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

(Regulation 2024)

First Semester

COMMON TO BT / FT / TXT

24MAI112 – Computational Linear Algebra and Calculus

COURSE OUTCOMES

CO1: Apply matrix operations (Gauss Jordan, Gauss Seidel) to solve systems of linear equations in textile manufacturing and material composition problems.

CO2: Apply eigenvalues and eigenvectors to simplify textile stress-strain matrices and design systems in fashion technology.

CO3: Apply differential calculus to optimize garment fitting, fabric draping, and bio-responses in biotechnological textiles by analysing changes in variables.

CO4: Analyse and estimate changes in textile production processes and biological systems with variable data points by utilizing numerical differentiation techniques (Newton's, Lagrange's methods).

CO5: Solve integration problems using analytical and numerical methods (Trapezoidal, Simpson's rule) for calculating fabric area or volume in garment design and textile engineering.

CO6: Apply numerical methods (Euler's method, Taylor series, Runge Kutta) to solve first order ordinary differential equations in dynamic biotechnological processes such as enzyme kinetics or fluid flow in textile materials.

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

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

1.	a)	Define the rank of a matrix with an example.	2	CO1	[K_1]
	b)	How linearly dependent vectors differ from linearly independent vectors?	2	CO1	[K_2]
	c)	**Scenario:** In a textile manufacturing unit, the following system of linear equations represents the material composition of different fabrics: $x + 2y + 3z = 12$, $2x + 3y + 4z = 18$, $x + y + 2z = 10$. Solve this system using the Gauss-Seidel method.	6	CO1	[K_3]

d) Solve the system $2x - y + z = 3, x + 2y - z = 0, x - y + 2z = 2$ using the Gauss-Jordan method. 6 CO1 [K₃]

e) Explain the concept of Row Echelon Form and solve the following system: $x + y + z = 6, 2x + 3y + 4z = 14, 3x + 4y + 5z = 22$. 4 CO1 [K₃]

2. a) Give the geometrical interpretation for the derivative of a function. 2 CO3 [K₁]

b) Provide an example to illustrate the maxima and minima of a function. 2 CO3 [K₂]

c) Find the maximum or minimum value of $f(x) = 3x^2 - 12x + 9$. 6 CO3 [K₃]

d) Using Newton's Forward Method, find $f'(1)$ for the following data. 6 CO4 [K₃]

X:	1	3	5	7	9
Y:	85.3	74.5	67	60.5	54.3

e) Describe Lagrange's numerical differentiation technique and its significance. 4 CO4 [K₂]

3. a) Solve the Leibnitz equation $\frac{dy}{dx} + \frac{y}{x} = \sin(x)$, given $x > 0$. 5 CO6 [K₂]

b) Solve the Bernoulli equation $x\frac{dy}{dx} - 2y = x^2 y^3$. 5 CO6 [K₂]

c) Using Euler's formula, solve the differential equation $\frac{dy}{dx} = x + y$, with the initial condition $y(0) = 1$, find $y(0.1), y(0.2)$ 4 CO6 [K₃]

d) Apply the Runge-Kutta method of 4th order to solve $\frac{dy}{dx} = x - y^2$, with the initial condition $y(0) = 0.5$, for $x = 0.1$, using a step size $h = 0.1$. 6 CO6 [K₃]

4. a) Integrate $\int \frac{x}{(x+1)(x+2)} dx$ by partial fraction method. 4 CO5 [K₂]

b) By dividing the range into 10 equal parts, evaluate $\int_0^\pi \sin x \, dx$ by Trapezoidal and Simpson's rule. 12 CO5 [K₁]

c) Solve $\int_0^1 e^x \, dx$ using the Trapezoidal rule with $h = 0.25$. 4 CO5 [K₃]

PART B (1 x 20 = 20 Marks)
Answer any ONE Question

5. a) Define eigenvalues and eigenvectors with an example.   2   CO2   [K$_1$]

   b) State the properties of orthogonal matrices.   2   CO2   [K$_1$]

   c) Diagonalize the matrix $A = \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$.   6   CO2   [K$_3$]

   d) Find the dominant eigenvalue of $A = \begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$ using the Power Method.   10   CO2   [K$_3$]

OR

6. a) Define orthogonal transformation with an example.   2   CO2   [K$_1$]

   b) Write down the procedure involved to reduce the quadratic form into canonical form.   2   CO2   [K$_2$]

   c) Reduce $Q = 2x^2 + 6y^2 + 2z^2 + 8xz$ to canonical form using an orthogonal transformation.   12   CO2   [K$_3$]

   d) Find the eigenvalues of $3A^{-1}$ and A^4 if $A = \begin{bmatrix} 1 & 4 & 5 \\ 0 & 2 & 7 \\ 0 & 0 & 3 \end{bmatrix}$ 4   CO2   [K$_3$]

CO distribution summary

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

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