Reg. No. : [ ]

Question Paper Code : 40726

M.E./M.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

First Semester

Control and Instrumentation Engineering

MA 5155 — APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

(Common to M.E. Electrical Drives and Embedded Control/M.E. Embedded System Technologies/M.E. Instrumentation Engineering/M.E. Power Electronics and Drives/M.E. Power Systems Engineering

(Regulations 2017)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find a generalized eigenvector of rank 3 and $\lambda = 5$ for the matrix $A = \begin{bmatrix} 5 & 1 & 0 \\ 0 & 5 & 1 \\ 0 & 0 & 5 \end{bmatrix}$

2. Define singular values of a matrix.

3. Find the extremal of the functional $I = \int_{x_0}^{x_1} \left(y'^2 - y^2\right) dx$.

4. Define isoperimetric problem.

5. Write down the axioms of probability.

6. If X is a Poisson variate such that $P(X = 1) = P(X = 2)$, then find $P(X = 0)$.

7. Define an optimal solution of an L.P.P.

8. Use graphical method to solve the L.P.P :
   Maximize $z = x_1 + x_2$,
   Subject to $x_1 + x_2 \le 1, -3x_1 + x_2 \ge 3, x_1 \ge 0, x_2 \ge 0$.

9. Find the Fourier series of $f(x) = x$ on $[-\pi, \pi]$.

10. State Parseval's theorem.

PART B — (5 × 13 = 65 marks)

11. (a) Compute the Cholesky's decomposition of the matrix $A = \begin{bmatrix} 1 & -1 & 3 & 2 \\ -1 & 5 & -5 & -2 \\ 3 & -5 & 19 & 3 \\ 2 & -2 & 3 & 21 \end{bmatrix}$. (13)

Or

(b) Obtain the QR factorization of the matrix $A = \begin{bmatrix} 9 & 0 & 26 \\ 12 & 0 & -7 \\ 0 & 4 & 4 \\ 0 & -3 & -3 \end{bmatrix}$. (13)

12. (a) State and prove Brachistochrone problem. (13)

Or

(b) Using Ritz method, solve the boundary value problem $y'' - y + x = 0,\ 0 \le x \le 1,\ y(0) = y(1) = 0$. (13)

13. (a) Find the moment generating function of geometric distribution and hence find its mean and variance. (13)

Or

(b) State and prove the memoryless property of exponential distribution. Use it to solve the problem :

The time (in hours) required to repair a machine is exponentially distributed with parameter 1/2.

(i) What is the probability that a repair time exceed 2h?

(ii) What is the probability that a repair time takes at least 10 hrs given that is duration exceeds 9 hours? (13)

14. (a) Use simplex method to solve the L.P.P :

Maximize $z = 2x_1 - x_2 + x_3$

Subject to $3x_1 + x_2 + x_3 \le 60,\ x_1 - x_2 + 2x_3 \le 10,$

$x_1 + x_2 - x_3 \le 20,\ x_1 \ge 0,\ x_2 \ge 0$ and $x_3 \ge 0$. (13)

Or

(b) Solve the assignment problem : (13)

	M_1	M_2	M_3	M_4
J_1	18	26	17	11
J_2	13	28	14	26
J_3	38	19	18	15
J_4	19	26	24	10

15. (a) Obtain the Fourier series of $f(x) = e^x$ in $[-1, 1]$. Also discuss the convergence of this series. (13)

Or

(b) Find the Fourier series of $f(x) = x^2$ for $0 \le x < 3$. Also find the amplitude spectrum of it. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Determine the extremal of the functional $I[y(x)] = \int_{-a}^{a} \left[\frac{1}{2}\mu y''^2 + \rho y\right] dx$ that satisfies the boundary conditions $y(-a) = 0,\ y'(-a) = 0,\ y(a) = 0,\ y'(a) = 0$. (15)

Or

(b) Find the basic feasible solution for the following transportation problem using Vogel's approximation method. (15)

	D	E	F	G	Available
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Demand	200	225	275	250	