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Reg. No. :

Question Paper Code : 30902

M.E./M.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022

First Semester

Power Systems Engineering

MA 4107 – APPLIED MATHEMATICS FOR POWER SYSTEMS ENGINEERS

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is the condition for a generalized eigen vectors.

2. Determine whether $A = \begin{bmatrix} 3 & 1 & 1 \\ 2 & 2 & 4 \\ 1 & 1 & 1 \end{bmatrix}$ is similar to $B = \begin{bmatrix} 2 & 1 & 1 \\ 3 & 0 & 1 \\ 4 & 2 & 1 \end{bmatrix}$.

3. Define the dirac delta function in Laplace transform.

4. If $L[f(t); s] = F(S)$, then prove that $L[e^{at} f(t); s] = F(S-a)$.

5. Define energy Signals and power signals in Fourier trigonometric series.

6. Explain the periodic function in Fourier trigonometric series.

7. Define feasible solution in LPP.

8. Determine the initial basic feasible solution for the following transportation problem by using the north-west corner rule.

	D_1	D_2	D_3	D_4	
O_1	6	4	1	5	14
O_2	8	9	2	7	16
O_3	4	3	6	2	5
	6	10	15	4	35

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9. Write down the general non-linear programming problem in matrix notation.

10. Write down the necessary conditions for a maximum or minimum of objective function in non-linear programming problems.

PART B — (5× 13 = 65 marks)

11. (a) Find a Canonical basis for the given matrix

$$A = \begin{bmatrix} 3 & 2 & 0 & 1 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 3 & -1 \\ 0 & 0 & 0 & 3 \end{bmatrix}.$$ (13)

Or

(b) Construct a QR decomposition for the given matrix

$$A = \begin{bmatrix} 25 & -131 & -86 \\ 11 & -41 & -18 \\ -4 & 28 & 0 \end{bmatrix}$$ (13)

12. (a) Solve the initial boundary value problem described by

PDE : $U_{tt} = U_{xx}, 0 < x < 1, t > 0$

BCS : $U(0,t) = U(1,t) = 0, t > 0$

ECS : $U(x,0) = \sin \pi x, U_t(x,0) = -\sin \pi x, 0 < x < 1.$ (13)

Or

(b) An infinitely long string having one end at $x = 0$ is initially at rest on the x-axis. The end $x = 0$ undergoes a periodic transverse displacement described by $A_0 \sin wt, t > 0$. Find the displacement of any point on the string at any time t. (12)

13. (a) Calculate the average power of the periodic signal (Period J =2) for $f(t) = 2\cos 5\pi t + \sin 6\pi t$

(i) Using a time domain analysis.

(ii) Using a frequency domain analysis. (13)

Or

(b) Find a generalized Fourier Series expansions of the function $f(x) = 1, 0 < x < 1$, interms of the eigen function of $y'' + \lambda y = 0;\ 0 < x < 1$, $y(0) = 0,\ y(1) + y^1(1) = 0.$ (13)

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14. (a) Use Big-M-Method to solve the following LPP.

Max $Z = 2x_1 + x_2 + x_3$

Subject to the constraints

$4x_1 + 6x_2 + 3x_3 \le 8;\ 3x_1 - 6x_2 - 4x_3 \le 1.$

$2x_1 + 3x_2 - 5x_3 \ge 4;$ where $x_1, x_2, x_3 \ge 0.$ (13)

Or

(b) Consider the problems of assigning five jobs to five persons. The assignment costs are given as follows.

Jobs

Persons	1	2	3	4	5
A	8	4	2	6	1
B	0	9	5	5	4
C	3	8	9	2	6
D	4	3	1	0	3
E	9	5	8	9	5

Determine the optimum assignment schedule.

15. (a) Solve the non-linear programming problem :

Optimize $A = 4x_1^2 + 2x_2^2 + x_3^2 - 4x_1x_2$

Subject to the constraints :

$x_1 + x_2 + x_3 = 15,\ 2x_1 - x_2 + 2x_3 = 20$ where $x_1, x_2, x_3 \ge 0.$ (13)

Or

(b) Solve the following non-linear programming problem

Maximize $Z = 3.6x_1 - 0.4x_1^2 + 1.6x_2 - 0.2x_2^2$

Subject to the constraints :

$2x_1 + x_2 \le 10; x_1, x_2 \ge 0.$ (13)

PART C — (1 × 15 = 15 marks)

16. (a) Find the generalized inverse of

$$A = \begin{bmatrix} 2 & 2 & -2 \\ 2 & 2 & -2 \\ -2 & -2 & 6 \end{bmatrix}$$

Or

(b) Use Two-Phase Simple method to solve the following L.P.P.

Minimize $Z = -2x_1 - x_2$

Subject to the constrains $x_1 + x_2 \ge 2,\ x_1 + x_2 \le 4, x_1, x_2 \ge 0.$

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