TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Chaitra

Exam.	Regular (New Course)		
Level	BE	Full Marks	60
Programme	BCE	Pass Marks	24
Year / Part	II / I	Time	3 hrs.

Subject: - Numerical Methods (*ENSH 202*)

- ✓ *Candidates are required to give their answers in their own words as far as practicable.*
- ✓ *Attempt **All** questions.*
- ✓ ***All** questions carry equal marks..*
- ✓ *Assume suitable data if necessary.*

1. Find a real root of $e^{0.5x+3} + \cos(0.4x) - 50 = 0$ precise to 4 significant figures using the bisection method.
2. Write Jacobian matrix for the following system of non-linear equations and use Newton-Raphson method to approximate a solution correct to two decimal places taking $(x_0, y_0) = (2, 1)$ as initial guess values.
$$x^3 - y^2 = 8$$
$$x^2 + y^3 = 6$$
3. Solve the following system of linear equations using Do-Little's Factorization method.
$$\begin{bmatrix} 2 & 5 & 4 \\ 3 & 4 & 5 \\ 5 & 4 & 4 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 24 \\ 28 \\ 32 \end{bmatrix}$$
4. Find dominant eigen value and corresponding vector of the given matrix using the power method.
$$\begin{bmatrix} 2 & 4 & 1 \\ 4 & 2 & 1 \\ 1 & 1 & -2 \end{bmatrix}$$
5. Construct divided difference table from the following data and use Newton's divided difference interpolation technique to approximate y (9).

x	0	2	5	7	8	10
y	4.72	7.1	5.72	5.7	7.04	14.22

6. Using the least square method, fit the following data to a curve of the form $y = ae^{bx}$.

x	2	4	6	8	10
y	4.1	11.2	30.2	81.9	204.6

7. Evaluate the following integral using Gauss-Legendre 3-point formula and compare the result with exact value of the integral.
$$\int_0^4 \left(\cos\left(\frac{\pi x}{2}\right) + 5\right) dx$$
8. Derive the expressions to evaluate first and second order derivatives from a set of tabulated data using Newton's forward interpolation formula. Also derive the expressions for the initial point.
9. Write a python program to solve an initial value problem involving a first order ordinary differential equation using Runge-Kutta fourth order method. The program should also show the results graphically.
10. Using finite difference method, solve the following boundary value problem for three internal nodes.
$$y'' - 5y' + 4y = 5x, \quad y(2) = 4, \quad y(4) = 5$$

11. Solve the Laplace equation $u_{xx} + u_{yy} = 0$ for a square mesh with the following boundary conditions using the finite difference method employing Gauss-Seidal iteration method to solve the equations.

$$0 \le x \le 1, \qquad 0 \le y \le 1,$$
$$\Delta x = \Delta y = h = 1/3,$$
$$u(x,0) = 360x, \qquad u(x,1) = 240(1-x),$$
$$u(0,y) = 240y, \qquad u(1,y) = 360(1-y)$$

12. Derive the recurrence relation for solving one dimensional heat equation using Bender-Schmidt method and use it to solve the following problem for five time steps taking $\Delta x = h = 1$.

$$u_t = 0.5\, u_{xx}, \qquad u(0,t) = u(4,t) = 0, \qquad u(x,0) = 2x(4-x)$$

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