Total No. of Printed Pages—8

2 SEM TDC ECOH (CBCS) C 4

2026

(May/June)

ECONOMICS

(Core)

Paper : C–4

(Mathematical Methods in Economics—II)

Full Marks : 80

Pass Marks : 32

Time : 3 hours

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

1. Choose the correct answer of the following : 1×8=8

(a) Which of the following is a first-order difference equation?

(i) $\frac{dy}{dx} + ay = b$

(ii) $\frac{d^2y}{dx^2} + ay = b$

(iii) $y_{t-1} + ay_t = c$

(iv) All of the above

(b) If $A = \begin{bmatrix} 2 & 4 & 3 \\ 3 & 5 & 1 \end{bmatrix}_{2\times3}$, then the norm of A is

(i) $N(A) = 5$

(ii) $N(A) = 9$

(iii) $N(A) = 4$

(iv) None of the above

(c) Which of the following is not true?

(i) $(AB)' = B'A'$

(ii) $(A')' = A$

(iii) $(A'B')' = (AB)'$

(iv) $(A - B)' = A' - B'$

(d) The expansion path of C-D production function

(i) intersects X axis

(ii) intersects Y axis

(iii) passes through the origin

(iv) None of the above

(Continued)

(e) The CES production function represents

(i) increasing returns to scale

(ii) diminishing returns to scale

(iii) constant returns to scale

(iv) All of the above

(f) A discriminating monopolist maximizes his profit by selling quantity of products Q_1 and Q_2 in two sub-markets, market I and market II respectively, when

(i) $\frac{dC}{dQ} = \frac{\delta R}{\delta Q_1} = \frac{\delta R}{\delta Q_2}$

(ii) $MC = AR_1 = AR_2$

(iii) $MR_1 = MR_2 = AC$

(iv) None of the above

(g) Lagrange function is applied in

(i) unconstrained optimization

(ii) constrained optimization

(iii) Both (i) and (ii)

(iv) None of the above

(Turn Over)

(h) The budget constraint for a consumer consuming two goods X and Y with his money income M, given the price of $X(P_X)$ and price of $Y(P_Y)$ is expressed as

(i) $\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$

(ii) $XP_X + YP_Y \leq M$

(iii) $XP_X + YP_Y \geq M$

(iv) None of the above

2. Answer any *four* of the following : 4×4=16

(a) Explain the rank of a matrix with the help of an example.

(b) Solve the following difference equation :

$$Y_{t-1} + 3Y_t = 10 \text{ with } Y_0 = 20$$

(c) If $z = x^3 e^{2y}$, then find $\frac{\partial Z}{\partial X}$ and $\frac{\partial Z}{\partial Y}$.

(d) Given the C-D production function $Q = AL^{\alpha}K^{\beta}$. Show that it satisfies Euler's theorem.

(e) What are the conditions of unconstrained optimization for the function with one independent variable and more than one independent variables?

3. (a) (i) Solve the following difference equation : 4

$$Y_{t+1} - Y_t = 3 \text{ with } Y_0 = 5$$

(ii) Solve the following Cobweb model : 7

$$Q_d = \alpha - \beta P_t$$
$$Q_s = -Y + \delta P_{t-1}$$
$$Q_d = Q_s$$

Or

(b) (i) Briefly explain the economic applications of first-order difference equation. 4

(ii) Given the demand and supply function as

$$3X_{dt} = 20 - P_1$$
$$3X_{st} = -20 + 7P_{t-1}$$

Find the equilibrium price, the time path and determine, whether or not, the equilibrium is stable. 7

4. (a) (i) If $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}_{2\times 2}$, then show that

$$A^2 - 3I = 2A \cdot$$ 4

(ii) Solve the following set of equations by using Cramer's rule : 8

$$3X + 2Y = 12$$
$$2X + 3Z = 16$$
$$4Y + 2Z = 20$$

Or

(b) (i) The two commodity market models are as follows :

Market – I	*Market – II*
$D_1 = S_1$	$D_2 = S_2$
$D_1 = 25 - 2P_1 + P_2$	$D_2 = 20 + 2P_1 - 2P_2$
$S_1 = -5 + 4P_1$	$S_2 = -10 + 5P_2$

Obtain equilibrium prices $\bar{P}_1$ and $\bar{P}_2$ using Cramer's rule. 6

(ii) Solve the following nation income model using matrix inversion technique :

$$Y = C + I_0 + G_0$$
$$C = a + bY$$

where Y and C stand for endogenous variables—national income and consumption expenditure, respectively, and I_0 and G_0 represent the exogenously determined investment and government expenditures, the two parameters a and b in the consumption function expenditure and the marginal propensity to consume $(1 > b > 0)$, respectively. 6

5. (a) (i) Derive elasticity of substitution for C-D production function. 3

(ii) Verify whether the Euler's theorem is satisfied or not for the following production function : 4

$$Q = L^{5/3}K^{-2/3}$$

(iii) Given the utility function, $U = u(x, y) = \log(x^2 + 4y^2)$, find the marginal utility of x and marginal utility of y. 2+2=4

Or

(b) State and prove the properties of the CES production function. 11

6. (a) In a monopoly, the AR and TC functions are $AR = 100 - 2Q$ and $C = 50 - 4Q + 2Q^2$. The government imposes as specific tax of ₹8 per unit. Examine the effect of tax on equilibrium output, price and profit. 11

Or

(b) A monopolist produces his product in two different plants and his total cost functions of the two plants are given by

$$TC_1 = 5 - 2Q_1 + Q_1^2$$
$$TC_2 = 10 - 4Q_2 + 2Q_2^2$$

If the average revenue function is given by $AR = 50 - 2Q$, where $Q = Q_1 + Q_2$, find—

(i) profit maximizing outputs;

(ii) maximum profit. 8+3=11

7. (a) (i) Maximize $Y = 5X_1X_2$, subject to $X_1 + 2X_2 = 8$ by applying Lagrange multiplier. 4

(ii) Given the utility function, $U = 2 + X + 2Y + XY$ and the budget constraint $4X + 6Y = 94$. Find out equilibrium level of X and Y which will maximize total utility. 7

Or

(b) A producer desires to minimize his cost of production, $C = 2L + 5K$, where L and K are the inputs, subject to the satisfaction of the production function $Q = LK$. Find the optimum combination of L and K in order to minimize cost of production when output is 40. 11

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