

2025

ECONOMICS — HONOURS

Paper : DSCC-5

(Mathematical Economics - I)

Full Marks : 75

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Group - A

1. Answer **any ten** questions :

2×10

- (a) Define the Cartesian product of two sets with example.
- (b) What is the determinant of a 2×2 matrix?
- (c) Define a monotonic transformation with an example.
- (d) What is the difference between a linear and non-linear function?
- (e) Suppose matrix B is an inverse of matrix A. What will be AB?
- (f) State Euler's Theorem for homogeneous functions.

- (g) Let $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & -1 \\ 6 & 7 \end{bmatrix}$. Show that $AB \neq BA$.

- (h) Find $f'(1)$ and $f'(2)$ from the following functions :
 - (i) $y = f(x) = 18x$
 - (ii) $f(x) = -5x^{-2}$

- (i) Consider the function :
$$y = x^2 - 2x - 1; x > 0.$$
Sketch the graph.

- (j) What is a Leontief production function?
- (k) Define a quasiconvex function.
- (l) What is the slope of an indifference curve?
- (m) Mention the condition under which one Hessian matrix is positive definite.
- (n) What is meant by implicit function?

Please Turn Over

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(o) Find 'b' such that the function $f(x)$ is continuous :

$$f(x) = \begin{cases} 2x^2 + b & ; x \geq -1 \\ -x^3 & ; x < -1 \end{cases} \infty.$$

Group - B

2. Answer *any five* questions :

- (a) Find the inverse of the matrix $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$. 5
- (b) Test whether the function $f(x, y) = 3x^2 + 2y^2 - 6xy$ is convex or concave using the Hessian matrix. 5
- (c) Show that the function $f(x, y) = \min(x, y)$ is quasiconcave but not concave. 5
- (d) A utility function is given by $U = x + y$. Derive the Marshallian demand functions subject to budget constraint $P_x x + P_y y = M$. 5
- (e) Solve the following linear programming problem graphically : 5
 Maximize $Z = 4x + y$ subject to : $x + y \leq 5$, $3x + 2y \leq 12$, $x, y \geq 0$.
- (f) For the production function $Q = L^{0.5}K^{0.5}$, derive the isoquant equation for output $Q = 20$. 5
- (g) What do you mean by a Basic Feasible Solution in a LPP? 5
- (h) Consider the function $u = x^\alpha y^\beta$. Show that the function is strictly concave (downward) for all values of x and y if $0 < \alpha < 1$, $0 < \beta < 1$ and if $(\alpha + \beta) < 1$. What shape does the function have if $(\alpha + \beta) = 1$? 3+2

Group - C

Answer *any three* questions.

3. Solve the following problem using Lagrange's method : Maximize $U = x^3y$ subject to $x + 2y = 12$. Interpret the economic meaning of the Lagrange multiplier. 10
4. A firm has the cost function $C = 3L + 2K$ and the production function $Q = L^{0.6}K^{0.4}$. Minimize cost subject to $Q = 100$ and derive the conditional input demand functions. 10
5. Use Kuhn-Tucker conditions to solve : 10
 Maximize $f(x, y) = 5x + 2y$ subject to $x^2 + y^2 \leq 16$, $x \geq 0$, $y \geq 0$.
6. Using Shephard's Lemma, derive compensated demand functions for the cost function 10
 $C(p_1, p_2, U) = U(p_1^{0.5} + p_2^{0.5})^2$.

(3)

D(4th Sm.)-Economics-H/DSCC-5/CCF

7. Consider the Leontief system where the input matrix and the final demand vectors are given by.

$$A = \begin{bmatrix} 0.05 & 0.25 & 0.34 \\ 0.33 & 0.1 & 0.12 \\ 0.19 & 0.38 & 0 \end{bmatrix}; \quad d = \begin{bmatrix} 1800 \\ 200 \\ 900 \end{bmatrix}.$$

- (a) Check whether the system satisfies Hawkins-Simon conditions.
(b) Find the values of the three outputs.

4+6

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