Register Number:……..

KUMARAGURU college of technology
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B.E/B.TECH DEGREE EXAMINATIONS: NOV/ DEC 2024

(Regulation 2024)

First Semester

COMMON TO ECE / EEE / E & I

24MAI113: Linear Algebra and Multivariate Calculus

COURSE OUTCOMES

CO1: Apply the concepts of eigenvalues, eigenvectors, and the Cayley-Hamilton theorem to diagonalize matrices and perform orthogonal transformations of symmetric matrices using matrix operations and eigenvalue computations.

CO2: Apply orthogonal transformations to reduce quadratic forms to their canonical forms and solve related matrix problems, leveraging to compute transformations and quadratic forms.

CO3: Analyze and solve unconstrained and constrained optimization problems using the Lagrange multiplier method and determine the maxima and minima of functions with two or more variables relevant to engineering applications.

CO4: Apply double and triple integrals in Cartesian coordinates by computing and using them to determine areas and volumes in engineering applications, including changing the order of integration.

CO5: Apply vector calculus operations like gradient, divergence, curl, and directional derivatives to verify Green's theorem, Gauss's divergence theorem, and Stokes' theorem used for computational verification.

CO6: Apply Cauchy-Riemann equations, Cauchy's integral theorem, and Cauchy's integral formula to solve complex analysis problems and evaluate integrals using the residue theorem for performing contour integration.

Time: Three Hours **Maximum Marks: 100**

PART A (4*20 = 80 Marks)
Answer all the Questions

1.	a)	Define eigenvalues and eigenvectors with examples.	2	CO1	[K_1]
	b)	State the Cayley-Hamilton theorem.	2	CO1	[K_1]
	c)	A symmetric matrix is given as $A = \begin{bmatrix} 2 & 0 & 4 \\ 0 & 6 & 0 \\ 4 & 0 & 2 \end{bmatrix}$. Perform orthogonal transformation and diagonalize the matrix.	8	CO1	[K_3]

	d)	Transform the quadratic form $2x^2 + 6xy + 2y^2$ into its canonical form using an orthogonal transformation.	8	CO2	[K3]
2.	a)	Define Lagrange multipliers with an example.	2	CO3	[K1]
	b)	What is a Jacobian determinant? Illustrate its importance in multivariable calculus?	2	CO3	[K2]
	c)	Using the method of Lagrange multipliers, determine the maximum and minimum values of $f(x, y) = x^2 + y^2$ subject to the constraint $x + y = 1$.	8	CO3	[K4]
	d)	For $f(x, y) = x^3 + y^3 - 3xy$, calculate the critical points and determine their nature.	8	CO3	[K5]
3.	a)	Define double integrals with an example.	2	CO4	[K1]
	b)	Describe the procedure for changing the order of integration with an example.	2	CO4	[K2]
	c)	Compute the area of the region bounded by $x = 0$, $y = 0$, and $x + y = 1$ using double integrals.	8	CO4	[K3]
	d)	Evaluate $\iiint_D (x^2 + y^2 + z^2)\, dx\, dy\, dz$, where the region D is bounded by $x = 0$, $y = 0$, $z = 0$, and $x + y + z = 1$.	8	CO4	[K3]
4.	a)	Define gradient and directional derivative with an example.	2	CO5	[K1]
	b)	What are irrotational and solenoidal fields? Provide examples.	2	CO5	[K2]
	c)	Verify Green's theorem for $\oint_C (y\, dx - x\, dy)$ where C is the boundary of the region $x = 0, y = 0$ x = a, y = a .	8	CO5	[K4]
	d)	Use Gauss's divergence theorem to evaluate the integral $\iiint_V (\nabla \cdot \mathbf{F})\, dV$, where $\mathbf{F} = x^2\mathrm{i} + y^2\mathrm{j} + z^2 k$, and V is taken over rectangular parallelopiped $0 \le x \le a$, $0 \le y \le b, 0 \le z \le c$.	8	CO5	[K5]

PART B (1 x 20 = 20 Marks)

Answer any ONE Question

5.	a)	What is an analytic function? Also, give its significance in engineering field.	2	CO6	[K1]
	b)	Write the Cauchy-Riemann equations in Cartesian form.	2	CO6	[K2]

c) Evaluate using contour integration $\int_0^{2\pi} \frac{d\theta}{5+4sin\theta}$. 12 CO6 [$K_3$]

d) Prove that the function $f(z) = z^2 + 1$ is analytic. 4 CO6 [K_3]

OR

6. a) State Cauchy's integral theorem. 2 CO6 [K_1]

b) Discuss the significance of singularities in complex analysis. 2 CO6 [K_2]

c) Evaluate $\int_0^{2\pi} \frac{d\theta}{2+cos\theta}$ using contour integration 12 CO6 [K_3]

d) Determine the residues of $\frac{1}{z^3-z}$ at its singular points. 4 CO6 [K_3]

CO distribution summary

	CO1	CO2	CO3	CO4	CO5	CO6
Marks (%)	10	10	20	20	20	20

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