

Exam.	Back	
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. Define error and write its types with suitable example. [4]
2. Find a real root of equation  $x \log x - \sin x = 1.2$  correct to 3 decimals using Bisection method. [6]
3. Derive Newton – Raphson formula geometrically. Using the formula, find a real root of the equation  $\cos x + 1.3x - 3 = 0$  using Newton – Raphson method, correct to 5 decimal places. [3+3]
4. Using Gauss – Elimination with partial pivoting technique, solve the following system of linear equations. [8]

$$\begin{aligned} 4x_2 + x_3 + 2x_4 &= 16 \\ -6x_1 + 3x_2 + 2x_4 &= -1 \\ x_1 - 2x_2 + 3x_3 &= 2 \\ 3x_1 + 3x_2 + x_3 - x_4 &= 16 \end{aligned}$$

5. Obtain the dominant Eigenvalue and its corresponding vector of following matrix using Power Method. [8]

$$\begin{pmatrix} 8 & -5 & 2 \\ -5 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix}$$

6. Derive the normal equation to fit the curve of the form  $y = a + bx$ . Fit this curve to the following set of data. [4+4]

x	1.0	1.7	2.4	3.1	3.8	4.5
y	1.20	7.10	9.50	10.32	12.0	13.25

7. Write a program code in C/C++ to evaluate the functional value from the given data using Lagrange interpolation. [8]

8. Write pseudo – code to evaluate the integral value using Simpson's three – eighth rule. [4]

9. Evaluate the following integral by using Gaussian 3 – point formula, correct to four decimal places. [6]

$$\int_0^{\pi} \frac{\tan^{-1} x}{x} dx$$

10. Find an approximate value of  $y(1.2)$  with an initial value  $y(1) = 1$ , using modified Euler's method, correct to three decimal places. [Take  $h = 0.1$ ] [6]

Given that:  $y' = x + y$

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

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

12. Solve the Poisson equation  $\nabla^2 u = -10(x^2 \sin(y))$  over the square grid with

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Exam.	Back	
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 relative error and its significance in contrast to absolute error, with an illustrative example.
2. Find a real root of the equation  $x(1.2 + x) + \cos x = 10$  correct to 3 decimals using regular falsi method (Method of false position).
3. Write a pseudo-code to find a real root of a non-linear equation using Bisection Method.
4. What is the importance of partial pivoting in Gauss-Elimination method? Using it solve. [1-]

$$2x_2 + x_4 = 0$$

$$2x_1 + 2x_2 + 3x_3 + 2x_4 = -2$$

$$4x_1 - 3x_2 + x_4 = -7$$

$$6x_1 + x_2 - 6x_3 - 5x_4 = 6$$

5. Find the largest Eigen value and the corresponding Eigen vector of the following matrix using Power method  $\begin{bmatrix} 1 & 2 & 5 \\ 2 & 5 & 8 \\ 5 & 8 & 10 \end{bmatrix}$ .
6. Evaluate  $y(2.25)$  and  $y(6.35)$  using appropriate polynomial interpolation from the following table.

x	2	4	6	8	10
y	9.584	9.346	10.96	9.855	9.161

7. Fit a second degree polynomial function to the following data.

x	2	4	6	8	10	12	14
y = f(x)	20.4	18.6	18.1	16.5	15.9	17.4	19.3

8. Write program code in C/C++ to evaluate a given definite integral using Simpson's one-third rule.
9. A rod is rotating in a plane. The following table gives the angle  $\theta$ (radians) through which the rod has turned for various values of the time  $t$  second.

t	0.2	0.4	0.6	0.8
$\theta$	0.12	0.49	1.12	2.02

Calculate the angular velocity and the angular acceleration of the rod, when  $t = 0.2$  second.

10. Approximate  $y(0.5)$  and  $y(1.0)$  using R-K4 method for the following initial value problem:

$$\frac{dy}{dt} - e^x + 2y = 0, \quad y(0) = 1$$

11. Solve the following boundary value problem using the finite difference method by dividing the interval into four subintervals:

$$y'' + 2y' - y = e^x, \quad y(0) = 3, \quad y(2) = 5$$

12. Solve the equation  $\nabla^2 f = (x^2 y + 2)$  over the square domain  $0 \leq x \leq 3, 0 \leq y \leq 3$  with  $f = 0$  on

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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.cm²)	3.685	4.854	6.302	8.076	10.225

Find the pressure at temperature  $T = 142^\circ\text{C}$  and  $T = 175^\circ\text{C}$  using Newton's Interpolation.

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

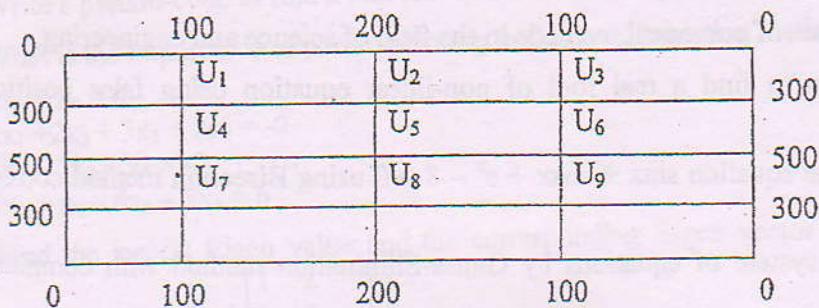
x	1	2	3	4
y	7.389	54.598	403.428	2980.958

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 an 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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[6] 2078 Baishakh

Exam.	Back		
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Year / Part	II / II	Time	3 hrs.

[6] *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.
- Write a program code in C/C++ find the real root of the given equation  $f(x) = \sin x + \cos x$  using False – Position method. [6]
- Find an approximate real root of the equation  $x^3 - 3x - 5 = 0$  correct to three decimal places using Bisection method. [6]
- Derive Newton-Raphson formula from Taylor's Series. Using this formula, find a real root of the equation  $x^3 = 3x + 4$  using Newton-Raphson method, correct to 5 decimal places. [3+3]
- Solve the system of equation  $3x+2y+7z=32$ ,  $2x+3y+z=40$ ,  $3x+4y-z=56$ , using LU factorization method. [6]
- Find the dominant Eigen value and the corresponding Eigen vector of the given matrix using Power method. [8]

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

- State the principle of Least Squares. Fit the curves of the form  $y = \frac{1}{mx+c}$  to the following data set. [1+7]

x	3	4	5	6	7	8
y	4.52	7.10	9.50	10.32	12.0	13.25

- Find a cubic spline function, and hence find  $y(1.5)$  from the following data: [8]

x:	-1	0	1	2
y:	1	4	13	31

- Write pseudo-code to evaluate the integral value using Simpson's three-eighth rule. [4]

- Derive the general Newton-Cotes quadrature formula and hence use it to derive composite Simpson's  $\frac{1}{3}$  formula. [4]

- Apply Runge-Kutta method of order 4 to approximate the value of y at  $x=0.2$  and  $x=0.4$  correct to three decimal places. Given that:  $y'' - 5y' + 6y = e^x$ ,  $y(0) = 1$ ,  $y'(0) = 2$ . [8]

- Solve the differential equation  $(1+x^2)y'' - 4xy' + 2y = 1+x^2$ ;  $y(0) = 1.25$ ;  $y(4) = -0.95$  by finite difference method by dividing four sub-intervals. [8]

- Solve the recurrence relation to solve Poisson's equation and hence use it to solve the following Poisson's equation:  $u_{xx} + u_{yy} = -10(x^2 + y^2 + 10)$  on a square domain [8]

Exam.	Regular
Level	BE
Programme	BEL, BEI, BEX BCT, BAG, BGE
Year / Part	II / II

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 interpolation 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]

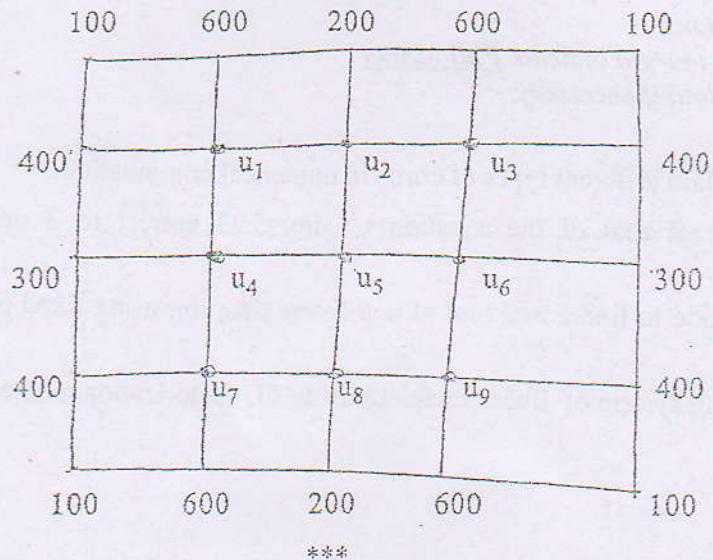
$$\int_{2}^{5} \frac{\sin x + e^x}{1+x} dx$$

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

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

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

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:



[6] TRIBHUVAN UNIVERSITY  
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 [8] 2076 Baisakh

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

[8] **Subject:** - Numerical Method (SH 553)

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

1. What do you mean by significant digits? Find the absolute, relative and percentage errors if the number  $X=4.320106$  is truncated to four significant digits. [4]

2. Define a root of a non linear equation  $f(x)=0$ . Give its geometrical meaning. Derive the formula of secant method. [6]

3. Find a real root of the equation  $\log(x)-\cos(x)=0$  using bisection method correct up to three decimal places. [6]

4. Solve the following system of linear equations using Gauss Elimination with partial pivot technique. [8]

$$\begin{aligned} 2x_1 + 5x_2 + x_3 + 5x_4 &= 45 \\ -5x_1 + 3x_2 + 5x_3 - 6x_4 &= -10 \\ 4x_1 - 3x_2 + x_3 + 5x_4 &= 26 \\ 2x_1 - 7x_2 - 2x_3 + 8x_4 &= 6 \end{aligned}$$

Or,

Write the program code in C/C++ to find the inverse of the given square matrix using Gauss-Jordan method. [8]

5. Obtain the dominant Eigen value and its corresponding Eigen vector of following matrix using Power Method. [8]

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

6. From the following table, evaluate  $y(2.4)$  and  $y(5.2)$  using appropriate interpolation formula. [6]

x	2	3	4	5	6	7	8
y	-0.62	2.72	22.00	81.83	223.38	508.52	1023.93

7. State normal equations for fitting a straight line  $y=a+bx$  to the given data  $(x_i, y_i), i=1, 2, \dots, n$  and hence use it to fit the curve  $y=ab^x$  to the following data: [2+6]

x:	20	25	30	35	40	45
y:	354	332	391	260	231	204

8. A slider in a machine moves along a fixed straight rod. Its distance 'x' along the rod is given below for various values of time 't' seconds. Find the velocity of the slider and its acceleration when  $t=0.1$  and  $t=0.6$  sec. [6]

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. Evaluate  $\int_{0.2}^{1.5} \frac{e^{-x^2}}{1+x^2} dx$  using the 3 point Gaussian quadrature formula. [4]

10. Given that:  $y' = 2\cos x - e^x + 3$ , find an approximate value of  $y(0.4)$  with an initial  $y(0)=1$  using fourth order Runge-Kutta method, with a step size of 0.2. [6]
11. Solve the following boundary value problem using shooting method by dividing the interval into four sub-intervals using Euler's formula. [10]  
 $y'' = 4e^x \sin x + 3y - xy'$ , with  $y(0)=1$  and  $y(1)=5$
12. Solve the equation  $u_{xx} + u_{yy} = 0$  over the square mesh of sides 3 units satisfying the following boundary conditions  $u(x,0) = 0$ ,  $u(x,3) = 10 + 3x^2$ ,  $0 \leq x \leq 3$ ,  $u(0,y) = y^3$ ,  $0 \leq y \leq 3$  for  $0 \leq y \leq 3$   $u(3,y) = \frac{1}{2}y^4$ , find the value of  $u(i,j)$ ,  $i=1,2; j=1,2$  [8]

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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.
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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]

$(x_i, y_i) : i = 1, 2, \dots, n$  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-Schmidt 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  $u(x, 0) = \sin(\pi x)$  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.
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- ✓ 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  $\times$  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  $\times$  2cm. [10]

Exam.		Regular	
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**Subject:** - Numerical Method (SH553)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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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]

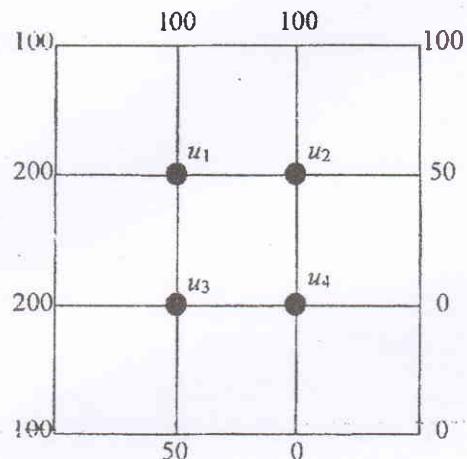
$$\int_0^2 \frac{e^x + \sin x}{1+x^2} dx$$

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 2<sup>nd</sup> 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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<b>Exam.</b>	New Back (2066 & Later Batch)		
<b>Level</b>	BE	<b>Full Marks</b>	80
<b>Programme</b>	BEL, BEX, BCT, B. Agri, BGE	<b>Pass Marks</b>	32
<b>Year / Part</b>	II / II	<b>Time</b>	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]

<b>x</b>	1.0	1.5	2.0	2.5	3.0	3.5	4.0
<b>y</b>	8.2	5.2	3.1	2.5	1.7	1.6	1.4

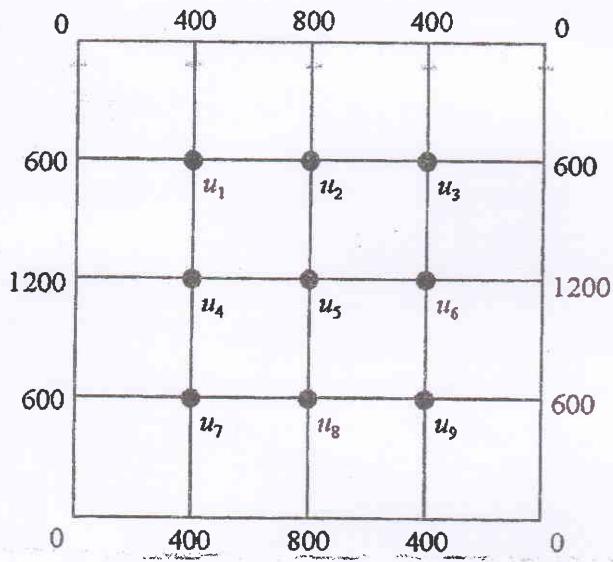
7. Estimate  $y(4.5)$  from the following data using Natural Cubic Spline Interpolation technique. [8]

<b>x</b>	1	3	5	7	9
<b>y</b>	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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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  $\int_0^{1.5} e^{-(x^2)} dx$  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  $0 \leq x \leq 3, 0 \leq y \leq 3$ . The boundary values are  $u(x, 0) = 10, u(x, 3) = 90, 0 \leq x \leq 3$  and  $u(0, y) = 70, u(3, y) = 0, 0 < y < 3$ . [10]

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

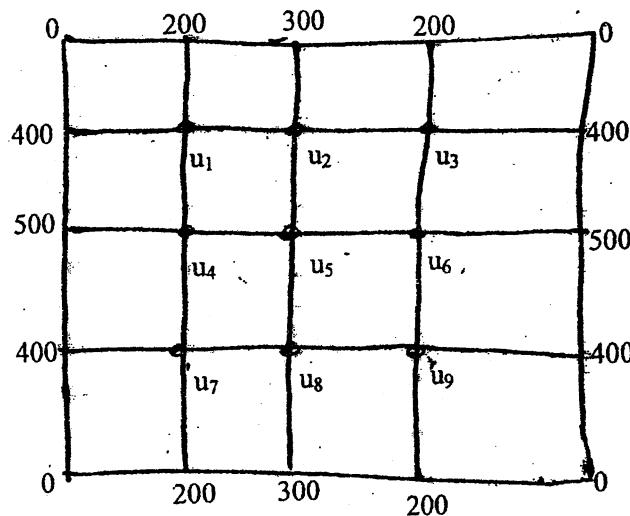
Distance (km): 0.25 1 2.2 4 6.5 8.5

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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**Examination Control Division**

2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, BGE, B.Agric.	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]

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.Agric.	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]
 
$$\begin{aligned} x - 3y + 10z &= 3 \\ -x + 4y + 2z &= 20 \\ 5x + 2y + z &= -12 \end{aligned}$$
5. Use Gauss Seidel method to solve the following equations: [8]
 
$$\begin{aligned} 20x + y - 2z &= 17 \\ 3x + 20y - z &= -18 \\ 2x - 3y + 20z &= 25 \end{aligned}$$
6. The following data are taken from the steam table. [8]

Temp. °C	140	150	160	170	180
Pressure kgf/cm <sup>2</sup>	3.685	4.854	6.302	8.076	10.225

Find the pressure at the temperature  $T = 142^\circ\text{C}$  and  $T = 175^\circ\text{C}$  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]

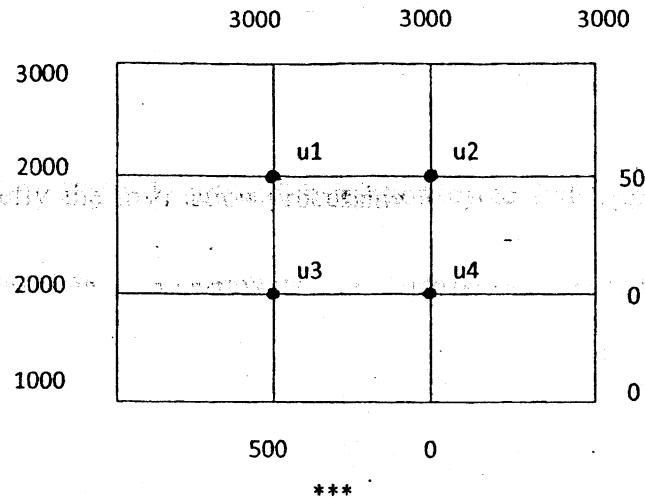
10. Using Euler's method find  $y(0.2)$  from following equation  $y' = x + y$ ,  $y(0) = 0$ , take  $h = 0.1$ . [4]

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

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEL, BEX, BCT, B.Agric.	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

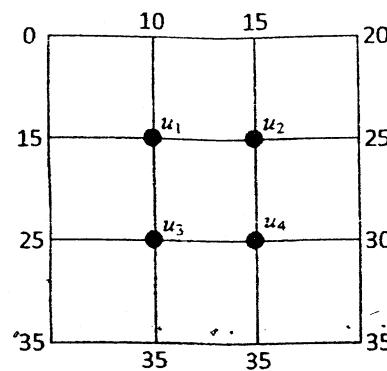
10. Solve the following initial value problem for  $y(1.2)$  using the Runge-Kutta fourth order method. [6]

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

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**

<b>Exam.</b>	Regular (2066 & Later Batch)		
<b>Level</b>	BE	<b>Full Marks</b>	80
<b>Programme</b>	BEL, BEX, BCT, B. Agri.	<b>Pass Marks</b>	32
<b>Year / Part</b>	II / II	<b>Time</b>	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]

$$\begin{aligned} x + 2y + 3z &= 6 \\ 2x + 3y + 5z &= 10 \\ 2x - y + 3z &= 4 \end{aligned}$$

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]

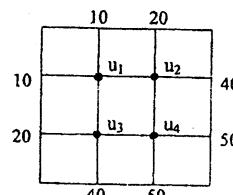
9. Evaluate:  $\int_2^4 e^{-x^2} dx$  using 2-point Gauss Legendre method. [6]

**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  $u_{xx} + u_{yy} = 0$  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.Agr.	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]
- $$\begin{aligned} 2x + y + z - 2w &= -10 \\ 4x + 2z + w &= 8 \\ 3x + 2y + 2z &= 7 \\ x + 3y + 2z - w &= -5 \end{aligned}$$
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

- EXAM. 1.2
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.

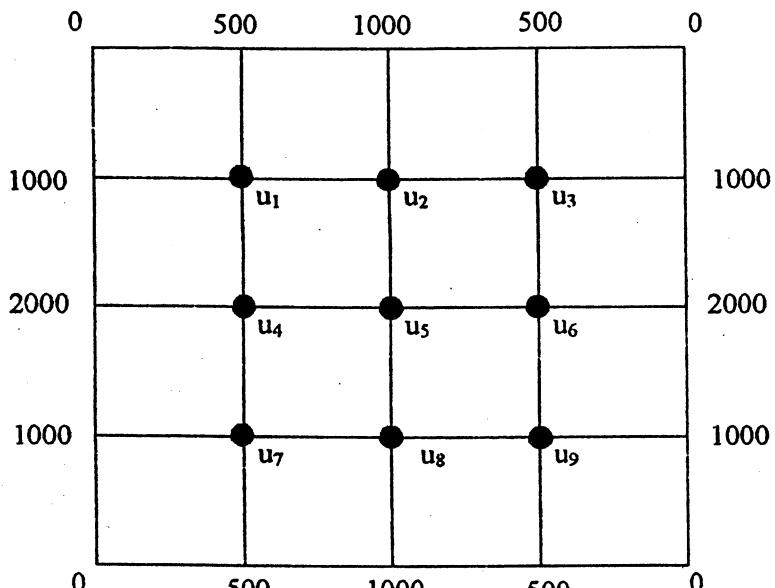
10. Solve the differential equation,  $\frac{dy}{dx} = (1+x^2)y$ , within  $x \in [0, 0.4]$  and  $y(0) = 1$  using RK 4<sup>th</sup> order method. [6]

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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