



**2023/TDC(CBCS)/EVEN/SEM/
ECOHC-202T/154**

TDC (CBCS) Even Semester Exam., 2023

ECONOMICS

(Honours)

(2nd Semester)

Course No. : ECOHC-202T

(Mathematical Methods in Economics—II)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

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

SECTION—A

Answer any *ten* of the following questions : $2 \times 10 = 20$

1. What are differential equations?
2. Express the general formula for first-order differential equation.
3. Specify the order and degree of the following differential equations :

$$\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^3 = 12x$$



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4. If $A = \begin{bmatrix} 2 & 3 & 2 \\ 4 & 0 & 1 \end{bmatrix}$, find A' .
5. Show that $(A')' = A$.
6. Mention the important properties of matrix inversion.
7. What is homogeneous function?
8. Determine whether the following function is homogeneous :
$$f(x, y) = \sqrt{xy}$$
9. Find the total differentiation of $z = \sqrt{x+y}$.
10. Mention one characteristic of quasi-converse function.
11. For a multivariate function $y = f(x_1, x_2)$, what are the 1st order and 2nd order conditions for optimization?
12. Given the total cost function of a firm $TC = 4Q^2 + 7Q + 81$, find the marginal cost function.
13. Distinguish between closed input-output model and open input-output model.
14. What is input coefficient matrix?
15. Mention two limitations of input-output model.

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SECTION-B

Answer any five of the following questions : 10×5=50

16. Find general solution for the following : 5+5=10

(a) $\frac{dy}{dt} + 3t^2y = t^2$

(b) $2\frac{dy}{dt} - 2t^2y = gt^2$

17. Solve the following exact equations : 5+5=10

(a) $(12y + 7t + 6)dy + (7y + 4t - 9)dt = 0$

(b) $(12y^2t^2 + 10y)dy + (18y^3t)dt = 0$

18. (a) If $A = \begin{bmatrix} 4 & 0 & 1 \\ 3 & 2 & 1 \\ 1 & 5 & 2 \end{bmatrix}$, find the inverse of A. 5

(b) Given $V_1 = \begin{bmatrix} 3 \\ 4 \end{bmatrix}$, $V_2 = \begin{bmatrix} 9 \\ 1 \end{bmatrix}$, $V_3 = \begin{bmatrix} 2 \\ 5 \end{bmatrix}$, find
 $(V_1 + V_2) - V_3$. 3

(c) Prove that any two scalars g and k ,
 $(g+k)A = gA + kA$. 2

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19. (a) Solve the following market model : 5

$$Q_d = Q_s, Q_s = -3 + 0.6p, Q_d = 10 - 0.4p$$

(b) In a three-sector economy model, the economies being denoted by 1, 2, 3 respectively

$$Y_1 = C_1 + (X_1 - M_1) + 100 \quad Y_2 = C_2 + (X_2 - M_2) + 1200$$

$$C_1 = 0.8 Y_1 \quad C_2 = 0.7 Y_2$$

$$M_1 = 0.2 Y_1 \quad M_2 = 0.18 Y_2$$

$$X_1 = 0.15 Y_2 + 0.1 Y_3 \quad X_2 = 0.12 Y_1 + 0.15 Y_3$$

$$\text{and } Y_3 = C_3 + (X_3 - M_3) + 900$$

$$C_3 = 0.75 Y_3$$

$$M_3 = 0.25 Y_3$$

$$X_3 = 0.2 Y_1 + 0.25 Y_2$$

where Y , C , M and X represent national income, consumption, import and export. Find the equilibrium income. 5

20. Prove that given the linearly homogeneous production function $Q = f(K, L)$ the marginal physical product of labour and capital (MPP_L and MPP_K) can be expressed as the function of K alone.

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21. (a) Find the total derivative $\frac{dy}{dt}$, given

$$y = 2x_1^2 - 5x_1x_2 - 6x_2^2, \text{ where } x_1 = 3t^2, x_2 = 5 - 2t.$$

5

(b) Find $\frac{\partial y}{\partial x_1}$ and $\frac{\partial y}{\partial x_2}$ of the following functions : 2+3=5

$$(i) y = (x_1x_2 + 2x_2^2)(x_1^3 - 5x_1^2x_2)$$

$$(ii) y = \sqrt{3x_1^2 + 10x_1x_2^2 + x_2^4}$$

22. Using Lagrange multiplication method, find the extreme value of the function

$$y = x_1^2 + x_1x_2 + \frac{3}{2}x_2^2$$

23. Derive the 1st order and 2nd order conditions in order to show that indifference curve is negatively sloped and convex to the origin taking the utility function $U = f(x, y)$ where U = total utility, x and y are the quantities of two commodities.

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24. Find the consistent output level of a three-sector economy X_1 , X_2 and X_3 , given the input coefficient matrix (A), capital matrix (B), diagonal matrix of sectoral growth rate (G) and final demand vector (F).

$$A = \begin{bmatrix} 0.2 & 0.1 & 0.2 \\ 0.3 & 0.3 & 0.2 \\ 0.2 & 0.2 & 0.2 \end{bmatrix}, \quad B = \begin{bmatrix} 0.1 & 0.2 & 0.1 \\ 0.2 & 0.1 & 0.2 \\ 0.1 & 0.1 & 0.1 \end{bmatrix}$$

$$G = \begin{bmatrix} 0.02 & 0 & 0 \\ 0 & 0.63 & 0 \\ 0 & 0 & 0.02 \end{bmatrix}, \quad F = \begin{bmatrix} 2 & 0 & 0 \\ 3 & 0 & 0 \\ 2 & 5 & 0 \end{bmatrix}$$

25. (a) What do you mean by Hawkins-Simon condition? Explain. 5
- (b) If input-output model generated input-coefficient matrix is given by

$$B = \begin{bmatrix} 0.64 & 1.2 \\ 0.06 & 0.8 \end{bmatrix}$$

test whether Hawkins-Simon condition is satisfied. 5
