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

Question Paper Code : 81753

M.E. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

First Semester

Power Electronics Drives

MA 9216/MA 9314/UMA 9111/MA 902/UMA 9122/10233 PS 101 — APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

(Common to M.E. Power Systems Engineering, M.E. Embedded System Technologies, M.E. Control and Instrumentation, M.E. Power Management and M.E. Electrical Drives and Embedded Control)

(Regulation 2009/2010)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Show that $X = [1,\ 0,\ 0]^T$ is a generalized eigen vector of rank 2 corresponding to the eigen value $\lambda = 3$ for the matrix $A = \begin{bmatrix} -7 & -25 & 1 \\ 4 & 13 & 1 \\ 0 & 0 & 2 \end{bmatrix}$.

2. Show that the generalized inverse is unique.

3. Explain any two assumptions in Linear Programming Models.

4. A plant manufactures washing machines and dryers. The major manufacturing departments are the stamping dept., motor and transmission dept. and assembly dept. The first two departments produce parts for both the products while the assembly lines are different for the two products. The monthly dept. Capacities are

Stamping dept	:	1,000	Washers or	1,000 dryers
Motor and transmission dept.	:	1,600	Washers or	7,000 dryers
Washer assembly line	:	9,000	Washers only	
Dryer assembly line	:	5,000	dryers only	

Profits per piece of washers and dryers Rs. 270 and Rs. 300 respectively. Formulate the L.P. model.

5. What is the moment generating function of Geometric distribution?

6. Write down any two properties of Normal distribution.

7. A self-service store employs one cashier at its counter. Nine customers arrive on an average every 5 minutes while the cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for service time, find average number of customers in a queque or average queue length.

8. Consider a situation in which the mean arrival rate is one customer every 4 minutes and the mean service time is $2\frac{1}{2}$ minutes. If the waiting cost is Rs. 5 per unit per minute and the minimum cost of servicing one unit is Rs. 4, find the minimum cost service rate.

9. Why is Crank Nicholson's scheme called on implicit scheme?

10. Write down the Runge-Kutta formula of fourth order to solve $\frac{dy}{dx} = f(x, y)$ with $y(x_0) = y_0$.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Construct a QR algorithm for $A = \begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 2 \end{pmatrix}$ working to six significant digits and show roundoff error can generated an incorrect Q matrix when the columns of A are linearly independent.

(ii) Determine the number of generalized eigen vectors of each rank corresponding to $\lambda = 4$ that will appear in a canonical basis for

$$A = \begin{bmatrix} 4 & 2 & 1 & 0 & 0 & 0 \\ 0 & 4 & -1 & 0 & 0 & 0 \\ 0 & 0 & 4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 4 & 2 & 0 \\ 0 & 0 & 0 & 0 & 4 & 0 \\ 0 & 0 & 0 & 0 & 0 & 7 \end{bmatrix}.$$

Or

(b) Compute the singular values and the singular value decomposition of $A = \begin{pmatrix} 1 & 1 \\ 1 & 1 \\ 0 & 0 \end{pmatrix}$.

12. (a) (i) By graphical method, solve the following LPP.

Max. : $Z = 3X_1 + 4X_2$

Subject to : $5X_1 + 4X_2 \le 200$; $3X_1 + 5X_2 \le 150$;

$5X_1 + 4X_2 \ge 100$; $8X_1 + 4X_2 \ge 80$ and

$X_1, X_2 \ge 0$.

(ii) Using simplex method, solve LPP

Maximize : $Z = X_1 + X_2 + 3X_3$

Subject to : $3X_1 + 2X_2 + X_3 \le 3$;

$2X_1 + X_2 + 2X_3 \le 2$;

$X_1, X_2, X_3 \ge 0$.

Or

(b) (i) Determine an initial basic feasible solution for the following transportation problem, using Matrix minima method.

	D_1	D_2	D_3	D_4	Supply
O_1	1	2	3	4	6
O_2	4	3	2	0	8
O_3	0	2	2	1	10
Demand	4	6	8	6	24

(ii) Four different jobs can be done on four different machines and taken down time costs are prohibitively high for change over. The matrix below gives the cost in rupees of producing job '*i*' on machine '*j*'.

Jobs	Machine M_1	M_2	M_3	M_4
J_1	5	7	11	6
J_2	8	5	9	6
J_3	4	7	10	7
J_4	10	4	8	3

How should the jobs be assigned to the various machines so that the total cost is minimised?

13. (a) (i) A random variable X has the probability function $p(x) = \frac{1}{2^x}$; $x = 1, 2, 3$. Find its (1) mgf (2) mean (3) variance.

(ii) If $X_1 \sim B(n_1, p)$, $X_2 \sim B(n_2, p)$ are independent random variables, then prove that $X_1 + X_2$ is $B(n_1 + n_2, p)$.

Or

(b) (i) Prove that the recurrence relation for central moments for poisson distribution is $\mu_{r+1} = r\lambda\mu_{r-1} + \lambda\frac{d\mu_r}{d\lambda}$.

(ii) If X is normally distributed with mean 8 and S.D. 4, find $P(5 \le x \le 10)$, $P(10 \le x \le 15)$, $P(X \ge 15)$ and $P(X \le 5)$.

(iii) The daily consumption of milk in a city, in excess of 20,000 litres is approximately distributed as a gamma variate with the parameter $\alpha = 2$ and $\beta = \frac{1}{10{,}000}$. The city has a daily stock of 30,000 litres. What is the probability that the stock is insufficient on a particular day?

14. (a) At a one-man barber shop, the customers arrive following poisson process at an average rate of 5 per hour and they are served according to experimental distribution with an average service rate of 10 minutes. Assuming that only 5 seats are available for waiting customers, find the average time a customer spends in the system.

Or

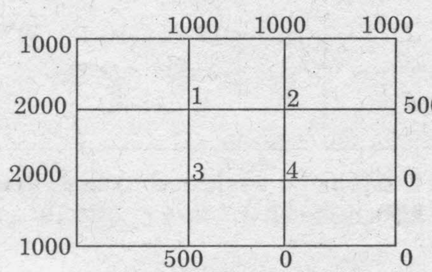
(b) An electricity board has 3 bill counters providing service exponentially distributed at the rate of 12 customers per hour. It receives on the average 24 customers per hour, in a poisson distribution. Determine.

(i) The probability that a customer will be sent immediately.

(ii) Find the probability that a customer will hav to wait

(iii) What is the average total time that a customer must spend at the bill counter?

15. (a) Given the values of $u\ (x,\ y)$ on the boundary of the square given in the figure, evaluate the function $u\ (x,\ y)$ satisfying Laplace's equation $\nabla^2 u = 0$ at the pivotal points of the figure.



Or

(b) Solve Numerically $4\ u_{xx} = u_{tt}$ given that $u(0,t) = 0 = u\ (4,t)$; $u_t(x,\ 0) = 0$ and $u(x,\ 0) = (4 - x)$, taking $h = 1$ and $K = \frac{1}{2}$.