Reg. No.																

Question Paper Code	14767

M.E. - DEGREE EXAMINATIONS, APRIL / MAY 2026

First Semester

M.E. - Embedded Systems Technologies

24PESMA102 - APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS

Regulations - 2024

(Use of *Tables* is permitted)

Duration: 3 Hours | Max. Marks: 100

PART – A (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	K – Level	CO
1.	Let A be a 4×4real symmetric positive definite matrix. Which of the following statements is true about its Cholesky decomposition? a) $A = LL^T$, where L is a lower triangular matrix with positive diagonal entries. b) $A = LL^T$, where $L$is lower triangular and $U$is upper triangular with all ones on the diagonal. c) A= QR, where Q is orthogonal and R is upper triangular. d) $A = PDP^{-1}$, where $D$is diagonal with eigenvalues of A.	1	K2	CO1
2.	Let V be an n-dimensional vector space over $\mathbb{R}$. Which statement is correct about the canonical basis? a) It exists only for infinite-dimensional spaces. b) It consists of vectors with a single 1 and the rest 0 in each coordinate. c) It is the set of eigenvectors of any matrix in V. d) It is orthonormal only if the space is complex.	1	K2	CO1
3.	Let A be $3 \times 2$with rank 2. If its SVD is $A = U\Sigma V^T$, what is the size of Σ? a) 2×2 b) 3×2 c) 3×3 d) 2×3	1	K1	CO1
4.	Let $[y] = \int_{x_0}^{x_1} F(x, y, y') \, dx$. The first variation δJ is defined as: a) $\delta J = \frac{d}{dx} F(x, y, y')$ b) $\delta J = \frac{d}{d\in} J(y+\in \eta)/_{\in=0}$ c) $\delta J = \int_{x_0}^{x_1} y \, dx$ d) $\delta J = F_y - \frac{d}{dx} F_{y'}$	1	K1	CO2
5.	For a functional $J[y] = \int_{x_0}^{x_1} F(x, y, y') \, dx$, the Euler-Lagrange equation is: a) $F_y = 0$ b) $F_{y'} = 0$ c) $F_y - \frac{d}{dx} F_{y'} = 0$ d) $\frac{dF}{dx} = 0$	1	K1	CO2
6.	The Ritz method is based on: a) Discretizing the independent variable b) Approximating the solution by a linear combination of trial functions c) Using Euler's equation only d) Integrating by parts	1	K2	CO2
7.	Let $A$and Bbe two events in a sample space. According to the axioms of probability, which of the following is always true? a) $P(A \cup B) = P(A) + P(B)$ b) $0 \leq P(A) \leq 1$ c) $P(A \cap B) \geq P(A) + P(B) - 1$ d) Both b) and c).	1	K3	CO3
8.	The moment generating function (MGF) of a random variable $X$is $M_X(t) = E[e^{tX}]$. If $M_X'(0) = 5$, then: a) E[X]=5 b) Var(X)=5 c) E[X^2]=5 d) E[e^X]=5	1	K3	CO3

9.	A Poisson random variable Xhas mean 4. The probability $P(X = 2)$ is: a) 0.1465 b) 0.2 c) 0.1 d) 0.3	*1*	*K3*	*CO3*
10.	Which of the following statements is **true** for a Linear Programming Problem? a) The objective function and constraints must be linear b) The solution always exists c) All variables can take negative values d) Constraints must be inequalities only	*1*	*K2*	*CO4*
11.	In the graphical method, for a maximization problem, the optimal solution occurs: a) At the intersection of the axes b) At any point inside the feasible region c) At a corner point of the feasible region d) At the midpoint of the feasible region	*1*	*K1*	*CO4*
12.	In a balanced transportation problem with 4 sources and 5 destinations, the number of basic variables in an initial feasible solution is: a) 8 b) 9 c) 10 d) 7	*1*	*K3*	*CO4*
13.	According to Dirichlet's conditions, the Fourier series of a function $f(x)$converges at a discontinuous point x_0 to: a) $f(x_0)$ b) Average of left and right limits: $\frac{f(x_0^-)+f(x_0^+)}{2}$ c) Zero d) Maximum of $f(x)$	*1*	*K1*	*CO5*
14.	A non-periodic function defined on $[0, \mathrm{L}]$ can be expanded as a Fourier series on $[-L, L]$ by: a) Reflecting as an even function → Cosine series b) Reflecting as an odd function → Sine series c) Both a) and b) d) Only by using complex exponentials	*1*	*K3*	*CO5*
15.	For a regular Sturm-Liouville problem: a) Eigen functions corresponding to different eigen values are orthogonal b) Eigen values can be negative c) There is only one eigenfunction d) Solutions are always polynomial	*1*	*K3*	*CO5*
16.	The generalized Fourier series expands a function $f(x)$as: a) Linear combination of orthogonal eigenfunctions of a Sturm-Liouville problem b) Only sines and cosines c) Only exponentials d) Only polynomials	*1*	*K2*	*CO5*

PART – A (ii) (Short Answer Questions)
(8 × 3 = 24 Marks)
Answer ALL Questions

17.	Find the Cholesky decomposition of $A = \begin{bmatrix} 4 & 2 \\ 2 & 3 \end{bmatrix}$.	*3*	*K3*	*CO1*
18.	Generate the canonical basis for $\mathbb{R}^4$and express the vector $\mathbf{v} = [1, -2, 3, 0]^T$ in terms of this basis.	*3*	*K4*	*CO1*
19.	State the general form of an isoperimetric problem and explain the use of a Lagrange multiplier.	*3*	*K3*	*CO2*
20.	State and explain the additivity property of a functional.	*3*	*K4*	*CO2*
21.	A test for a disease is 95% accurate. The disease occurs in 1% of the population. If a person tests positive, find the probability that the person actually has the disease using Bayes' theorem.	*3*	*K3*	*CO3*
22.	Explain what is meant by degeneracy in the simplex method and give an example.	*3*	*K3*	*CO4*

23. Explain how to test the optimality of a basic feasible solution in a transportation problem using MODI method. *3* *K4* *CO4*

24. Explain the concept of generalized Fourier series and its relation to eigenfunctions of a Sturm-Liouville system. *3* *K3* *CO5*

PART - B (Descriptive Answer Questions)
(5 × 12 = 60 Marks)
Answer ALL Questions

25. a) Solve the system of equations by Cholesky decomposition method: $x - y + 3z = 2, -2x + 3y + 4z = 4, 3x + 4y - 10z = 7$. *12* *K3* *CO1*

OR

b) Derive the singular value decomposition of A = $\begin{pmatrix} 1 & 2 \\ 2 & 1 \\ 1 & 3 \end{pmatrix}$. *12* *K3* *CO1*

26. a) State and Prove Brachistochrone Problem. *12* *K3* *CO2*

OR

b) Solve the *boundary value problem* $\frac{d^2y}{dx^2} - y + x = 0$, $0 \leq x \leq 1$, $y(0) = 0$ *and* $y(1) = 0$ by Rayleigh Ritz method. *12* *K3* *CO2*

27. a) A random variable X has the following probability function: *12* *K4* *CO3*

X	0	1	2	3	4	5	6	7
P(x)	0	K	2K	2K	3K	K_2	$2K_2$	$7K^2 + K$

i) Find K.

ii) Evaluate P[$X < 6$], P[$X \geq 6$]

iii) If P[$X \leq C$]>$\frac{1}{2}$, then find the minimum value of C

iv) P[$1 < X < 5$]

v) Evaluate P[$1.5 < X < 4.5/X > 2$]

Find the mean and variance of X.

OR

b) (i) Derive the moment generating function and hence find its mean and variance of Poisson distribution. *6* *K4* *CO3*

(ii) If X is a normal variate with mean 30 and S.D 5. Calculate the probabilities that (a) 26 ≤ X ≤ 40, b) X ≥ 45, c)$|X - 30| > 5$. *6* *K4* *CO3*

28. a) Evaluate using Big -M method : *12* *K5* *CO4*

Minimize $Z = 4x_1 + 3x_2$

Subject to $2x_1 + x_2 \geq 10$

$3x_1 + 2x_2 \leq 6$

$x_1 + x_2 \geq 6$

and $x_1, x_2 \geq 0$.

OR

b) Determine the initial Basic Feasible solution from the following Transportation table by Vogel's Approximation Method. The cost of shipping from each plant to each destination is given in Rs. 100. *12 K5 CO4*

Plant	Destination				Supply
	1	2	3	4	
1	2	3	11	7	6
2	1	0	6	1	1
3	5	8	15	9	10
Demand	7	5	3	2	17

Hence evaluate whether the initial solution is optimum by MODI method.

29. a) (i) Evaluate the Fourier series $f(x) = x^2, 0 < x < 1$. *6 K5 CO5*

(ii) Evaluate the eigen values of the system $y'' + \lambda y = 0, y(0) = 0, y(1) = 0$. *6 K5 CO5*

OR

b) Given the Sturm Liouville's problem $y'' + \lambda y = 0, y(0), y'(L) + \beta(L) = 0$. Evaluate (a) Eigen values (b) the normalized eigen functions, (c) Expand f(x), 0< x< 1 in a series of those normalized eigen function. *12 K5 CO5*