W 2638

M.E. DEGREE EXAMINATION, JANUARY 2007.

First Semester

Power Systems Engineering

MA 1614 – APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

(Common to M.E. – Power Electronics and Drives, M.E. – Control and Instrumentation and M.E. – High Voltage Engineering)

(Regulation 2005)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define a norm of a square matrix A.

2. Prove that $\left(A^{+}\right)^{+} = A$.

3. Find the extremal of the functional

$$v[y(x)] = \int_0^1 \left(1 + y''^2\right) dx,$$

$y(0) = 0, y'(0) = 1, y(1) = 1, y'(1) = 1.$

4. State brachistochrone problem.

5. Solve the following problem graphically :

Max $z = 6x_1 + 15x_2$ such that

$$5x_1 + 3x_2 \le 15$$
$$2x_1 + 5x_2 \le 10, \ x_1, x_2 \ge 0.$$

6. Explain assignment problem.

7. What is meant by stage in Dynamic programming?

8. Give an example of Dynamic programming model.

9. Explain statistically independence processes.

10. Write any four properties of Power density spectrum.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find the generalized eigen vector of rank 2 corresponding to the eigen value $\lambda = 4$ for the matrix

$$A = \begin{pmatrix} 4 & 0 & 0 & 0 \\ 1 & 5 & 1 & 0 \\ -1 & -1 & 3 & 0 \\ 0 & 0 & 0 & 3 \end{pmatrix}$$

(8)

(ii) Find the Pseudo inverse of the matrix

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

(8)

Or

(b) Construct a singular value decomposition for the matrix.

$$A = \begin{pmatrix} -3 & 1 \\ -2 & 1 \\ -1 & 1 \\ 0 & 1 \\ 1 & 1 \\ 2 & 1 \\ 3 & 1 \end{pmatrix}$$

(16)

12. (a) (i) Find a curve with specified boundary points whose rotation about the axis of abscissas generates a surface of minimum area. (10)

(ii) Find the extremal of the functional $v[y(x)] = \int_0^{\pi/2} \left(y''^2 - y^2 + x^2\right) dx$ that satisfies the condition $y(0) = 1,\ y'(0) = 0,\ y(\pi/2) = 0,\ y'(\pi/2) = -1$. (6)

Or

(b) Find a solution of the equation

$$\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = f(x, y)$$

inside a rectangle $D, 0 \le x \le a,\ 0 \le y \le b$, that vanishes on the boundary of D. (16)

13. (a) (i) Using simplex method, solve the LPP to

Maximize $z = 6x_1 + 9x_2$ subject to,

$$2x_1 + 2x_2 \leq 24$$
$$x_1 + 5x_2 \leq 44$$
$$6x_1 + 2x_2 \leq 60 \text{ and}$$
$$x_1, x_2 \geq 0.$$

(8)

(ii) Obtain a first feasible solution of a transportation problem whose cost and requirements table is given in the following table.

Destination

		D_1	D_2	D_3	Supply
Origin	O_1	2	7	4	5
	O_2	3	3	1	8
	O_3	5	4	7	7
	O_4	1	6	2	14
	Demand	7	9	18	Total 34

(8)

Or

(b) (i) Solve the following problem graphically :

Maximize $z = 3x_1 - x_2$ subject to

$$2x_1 + x_2 \geq 2$$
$$x_1 + 3x_2 \leq 3$$
$$x_2 \leq 4, x_1, x_2 \geq 0.$$

(8)

(ii) Solve the assignment problem for minimum cost :

	Jobs	J_1	J_2	J_3	J_4
Persons	P_1	20	13	7	5
	P_2	25	18	13	10
	P_3	31	23	18	15
	P_4	45	40	23	21

(8)

14. (a) Use Dynamic programming to solve :

Maximize $z = 2x_1 + 5x_2$ such that

$$2x_1 + x_2 \le 43$$
$$2x_2 \le 46, x_1, x_2 \ge 0.$$

(16)

Or

(b) Solve the following LPP by dynamic programming :

Maximize $z = 8x_1 + 7x_2$ subject to

$$2x_1 + x_2 \le 8$$
$$5x_1 + 2x_2 \le 15, \; x_1, x_2 \ge 0.$$

(16)

15. (a) (i) Show that the random process $X(t) = A\cos(\omega_0 t + \theta)$ is wide sense stationary, where A and ω_0 are constants and θ is uniformly distributed random variable on the interval $(0, 2\pi)$. (8)

(ii) If the auto correlation function for a stationary process is

$$R_{XX}(z) = 25 + \frac{4}{1 + 6z^2},$$

find the mean value and variance of the process $X(t)$. (8)

Or

(b) Consider the random process $X(t) = A\cos(\omega_0 t + \theta)$, where A and ω_0 are real constants and θ is a random variable uniformly distributed on the interval $(0, \pi/2)$. Find the power density spectrum and the average power. (16)