Reg. No. : | | | | | | | | | | | |

L 5252

M.E. DEGREE EXAMINATION, MAY/JUNE 2009.

First Semester

Power Systems Engineering

MA 149 — APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

(Common to M.E. – Power Electronics and Drives and
M.E. Control and Instrumentation)

(Regulation 2002)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Do all matrix norms satisfy sub-multiplicative property? If not give example.

2. It is known that the matrix $A = \begin{bmatrix} 4 & 1 \\ 0 & 4 \end{bmatrix}$ has a generalized eigen vector of type 2 corresponding to $\lambda = 4$. Find it.

3. Show that the shortest curve joining two points is a straight line.

4. For $\frac{dy}{dx} \equiv y_x \neq 0$, show the equivalence of the two forms of Euler's equation $\frac{\partial f}{\partial x} - \frac{d}{dx}\frac{\partial f}{\partial y_x} = 0$ and $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(f - y_x \frac{\partial f}{\partial y_x}\right) = 0$.

5. Solve the LPP graphically :

   Maximize $Z = x_1 + 2x_2$

   Subject to $x_1 - x_2 \leq 1$

   $x_1 + x_2 \geq 3$

   $x_1, x_2 \geq 0$.

6. What is degeneracy in a Transportation problem? How will you resolve it?

7. Why are the components numbered in reverse order in dynamic programming.

8. State the principles of optimality.

9. Let $\{X(t), t \geq 0\}$ be a random process defined by $X(t) = Y \cos \omega t$, $t \geq 0$ where ω is a constant and Y is a uniform random variable over (0, 1). Describe $X(t)$.

10. Define Markov process and Markov chain.

PART B — (5 × 16 = 80 marks)

11. (a) Find the eigen values of $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 18 & -1 & -7 \end{bmatrix}$ using QR algorithm.

Or

(b) Find the least squares solution to $x + 2y + z = 1$, $3x - y = 2$, $2x + y - z = 2$, $x + 2y + 2z = 1$.

12. (a) Find the extrema of the function $V(x) = \int_0^{\pi/2} \left(x_1'^2 + x_2'^2 + 2x_1 x_2\right) dt$ subject to the boundary conditions $x_1(0) = 0$, $x_1(\pi/2) = 1$, $x_2(0) = 0$, $x_2(\pi/2) = 1$.

Or

(b) Use Ritz method to get an approximate solution of $\frac{d^2y}{dx^2} + xy = x$ subject to $y(0) = 0$, $y(1) = 0$.

13. (a) Solve the LPP by Two-Phase method :

Maximize $Z = 3x_1 - x_2$

Subject to $2x_1 + x_2 \geq 2$

$x_1 + 3x_2 \leq 3$

$x_2 \leq 4$

$x_1, x_2 \geq 0$.

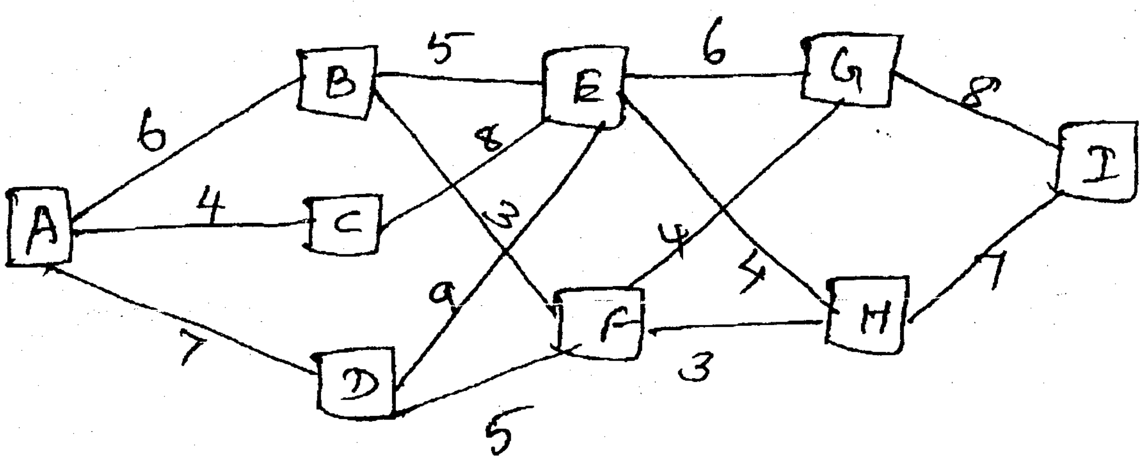
Or

(b) A software company that has four projects with four departments of a Government. Based on the experience of the project leaders, they differ in terms of their performance of various projects. The estimated time of completion is given below :

		Projects			
		A	B	C	D
Departments	I	20	28	19	13
	II	15	30	16	28
	III	40	21	20	17
	IV	21	28	26	12

How should tasks be allocated, so as to minimize the time?

14. (a) Let the cities A to I be connected by road as per the following network. Numbers on the line represent the distance in km. Find the shortest route from A to I.



Or

(b) Use dynamic programming problem to solve

Minimize $y_1^2 + y_2^2 + y_3^2$

Subject to $y_1 y_2 y_3 = 6$

$y_i > 0$ and integers.

15. (a) (i) Consider a random process $X(t)$ defined by $X(t) = U\cos\omega t + V\sin\omega t$, $-\infty < t < \infty$ where ω is constant and U and V are random variables. Show that the condition $E(U) = E(V) = 0$ is necessary for $X(t)$ to be stationary and that $X(t)$ is wss iff U and V are uncorrelated with equal variance.

(ii) Find the power spectral density of a WSS process with autocorrelation function $R(\tau) = e^{-\alpha\tau^2}$.

Or

(b) Let Z and θ be independent random variables such that Z has a density function

$$f(z) = \begin{cases} 0 & z < 0 \\ z e^{-z^2/2} & z > 0 \end{cases}$$

and θ is uniformly distributed in $(0, 2\pi)$. Show that $\{X_t, -\infty < t < \infty\}$ is a Gaussian process if $X_t = Z\cos(2\pi t + \theta)$.