

6 SEM TDC DSE MTH (CBCS) 6 (H)

2025

(May)

MATHEMATICS

(Discipline Specific Elective)

(For Honours)

Paper : DSE-6

(**Mathematical Methods**)

Full Marks : 80

Pass Marks : 32

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. (a) Write the period of the function $\sin 2x$. 1

(b) Write the values of the coefficients a_n and b_n in the Fourier expansion of the function $f(x)$ in the interval $(-\pi, \pi)$ as

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cosh x + b_n \sinh x) \quad 2$$

(c) Find a Fourier series for the function $f(x) = \pi + x$ in the interval $(-\pi, \pi)$. 7

(2)

Or

Find a Fourier series for the function defined by the equation

$$f(x) = \begin{cases} -1 & \text{for } -\pi < x < 0 \\ 0 & \text{for } x = 0 \\ 1 & \text{for } 0 < x < \pi \end{cases}$$

2. (a) Write when Laplace transform of a function exists. 1
- (b) Write the value of (i) $L\{1\}$ and (ii) $L\{e^{-t}\}$. 1+1=2
- (c) Find (i) $L\{\cos^2 2t\}$ and (ii) $L\{\cos ht\}$. 2+2=4
- (d) Find the following (any two) : 4×2=8
- (i) $L\{(\sin t - \cos t)^2\}$
- (ii) $L\{(1 + te^t)^2\}$
- (iii) $L\{t^2 \cos 2t\}$
- (e) Find the Laplace transform of n th order derivative of a function. 5

Or

If $L\{F(t)\} = f(s)$, then show that

$$L\{F(at)\} = \frac{1}{a} f\left(\frac{s}{a}\right)$$

(3)

3. (a) Write the value of $L^{-1}\left\{\frac{1}{s^2+4}\right\}$. 1
- (b) Find (i) $L^{-1}\left\{\frac{1}{2s-7}\right\}$ and (ii) $L^{-1}\left\{\frac{9}{s^2+9}\right\}$. 2+2=4
- (c) Find $L^{-1}\left\{\frac{e^{-s}}{s^2+1}\right\}$. 2
- (d) Find the following (any one) : 3
- (i) $L^{-1}\left\{\frac{s}{(s^2+a^2)(s^2+b^2)}\right\}$
- (ii) $L^{-1}\left\{\frac{s+1}{s^2+6s+25}\right\}$
4. (a) Write the Fourier cosine integral formula. 1
- (b) If $F[f(x)] = f(p)$, then write the value of $F[f(ax)]$. 1
- (c) Find the Fourier cosine transform of the function defined by
- $$f(x) = \begin{cases} \cos x, & 0 < x < a \\ 0, & x \geq a \end{cases}$$
- 3
- (d) State and prove shifting property of Fourier transform. 6
- (e) Answer the following (any two) : 7×2=14
- (i) Find Fourier transform of $f(x)$ defined by $f(x) = e^{-\frac{x^2}{2}}$, $-\infty < x < \infty$.

(ii) Find Fourier transform of $f(x)$ defined by

$$f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a \end{cases}$$

(iii) Find Fourier transform of

$$f(x) = xe^{-x}, \quad 0 \leq x < \infty.$$

5. (a) Write the value of $L\left\{\frac{\partial^2 y}{\partial x^2}\right\}$. 1

(b) Find the transformed ordinary differential equation of

$$\frac{\partial y}{\partial t} = \frac{\partial^2 y}{\partial x^2}$$

by using Laplace transform. 2

(c) Solve the following using Laplace transform (any two) : 6×2=12

(i) $4 \frac{d^2 y}{dt^2} + \pi^2 y = 0, \quad y(0) = 2, \quad y'(0) = 0$

(ii) $\frac{d^2 y}{dt^2} + y = 6 \cos 2t, \quad y(0) = 3, \quad y'(0) = 1$

(iii) $\frac{d^2 y}{dt^2} + \frac{dy}{dt} = t^2 + 2t, \quad y(0) = 4, \quad y'(0) = -2$

(iv) $\frac{\partial y}{\partial t} = 2 \frac{\partial^2 y}{\partial x^2}, \quad y(0, t) = 0 = y(5, t),$

$$y(x, 0) = 10 \sin 4\pi x$$

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6 SEM TDC DSE MTH (CBCS) 2 (H)

2025

(May)

MATHEMATICS

(Discipline Specific Elective)

(For Honours)

Paper : DSE-2

(**Linear Programming**)

Full Marks : 80

Pass Marks : 32

Time : 3 hours

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

1. Answer the following :

- (a) Define basic feasible solution of a linear programming problem. 1
- (b) Under what condition you will proceed to Phase-II from Phase-I in two-phase method? 1

(2)

(c) Write the advantages of two-phase method over Big-M method. 2

(d) Solve by simplex method : 7

$$\text{Max } Z = 3x_1 + 2x_2$$

subject to

$$2x_1 + x_2 \leq 5$$

$$x_1 + x_2 \leq 3$$

$$\text{and } x_1, x_2 \geq 0$$

2. Answer any two from the following : 7×2=14

(a) Solve by two-phase method :

$$\text{Min } Z = 4x_1 + x_2$$

subject to

$$x_1 + 2x_2 \leq 3$$

$$4x_1 + 3x_2 \geq 6$$

$$3x_1 + x_2 = 3$$

$$\text{and } x_1, x_2 \geq 0$$

(b) Solve by Big-M method :

$$\text{Min } Z = 4x_1 + 3x_2$$

subject to

$$x_1 + 2x_2 \geq 8$$

$$3x_1 + 2x_2 \geq 12$$

$$\text{and } x_1, x_2 \geq 0$$

(3)

(c) Solving by Big-M method, prove that the following LPP has no feasible solution :

$$\text{Max } Z = 2x_1 - x_2 + 5x_3$$

subject to

$$x_1 + 2x_2 + 2x_3 \leq 2$$

$$\frac{5}{2}x_1 + 3x_2 + 4x_3 = 12$$

$$4x_1 + 3x_2 + 2x_3 \geq 24$$

$$\text{and } x_1, x_2, x_3 \geq 0$$

3. (a) Write True or False : 1

The dual of a maximization problem is a minimization problem.

(b) What do you mean by symmetric primal dual and unsymmetric primal dual problems? 2

(c) Write two advantages of duality. 2

(d) Find the dual of the primal : 5

$$\text{Max } Z = 2x_1 + 2x_2 - 5x_3$$

subject to

$$x_1 - x_2 + 2x_3 \leq 6$$

$$3x_1 + 2x_2 - 3x_3 \geq 4$$

$$x_1 + 3x_2 = 5$$

$$\text{and } x_1, x_2, x_3 \geq 0$$

- (e) If x_0 be any feasible solution to the primal $\text{Max } Z_x = Cx$, subject to $Ax \leq b$; $x \geq 0$ and w_0 be any solution to its dual $\text{Min } Z_D = b'w$ subject to $A'w \geq C'$, $w \geq 0$, then show that $Cx_0 \leq b'w_0$. 5

Or

Write the correspondence rules between the primal problem and the dual problem.

4. (a) Define feasible solution of a transportation problem. 1
- (b) Write down the mathematical formulation of transportation problem. 2
- (c) Find the initial basic feasible solution of the following transportation problem using Vogel's Approximation Method : 7

		Warehouse				Supply
		D_1	D_2	D_3	D_4	
Factory	O_1	15	28	13	21	18
	O_2	22	15	19	14	14
	O_3	16	12	14	31	13
	O_4	24	23	15	30	20
	Demand	16	15	10	24	

5. (a) Write True or False : 1
An assignment problem is a minimization problem.
- (b) What is an unbalanced assignment problem? How can you convert it into a balanced assignment problem? 2
- (c) Write down the computational procedure of Hungarian method for solving an assignment problem. 7

Or

Solve the assignment problem :

		I	II	III	IV
Operators	A	10	12	9	11
	B	5	10	7	8
	C	12	14	13	11
	D	8	15	11	9

6. (a) What do you mean by two-person zero-sum game? 1
- (b) Write the assumption made in the theory of games. 2

(6)

(c) Write short notes on any two from the following : $2 \times 2 = 4$

- (i) Mixed strategy
- (ii) Minimax principle
- (iii) Saddle point

(d) Each of two players A and B shows one or two fingers simultaneously. The player B pays to A an amount equal to the total number of fingers shown; on the other hand, A pays to B equal to the product of the numbers of fingers shown. Form the pay-off matrix. 4

Or

Find the value of 2×2 game algebraically by using mixed strategies :

		Player B	
		B ₁	B ₂
Player A	A ₁	6	-4
	A ₂	-1	2

(e) Use graphical method for solving the following game and find the value of the game : 9

		Player B			
		B ₁	B ₂	B ₃	B ₄
Player A	A ₁	2	2	3	-1
	A ₂	4	3	2	6

(7)

Or

Solve the following game problem by converting it into LPP :

		Player B	
		B ₁	B ₂
Player A	A ₁	3	1
	A ₂	-1	2
