Register No : ____________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL-MAY 2025

Third Semester

Agricultural Engineering

MA3301- Fourier Series and Linear Programming

Regulations - 2021

Duration : 3 Hrs ***Maximum : 100 Marks***

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	*Questions*	*BLT*	*CO*	*Marks*
1.	State Dirichlet's conditions for the existence of Fourier series of $f(x)$.	L1	1	2
2.	Obtain Fourier sine series of unity in (0,1)	L2	1	2
3.	Define Fourier Transform pair.	L1	2	2
4.	Define self reciprocal under Fourier Transform with an example.	L1	2	2
5.	Define slack and surplus variables.	L1	3	2
6.	Express the following LPP in standard form : $Max\ Z = 4x_1 + 5x_2 - 3x_3$ Subject to the constraints $x_1 + x_2 + x_3 = 10$, $x_1 - x_2 \geq 1$, $x_1 + 3x_2 + x_3 \leq 40$ and $x_1, x_2, x_3 \geq 0$.	L2	3	2
7.	Define unbalanced assignment problem.	L1	4	2
8.	Mention any three methods for finding the initial basic feasible solution of a transportation problem.	L2	4	2
9.	Define Non-linear programming problem.	L1	5	2
10.	State necessary and sufficient condition for Kuhn-Tucker.	L1	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)*

Q.No		*Questions*	*BLT*	*CO*	*Marks*
11.	a	Find the Fourier Series of the function $f(x) = x(2\pi - x)$ for $0 < x < 2\pi$.Also deduce the series $\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \cdots = \frac{\pi^2}{6}$.	L3	1	16
		Or			
	b	Find the Fourier Series expansion up to second harmonic for the function $f(x)$ given by the following table of values.	L2	1	16

x	0	π/3	2π/3	π	4π/3	5π/3	2π
f(x)	1.0	1.4	1.9	1.7	1.5	1.2	1.0

12.	a	Find the Fourier Transform of given $f(x) = \begin{cases} a^2 - x^2; & \lvert x \rvert < a \\ 0 & ; \lvert x \rvert > a > 0 \end{cases}$ and hence deduce (i) $\int_0^\infty \frac{sint - tcost}{t^3} dt = \frac{\pi}{4}$, (ii) $\int_0^\infty \left(\frac{sint - tcost}{t^3}\right)^2 dt = \frac{\pi}{15}$	L3	2	16

Or

	b	Find the Fourier sine and cosine transforms of $e^{-ax}, a > 0$ and hence evaluate (i) $\int_0^\infty \frac{dx}{(x^2+a^2)^2}$ (ii) $\int_0^\infty \frac{x^2 dx}{(x^2+a^2)^2}$.	L3	2	16
13.	a i	A firm manufactures headache pills in two sizes A and B. Size A contains 2 grains of Aspirin, 5 grains of Bicarbonate and 1 grain of Codeine. Size B contains 1 grain of Aspirin, 8 grains of Bicarbonate and 6 grain of Codeine. It is found by users that it requires at least 12 grains of Aspirin, 74 grains of Bicarbonate and 24 grains of Codeine for providing immediate effect. It is required to determine the least number of pills to cure Headache. Formulate the problem	L3	3	6
	ii	Solve the following Linear Programming Problem by using Graphical Method. $Maximize\ Z = 6x_1 + 8x_2$	L3	3	10

Subject to constraints:

$$5x_1 + 10x_2 \le 60$$
$$4x_1 + 4x_2 \le 40$$

and $x_1, x_2 \ge 0.$

Or

	b	Solve the following Linear Programming Problem by using Simplex Method $Maximize\ Z = 4x_1 + 10x_2$	L3	3	16

Subject to constraints:

$$2x_1 + x_2 \le 50$$
$$2x_1 + 5x_2 \le 100$$
$$2x_1 + 3x_2 \le 90$$

and $x_1, x_2 \ge 0.$

14.	a	Find the Optimal Solution for the Transportation Problem by using MODI Method:	L3	4	16

	1	2	3	4	Supply
I	21	16	25	13	11
II	17	18	14	23	13
III	32	27	18	41	19
Demand	6	10	12	15	

Or

	b i	Find the Initial basic feasible solution of the following Transportation Problem by using Least Cost Method:	L3	4	8

Sink →/ Origin ↓	A	B	C	D	E	Supply
P	2	11	10	3	7	4
Q	1	4	7	2	1	8
R	3	9	4	8	12	9
Demand	3	3	4	5	6	

	i i	Consider the problem of assigning five jobs to five persons. The assignments are given as follows. $$\begin{array}{cc} & \text{Job} \\ & \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\ \text{Person} \begin{array}{c} A \\ B \\ C \\ D \\ E \end{array} & \begin{pmatrix} 8 & 4 & 2 & 6 & 1 \\ 0 & 9 & 5 & 5 & 4 \\ 3 & 8 & 9 & 2 & 6 \\ 4 & 3 & 1 & 0 & 3 \\ 9 & 5 & 8 & 9 & 5 \end{pmatrix} \end{array}$$ Determine the Optimum Assignment schedule.	L3	4	8
15.	a	Using Kuhn-Tucker condition, Maximize $z = 3.6x_1 - 0.4x_1^2 + 1.6x_2 - 0.2x_2^2$ subject to the constraints $2x_1 + x_2 \leq 10, and\ x_1, x_2 \geq 0.$	L2	5	16
		Or			
	b	Obtain the sufficient and necessary conditions for the following Non-linear Programming Problem: Minimize $z = 2x_1^2 - 24x_1 + 2x_2^2 - 8x_2 + 2x_3^2 - 12x_3 + 200$ Subject to the constraints $x_1 + x_2 + x_3 = 11, x_1, x_2, x_3 \geq 0.$	L3	5	16