Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech(EE-OLD)/SEM-2/EEP-206/2011

2011

APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

[*Graph sheet(s) will be supplied by the Institute.*]

Answer any *five* questions. 5 × 14 = 70

1. a) Reduce the quadratic form

$$6x^2 + y^2 + 18z^2 - 4yz - 12zx$$

to the normal form and find its rank, index and signature and hence determine its nature.

b) Find the absolutely smallest eigenvalue and the corresponding eigenvector of the matrix

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

correct to 2 decimal places using the power method.

7 + 7

2. a) A firm manufactures two products A and B on which the profits earned are Rs. 5 and Rs. 8 respectively. Each product is prepared on two machines X and Y . The machine time (in minutes) required for these products on two machines and their availability are as shown below :

Machine	Product		Availability of machine (minutes) per day
	A	B	
X	2	1	400
Y	4	1	600

It is required to find the number of units of products A and B to be manufactured per day to get maximum profit. Formulate the problem as linear programming mathematical model and solve it graphically by iso-profit line method.

b) Prove that every extreme point of the convex set of all feasible solutions of the system $Ax = b$, $x \geq 0$ corresponds to a basic feasible solution. 7 + 7

3. a) What are the disadvantages of Big M method over two-phase method ?

b) Use the two-phase simplex method to solve the following linear programming problem :

Maximize $Z = 2x_1 + x_2 + 3x_3$

subject to the constraints

$x_1 + x_2 + 2x_3 \geq 5$

$2x_1 + 3x_2 + 4x_3 = 12$

$x_1, x_2, x_3 \geq 0.$ 4 + 10

4. Use the revised simplex method to solve the following linear programming problem :

Maximize $Z = 5x_1 + 3x_2$

subject to the constraints

$3x_1 + 8x_2 \leq 12$

$5x_1 + 2x_2 \leq 10$

$x_1 + x_2 \leq 2$

$x_1, x_2 \geq 0$ 14

5. Use Wolfe's method to solve the quadratic programming problem :

Maximize $f(x) = 4x_1 + 6x_2 - 2x_1^2 - 2x_1 x_2 - 2x_2^2$

subject to the constraints

$x_1 + 2x_2 \leq 2$

$x_1, x_2 \geq 0.$ 14

6. a) Convert the following differential equation into an integral equation :

$$\frac{d^2y}{dx^2} + \lambda xy = f(x)$$

b) Using iterative method, solve

$$y(x) = (5x/6) + (1/2)\int_0^1 xt\, y(t)\, dt .$$ 7 + 7

7. Solve the following integral equation and discuss all its possible cases :

$$y(x) = f(x) + \lambda \int_0^1 (1 - 3xt)\ y(t)\, dt\ . \qquad 14$$

8. A small maitenance project consists of the following jobs whose precedence relationships are given below :

Job	1-2	1-3	2-3	2-5	3-4	3-6	4-5	4-6	5-6	6-7
Duration (days)	15	15	3	5	8	12	1	14	3	14

a) Draw an arrow diagram representing the project.

b) Find the total float for each activity.

c) Find the critical path and the total project duration.