$$

has a local minimum at the point $\left(\frac{2}{3}, \frac{1}{3}\right)$ with local minimum value $\left(-\frac{1}{9}\right)$.

(b) Find the rank of the matrix given below :

$$A = \begin{bmatrix} 1 & 5 & 1 \\ 0 & 3 & 9 \\ -1 & 0 & 0 \end{bmatrix}$$

4+6