

- (c) The production function of a particular commodity is  $Q = L^{0.64} K^{0.36}$ . Show that the isoquant is negatively sloped and convex to the origin.

5. Answer any one of the following questions : 14

(a) If

$$A = \begin{bmatrix} 0.3 & 0.2 & 0.3 \\ 0.1 & 0.3 & 0.4 \\ 0.2 & 0.3 & 0 \end{bmatrix} \text{ and } F = \begin{bmatrix} 500 \\ 700 \\ 600 \end{bmatrix}$$

then find the sectoral outputs  $(x_1, x_2 \text{ and } x_3)$ .

- (b) A utility function of a consumer is given by  $U = (x+4)(y+3)$ , where  $x$  and  $y$  are two commodities consumed by the consumer. His budget line is given by  $150 = 5x + 6y$ . Find the values of  $x$  and  $y$  that maximize the consumer's utility.

\*\*\*

2022

( Held in 2023 )

ECONOMICS

Paper : ECOHC3066

( Mathematical Methods for Economics—II )

Full Marks : 80

Pass Marks : 32

Time : 3 hours

The figures in the margin indicate full marks for the questions

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

- (a) What is an adjoint matrix?
- (b) If  $A$  is a matrix of order  $m \times n$  and  $B$  is a matrix such that  $AB'$  and  $B'A$  are both defined, then order of matrix  $B$  is
- (i)  $m \times n$
- (ii)  $n \times m$
- (iii)  $n \times n$
- (iv)  $m \times m$
- (c) What do you mean by Lagrange multiplier?

- (d) If an estimated production function is  $Q = 5L^{0.5}K^{0.5}$ , then the function is homogeneous of degree

(i) 1

(ii) 0

(iii)  $\infty$

(iv) None of the above

- (e) The general solution of

$$\left(xy \frac{dy}{dx} - 1\right) = 0$$

is

(i)  $xy = \log x + c$

(ii)  $\frac{y^2}{2} = \log x + c$

(iii)  $\frac{x^2}{2} = \log y + c$

(iv) None of the above

- (f) If  $A$  is a singular matrix, then which one of the following is true?

(i)  $|A| = 1$

(ii)  $|A| = 0$

(iii)  $|A| > 1$

(iv)  $|A| > 0$

KB23/374

( Continued )

2. Answer the following questions :  $2 \times 5 = 10$

(a) If

$$A = \begin{bmatrix} 1 & 2 \\ 4 & -5 \end{bmatrix} \text{ and } B = \begin{bmatrix} 3 & 2 & 3 \\ 4 & 6 & 6 \end{bmatrix}$$

then find  $AB$ .

- (b) If the total cost function is given by  $C = 1000 + 6x + 0.5x^2$ , where  $x$  is output, then find the marginal cost function.

(c) If  $A = \begin{bmatrix} 2 & 0 \\ 1 & 3 \end{bmatrix}$ , then show that  $(A')' = A$ .

(d) A utility function is given by  $U = x^3 - 3xy^2 + y^3$ , then find the marginal utilities of  $x$  and  $y$ .

(e) What is a determinant? Can it exist for a non-square matrix?

3. Answer any six of the following questions :

$5 \times 6 = 30$

(a) If a demand and a supply function are given by

$$\begin{aligned} Q_d &= a - bP & (a, b > 0) \\ Q_s &= -c + dP & (c, d > 0) \end{aligned}$$

then analyze the effect of change in the slope of demand function  $b$  on equilibrium quantity  $Q$ .

KB23/374

( Turn Over )



(b) Show that the production function  $Z = \sqrt[3]{x^2 y}$  has a unit elasticity of substitution.

(c) Given  $P_1 = 80 - 3Q_1$  and  $P_2 = 104 - 4Q_2$  with joint cost function  $C = 50 - 10Q + 2Q^2$ , where  $Q = Q_1 + Q_2$ . Determine profit maximizing output level and maximum profit.

(d) What is a rank of a matrix? Find the rank of the following matrix :

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 1 & 0 \\ 0 & 1 & 2 \end{bmatrix}$$

(e) If  $A = \begin{bmatrix} 1 & 2 & -3 \\ 4 & -5 & 6 \end{bmatrix}$  and  $B = \begin{bmatrix} 3 & 2 & 3 \\ 4 & 6 & 6 \end{bmatrix}$  then prove that  $4(A+B) = 4A + 4B$ .

(f) Solve the following differential equation :

$$\frac{dy}{dx} + 5y = 9$$

Given  $y(0) = 4$ .

(g) If the production function is given by  $Q = 4L^{3/4}K^{5/4}$ , then find elasticity of substitution.

(h) If  $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ , then show that

$$A^2 - 4A - 5I = 0.$$

(i) A consumer's utility function is given by  $U = x^2 \sqrt{y}$ . Find the slope of the indifference curve.

4. Answer any two of the following questions :

$$10 \times 2 = 20$$

(a) Given the demand function  $P = 90 - 0.5Q$  and cost functions  $C_1 = 0.5Q_1^2$  and  $C_2 = 0.5Q_2^2$ , where  $Q = Q_1 + Q_2$  of two firms I and II. Determine equilibrium output, profit and price.

(b) The demand function under monopolistic competition with advertisement expenditure is given by  $P = 100 - 2Q + 5\sqrt{A}$ , where  $P$  is price,  $Q$  is output and  $A$  is advertisement expenditure. If his total cost function  $C = Q^2 - 5Q + 10 + A$ , then find the values of  $Q$  and  $A$  that will maximize profit of the firm.