

SECTION - AThere are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Derive Simpson's one-third rule for numerical integral. (10½)

- (b) Evaluate $\int_0^{\pi/2} \sin x \, dx$ using Gauss Quadrature method for $n = 4$. (13)

2. (a) Derive mathematical molecules up to D^4y for Central Difference technique. (10½)

- (b) The deflection at various points on a normally loaded plate are shown in Table 1.

Estimate the bending moments at points 1, 4, 9 and 12. (13)

Given : $E = 30 \times 10^6$ psi

$t = 5$ in

$\nu = 0.20$

Point	Deflection (in) $\times 10^{-4}$
1	2.0
2	2.5
3	3.1
4	2.2
5	2.4
6	3.2
7	3.4
8	2.6
9	2.4
10	2.9
11	3.2
12	2.5
13	2.2
14	3.1
15	3.5
16	2.4

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3. (a) Explain Graphical Method for Algebraic and Transcendental Equation with relevant theorems. (10½)
- (b) Find the root near 0.70 of $f(x) = e^x - 4x^2$ by Newton's method, beginning with $x_0 = 1.0$. How accurate is the estimate after four iterations? How many iterations with Newton's Method does it take to match the accuracy achieved after eight iteration of Bisection method? (13)
4. (a) Explain Iteration Method for Algebraic and Transcendental Equation with geometric interpretations. (10½)
- (b) Observe that the following data seem to be fit by a curve $y = ae^{bx}$ by plotting on semilog paper and noting that the points appear to fall on a straight line. Find values of a and b from the plot. (13)

<u>Temperature (°F)</u>	<u>Solubility (wt %)</u>
77	2.4
100	3.4
185	7.0
239	11.1
285	19.6

SECTION - B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) The non-linear first-order Ordinary Differential Equation (ODE) governing unsteady radiation heat transfer per unit time from a mass can be expressed as follows: (13½)

$$\frac{dT}{dt} = -\alpha(T^4 - T_a^4) \quad \text{where, } \alpha = 4 \times 10^{-12}, T_a = 250, T(0) = T_0 = 2500$$

Solve the ODE for $t = 4$ by Simple Euler's method using step-size of 1.

- (b) Invert the following matrix using Gauss-Jordan method: (10)

$$\begin{bmatrix} 3 & -0.1 & -0.2 \\ 0.1 & 7 & -0.3 \\ 0.3 & -0.2 & 10 \end{bmatrix}$$

6. (a) Solve the following system using Gauss-Seidel method. Show the steps clearly. (10½)

$$7m - 3n + 4p = 6$$

$$-3m + 2n + 6p = 2$$

$$2m + 5n + 3p = -5$$

- (b) If you had used Jacobi method, would you have required fewer iterations? Why or why not? (5)

- (c) In interpolation problems, what are the disadvantages of using the following methods? (8)

(i) Lagrange's method (ii) Neville's method

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7. (a) Use the following data to construct the forward difference table and determine interpolated value of $x = 0.65$: (10½)

X	f(x)
0.3	0.404958
0.5	0.824361
0.7	1.40963
0.9	2.21364

- (b) Would it have been more appropriate to use the backward difference method? Why or why not? (5)
- (c) Suppose, you are now told that $f(0.6) = 1.41325$. Do you think this will change the interpolated value significantly? Why or why not? (No need to re-calculate) (5)
- (d) State the names of three single step methods for solving ordinary Differential Equations (ODE). (3)
8. (a) Solve the following pair of simultaneous equations using 2nd order Runge-Kutta Method from $t = 0$ to $t = 1$ in steps of 0.2. (13½)

$$\frac{dx}{dt} = xy - t \quad x(0) = 1$$

$$\frac{dy}{dt} = x + t \quad y(0) = 0$$

- (b) If $e^0 = 1$, $e^1 = 2.718$, $e^2 = 7.389$, determine value of $e^{1.3}$ using Lagrangian Interpolation and compare to the actual value. (10)

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