2020

(Held in 2021)

ECONOMICS

Paper : CC–6

(Mathematical Methods in Economics—II)

Full Marks : 80

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Answer/Choose the correct option of the following : 1×6=6

(a) Identify the identity matrix of the following :

(i) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

(ii) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

(iii) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

(iv) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

(b) Find $\frac{dy}{dx}$ of the function, $y = 5e^{3x}$.

(i) $15e^{3x}$

(ii) $5e^{3x}$

(iii) $3e^{3x}$

(iv) e^{3x}

(c) What is scalar multiplication?

(d) Given

$S = \{1, 5, 9, b, c\}$ and $T = \{2, 5, 6, b, d\}$

Then

(i) $S \cup T = \{1, 2, 5, 6, 9, b, c, d\}$

(ii) $S \cup T = \{b, c, d\}$

(iii) $S \cup T = \{1, 2, 5, 6, 9\}$

(iv) All of the above

(e) Explain the meaning of optimisation.

(f) Give an example of null set.

2. Answer the following questions : 2×5=10

(a) Find the inverse of the following matrices :

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

(ii) $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$

(b) Find $\frac{dy}{dx}$, if $y = 3x^3(4x^2 - 2x)$.

(c) Explain the criteria for relative extrema.

(d) Explain the first-order and second-order conditions for unconstraint maxima and minima with more than one explanatory variables.

(e) Explain polynomial function.

3. Answer the following questions (any *six*) : 5×6=30

(a) Given the matrices

$$A = \begin{bmatrix} 3 & 2 & 0 \\ 4 & 1 & 3 \\ 2 & 2 & 3 \end{bmatrix}_{3\times3}, \quad B = \begin{bmatrix} 2 & 1 & 2 \\ 4 & 0 & 1 \\ 2 & 2 & 5 \end{bmatrix}_{3\times3}$$

Find *AB*.

(b) For the Cobb-Douglas production function $Q = AK^{\alpha}L^{1-\alpha}$, find the marginal productivity of labour and marginal productivity of capital.

(c) Given that, Q_d is demand function and Q_s is supply function :

$$Q_d = a - bP \ (a, b > 0)$$

$$Q_s = -c + dP \ (c, d > 0)$$

Find out equilibrium price and quantity.

(d) The average revenue function is given by $AR = 100 - 3q$. Find out the elasticity of demand when $q = 5$.

(e) Explain the procedure of solving first-order difference equation.

(f) Show that the elasticity of substitution is equal to unity in *C-D* production function.

(g) The total cost function of a firm is given by $C = \frac{1}{3}Q^3 + 6Q^2 + 12Q$, where Q is quantity produced. Find the marginal cost function and average cost function.

(h) Calculate the adjoint of A, where

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & -3 \\ 2 & -1 & 3 \end{bmatrix}_{3\times 3}$$

(i) Explain the procedure of solving first-order differential equation.

4. Answer the following questions (any *two*) : 10×2=20

(a) The demand functions of a monopolist in two different markets are $P_1 = 53 - 4Q_1$ $P_2 = 24 - 3Q_2$ and total cost function is $C = 20 + 5Q$, where P_1 and P_2 are the prices and Q_1 and Q_2 are the output in market 1 and 2 respectively, such that $Q = Q_1 + Q_2$. Find—

(i) profit maximising output;

(ii) maximum profit. 7+3=10

(b) A firm has the following Total Revenue (TR) and Total Cost (TC) function :

$$TR = 160Q - Q^2$$

$$TC = 200 + 4Q + 7Q^2$$

A subsidy of ₹ 4 per unit of output is paid. Analyse the effect of subsidy on equilibrium output.

(c) The utility function of a consumer that has to be maximized subject to budget constraint $\beta = xP_x + yP_y$ is given by $u = xy$. Find out demand functions for x and y.

5. Answer any *one* of the following questions : 14

(a) Given the market model :

$$Q_d = 14 - 3P$$
$$Q_s = -10 + 2P$$
$$\frac{dP}{dt} = 4(Q_d - Q_s)$$

Analyse the market model for stability. 14

(b) A firm has total cost function, $C = Q^3 - 7Q^2 + 20 + 16$, where Q is the output produced. Derive—

(i) average variable cost (AVC) function and show that when AVC is minimum, AVC = MC;

(ii) average cost function and check when $Q = 4$, the average cost is minimum and at that level of output MC = AC. 7+7=14

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