TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BAM, BIE, BAS	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods (*SH 603*)

- ✓ 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. Write an algorithm to find a real root of a non linear equation using scant method. [6]
3. Using Newton- Raphson method, find the positive root of $\cos x = 1.3\,x$ correct to six decimal places. [6]
4. Solve the following system of equations using LU Factorization method [8]

$$x + 2y - z = 2$$
$$x - 3y + 2z = 1$$
$$2x + 4y + 3z = 19$$

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

$$\begin{bmatrix} 2 & 3 & 4 \\ 3 & 5 & -2 \\ 4 & -2 & 2 \end{bmatrix}$$

6. Find the best fit in the form $y = ax^2 + bx + c$ using least square approximation from the following data [8]

x	2	3	4	5	6	7	8
y	40	36	53	60	45	43	38

7. Using the appropriate interpolation formula, approximate the values $y(1.5)$ and $y(7.8)$ from the following data: [8]

x	1	2	3	4	5	6	7	8
y	33	39	60	25	22	30	45	56

8. Derive the Newton-Cotes Quadrature formula and use it to derive the formula for Simpson's 1/3 rule. [6]
9. Write a program in C/C++ to solve a first order linear differential equation (Initial Value Problem) using RK-4 method. [6]
10. Approximate the following integral using 3-point Gaussian Quadrature formula. [4]

$$\int_1^2 e^{\sin x} dx.$$

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

$$y'' + 3y' - \cos(x) - y = 0, \quad y(0) = 2, \quad y(2) = 3$$

12. Derive the recurrence relation for solving Poisson' s equation and hence use it to solve the Poisson's equation $u_{xx} + u_{yy} = 729x^2y^2$ on a square grid with $0 \le x \le 1$ and $0 \le y \le 1$ and given that $u = 0$ on the boundary (consider step size $h = \frac{1}{3}$). [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2078 Kartik

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BAM, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH 603)*

- ✓ 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 Engineering in modern day context. [4]
2. State the condition for which fixed point iteration method converges. Solve the equation $x^3 + x^2 - 3 = 0$ correct to four decimal places using fixed point iteration method. [2+4]
3. Write a pseudo-code to find a real root of a non linear equation using Secant method. [6]
4. Solve the following system of equations using Gauss Elimination with Partial Pivoting. [8]

$$-x + 2y + 3z + w = 3$$
$$2x - 4y + z + 2w = -1$$
$$-3x + 8y + 4z - w = 6$$
$$x + 4y + 7z - 2w = -4$$

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

$$\begin{pmatrix} 1 & 3 & 5 \\ 3 & 1 & 3 \\ 5 & 3 & 1 \end{pmatrix}$$

6. For the following set of data, fit a second degree polynomial function using least square method. [8]

x	0.5	1	1.5	4.5	6.5	7.5
f(x)	2.5	2.7	3.5	6.5	5.4	4.8

7. From the following table, evaluate y(4.3) using cubic spline interpolation technique. [8]

x	1	3	5	7	9
y	3.82	7.59	9.65	8.92	11.10

8. Evaluate the following integral using 3-point Gaussian quadrature formula. [4]

$$I = \int_{-1}^{1} \frac{e^x - \sin x}{1+x^2}\, dx$$

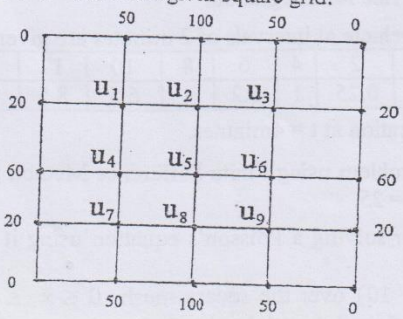
9. Use following table of data to estimate velocity and acceleration at time t = 9 sec. [6]

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

10. Write a program in any high level language (C/C ++) to solve a second order differential equation (IVP) using classical RK-4 method. [6]
11. Solve the following boundary value problem using finite difference method by dividing the interval into four sub-intervals. [8]

$$y'' = \sin x + 3y - y', \text{ with } y(0) = 1 \text{ and } y(2) = 5$$

12. Solve the Laplace equation $\nabla^2 u = 0$ over the given square grid. [8]



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BAM, BIE, BAS	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH 603)*

- ✓ 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 absolute, relative and percentage errors and hence find the absolute and relative errors if the number x = 0.004997 is rounded off to three decimal places. [4]
2. Write an algorithm to find a real root of a non linear equation using secant method. [6]
3. Find a real root of $3 - e^x + \cos x = 0$ correct to three places of decimal using Bisection method. [6]
4. Solve the following system of linear equations using Gauss-seidel method, correct to 3 decimal places. [8]

$$2a_1 + 6a_3 - 3a_4 - 31 = 0$$
$$6a_1 + 2a_4 - 14 = 0$$
$$-3a_1 + 5a_2 - 9 = 0$$
$$2a_1 + a_2 - 5a_3 + 9a_4 + 9 = 0$$

5. Using Power method evaluate the dominant eigen value and its corresponding eigen vector of following matrix. [8]

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

6. Fit the following set data to a parabola $y = a + bx + cx^2$ [8]

x	1	2	3	4	5	6
y	8.5	10	9.5	7	2.5	-4

7. Approximate y(3) and y(12) using appropriate interpolation formula for the following data. [8]

x	4	5	6	7	8	9	10	11
y	18.5	23.5	29.5	33.2	39.5	43.3	47.2	52.2

8. Solve $\frac{dy}{dx} = \frac{x^2 - y^2}{x^2 + y^2}$ to approximate y(0.4) subject to condition y(0) = 1 taking step size h = 0.2. [4]
9. Using interpolation formula, derive Newton-cotes quadrature formula and hence use it to derive composite trapezoidal rule for integration. [6]
10. The distance travelled by a vehicle at intervals of 2 minutes are given as: [4]

t (minutes)	2	4	6	8	10	12	14
distance (k.m)	0.25	1	2.2	4	6.5	8.5	11

Calculate velocity and acceleration at t = 4minutes.

11. Solve the Boundary Value Problem using Finite Difference Method $y'' + xy' + y = 3x^2 + 2$, y(0) = 0 and y(1) = 1. Take h = 25. [8]
12. Derive recurrence formula for solving a Poisson's equation using it solve the following Poisson's equation:
$u_{xx} + u_{yy} = -10(x^2 + y^2 + 10)$ over the square mesh $0 \le x \le 3$, $0 \le y \le 3$ with u(x, y) = 0 on the boundary and mesh length h = k = 1. [2+8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2076 Chaitra

Exam.			
Level	BE	Full Marks	80
Programme	BCE, BME, BAM, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH 603)*

- ✓ 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 importances of Numerical Methods in the field of science and engineering? [4]
2. Write an algorithm to find a real root of a non-linear equation using Bisection method. [6]
3. What are the limitations of Newton- Raphson method? Using this method, find the real root of the equation $\cos x - 3x + 1 = 0$, correct to four decimal places. [6]
4. Solve the following system of equations by LU factorization method. [8]

$$2x_1 + x_2 + 5x_3 = 25$$
$$x_1 - x_2 + 3x_3 = 13$$
$$x_2 - 2x_1 + 4x_3 = 13$$

5. Find the largest eigenvalue and corresponding eigen vector of the matrix $A = \begin{bmatrix} 2 & -2 & 4 \\ 2 & 3 & 2 \\ -1 & 1 & 1 \end{bmatrix}$ using power method. [8]
6. Fit a curve $y = ax^b$ to the following data: [8]

x	1	2	3	4	5
y	0.5	2	4.5	8	12.5

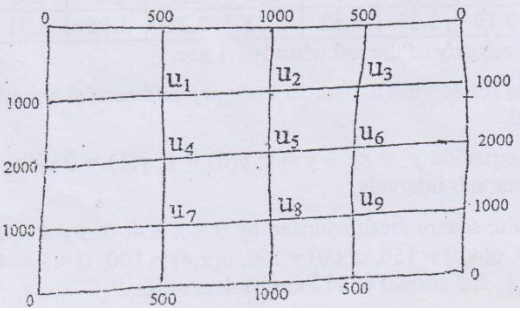
7. Estimate y(4) using cubic spline interpolation technique from the following data. [8]

x	3	5	7	9	11
y	6	9	12	9	6

8. Evaluate $\int_{-1}^{2} e^{-x^2} dx$ using Gaussion 3 – point formula. [4]
9. Derive the general Newton-cotes quadrature formula and use it to obtain simpson's 1/3 formula. [6]
10. Write a pseudo – code to solve first order differential equation using RK-4 method. [4]
11. Solve the following boundary value problem using finite difference method by dividing the interval into four sub intervals. [8]

$$y'' + 3y' - y = \cos x \quad y(0) = 2 \text{ and } y(2) = 3$$

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



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

9 ε

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BAM, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH 603)*

- ✓ 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. Using finite difference table, show that the following data satisfies a cubic polynomial. [4]

x	0	1	2	3	4
y	-8	0	26	88	204

2. Write an algorithm/pseudo-code to find a real root of a non-linear equation using Bisection method. [6]
3. Find a real root of the equation $3x+\sin(x)-e^x=0$ correct to 3 decimals using False Position (Regular-Falsi) method. [6]
4. Compute the inverse of the following matrix using the Gauss-Jordan Method. [8]
$$\begin{bmatrix} 9 & 9 & 8 \\ 7 & 8 & 7 \\ 6 & 8 & 8 \end{bmatrix}$$
5. Find the largest Eigen value and corresponding Eigen vector of the matrix $\begin{bmatrix} 1 & 4 & 4 \\ 4 & 1 & 8 \\ 4 & 8 & 1 \end{bmatrix}$ using power method. [8]
6. Using the Least Squares Method, fit a second-order polynomial $y = ax^2 + bx + c$ to the following set of data: [8]

x	1.0	1.50	2.0	2.5
y	0.75	1.25	1.45	1.25

7. Interpolate y(24) from the following data using natural cubic spline. [8]

x	10	15	20	25	30
y	22	31	28	25	26

8. Using Gauss-Legendre 3-point formula, evaluate: $\int_1^3 (x\sin x + \log_e x)dx$ [6]
9. A rod is rotating in a plane. The following table gives the angle θ (radian) through which the rod has turned for various of time t seconds. [4]

t	1.0	1.2	1.4	1.6	1.8	1.9	2.0
θ	2.10	2.31	2.52	2.85	3.24	3.95	4.31

Calculate the angular velocity of the rod when t=1.1 sec.

10. Write the pseudo-code for solving a 1st order ordinary differential equation using Runge-Kutta 4th order method. [6]
11. Solve the differential equation $y'' + xy' - y = x$; $y(0) = 1$; $y(1) = 0$ using finite difference method by dividing four sub-intervals. [8]
12. Solve $U_{xx}+U_{yy}=0$ for the square mesh bounded by $0 \le x \le 4$; $0 \le y \le 4$ and the boundary conditions $u(0,y)=150$, $u(4,y) = 150$, $u(x,0) = 100$, $u(x,4) = 100$; $0 < x < 4$; $0 \le y \le 4$. Find the values of u(i,j), i= 1, 2, 3 correct to 3 places of decimals. [8]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BAM, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH 603)*

- ✓ 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 advantages and limitations in solving mathematical problems by numerical techniques rather than analytically. [4]

2. Find a negative real root of the following equation correctto three decimals using Bisection Mehod. [6]

$$\frac{1-(x+1)^4}{x}-1=0$$

3. What are limitations of Newton-Raphson method? Using Newton-Raphson method, find a root of the equation $x\sin x - \cos x = 0$ correct to four decimal places. [2+4]

4. Solve the following system of linear equation, using Gauss-Elimination method with partial pivoting technique. [8]

$x_1-3x_2+8x_3=3$
$5x_1+x_2+2x_3=9$
$x_1+7x_2-x_3=14$

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

$$\begin{bmatrix} 1 & 4 & 4 \\ 4 & 1 & 8 \\ 4 & 8 & 1 \end{bmatrix}$$

6. Using the Method of Least Squares, fit the following set of data to a curve of the form $y = a\log_e x + b$. [8]

x	0.5	1.0	1.5	2	2.5	3
y	3.7	5.3	5.8	6.6	6.9	7.5

7. Using the cubic spline technique, estimate f(4) from the following data: [8]

x	1	3	5	7	9
f(x)	1.5	-0.4	-6.9	6.1	6.4

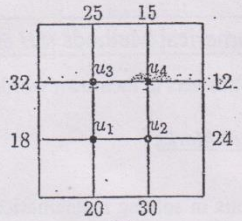
8. Derive composite Simpson's 3/8 formula for integration. [4]

9. Use Romberg's method to compute $\int_0^1 \frac{1}{1+x^2}dx$ correct to three decimal places. [6]

10. Using Euler's method, solve $\frac{dy}{dx}=\frac{y+x}{y-x}$, with y=1 at x=0, for x=0.1, h=0.02. [6]

11. Solve the following boundary value problem using Finite Difference Method taking a step-size of 0.5. $y''+2y'+y=3x^2$ subject to boundary conditions $y(0) = 5$ and $y(2)=4$. [8]

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



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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BAME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Explain the importance of Numerical Methods in the field of Science and Engineering. [4]
2. Write a pseudo-code to find a real root of a non-linear equation using False Position method. [6]
3. Find a positive root of the equation $x^2 \sin x - e^x + 2 = 0$ correct to 3 decimals using Bisection method. [6]
4. Using L-U method solve, the following system of equations [8]

$$2x + 3y + z = 1$$
$$6x - 3y + 4z = 17$$
$$5x + 7y + 6z = 10$$

5. Determine the dominant eigen value and corresponding vector of the following matrix using the power method: [8]

$$\begin{bmatrix} 2 & 6 & 3 \\ 6 & 5 & 4 \\ 3 & 4 & 9 \end{bmatrix}$$

6. Fit the following set of data to a curve of the form $y = ae^{bx}$. [8]

x	2	3	4	5	6	7
y	15.1	10.2	7.8	5.5	3.8	1.7

7. Using the Cubic Spline interpolation technique, estimate the value of y(4) from the following data: [8]

x	1	3	5	7
y	1.56	-0.43	-16.90	6.10

8. Derive an expression to evaluate first derivative from Newton's backward interpolation formula and evaluate $\frac{dy}{dx}$ at x = 8 from the following table. [3+3]

x	0	2	4	6	8
y	0	-0.7553	-11.2151	34.2867	-8.3226

9. Use Simpson's $\frac{1}{3}$ – rule to evaluate $\int_0^6 \frac{2x^2+5}{1+x} dx$, taking n = 6 and also find the absolute error with exact value. [3+1]

10. Write a pseudo-code to solve an initial value problem of first order differential equation using Runge-Kutta 2 method. [4]

11. Using Fourth-order Runge Kutta method, solve the following differential equation for y at x = 0.2 and r = 0.4;

$$y'' - xy'^2 + y^2 = 0, \quad y(0) = 1, \quad y'(0) = 0$$ [8]

12. Solve Poisson's equation $Uxx + Uyy = 243(x^3 + y^3)$ over the square domain $0 \le x \le 1$, $0 \le y \le 1$ with step size $h = 1/3$ with u = 100 on the boundary. [10]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BAME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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 different types with examples. If x = 1.350253 is rounded off to Four significant digits, find absolute and relative errors. [4]
2. Write an algorithm to find a real root of a non linear equation using secant method. [6]
3. What are limitations of Newton-Raphson method? Using Newton-Raphson method, find a root of equation
   $x\sin x + \cos x = 0$ which is near to $x = \pi$. [2+4]
4. Solve the following system of linear equation using Gauss-Seidal method, correct to 3 decimal places. [8]

$$2x_1 + 6x_3 - 3x_4 = 31$$
$$6x_1 + 2x_4 = 14$$
$$-3x_1 + 5x_2 = 9$$
$$2x_1 + x_2 - 5x_3 + 9x_4 = -9$$

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

$$\begin{bmatrix} 1 & 4 & 4 \\ 4 & 1 & 8 \\ 4 & 8 & 1 \end{bmatrix}$$

6. Fit the curve of the form $y = a \log_e x + b$ to the following data sets. [8]

x	2	3	4	5	6	7
y	5.45	6.26	6.84	7.29	7.66	7.96

7. Approximate y(2) and y(10) using appropriate interpolation formula from the following data: [8]

x	3	4	5	6	7	8	9
y	4.8	8.4	14.5	23.6	36.2	52.8	73.9

8. Derive Newton-Cotes general quadrature formula for integration and use it to obtain Simpson's $\frac{1}{3}$ rule of integration. [6]
9. Evaluate $\int_0^1 \frac{\tan^{-1} x}{x}$ using Gaussian 3 point formula. [4]
10. Solve the following boundary value problem using shooting method [10]
    $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = e^x$, with y(1) = 1 and y(2) = 5; Taking h = 0.25
11. Write a pseudo-code to solve an initial value problem of first order using Runge - Kutta 4 method. [4]
12. Derive recurrence formula for solving one dimensional heat equation $U_t = c^2 U_{xx}$. Using it solve the heat equation $U_t = 0.5\ U_{xx}$, $0 \le x \le 5$, $0 \le t \le 4$ with boundary conditions [4+4]

05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. [4]
2. Find a real root of the equation $\cos x - xe^x = 0$, correct to four decimal places, using Regula-falsi method. [6]
3. Write pseudo-code for finding a real root of a non-linear equation using the Secant Method. [6]
4. Solve the following system of linear equations using the Gauss-Elimination Method. [8]

$$3x_1 - 2x_2 + 3x_3 + 2x_4 = 16$$
$$2x_1 - 3x_2 + 2x_3 + 3x_4 = 9$$
$$5x_1 + 3x_2 - 5x_3 + 4x_4 = 7$$
$$4x_1 + 2x_2 + 2x_3 - 3x_4 = 16$$

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

$$\begin{bmatrix} 5 & 2 & 3 \\ 2 & 4 & 2 \\ 3 & 2 & 5 \end{bmatrix}$$

6. Write the pseudocode to fix a given set of data to a second degree polynomial $(y = a + bx + cx^2)$ using the Least Square Method. [8]
7. Fit the following data to the curve $y = ax^b$ using least square method. [8]

x	350	400	500	600
y	61	26	7	2.6

8. Evaluate $\int_0^2 (\sin x + \cos x)dx$ using Gaussian 3-point formula. [6]
9. Derive the formula for computing first and second derivative using Newton's forward difference interpolation formula. [6]
10. Solve the following boundary value problem using Shooting Method employing Euler's formula taking a step-size of 0.25. [10]

$y'' = x - y + y'$ subject to boundary conditions $y(0) = 2$ and $y(1) = 3$

11. Solve the elliptic equation (Laplace) $\mu_{xx} + \mu_{yy} = 0$ for the square mesh $0 \le x \le 1, 0 \le y \le 1$ where $h = \Delta x = 0.25$ and $k = \Delta y = 0.25$ with the following boundary conditions: [10]

$u(0,0) = 0$ $u(0,0.25) = 1000$ $u(0,0.50) = 2000$	$u(0.25,0) = 500$	$u(0.5,0) = 1000$	$u(0.75,0) = 500$	$u(1,0) = 0$ $u(1,0.25) = 1000$ $u(1,0.50) = 2000$

05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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 Divided Difference table from the following data: [4]

x	1	2	4	5	6
y	14	15	5	6	19

2. Find an approximation of the root of the equation $x^3 - x - 11 = 0$ by using Bisection method correct to three decimal places. [6]
3. Write an algorithm for finding a real root of non-linear equation using Newton Raphson method. [6]
4. Solve the following system of linear equations using Gauss-Seidal iteration method. [8]

$$6x_1 + x_2 - x_3 + 2x_4 = 4$$
$$2x_1 + 5x_2 - 4x_3 + 6x_4 = -5$$
$$x_1 + 4x_2 + 3x_3 - x_4 = 2$$
$$x_1 + x_2 + 2x_3 + x_4 = 5$$

5. Find the largest Eigenvalue and corresponding Eigenvector of the following matrix using power method. [8]

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

6. Evaluate y(10) by using Lagrange's interpolation formula from the following data: [8]

x	5	6	9	11
y	12	13	14	16

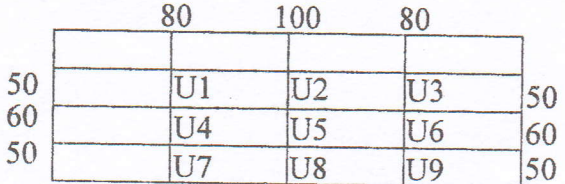
7. Using least square method, fit a curve $y = ae^{bx}$ to the following data: [8]

x	4	5.5	7	8	10
y	18.47	39.11	82.79	136.5	371.03

8. Find the value of cos(1.74) from the following table. [4]

x	1.7	1.74	1.78	1.82	1.86
sinx	0.9916	0.9857	0.9781	0.9691	0.9584

9. Derive composite simpson's three-eight formula for the integration. [6]
10. Write Psudocode to solve a first order differential equation using R-K 4 method. [6]
11. Solve the boundary value problem $y''+xy'+y = 3x^2 + 2, y(0) = 0, y(1) = 1$ [6]
12. Solve the laplace equation $U_{xx} + U_{yy} = 0$ over the square grid with boundary condition as shown in figure. [10]



05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Write an algorithm to solve a non-linear equation using secant method. [6]
2. Find the positive root of equation $\cos x - 1.3x = 0$, correct to six decimal places using Newton Raphson Method. [6]
3. Discuss the limitations of fixed point iteration methods graphically. [4]
4. Using Factorisation method, solve the given system of linear equations. [8]

$$2x - 5y + z = 12$$
$$-x + 3y - z = -8$$
$$3x - 4y + 2z = 16$$

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

$$\begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$$

6. using least square method, fit a curve $y = ax^2 + bx + c$ to the following data: [8]

x	20	40	60	80	100	120
y	5.5	9.1	14.9	22.8	33.3	46.0

7. Use cubic spline interpolation to estimate f(2.5) from given table. [8]

x	1	2	3	4
f(x)	0.5	0.3333	0.25	0.20

8. Derive Newton-cotes quadrature formula for integration and use it to obtain the trapezoidal rule of integration. [6]
9. The following table gives distance (s) of a particle at time (t): [4]

t	0.2	0.4	0.6	0.8	1.0	1.2
s	0.12	0.49	1.12	2.02	3.20	4.67

Calculate the velocity at time t = 0.3

10. Write Pseudocode to solve a first order differential equation using Euler's method. [4]
11. Using Fourth order Runge-Kutta method, solve the following differential equation for y at x = 0.2 and x = 0.4: [8]

$$y'' - xy'^2 + y^2 = 0,\ y(0) = 1,\ y'(0) = 0$$

12. Solve Poisson's equation $u_{xx} + u_{yy} = 729x^2y^2$ over the square domain $0 \le x \le 1, 0 \le y \le 1$ with step size h = 1/3 with u = 0 on the boundary. [10]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Show that the following data pairs satisfy a cubic polynomial by constructing a divided difference table. [4]

x	1	2	4	5	7	8
y	8.8	5.5	3.7	4.0	4.0	2.5

2. Find a positive real root of the equation $xe^x + \sin x = 0.5$ with an accuracy of 6 decimal places using Newton-Raphson Method. [6]
3. Write pseudo-code to find a real root of a given non-linear equation using Secant Method. [6]
4. Solve the following system of linear equations using Factorization Method. [8]

$$9x_1 + 5x_2 - 8x_3 = 19$$
$$5x_1 - 3x_2 + 8x_3 = 19$$
$$7x_1 + 4x_2 - 5x_3 = 19$$

OR

Write a high-level language (C/C++/FORTRAN) program to compute the inverse of a non-singular square matrix using Gauss Jordan Method.

5. Find the largest Eigen value and corresponding vector of the following matrix using Power Method. [8]

$$\begin{bmatrix} 1.4 & 1.3 & 2.2 \\ 1.3 & 3.5 & 1.5 \\ 2.2 & 1.5 & 3.2 \end{bmatrix}$$

6. Fit the following set of data to a curve of the form $y = a\log_e x + b$ [8]

x	2	4	6	8	10	12	14
y	4.7	7.2	8.3	9.6	10.4	10.7	10.9

7. Evaluate y (1.6), y (7.8) and y (4.2) from the following data using appropriate polynomial interpolation technique used for equally spaced intervals. [8]

x	1	2	3	4	5	6	7	8
y	2.3	1.8	2.0	3.0	4.4	5.0	3.9	1.7

8. Derive formula for first derivative using Newton forward interpolation formula. [5]
9. Evaluate $\int_0^{\pi} x\sin x dx$ using 3-point Gauss Legendre formula. [5]
10. Solve $y' = \sin x + \cos y, y(0) = \pi$ in the range $0 \le x \le 2$ by dividing the interval into 5 sub-intervals using Euler's method. [4]
11. Apply Runge-Kutta method of fourth order to find y(0.5) and y(1) from following equation $\frac{dy}{dx} = \frac{y^2 + x^2}{x + y}$ with $y(0) = 1$. [8]
12. Solve the Poisson's equation $\nabla^2 u = x^3 + y^3$ over the square region $0 \le x \le 3$ and $0 \le y \le 3$ subject to $u(x,0) = 0, u(0,y) = 0, u(3,0)$ and $u(0,3) = 0$ taking $\Delta x = \Delta y = 1$. [10]

01/06

05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Calculate a real root of $x^7 + \sin x - \cos x = 0$ accurate up to 3 decimal places using Bisection Method. [6]
2. Write pseudo-code to find a real root of a given non linear equation using False Position Method. [6]
3. Discuss the limitations of Newton-Raphson Method in finding a real-root of a non-linear equation. [4]
4. Use Gauss Jordan method to find the inverse of following matrix A. [8]

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

5. Compute the dominant Eigen value of the following matrix using Power Method. [8]

$$\begin{bmatrix} 3 & 4 & 5 \\ 4 & 3 & 6 \\ 5 & 6 & 5 \end{bmatrix}$$

6. From the following table estimate f(1.6) using Newton's forward interpolation method. [8]

x	1	1.4	1.8	2.2
f(x)	3.49	4.82	5.96	6.5

7. Estimate y(5) from the following data using Cubic Spline Interpolation technique. [8]

x	2	4	6	8
y	4	5	7	6

OR

Write a high-level language (C/C++/FORTRAN) program to complete Largrange's interpolation.

8. Find approximate values of y'(3) and y"(3) from the following function: [4]

x	2	2.5	3	3.5	4
y	5.53	5.74	4.62	2.96	2.89

9. Evaluate $\int_0^1 \frac{\tan^{-1} x}{x} dx$ using Romberg method correct up to 3 decimal places. [6]
10. Solve $y''+3y'-y = 2x$ subject to the boundary conditions $y(0) = 3$ and $y(2) = 4$ in the range $0 \le x \le 2$ by dividing the interval into four sub-intervals using the finite difference method. [8]
11. Write pseudo-code to solve an initial value problem (first order ordinary differential equation) using the Runge- Kutta fourth order method. [4]
12. Solve the equation $\nabla^2 u = -10(x^2 + y^2 + 10)$ over the square with sides $x = 0 = y$, $x = 3 = y$ with $u = 0$ on the boundary and mesh length = 1 [10]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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 the following equation, correct to four decimals, using the False Position method. [6]

$$x^3 - 5x - \sin(x) - 6 = 0$$

2. Derive analytically the iteration formula for Newton-Raphson method to find a real root of a non-linear equation. [4]
3. Write an algorithm to find a real root of a non-linear equation using the Bisection Method. [6]
4. Solve the following system of linear equations using the Gauss-Seidal Iteration Method. [8]

$$9x_1 + 2x_2 - 3x_3 = 10$$
$$5x_1 + 11x_3 + 2x_4 = 30$$
$$x_2 + 3x_3 + 7x_4 = 25$$
$$2x_1 + 8x_2 - 2x_4 = 15$$

OR

Write pseudo-code for solving a system of linear equations using the Gauss Elimination Meythod.

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

$$\begin{bmatrix} 1 & 4 & 3 \\ 4 & 2 & 7 \\ 2 & 6 & 5 \end{bmatrix}$$

6. Evaluate f(2.5) from the following data using Newton's Divided difference interpolation formula: [8]

x	1	2	3	4	5	6
$f(x)$	8.9	9.2	16.3	35.5	72.5	132.4

7. Fit the following data to an exponential curve of the form $y = ab^x$. [8]

x	2	4	6	8	10
y	2	6	25	115	300

8. Find y'(0.2) and y''(0.2) from the following data: [5]

x	0.1	0.2	0.3	0.4	0.5
y	2.6	8.2	15.4	25.6	37.8

9. Evaluate the following using Gaussian three point formula: [5]

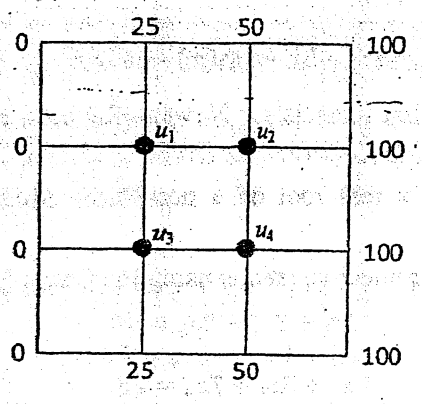
$$\int_0^2 x \sin(\cos x) + 2 \, dx$$

10. Solve the following initial value problem using the Modified Euler's method for $0 \leq x \leq 0.6$ with an interval of 0.2 [6]

$$\frac{dy}{dx} = \sin x + \cos y; \quad y(0) = 3$$

11. Explain the technique of solving a two-point boundary value problem using the shooting method. [6]

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



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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE,BME,BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. How do we obtain a real root of a non-linear equation using Secant method? Explain graphically and hence deduce the iteration formula. [4]
2. Write an algorithm to find a real root of a non-linear equation using Bisection method. [4]
3. Find a positive real root of $\sin(x) + \cos(x) + e^x - 8 = 0$ correct up to 4 decimal places using Newton-Raphson method. [6]
4. Solve the following system of equations using the LU Factorization method. [8]
   $4x + 3y + z = 33$
   $2x + 5y + 3z = 41$
   $2x + y + 5z = 47$
5. Obtain the numerically dominant Eight value and corresponding eigen vector of the following matrix, using power method. [8]

$$\begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$$

6. From the following data, find the cubic polynomial between x = 3 and x = 4 using the natural cubic Spline interpolation technique. [8]

x	2	3	4	5	6
y	5	6	4	3	2

OR

Write a program in C to numerically interpolate a value from a given data set using Lagrange's interpolation formula.

7. Fit the following set of data to a curve of the form $y = a e^{bx}$ [8]

x	1	2	3	4	5	6	7	8
y	2	3	4	5	7	10	15	30

8. A slider in a machine moves along a fixed straight rod. Its displacement x cm. along the rod is given below at different instant of time t seconds. Find the velocity of the slider and its acceleration when t = 0.2 seconds. [4]

t	0.0	0.1	0.2	0.3	0.4
x	30.13	31.62	32.87	33.64	33.95

9. Evaluate the following integral correct to three decimals using Romberg's method. [6]

$$\int_2^4 \left(4 + \frac{\cos(X)}{e^{\sin x}}\right) dx$$

10. Using the finite difference approximation, solve the following boundary value problem for three interior points. [8]

$y''+4y'-3y = \sin(x)$; with boundary conditions $y(2) = 3$ and $y(4) = 4$

11. Write pseudo-code to solve an initial value problem (first order ordinary differential equation) using the Runge-Kutta fourth order method. [6]

12. Solve the Poisson's partial differential equation $u_{xx} + y_{yy} = -10(x^2 + y^2 + 10)$ over the region $0 \le x \le 3$ and $0 \le y \le 3$ with boundary conditions: [10]

$u(0, y) = 0, u(3, y) = 0, u(x,0) = 0$ and $u(x,3) = 0$ Assume mess length = 1

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06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	All (except B. Arch)	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(EG601SH)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions. **Question No. 6 is compulsory.***
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Use the Bisection method to find a real root having accuracy within 10^{-2} for $x^3-7x^2+14x-6=0$ on the interval [0,1]. [8]

   b) Let $f(x) = -x^3-\cos x$, find a real root using secant method with accuracy 0.01. [8]

2. a) Construct the interpolating polynomial of degree four for the unequally spaced points given in the following table: [8]

x	0.0	0.1	0.3	0.6	1.0
f(x)	–6.000000	–5.89483	–5.65014	–5.17788	–4.28172

   Find the value for x = 2.5 using polynomial.

   b) Estimate coefficient of Y = ax+b for following data using least square method. [8]

x	4	5	6	7	8	9
y	14	12	11	9	6	4

3. a) A car laps a race track in 84 s. The speed of the car at each 6-s interval is determined using a radar gun and is given from the beginning of the lap, in feet/second, by the entries in the following table. [8]

Time	0	6	12	18	24	30	36	42	48	54	60	66	72	78	84
Speed	124	134	148	156	147	133	121	109	99	85	78	89	104	116	123

   Calculate the acceleration at t = 12S and t = 54S.

   b) Approximate the following integrals using Gaussian quadrature with n=2 and compare your results to the values of the integrals $\int_0^1 x^2e^{-x}dx$. [8]

4. a) Solve the following linear algebraic equation using Gauss-Jordan method: [8]

   $X_1 + 3X_3 + 2X_4 = 17$

   $3X_2 + 3X_3 + 2X_4 = 18$

   $-2X_1 + 2X_2 + X_3 = 20$

   b) Solve the following equations using Jacobi' Iteration method. [8]

   $3x + 4y + 15z = 54.8$; $x + 12y + 3z = 39.66$; $10x + y - 2z = 7.74$

5. a) What is initial value problem and boundary value problem? Explain with example. [4]

   b) Using Runge Kutta method of order 4^{th}, solve $y'' = y + xy'$, given that $y(0) = 1$, $y'(0) = 0$, find $y(0.2)$ and $y'(0.2)$ with step size $h = 0.1$

6. Write an algorithm, flow chart and Pseudo code to solve system of equation by Gauss-Jordan method. Program should capable to solve 2 to 10 system of equations. [16]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH 603)*

- ✓ 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 the forward difference table from the following data: [4]

x	0	1	2	3	4	5	6
f(x)	0	2.2	4.7	8.5	14.3	20.7	30.1

2. Derive iterative formula for Newton-Raphson method using Taylor-series. [4]
3. Find a root of the equation $x^3-4x-9=0$, using bisection method, correct upto three decimal places. [8]
4. Solve the following system of linear equations using the factorization method. [8]

$$2x+2y+3z = 17$$
$$3x+2y+z = 12$$
$$5x+2y+2z = 18$$

OR

Write the Pseudo-code for solving a system of linear equations using the Gauss Jordan Method.

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

$$\begin{bmatrix} 1 & -2 & 3 \\ -2 & 4 & 2 \\ 3 & 2 & 9 \end{bmatrix}$$

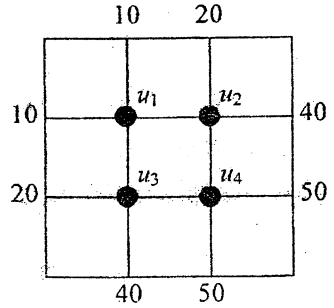
6. Using Lagrange interpolation formula, find the value of f(1.3) from following data [8]

X	1	3	4
Y	4.28	2.18	4.13

7. Estimate the co-efficients of y = ax+b for the following data using least square method. [8]

X	–2.0	–1.0	0.5	2.0	3.0	5.5
Y	–0.4	1.2	3.5	6.0	7.4	11.0

8. Derive the expression for evaluating derivative by forward difference method. [4]
9. Evaluate $\int_0^6 \frac{dx}{1+x^2}$ using Simpson's 1/3 rule taking unit interval size. [6]
10. Solve $\frac{dy}{dx} = y - \frac{3x}{y}, y(0) = 1.5$ in the range $0 \le x \le 0.4$ taking h = 0.2 using Modified Euler's method, performing iteration for an accuracy of four decimal places in each step. [10]
11. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary conditions as exhibited in the figure below. [12]



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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2069 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Using the divided different table, show that the following data satisfies a cubic polynomial. [4]

x	1	3	4	5	7	9
y	2.9	2.3	14.6	41.5	166.7	418.1

2. Write an algorithm to find a real root of a non-linear equation using Bisection Method. [6]
3. Find a real root of the following equation correct to three decimals using the Secant method. $e^{\cos x} = \sin x$ [6]
4. Solve the following system of linear equations using Gauss-Seidel's method [8]

$-x_1 - x_2 - 2x_3 + 10x_4 = -9$
$10x_1 - 2x_2 - x_3 - x_4 = 3$
$-2x_1 + 10x_2 - x_3 - x_4 = 15$
$-x_1 - x_2 + 10x_3 - 2x_4 = 27$

Your answer must be correct to three decimal places.

OR

Write pseudo-code to solve a system of linear equations of 'N' unknowns using the Gauss-elimination method.

5. Obtain the numerically dominant Eigen value and corresponding eigenvector of the following matrix using Power Method. $\begin{bmatrix} 15 & -4 & -3 \\ 10 & 12 & -6 \\ -20 & 4 & -2 \end{bmatrix}$ [8]
6. Using the Cubic Spline interpolation technique, estimate the value of y(9) from the following data: [8]

x	4	6	8	10
y	2	5	8	6

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

x	2	3	4	5	6	7
y	15.1	10.2	7.8	5.5	3.8	1.7

8. A rod is rotating in a plane. The following table gives the angle θ (radians) through which the rod is turned for various values of the time t second: [4]

t	0.0	0.2	0.4	0.6	0.8	1.0	1.2
θ	0	0.12	0.49	1.12	2.02	3.20	4.67

Calculate the angular velocity and the angular acceleration of the rod, when t = 0.2 and 1.0 second.

9. Derive simpson's 1/3 rule for integration. Evaluate the following integral using Simpson's 1/3 rule, taking h = 0.25 $\int_0^1 \frac{e^x}{x+1} dx$ [4+2]

10. Solve the following boundary value problem using the finite difference method by dividing the interval into four sub-intervals. $\frac{d^2y}{dx^2} = \sin x + y;\ y(0) = 3;\ y(1) = 4$ [8]

11. Write pseudo-code to solve an initial value problem (first order ordinary differential equation) using Euler's method. [4]

12. Solve the Poisson's equation $u_{xx} + u_{yy} = -81xy,\ 0 < x < 1,\ 0 < y < 1$ with boundary condition: u (0,y) = u (x,0) = 0 and u (1,y) = u (x,1) = 100; taking h = 1/3. [10]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH 603)*

- ✓ 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 the forward difference table from the following data: [4]

x	0	1	2	3	4	5	6
f(x)	0	2.2	4.7	8.5	14.3	20.7	30.1

2. Derive iterative formula for Newton-Raphson method using Taylor-series. [4]
3. Find a root of the equation $x^3-4x-9=0$, using bisection method, correct upto three decimal places. [8]
4. Solve the following system of linear equations using the factorization method. [8]

$$2x+2y+3z = 17$$
$$3x+2y+z = 12$$
$$5x+2y+2z = 18$$

OR

Write the Pseudo-code for solving a system of linear equations using the Gauss Jordan Method.

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

$$\begin{bmatrix} 1 & -2 & 3 \\ -2 & 4 & 2 \\ 3 & 2 & 9 \end{bmatrix}$$

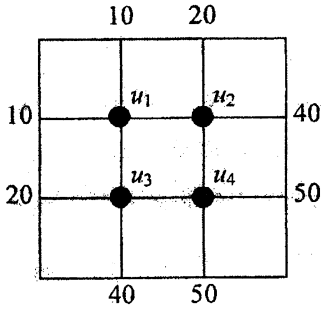
6. Using Lagrange interpolation formula, find the value of f(1.3) from following data [8]

X	1	3	4
Y	4.28	2.18	4.13

7. Estimate the co-efficients of $y = ax+b$ for the following data using least square method. [8]

X	–2.0	–1.0	0.5	2.0	3.0	5.5
Y	–0.4	1.2	3.5	6.0	7.4	11.0

8. Derive the expression for evaluating derivative by forward difference method. [4]
9. Evaluate $\int_0^6 \frac{dx}{1+x^2}$ using Simpson's 1/3 rule taking unit interval size. [6]
10. Solve $\frac{dy}{dx} = y - \frac{3x}{y}, y(0) = 1.5$ in the range $0 \le x \le 0.4$ taking h = 0.2 using Modified Euler's method, performing iteration for an accuracy of four decimal places in each step. [10]
11. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary conditions as exhibited in the figure below. [12]



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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions. **Question No. 6 is compulsory.***
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Find the root of the equation $e^x - 3x = 0$ correct upto three decimal places using bisection method. [8]

   b) Find the reciprocal of 3 using Newton Raphson method. [8]

2. a) Apply Newton's forward difference formula to find y(3.5) from the following data. [8]

x	1	2	3	4	5	6	7	8
y	1	8	27	64	125	216	343	512

   b) Obtain a relation of the form $y = ae^{bx}$ for the following data by the method of least squares. [8]

x:	0.0	0.5	1.0	1.5	2.0	2.5
y:	0.10	0.45	2.15	9.15	40.35	180.75

3. a) Use Romberg integration method to evaluate the integral $\int_1^2 \frac{dx}{x}$ correct upto 3 decimal places taking the initial sub interval size as $h = (b - a)/2$. [10]

   b) The velocity V of a particle at a distance S from a point on its path is given in the table below: [6]

S (ft)	0	10	20	30	40	50	60
V (ft/sec)	47	58	64	65	61	52	38

   Estimate the time taken to travel a distance of 60ft by using Simpson's 1/3 rule. Compare the result with Simpson's 3/8 rule.

4. a) Find the largest eigen value correct to three significant digits and corresponding eigen vector of the following matrix using power method. [8]

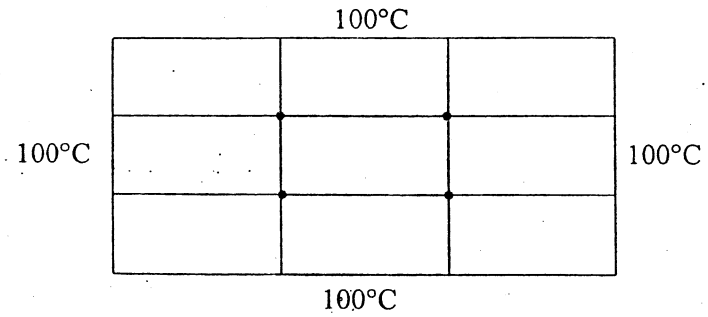
$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 4 & 5 \end{bmatrix}$$

   b) Use Gauss Jordan method to find the inverse of the following matrix. [8]

$$A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$$

5. a) Solve $y' = xy + y^2$, $y(0) = 1$ for $y(0.1)$ and $y(0.2)$ using Runge-Kutta method of fourth order. [8]

   b) Consider a metal plate of size 30cm × 30cm, the boundaries of which are held at 100°C. Calculate the temperature at interior points of the plate. Assume the grid size of 10cm ×10cm. [8]



6. Write algorithm, flowchart and program code in any one of the high level languages (FORTRAN or C) to fit the parabola $y = a + bx + cx^2$ where a, b and c are constants, Hence find the value of y when x is an user defined value. [16]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods 2612ce

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions. **Question No. 6 is compulsory.***
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Find at least one root of $x^3 - x - 3 = 0$ with the accuracy of 0.08%, using Bisection method. [8]

   b) Find an approximate root of $x \log_{10} x - 1.2 = 0$ using secant method upto three decimal places of accuracy. [8]

2. a) Use a suitable method to fit an exponential curve $y = ae^{bx}$ for the following data: [8]

X	1	2	3	4	5
Y	1.65	2.7	4.5	7.35	12.2

   b) The followings are the measurement of t (time) made on a curve recorded by an oscillograph representing a change in the conditions of an electric current (I). [8]

t (time)	1.2	2.0	2.5	3.0
I	1.36	0.58	0.34	0.20

   Find the value of I when t = 1.6 with appropriate Newton's Gregory Interpolation method.

3. a) Evaluate $I = \int_0^2 \frac{(x^2+2x+1)}{1+(x+1)^4} dx$ using Gauss two point and three point formula. Also, compare results obtained from both the methods. [8]

   b) Find the largest Eigen value of the matrix $A = \begin{bmatrix} 2 & -2 & 4 \\ 2 & 3 & 2 \\ -1 & 1 & 1 \end{bmatrix}$ using power method. [8]

4. a) Solve the system of equations given using the Gauss elimination method with partial pivoting. [8]

$$2x_1 + x_2 + x_3 - 2x_4 = -10$$
$$4x_1 + 2x_3 + x_4 = 8$$
$$3x_1 + 2x_2 + 2x_3 = 7$$
$$x_1 + 3x_2 + 2x_3 - x_4 = -5$$

   b) Solve the following differential equation within $0 \le x \le 0.4$ using RK 4th order method. $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 3y = 6x$, with $y(0) = 0$ and $y'(0) = 1$. (take $h = 0.2$) [8]

5. a) A rod is rotating in a plane. The following table gives the angle θ(radian) through which the rod has turned for various values of the time t seconds. [8]

t	0	0.2	0.4	0.6	0.8	1.0	1.2
θ	0	0.12	0.49	1.12	2.02	3.20	4.67

   Calculate the angular velocity and angular acceleration of the rod, when t = 0.1 second.

   b) Solve the Poisson equation $\nabla^2 f = 2x^2y^2$, over the square domain of $0 \le x \le 3$ and $0 \le y \le 3$ with $h = k = 1$. Consider $f = 0$ at all its boundaries, $x = 0$, $y = 0$, $x = 3$ and $y = 3$. [8]

6. Develop algorithm, flowchart and program coding to interpolate at any points within a given set of data using Lagrange's interpolation method. [16]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Jestha

Exam.	Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Five questions. Question No. 6 is compulsory.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Find a real root of the following equation using Harner's rule, correct upto three decimal places. $x^3 - 6x^2 + 11x - 6 = 0$ [8]

   b) Estimate a root of $x^2 + \ell nx = 3$, using Bisection method, correct up to three decimal places. [8]

2. a) Using Newton's forward difference formula or Lagrange interpolation estimate the square of 3.25, if. [8]

X	1	2	3	4	5
X^2	1	4	9	16	25

   b) Fit the following data to the function $y = \ell n\,(ax + b)$ using least square method. [8]

X	-2.0	-1.0	0.5	2.0	3.0	5.5
Y	-0.4	1.2	3.5	6.0	7.4	11.0

3. a) Using trapezoidal, Simpon's 1/3 (Composite) formulate with number of strips, n = g, evaluate $\int_0^{\pi} \sqrt{1.3\cos x}\, dx$. [8]

   b) Use Romberg Integration method to evaluate $I = \int_0^2 \frac{e^x + e^{-x}}{2}$ correct up to three decimal places. [8]

4. a) Find out the largest Eigen value and corresponding Eigen vector from the following square matrix: [8]

$$A = \begin{bmatrix} 1 & 2 & 3 \\ -2 & 4 & 6 \\ -1 & -2 & 3 \end{bmatrix}$$

   b) Solve the following linear algebraic equations using Cholesky's factorization method. [8]

$$2a + 3b + 4c = 20$$
$$3a + 4b + 5c = 26$$
$$4a + 5b + 6c = 32$$

5. a) Determine y at x = 1, using RK second order (RK–2) method. (take h = 0.5) [8]

$$\frac{dy}{dx} = \frac{1}{x + y},\quad y(0) = 2$$

   b) Solve the following differential equation within $0 \le x \le 1$, h = 0.5 using Euler's method. [8]

$$\frac{d^2y}{dx^2} + 6\frac{dy}{dx} + y = 2x \text{ with } y(0) = 0 \text{ and } y'(0) = 2.$$

6. Write an algorithm, flowchart, and computer program in any of the language C or FORTRAN to solve a system of linear equations using Gauss elimination method with partial pivoting. [6+4+6]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2066 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods

- Candidates are required to give their answers in their own words as far as practicable.
- *Attempt any Five questions. Question No. 6 is compulsory.*
- *The figures in the margin indicate Full Marks.*
- *Assume suitable data if necessary.*

1. a) Find a real root of the equation $x^3 + x^2 - 1 = 0$ by the fixed point iteration method, correct to six decimal places. [8]

   b) Calculate a real root of non-linear equation $x \sin x + \cos x = 0$ using Newton Raphson Method. The absolute error of functional value at our calculated root should be less than 10^{-4}. [8]

2. a) Use appropriate method of interpolation to get f(0.675) from the given table. [8]

x	0.125	0.25	0.375	0.5	0.625	0.75
f(x)	0.7916	0.7733	0.7437	0.7041	0.6532	0.6022

   b) Use the suitable method to fit a quadratic curve $y = ax^2 + bx + C$ for the following data. [8]

x	−3	−2	−1	0	1	2	3
y	4.63	2.11	0.67	0.09	0.63	2.15	4.56

3. a) Evaluate the integral $I = \int_0^1 e^{-x^2} dx$ and compare the result in both conditions for Simpson's 1/3 rule and 3 point Gauss Legendre method. [10]

   b) The following data gives corresponding values of pressure (P) and specific volume (V) of superheated steam: [6]

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.

4. a) Using the power method, find the largest eigen value of the following matrix. [6]

$$A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

   b) Solve the following system of linear equations by Gauss-Elimination method. [10]

$$5x_1 + x_2 + x_3 + x_4 = 4$$
$$x_1 + 7x_2 + x_3 + 4x_4 = 6$$
$$x_1 + x_2 + 6x_3 + x_4 = -5$$
$$x_1 + x_2 + x_3 + x_4 = 0$$

5. a) Use second order Runge-Kutta method to solve $\frac{dy}{dx} + xz = 0$; $\frac{dy}{dx} - y^2 = 0$ at x = 0.2 and 0.4 given that y = 1, z = 1 at x = 0. [8]

   b) Apply Runge Kutta fourth order method to approximate the value of y when x = 0.2 and 0.4 given that $y' = x + y$, $y(0) = 1$. [8]

6. Write an algorithm, flowchart and program code in any high level language to solve a system of linear equations in 'n' unknowns using the Gauss Jordan Method. The program should display the augmented co-efficient matrix at each step of elimination. [5+5+6]

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2065 Shrawan

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Five questions. Question No. 6 is compulsory.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Find the point with accuracy 0.001, where the line $y = x - 3$ and $y = \ln x$ is intersecting, using bisection method. [8]

   b) Calculate the root of non-linear equation $f(x) = \sin x - 2x + 1$ using secant method. The absolute error of functional value at our calculated root should be less than 10^{-3}. [8]

2. a) Find the missing values of collected water level using Lagrange' interpolation. [8]

Time duration of rainfall (t) min	1	3	6.5	10
Collected Water level (h) mm	23	61	?	203

   b) Use the suitable method and determine the exponential fit of $y = Ce^{Ax}$ for the following data: [8]

X	0	-1	2	3	4
Y	1.5	2.5	3.5	5.0	7.5

3. a) Evaluate the integral $I = \int_0^{1.5} \sin x dx$, compare the absolute error in both conditions for Simpson 1/3 rule and Simpson's 3/8 rule. [8]

   b) Use Romberg Integration find the integral of $e^x \sin x$ between the limits –1 and 1. [8]

4. a) Find the inverse of the matrix $A = \begin{bmatrix} 2 & -2 & 4 \\ 2 & 3 & 2 \\ -1 & 1 & 1 \end{bmatrix}$ using Gauss-Jordan method. [8]

   b) Solve the following by Gauss Elimination method with complete pivoting. [8]

   $2x + 3y + 2z = 2$
   $10x + 3y + 4z = 16$
   $3x + 6y + z = 6$

5. a) Solve the following differential equation within $0 \le x \le 1.0$ using RK 4th order method. [8]

   $\frac{d^2y}{dx^2} + \frac{dy}{dx} - 4y = 3x$, with $y(0) = 0$ and $y'(0) = 1$. (take $h = 0.5$)

   b) Consider a sheet metal of size 30cm by 30cm. The two adjacent sides are maintained at temperature of 50°C and other two sides are held at 500°C. Calculate the steady state temperature at interior points assuming a grid size of 10cm by 10cm. [8]

6. Write algorithm flow chart and program code of any high level language to solve polynomial of n^{th} degree using Hamer's rule. Your program should read the coefficients of polynomial and display all roots of that polynomial correct up to five decimal places. [5+5+6]

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3 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions. **Question No. 6 is compulsory.***
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Find a real root of the equation $x^3 + x^2 - 1 = 0$ by the fixed point iteration method, correct to six decimal places. [8]

   b) Calculate a real root of non-linear equation $x \sin x + \cos x = 0$ using Newton Raphson Method. The absolute error of functional value at our calculated root should be less than 10^{-4}. [8]

2. a) Use appropriate method of interpolation to get f(0.675) from the given table. [8]

x	0.125	0.25	0.375	0.5	0.625	0.75
f(x)	0.7916	0.7733	0.7437	0.7041	0.6532	0.6022

   b) Use the suitable method to fit a quadratic curve $y = ax^2 + bx + C$ for the following data. [8]

x	–3	–2	–1	0	1	2	3
y	4.63	2.11	0.67	0.09	0.63	2.15	4.56

3. a) Evaluate the integral $I = \int_0^1 e^{-x^2} dx$ and compare the result in both conditions for Simpson's 1/3 rule and 3 point Gauss Legendre method. [10]

   b) The following data gives corresponding values of pressure (P) and specific volume (V) of superheated steam: [6]

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.

4. a) Using the power method, find the largest eigen value of the following matrix. [6]

$$A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

   b) Solve the following system of linear equations by Gauss-Elimination method. [10]

$$5x_1 + x_2 + x_3 + x_4 = 4$$
$$x_1 + 7x_2 + x_3 + 4x_4 = 6$$
$$x_1 + x_2 + 6x_3 + x_4 = -5$$
$$x_1 + x_2 + x_3 + x_4 = 0$$

5. a) Use second order Runge-Kutta method to solve $\frac{dy}{dx} + xz = 0$; $\frac{dy}{dx} - y^2 = 0$ at x = 0.2 and 0.4 given that y = 1, z = 1 at x = 0. [8]

   b) Apply Runge Kutta fourth order method to approximate the value of y when x = 0.2 and 0.4 given that $y' = x + y$, $y(0) = 1$. [8]

6. Write an algorithm, flowchart and program code in any high level language to solve a system of linear equations in 'n' unknowns using the Gauss Jordan Method. The program should display the augmented co-efficient matrix at each step of elimination. [5+5+6]

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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2065 Shrawan

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions. **Question No. 6 is compulsory.***
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Find the point with accuracy 0.001, where the line $y = x - 3$ and $y = ln\ x$ is intersecting, using bisection method. [8]

   b) Calculate the root of non-linear equation $f(x) = \sin x - 2x + 1$ using secant method. The absolute error of functional value at our calculated root should be less than 10^{-3}. [8]

2. a) Find the missing values of collected water level using Lagrange' interpolation. [8]

Time duration of rainfall (t) min	1	3	6.5	10
Collected Water level (h) mm	23	61	?	203

   b) Use the suitable method and determine the exponential fit of $y = Ce^{Ax}$ for the following data: [8]

X	0	1	2	3	4
Y	1.5	2.5	3.5	5.0	7.5

3. a) Evaluate the integral $I = \int_0^{1.5} \sin x dx$, compare the absolute error in both conditions for Simpson 1/3 rule and Simpson's 3/8 rule. [8]

   b) Use Romberg Integration find the integral of $e^x \sin x$ between the limits –1 and 1. [8]

4. a) Find the inverse of the matrix $A = \begin{bmatrix} 2 & -2 & 4 \\ 2 & 3 & 2 \\ -1 & 1 & 1 \end{bmatrix}$ using Gauss-Jordan method. [8]

   b) Solve the following by Gauss Elimination method with complete pivoting. [8]

   $2x + 3y + 2z = 2$
   $10x + 3y + 4z = 16$
   $3x + 6y + z = 6$

5. a) Solve the following differential equation within $0 \le x \le 1.0$ using RK 4th order method. [8]

   $$\frac{d^2y}{dx^2} + \frac{dy}{dx} - 4y = 3x, \text{ with } y(0) = 0 \text{ and } y'(0) = 1. \text{ (take } h = 0.5)$$

   b) Consider a sheet metal of size 30cm by 30cm. The two adjacent sides are maintained at temperature of 50°C and other two sides are held at 500°C. Calculate the steady state temperature at interior points assuming a grid size of 10cm by 10cm. [8]

6. Write algorithm flow chart and program code of any high level language to solve polynomial of n^{th} degree using Harner's rule. Your program should read the coefficients of polynomial and display all roots of that polynomial correct up to five decimal places. [5+5+6]

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