Total No. of Printed Pages—8

2 SEM TDC ECOH (CBCS) C 4

2022

(June/July)

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 from 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) Let A be a matrix of order $m \times n$ and B be a matrix of order $p \times q$. Then A and B are conformable for multiplication in the form AB, if

(i) $m = p$

(ii) $n = p$

(iii) $m = q$

(iv) $n = q$

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

(i) $N(A) = 5$

(ii) $N(A) = 9$

(iii) $N(A) = 4$

(iv) None of the above

(d) For a curve representing $u = f(x, y)$, if $\dfrac{d^2y}{dx^2} = -\text{ve}$, then the curve is

(i) convex to the origin

(ii) concave to the origin

(iii) horizontal to x-axis

(iv) vertical on x-axis

(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) Under perfect competition, a firm attains equilibrium when its

(i) $\frac{dC}{dQ} = \frac{dR}{dQ}$

(ii) $\frac{d^2C}{dQ^2} = +\text{ve}$

(iii) $\frac{d\pi}{dQ} = 0$ and $\frac{d^2\pi}{dQ^2} = -\text{ve}$

(iv) All of the above

(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) $\dfrac{MU_x}{P_x} = \dfrac{MU_y}{P_y}$

(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) Explain the properties of CES production function.

(c) If $z = x^3 e^{2y}$, then find $\dfrac{\delta z}{\delta x}$ and $\dfrac{\delta z}{\delta y}$.

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

(e) A consumer consumes two goods x_1 and x_2. His utility function is given by $U = u(x_1, x_2)$ and the budget line is given by $B = x_1 P_1 + x_2 P_2$. Find out the conditions of consumer's equilibrium.

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 :

$$Q_d = \alpha - \beta P_t$$
$$Q_s = -y + \delta P_{t-1}$$
$$Q_d = Q_s$$ 7

Or

(b) (i) Write a short note on Cobweb market model. 4

(ii) Given the demand function

$$Q_d = 10 - 2P_t$$

and the supply function $Q_s = -5 + 3P_{t-1}$. What is inter-temporal equilibrium price? Find the time path of P_t and determine whether stable equilibrium is attainable or not. 1+5+1=7

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

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

(ii) Solve the following set of equations by using Cramer's rule : 4

$$3x + 2y = 12$$
$$2x + 3z = 16$$
$$4y + 2z = 20$$

(iii) Write down two economic applications of matrix algebra. 2

Or

(b) (i) Explain with examples any five properties of determinant. 5

(ii) Find the value of the following determinant : 4

$$\begin{vmatrix} 2 & 2 & 4 & 9 \\ 4 & 1 & 0 & 2 \\ 4 & 1 & 0 & 0 \\ 3 & 2 & 1 & 1 \end{vmatrix}$$

(iii) What is idempotent matrix? 1

5. (a) (i) Show that the indifference curve representing the utility function of a consumer consuming two goods x and y is negatively slopped. 4

(ii) Given the production function $Q = AK^{\alpha}L^{1-\alpha}$, find—

(1) average productivity of labour;

(2) average productivity of capital;

(3) marginal physical productivity of labour;

(4) marginal physical productivity of capital. 1+1+2+2=6

(iii) Write down two economic applications of matrix algebra. 2

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(iii) What are the economic applications of first-order and second-order partial differentiations? 2+2=4

Or

(b) *(i)* Derive elasticity of substitution for C-D production function. 4

(ii) Verify whether the Euler's theorem is satisfied or not for the following production function : 6

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

(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

6. *(a)* In a monopoly market, the AR and TC functions are $AR = 100 - 2Q$ and $C = 50 - 4Q + 2Q^2$. The government imposes a specific tax of ₹ 8 per unit. Examine the effect of tax on equilibrium output, price and profit. 4+3+3=10

Or

(b) The demand functions of a monopoly in two different markets are given by $P_1 = 53 - 4Q_1$ and $P_2 = 29 - 3Q_2$

and the total cost function is $C = 20 + 5Q$, where $Q = Q_1 + Q_2$. Find—

(i) equilibrium outputs Q_1 and Q_2;

(ii) equilibrium prices P_1 and P_2;

(iii) maximum profit. 6+2+2=10

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) *(i)* Minimize $Y = x_1^2 - x_1x_2 + 2x_2$, subject to $2x_1 + 4x_2 = 12$. 4

(ii) 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. 7

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