TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2078 Chaitra

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEI, BEX, BCT, BAG, BGE, BCH | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

## *Subject:* - Numerical Methods (*SH553*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*



1. Discuss the importance of numerical methods in the field of science and engineering. [4]
2. Write a pseudo-code to find a real root of non-linear equation using false position method. [6]
3. Find a real root of the equation $\sin x + \cos x + e^x - 8 = 0$ using Bisection method correct upto 3 decimal places. [6]
4. Solve the following system of equations by Gauss-Elimination method with complete pivoting. [8]

$$x + y - z = 3$$
$$4x - 2y + z = 5$$
$$3x - y + 3z = 8$$

5. Find the largest Eigen values and the corresponding Eigen vector of the following matrix using power method. [8]

$$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

6. The following data are taken the steam table. [8]

| temp. °C | 140 | 150 | 160 | 170 | 180 |
|---|---|---|---|---|---|
| Pressure ( $kgf.cm^2$) | 3.685 | 4.854 | 6.302 | 8.076 | 10.225 |

Find the pressure at temperature T = 142°C and T = 175°C using Newton's Interpolation.

7. Fit an exponential function of the type $y = ae^{bx}$ to the following data. [8]

| x | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| y | 7.389 | 54.598 | 403.428 | 2980.958 |

8. The distances traveled by a vehicle at the interval of 4 minutes are given as following: [4]

| t(*s*): | 2 | 6 | 10 | 14 |
|---|---|---|---|---|
| d(*km*): | 0.25 | 2.2 | 6.5 | 11 |

Evaluate the velocity and acceleration of the vehicle at t = 2 sec.

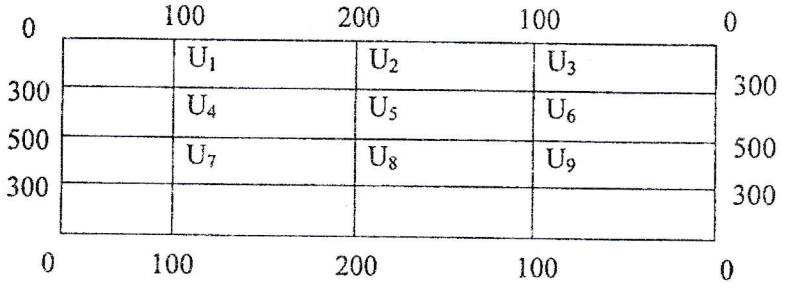
9. Compute $\int_{0.2}^{1.5} e^{-x^2}\,dx$ using the 3-point Gaussian quadrature. [6]

10. Write on algorithm to solve an initial value problem of first order ordinary differential equation for a given number of sub intervals using R – K 4 method. [6]

11. Solve the following boundary value problem using the finite difference method by dividing the interval into four sub-intervals. [8]

$y'' = 4y' - 4y + e^{2x}$ ; $y(0) = 0$ , $y(1) = 2$

12. Solve the Laplace equation $u_{xx} + u_{yy} = 0$ for the square mesh with boundary values as shown in the figure below. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**

**2077 Chaitra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEI, BEX, BCT, BAG, BGE | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

***Subject:*** - Numerical Methods *(SH 553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define error. Explain different types of errors in numerical computation. [4]
2. Find a positive real root of the equation $x^2+\sin x=5.23$ correct to 3 decimals using Bisection method. [6]
3. Write a pseudo-code to find a real root of non-linear equation using fixed point iteration method. [6]
4. Solve the following system of linear equations using LU factorization method. [8]

   $3x+2y+7z=4$

   $2x+3y+z=5$

   $3x+4y+z=7$

5. Find the largest Eigenvalue and corresponding Eigenvetor of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 4 & 5 \end{bmatrix}$ using power method. [8]
6. Find the best fit curve in the form $y = ae^{bx}$ using least square approximation form the following data. [8]

| x: | 0.4 | 0.8 | 1.2 | 1.6 | 2.0 | 2.4 |
|---|---|---|---|---|---|---|
| y: | 75 | 100 | 140 | 200 | 270 | 375 |

7. From the following table, evaluate y(3.2) using cubic spline inerpolation technique. [8]

| x | 2 | 4 | 6 | 8 | 10 |
|---|---|---|---|---|---|
| y | 5.13 | 8.39 | 10.90 | 7.82 | 13.78 |

8. The following data gives corresponding values of pressure (P) and specific volume (V) of superheated steam:

| V | 2 | 4 | 6 | 8 | 10 |
|---|---|---|---|---|---|
| P | 105 | 42.7 | 25.3 | 16.7 | 13 |

   Find the rate of change of pressure with respect to volume when V=2 and V=8. [6]
9. Evaluate the following integral by using Gaussian 3-point formula. [4]

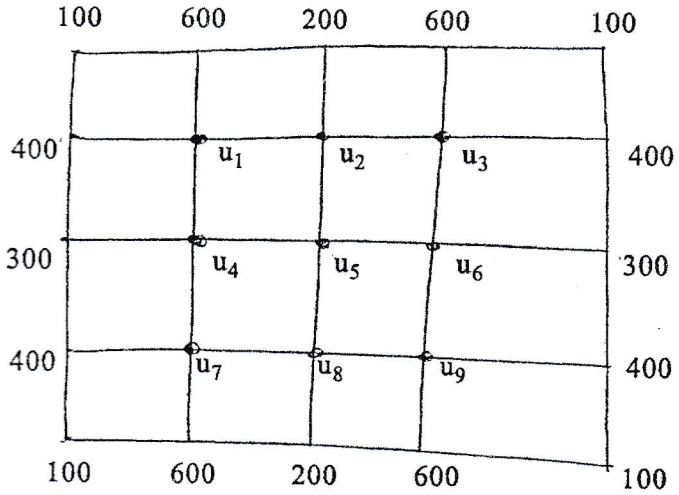
$$\int_2^5 \frac{\sin x + e^x}{1+x} dx$$

10. Write a program in C/C++/FORTRAN to solve a second order differential equation (initial value problem) using RK-4 method. [6]

11. Solve the following boundary value problem using shooting method by dividing the interval into four sub-intervals employ Euler's method. [8]

$$y'' = \cos x + 3y - y', \text{ with } y(2) = 2 \text{ and } y(3) = 6.$$

12. Derive the recurrence relation for Laplace equation $u_{xx} + u_{yy} = 0$ and hence use it to solve the equation over the following square grid: [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2076 Bhadra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, BAG, BGE | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

***Subject:*** - Numerical Method *(SH 553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Describe the importance of numerical methods in science and engineering. [4]
2. What is bracketing and non-bracketing method? Estimate the real root of non linear equation $x^2 \sin x + e^x = 3$ using bracketing method. [2+4]
3. Write a pseudo-code to find the real root of non linear equation using Newton-Raptison method. [6]
4. Solve the following system of linear equation, using factorization method. [8]

$$4x_1 - x_2 + 4x_3 = 30$$
$$2x_1 + 3x_2 - 7x_3 = -5$$
$$5x_1 - 3x_2 + x_3 = 22$$

5. Find the largest Eigen value and the corresponding Eigen vector of the following matrix using Power method $\begin{bmatrix} 1 & 2 & 4 \\ 2 & 5 & 7 \\ 4 & 7 & 10 \end{bmatrix}$. [8]
6. For the following set of data, fit a parabolic curve $f(x) = ax^2 + bx + c$ using least square method and find $f(2)$. [6+2]

| x | 0.5 | 1 | 1.5 | 4.5 | 6.5 | 7.5 |
|---|---|---|---|---|---|---|
| f(x) | 2.5 | 2.7 | 3.5 | 6.5 | 8.4 | 9.5 |

7. Develop a pseudo-code to interpolate the given sets of data using Lagrange's interpolation. [6]
8. Use following table of data to estimate velocity at t = 6 sec. [4]

| Time in second | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|
| Distance travelled (in meter) | 10 | 14.5 | 19.5 | 25.5 | 32 |

9. Evaluate $\int_0^1 \frac{\tan^{-1} x}{x} dx$ using Gaussian 3 point formula. [6]
10. Given that: $y' = -1.2y + 7e^{0.3x}$, find an approximate value of y(0.2) with an initial condition y(0) = 1 using Runge-Kutta fourth order method, with a step size of 0.1. [6]
11. Solve the following boundary value problem using shooting method by dividing the interval into four sub-intervals. (Using Euler's formula) [10]

    $y'' = \sin x + 3y - y'$, with y(1) = 1 and y(2) = 2
12. Solve the Poisson's equation $\nabla^2 u = -10(e^x + \sin y)$ over the square domain $0 \le x \le 3$, $0 \le y \le 3$ with step size h = 1 with u = 100 on the boundary. [8]

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13 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2075 Bhadra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, B. Agri. BGE | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

***Subject:*** - Numerical Method *(SH553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Construct the divided difference table from the following data set: $(x_0,y_0),(x_1,y_1),(x_2,y_2),(x_3,y_3)$ and $(x_4,y_4)$. [4]
2. Write a pseudo-code to find a real root of non-linear equation using Fixed Point Iteration method. [6]
3. Find a real root of the equation $e^{2.80x}+\cos x=3x^2$ correct to 3 decimals using bracketing method. [6]
4. Solve the following system of equations using Gauss-seidel method. Correct to four decimal places. [8]

$$x_1+x_2+3x_3+2x_4=12$$
$$2x_1+x_2+x_3+4x_4=11$$
$$10x_1+2x_2-4x_3+x_4=3$$
$$5x_1+8x_2-3x_3+2x_4=-3$$

5. Find the largest Eigen value and the corresponding Eigen vector of the matrix using Power Method. [8]
6. State normal equations for fitting a parabola $y=ax^2+bx+c$ to the given data; [8]

   $(x_i,y_i): i=1,2....n$ and hence use it to fit $y=ax^2+bx+c$ to the following data:

| X | 1.0 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 |
|---|---|---|---|---|---|---|
| Y | 1.1 | 1.3 | 2.0 | 2.7 | 3.4 | 4.1 |

7. Develop a pseudocode to interpolate the given sets of data using Lagrange's interpolation. [6]
8. Derive an expression to evaluate first derivative from Newton's backward interpolation formula and evaluate $\frac{dy}{dx}$ at $x=9$ from the following table. [6]

| x | 1 | 3 | 5 | 7 | 9 |
|---|---|---|---|---|---|
| y | -1.20 | 12.80 | 119.60 | 472.80 | 1302.80 |

9. Derive the general Newton-cotes quadrature formula and hence use it to obtain simpson's -3/8 formula. [6]

10. Using finite difference method solve the following BVP: [6]

$$y''-3y'+2y=2, y(0)=1, y(1)=4$$

in the interval [0,1]. Take h = 0.25

11. Write a program in any high level language (C/C++/FORTRAN) to solve the second order differential equations using classical RK-4 method. [6]

12. Derive Bende-Schimidt recurrence formula for solving one-dimensional heat equation $u_t = c^2 u_{xx}$ and use it to solve the boundary value problem $u_t = u_{xx}$ under the condition $u(0,t) = u(1,t) = 0$ and $u(x,o) = \sin(\pi x)$ upto t =5 seconds. (Take h = 0.2) [5+5]

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13 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
# Examination Control Division
**2075 Baisakh**

| Exam. | Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BGE, BEL, BEX, BCT, BAG | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

## *Subject:* - Numerical Method *(SH553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What are the applications of Numerical Method in engineering and science? Discuss it. [4]
2. Write an algorithm of Secant method to calculate the roots of a nonlinear equations $f(x) = 0$. Write the differences between secant and the false position methods. [4+2]
3. Find a real root of the equation $x\log_{10}x = 1.2$ by N-R method correct up to 4 decimal places. [6]
4. Write the pseudo code of the Gauss Jordan method to solve the linear system $Ax = b$. [8]
5. Find the dominant eigenvalue and eigenvector of the matrix: [8]

$$A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

6. Estimate y(6.5) using Natural cubic spline interpolation technique from the following data. [8]

| x | 3 | 5 | 7 | 9 | 11 |
|---|---|---|---|---|---|
| y | 8 | 10 | 9 | 12 | 5 |

7. Fit the curve $y = ax^b$ to the following data: [8]

| 4 | 5 | 7 | 10 | 11 | 13 |
|---|---|---|---|---|---|
| 48 | 100 | 294 | 900 | 1210 | 2028 |

8. Evaluate $\int_0^{\pi/2} e^{\sin x} dx$ using Gaussian 3-point formula. [6]
9. Find $f'(3)$ from the following table: [5]

| x: | 2 | 4 | 8 | 12 | 16 |
|---|---|---|---|---|---|
| f(x): | 20 | 23 | 30 | 35 | 40 |

10. Solve $y' = \frac{y}{x^2 + y^2}$, $y(0) = 1$ using R - K2 method in the range 0, 0.5, 1. [6]
11. Solve the BVP: $y'' + 3y' = y + x^2, y(0) = 2, y(2) = 5$ at x = 0.5, 1, 1.5 using finite difference method. [5]
12. Solve the elliptic equation $\nabla^2 u = 0$ in the square plate of size 8cm × 8cm if the boundary values are given 50 on one side of the plate and 30 on its opposite side. On the other sides the values are given 10. Assume the square grids of size 2cm × 2cm. [10]

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13 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2074 Bhadra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BGE, BEL, BEX, BCT, BAG | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

***Subject:*** - Numerical Method *(SH553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Discuss the significance of Numerical Methods in the field of science and engineering in modern day context. [4]
2. Write pseudo-code for finding a real of a non-linear equation using the False Position Method. [6]
3. Find a real root of the following equation, correct to six decimals, using the Fixed Point iteration method. [6]
$$\sin x + 3x - 2 = 0$$
4. Solve the following system of equations using LU factorization method. [8]
$$5x_1 + 2x_2 + 3x_3 = 31$$
$$3x_1 + 3x_2 + 2x_3 = 25$$
$$x_1 + 2x_2 + 4x_4 = 25$$
5. Write a pseudo-code to determine the largest Eigen value and the corresponding vector of a square matrix using Power Method. [8]
6. The following data are provided; use least-squares method to fit these data with the following model, $y = ax + b + \frac{c}{x}$ [8]
7. From the following data, compute: (a) y(3) using Newton's forward interpolation formula (b) y(6.4) using stirling's formula. [8]

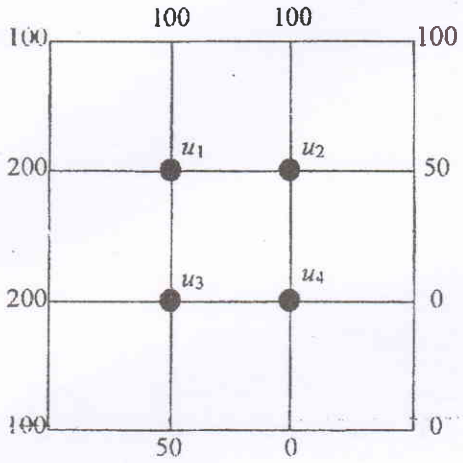
| x | 2 | 4 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|
| y | 5.1 | 4.2 | 3.1 | 3.5 | 6.2 | 7.3 |

8. Evaluate the following integral using Romberg's method. (correct to two decimal planes) [8]
$$\int_0^2 \frac{e^x + \sin x}{1 + x^2}\, dx$$
9. Solve $y' = 4e^{0.8x} - 0.5y$ ; subject to initial condition y(0) = 2. for y(0.5) and y(1.0) using Runge-Kutta 2nd order method. [6]

10. Solve the following boundary value problem using the finite difference method by dividing the interval into four sub-intervals. [8]

$$y'' = e^x + 2y' - y; \quad y(0) = 1.5; \quad y(2) = 2.5$$

11. Find the values of u(x, y) satisfying the Laplace equation $\nabla^2 u = 0$, at the pivotal points of the square region with boundary conditions as shown below. [10]

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13 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2073 Magh**

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, B. Agri, BGE | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

## *Subject:* - Numerical Method *(SH553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Discuss the importance of Numerical Methods in Science and Engineering. [4]

2. Find a real root of $\cos x + e^x - 5 = 0$ accurate to 4 decimal places using the Secant Method. [6]

3. Write pseudo-code to find a real root of a non-linear equation using the Bisection Method. [6]

4. Compute the inverse of following matrix using the Gauss-Jordan Method. [8]

$$\begin{bmatrix} 3 & 1 & 2 \\ 1 & 2 & 3 \\ 2 & 3 & 5 \end{bmatrix}$$

5. Write algorithm for computing the dominant Eigen value and corresponding vector of a square matrix using the Power method. [8]

6. Fit the following set of data to a curve of the form $y = ab^x$. [8]

| $x$ | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 |
|---|---|---|---|---|---|---|---|
| $y$ | 8.2 | 5.2 | 3.1 | 2.5 | 1.7 | 1.6 | 1.4 |

7. Estimate $y(4.5)$ from the following data using Natural Cubic Spline Interpolation technique. [8]

| $x$ | 1 | 3 | 5 | 7 | 9 |
|---|---|---|---|---|---|
| $y$ | 10 | 12 | 11 | 13 | 9 |

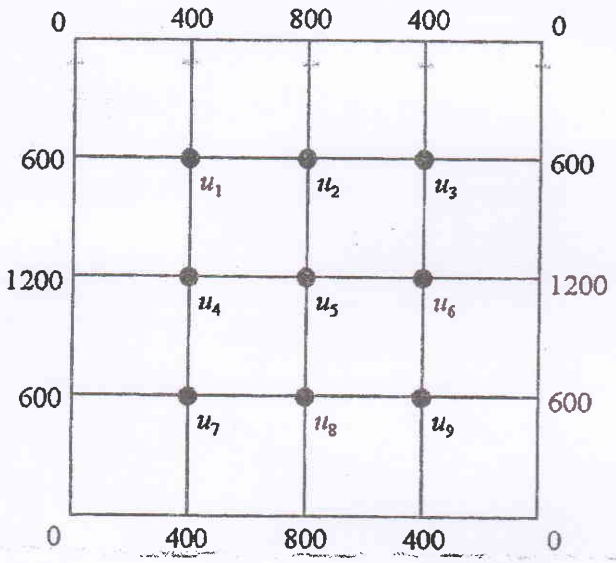
8. Derive the formula to evaluate $y'(x)$ and $y''(x)$ from Newton's Forward Interpolation formula. [4]

9. Evaluate $\int_0^{1.4} (\sin x^3 + \cos x^2)\, dx$ using Gaussian 3-point formula. [6]

10. Solve $y' = \sin x + \cos y$ subject to initial condition $y(0) = 2$ in the range 0(0.5)2 using the Runge-Kutta second order method. [6]

11. Write a program in C/C++/FORTRAN to solve a second order ordinary differential equation (initial value problem) using the Runge-Kutta fourth order method. [6]

12. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the square mesh with boundary values as shown in the figure below. [10]

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13 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
# Examination Control Division
**2073 Bhadra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, B. Agri., BGE | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

## *Subject:* - Numerical Method *(SH553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Discuss the difference between absolute error and relative error with appropriate examples. [4]
2. Write an algorithm of Secant method for finding a real root of a non linear equation. [4]
3. Find a real root of the equation $\sin x = e^{-x}$ correct up to four decimal places using N-R method. What are the limitations of this method? [8]
4. Apply Gauss Seidal Iterative Method to solve the linear equations correct to 2 decimal places. [8]

$$10x + y - z = 11.19$$
$$x + 10y + z = 28.08$$
$$-x + y + 10z = 35.61$$

5. Find the dominant Eigen value and the corresponding Eigen vector of the given matrix using power method. [8]

$$\begin{bmatrix} 15 & -4 & -3 \\ -10 & 12 & -6 \\ -20 & 4 & -2 \end{bmatrix}$$

6. What is the practical significance of the least squares method of curve fitting? Derive the normal equations to fit a given set of data to a linear equation $(y = ax + b)$ [2+6]
7. Using stirling formula find $u_{28}$, given; [8]

$$u_{20} = 49225, u_{25} = 48316, u_{30} = 47236, u_{35} = 45926, u_{40} = 44306$$

8. Estimate the value of cost (1.74) from the following data: [4]

| x | 1.7 | 1.74 | 1.78 | 1.82 | 1.86 |
|---|---|---|---|---|---|
| Sin(x) | 0.9916 | 0.9857 | 0.9781 | 0.9691 | 0.9584 |

9. Evaluate $\int_{0.2}^{1.5} e^{-(x^2)} dx$ using the 3 point Gaussian quadrature formula. [6]
10. Solve the following simultaneous differential equations using Runge-Kutta second order method at x = 0.1 and 0.2. $dy/dx = xz + 1; dz/dx = -xy$ with initial conditions $y(0) = 0, z(0)=1$ [6]
11. Write a program in any high level language (C/C++/FORTRAN) to solve a first order initial value problem using classical RK-4 Method. [6]
12. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ on the square mesh bounded by $0 \le x \le 3, 0 \le y \le 3$. The boundary values are $u(x,0) = 10, u(x,3) = 90, 0 \le x \le 3$ and $u(0,y) = 70, u(3,y) = 0, 0 < y < 3$. [10]

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14 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2072 Ashwin**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, B. Agri, BGE | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

***Subject:*** - Numerical Method *(SH553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Discuss the difference between Absolute error and Relative error with examples. [4]
2. Derive Newton Raphson interative formula for solving nonlinear equation, using Taylor series. [4]
3. Using the Bisection method, find a real root of the equation $f(x) = 3x - \sqrt{1+\sin x}$ correct up to three decimal points. [8]
4. Develop pseudocode to solve a system of linear equations using Gauss Jordan method. [8]
5. Find the largest Eigen value and the corresponding Eigen vector of the following matrix using the power method with an accuracy of 2 decimal points. [8]

$$\begin{pmatrix} 1 & 2 & 1 \\ 2 & 1 & 2 \\ 1 & 2 & -1 \end{pmatrix}$$

6. Using appropriate Newton's Interpolation Techniques, estimate y(15) and y(85) from the following data: [8]

| x | 10 | 30 | 50 | 70 | 90 |
|---|---|---|---|---|---|
| y | 34 | 56 | 45 | 23 | 36 |

7. Fit the following data in to $y = a + b\sqrt{x}$ [8]

| X | 500 | 1000 | 2000 | 4000 | 6000 |
|---|---|---|---|---|---|
| Y | 0.20 | 0.33 | 0.38 | 0.45 | 0.51 |

8. Write an algorithm to calculate the definite integral $\int_a^b f(x)dx$ using composite simpson's 1/3 rule. [4]
9. The distance travelled by a vehicle at intervals of 2 minutes are given as follows: [6]

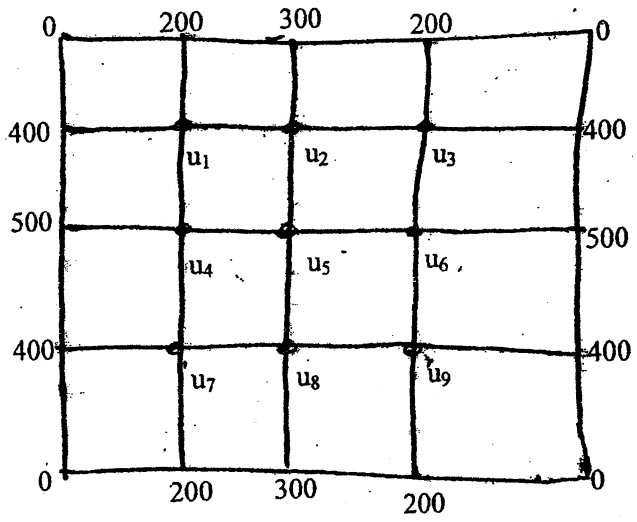
   Time (min): 2 4 6 8 10 12

   Distance (km): 0.25 1 2.2 4 6.5 8.5

   Evaluate the velocity and acceleration of the vehicle at t = 3 minutes. [8]
10. Solve the following by RK-2 method for x = 0 (0.1) 0.2

$$\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0;\ y(0) = 1, y'(0) = 0$$

11. Solve the Laplace equation $u_{xx} + u_{yy} = 0$ for the square mesh with boundary values as shown in the figure. [10]




12. Derive Euler's formula for solving initial value problem. [4]

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13 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**

**2071 Bhadra**

| Exam. | Regular / Back | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, BGE, B.Agri. | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

## *Subject:* - Numerical Methods *(SH553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Create difference table from following data. [4]

| X | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 |
|---|---|---|---|---|---|
| Y | 0.4771 | 0.5051 | 0.5315 | 0.5563 | 0.5798 |

2. Use bisection method to find a real positive root of $\sin x = \frac{1}{x}$ correct upto three decimal places. [8]
3. Write a pseudo-code to find a real root of a non-linear equation using Secant Method. [4]
4. Solve the following linear equations using Gauss Elimination or Gauss Jordan method using partial pivoting. [8]

$$\begin{aligned} 2x+3y+2z &= 2 \\ 10x+3y+4z &= 16 \\ 3x+6y+z &= 6 \end{aligned}$$

5. Find the largest eigen-value and the corresponding eigen-vector of the following matrix. [8]

$$\begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$$

6. Find the best fit curve in the form of $y = a + bx + cx^2$ using least square approximation from the following discrete data. [8]

| x | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 |
|---|---|---|---|---|---|---|---|
| y | 1.1 | 1.3 | 1.6 | 2.0 | 2.7 | 3.4 | 4.1 |

7. Use Lagrange's Interpolation formula to find the value of y when x = 3.0, from the following table. [8]

| x | 3.2 | 2.7 | 1.0 | 4.8 | 5.6 |
|---|---|---|---|---|---|
| y | 22.0 | 17.8 | 14.2 | 38.3 | 51.7 |

8. Evaluate $\int_0^2 f(x)dx$, for the function $f(x) = e^x + \sin 2x$ using composite Simpson's 3/8 formula taking step size h = 0.4. [5]
9. Evaluate $\int_0^2 \frac{dx}{x^2+2x+1}$ using Gaussian 3 point formula. [5]
10. Solve $\frac{dy}{dx} = \frac{y^2-x^2}{y^2+x^2}$ using RK – 4 method, for y(0.4). (Given, y(0) = 1, h = 0.2) [6]
11. Using the finite difference method, find y(0.25), y(0.5) and y(0.75) satisfying the differential equation $xy'' + y = 0$, subject to the boundary conditions y(0) = 1, y(1) = 2. [6]
12. Solve the Poisson equation $u_{xx} + u_{yy} = -81xy$, $0 < x < 1$, $0 < y < 1$ given that u(0, y) = 0, u(x, 0) = 0, u(1, y) = 100, u(x, 1) = 100 and h = 1/3. [10]

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11 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**

**2071 Magh**

| Exam. | New Back (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, BGE, B.Agri. | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

## *Subject:* - Numerical Method *(SH553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Find a root of the equation $\cos x = xe^x$ using the regula-falsi method correct upto four decimal places. [8]
2. Derive Newton-Raphson iterative formula for solving non-linear equation. [4]
3. Define error. Discuss different types of errors in numerical computation. [4]
4. Solve the following set of linear equations using LU factorization method. [8]

   $x - 3y + 10z = 3$
   $-x + 4y + 2z = 20$
   $5x + 2y + z = -12$

5. Use Gauss Seidel method to solve the following equations: [8]

   $20x + y - 2z = 17$
   $3x + 20y - z = -18$
   $2x - 3y + 20z = 25$

6. The following data are taken from the steam table. [8]

| Temp. °C | 140 | 150 | 160 | 170 | 180 |
|---|---|---|---|---|---|
| Pressure kgf/cm$^2$ | 3.685 | 4.854 | 6.302 | 8.076 | 10.225 |

   Find the pressure at the temperature T = 142°C and T = 175°C using Newton's interpolation.

7. Derive expression for least square method of fitting a linear curve. [8]

   ***OR***

   Develop pseudocode to interpolate the given set of data using Langrange interpolation.

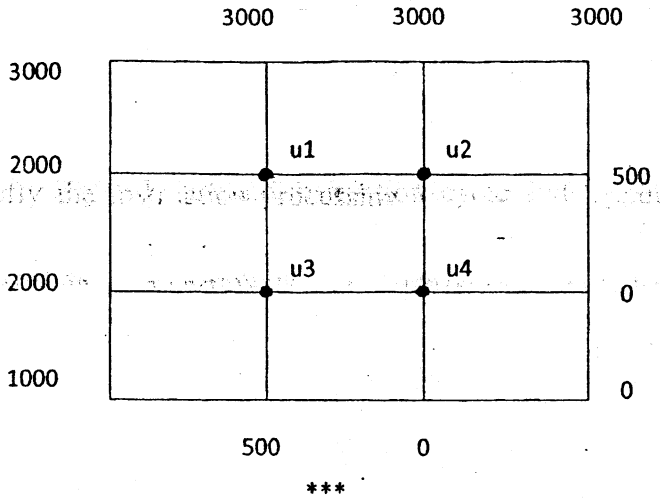
8. If 'x' is in cm and 't' is in time then find velocity and acceleration when t = 0.1 second. [4]

| t | 0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
|---|---|---|---|---|---|---|---|
| x | 30.13 | 31.62 | 32.87 | 33.64 | 33.95 | 33.81 | 33.24 |

9. Compute integration of the following function using Romberg integration $\int_{-1}^{1} \frac{dx}{1+x^2}$. [6]
10. Using Euler's method find y(0.2) from following equation $y' = x + y$, $y(0) = 0$, take $h = 0.1$. [4]

11. Using the Runge-Kutta method of second order, obtain a solution of the equation $y'' = y + xy'$ with the initial condition $y(0) = 1$, $y'(0) = 0$ to find $y(0.2)$ and $y'(0.2)$. (Take $h = 0.1$) [8]

12. Calculate the value of $u(x, y)$ satisfying the Laplace equation $\nabla^2 u = 0$ at the interior points of the square region with boundary conditions shown in figure below. [10]

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Shankar Poudel

24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2070 Bhadra**

| Exam. | Regular | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, B.Agri. | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

## *Subject*: - Numerical Method *(SH553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Define error. Explain different types of errors in numerical computation. [6]
2. Find a real root of the following equation correct to four decimals using False Position method. [6]

$$e^{\cos x} - \sin x - 1 = 0$$

3. Discuss the limitations of Newton-Raphson method while finding a real root of a non-linear equation. [4]
4. Solve the following system of equations using LU factorization method. [8]

$$5x_1 + 2x_2 + 3x_3 = 31$$
$$3x_1 + 3x_2 + 2x_3 = 25$$
$$x_1 + 2x_2 + 4x_3 = 25$$

5. Write an algorithm for solving a system of linear equations of 'N' unknowns using Gauss-Jordan Method. [8]
6. Find y at x = 8 from the following data using Natural Cubic Spline interpolation. [8]

| x | 3 | 5 | 7 | 9 |
|---|---|---|---|---|
| y | 3 | 2 | 3 | 1 |

7. Fit the following set of data to a curve of them form $y = a\,b^x$. Also evaluate y(7). [8]

| x | 2 | 4 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|
| y | 16.0 | 11.1 | 8.7 | 6.4 | 4.7 | 2.6 |

8. Evaluate the following integral using Romberg method. [6]

$$\int_0^2 \frac{e^x + \sin x}{1+x^2}\,dx$$

9. Determine y'(1) and y''(1) from the following data. [4]

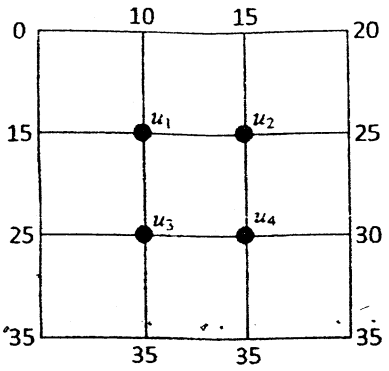
| x | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 |
|---|---|---|---|---|---|
| y | 6 | 3 | 2 | 1.2 | 0.8 |

10. Solve the following initial value problem for y(1.2) using the Runge-Kutta fourth order method. [6]

$y'' - 3y' + y = \sin x$; $y(1) = 1.2$; $y'(1) = 0.5$

11. Write an algorithm to solve two point boundary value problem using shooting method. [6]

12. Solve $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary conditions as shown in figure below. [10]

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
# Examination Control Division
**2069 Bhadra**

| Exam. | Regular (2066 & Later Batch) | | |
|---|---|---|---|
| Level | BE | Full Marks | 80 |
| Programme | BEL, BEX, BCT, B. Agri. | Pass Marks | 32 |
| Year / Part | II / II | Time | 3 hrs. |

## *Subject:* - Numerical Method *(SH553)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Generate forward difference table from the following data. [4]

| x | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| f(x) | 2 | 9 | 28 | 65 | 126 | 217 |

2. Explain the mechanism of finding a real root of a non-liner equation using secant method. [4]
3. Find a root of $e^x = 3x$ using bisection method and Newtons Raphson method correct upto 3 decimal places. [4+4]
4. Solve following system of linear equation using Gauss elimination method. [8]

$$x + 2y + 3z = 6$$
$$2x + 3y + 5z = 10$$
$$2x - y + 3z = 4$$

5. Write Pseudo- code to solve a system of linear equations of 'N' unknowns using Gauss-Jordan method. [8]
6. Use Lagrange method to find f(2.5) from the following data : [8]

| x | 1 | 2 | 4 | 5 | 7 |
|---|---|---|---|---|---|
| f(x) | 1 | 1.414 | 1.732 | 2.00 | 2.6 |

7. Fit the following set of data to a curve of the form $y = a\,e^{bx}$ from the following observation by least square method. [8]

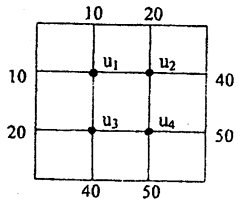
| x | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| y | 5.5 | 6.5 | 9.4 | 15.2 | 30.6 | 49.8 |

8. Derive the expression of Simpson's 1/3 rule for integration. [4]
9. Evaluate: $\int_2^4 e^{-x^2} dx$ using 2-point Gauss Legendre method. [6]

***OR***

Evaluate $\int_1^2 e^{-x^2} dx$ using Romberg method correct up to 3 decimal places.

10. Solve: $y'' + xy' + y = 0$; $y(0) = 1$; $y'(0) = 0$ for $x = 0(0.1)0.2$ using the RK2 method. [10]
11. Solve the elliptic equation $u_{xx} + y_{xx} = 0$ for the following square mesh with boundary conditions as shown in figure below. [12]

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24 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
**Examination Control Division**
**2068 Bhadra**

| | | | |
|---|---|---|---|
| **Exam:** | **Regular** | | |
| **Level** | BE | **Full Marks** | 80 |
| **Programme** | BEL, BEX, BCT, B.Agri. | **Pass Marks** | 32 |
| **Year / Part** | II / II | **Time** | 3 hrs. |

***Subject:*** - Numerical Methods

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Find a real root of $x^5 - 3x^3 - 1 = 0$ correct up to four decimal places using the Secant Method. [8]
2. Write a Pseudo-code to find a real root of a non- linear equation using Bisection Method. [4]
3. Obtain the iteration formula of Secant method and explain its working procedure in finding a root of a non linear equation. [4]

   ***OR***

   Explain the working principle of the bisection method to find a real root of a non-linear equation.
4. Solve the following set of linear equations using a suitable iterative method. [8]

   $2x + y + z - 2w = -10$
   $4x + 2z + w = 8$
   $3x + 2y + 2z = 7$
   $x + 3y + 2z - w = -5$
5. Find the largest eigen value and corresponding eigen vector of the following matrix, using power method [8]

$$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

6. Find the values of y at x = 1.6 and x = 4.8 from the following points using Newton's interpolation technique. [8]

| x | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| y | 4 | 7.5 | 4 | 8.5 | 9.6 |

7. Find a curve of the form $y = ab^x$ that fits the following set of observations using least square method. [8]

| x | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| y | 1.2 | 2.5 | 6.25 | 15.75 | 28.65 |

8. The following table gives the angle in radians ($\theta$) through which a rotating rod has turned for various values of time in seconds (t). Find the angular velocity and angular acceleration at t = 0.2. [4]

| t | 0 | 0.2 | 0.4 | 0.6 | 0.8 |
|---|---|---|---|---|---|
| $\theta$ | 0 | 0.122 | 0.493 | 0.123 | 2.022 |

9. Evaluate the integral $I = \int_{0.2}^{1.2} (\log(x+1) + \sin 2x)dx$, using Gaussian 2 point and 3 point formula. [6]

*OR*

Write a Pseudo-code to integrate a given function within given limits using Simpson's 3/8 rule.

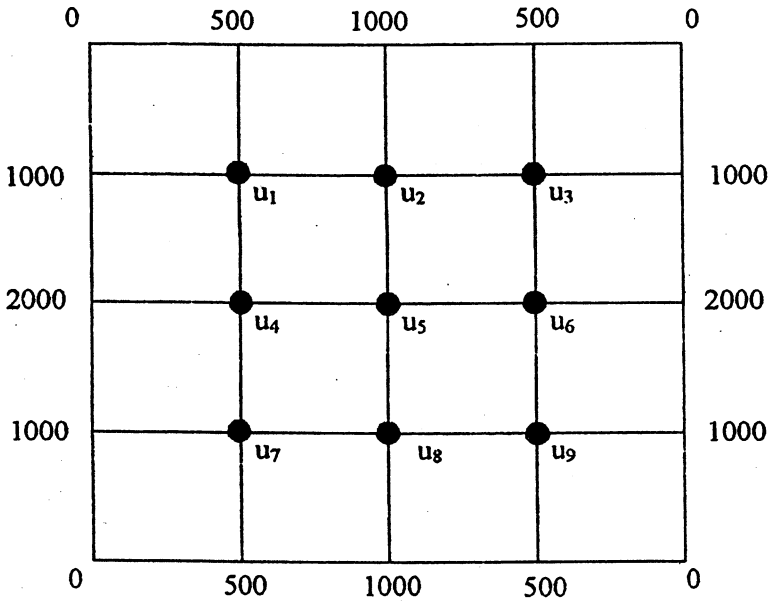
10. Solve the differential equation, $\frac{dy}{dx} = (1+x^2)y$, within $x \le 0(0.2)0.4$ and $y(0) = 1$ using RK 4th order method. [6]

11. Solve the following boundary value problem using the finite difference method, by dividing the interval into four sub-intervals. $\frac{d^2y}{dx^2} = x + y, y(0) = y(1) = 0.$ [6]

12. Solve the equation $\nabla^2 u = -10(x^2 + y^2 + 10)$ over a square mesh with sides $x = 0$, $y = 0$, $x = 3$, $y = 3$ with $u = 0$ on the boundary and mesh length = 1. [10]

*OR*

Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the following square mesh with the boundary values as shown.

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