

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 $I = \int_{x_0}^{x_1} (y'^2 - y^2) dx$.
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 $x_1 + x_2 \leq 1$, $-3x_1 + x_2 \geq 3$, $x_1 \geq 0$, $x_2 \geq 0$.
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

$$A = \begin{bmatrix} 1 & -1 & 3 & 2 \\ -1 & 5 & -5 & -2 \\ 3 & -5 & 19 & 3 \\ 2 & -2 & 3 & 21 \end{bmatrix} \quad (13)$$

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 $y'' - y + x = 0$, $0 \leq x \leq 1$, $y(0) = y(1) = 0$. (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 $3x_1 + x_2 + x_3 \leq 60$, $x_1 - x_2 + 2x_3 \leq 10$,
 $x_1 + x_2 - x_3 \leq 20$, $x_1 \geq 0$, $x_2 \geq 0$ and $x_3 \geq 0$. (13)

Or

- (b) Solve the assignment problem : (13)

$$\begin{matrix} & M_1 & M_2 & M_3 & M_4 \\ J_1 & 18 & 26 & 17 & 11 \\ J_2 & 13 & 28 & 14 & 26 \\ J_3 & 38 & 19 & 18 & 15 \\ J_4 & 19 & 26 & 24 & 10 \end{matrix}$$

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 $0 \leq x < 3$. 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	