

POKHARA UNIVERSITY

Level: Bachelor

Semester: Fall

Year : 2023

Programme: BE

Full Marks: 100

Course: Numerical Methods (Old)

Pass Marks: 45

Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Find where the graph of $y = x - 3$ and $y = \ln(x)$ intersect using bisection method. Get the intersection value correct to four decimal places. 8
- b) Find value of $\sqrt{18}$ using Newton Raphson method. 7
2. a) Find the root of the equation $3x + \sin x - e^x = 0$ corrected up to 3 decimal places using Secant Method. 7
- b) Given populations of a city in different year as shown in table below. 8

x (in year)	1891	1901	1911	1921	1931
f(x)(population of that year in 0000)	46	66	81	93	101

Observe the data carefully and answer the following questions:

- i. Which method is applicable for finding population in the year 1860 and why? Also find the population of that year.
- ii. If you are asked to find the change in population between the year 1925 to 1930, how will you find? (mention formula and steps)
3. a) Fit a power function model of the form $y = ax^b$ from the given data points. 8

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

- b) Use Romborg method to evaluate: 7

$$\int_0^{3\pi/2} e^x \sin x \, dx$$

4. a) Solve the following system of equations using partial pivoting method. 8

$$x + y + z = 4, \quad x + 4y + 3z = 8, \quad x + 6y + 2z = 6$$

- b) Obtain the solution of following system using Gauss-Seidel iteration method.

$$2x_1 + x_2 + x_3 = 5$$

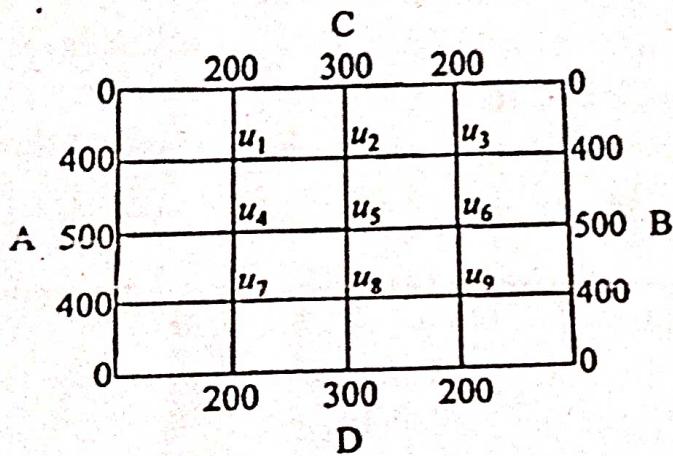
$$3x_1 + 5x_2 + 2x_3 = 15$$

$$2x_1 + x_2 + 4x_3 = 8$$

5. a) Determine the largest eigenvalue and the corresponding eigenvector of the matrix:

$$A = \begin{bmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 5 \end{bmatrix} \text{ using the power method.}$$

- b) Solve the Laplace equation $U_{xx} + U_{yy} = 0$ for the square mesh with boundary values as shown in the figure.



6. a) Solve the following equation for $y(0.2)$ using shooting method:

$$\frac{d^2y}{dx^2} + 2 \frac{dy}{dx} - 3y = 6x \text{ Given } y(0) = 0, y'(0) = 1.$$

- b) Use Picard's method to approximate the value of y when $x=0.1, x=0.2$ and $x=0.4$, given that $y=1$ at $x=0$ and $dy/dx = 1+xy$ correct to three decimal places (Use upto second approximations).

7. Write short notes on: (Any two)

- a) Newton's backward differentiation formulas
- b) Partial differential equation and their examples
- c) Algorithm of fixed point iteration method

7

7

8

9

6

2x5

POKHARA UNIVERSITY

Level: Bachelor

Semester: Fall

Year : 2023

Programme: BE

Full Marks: 100

Course: Numerical Methods (New)

Pass Marks: 45

Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Evaluate a real root of the given equation: $f(x) = 3x + \sin x - 2$ 7 using Fixed point iterative method correct to four decimal places.

OR

Define error. Explain its type with sources of error in Numerical computation.

- b) Calculate the root of the equation: $4x^3 - 2x - 6 = 0$ correct upto 8 three decimal places using Bisection Method.

2. a) What is interpolation? Find the value of $f(1.2)$ using appropriate interpolation technique. 8

x	1	1.4	1.8	2.2
$f(x)$	50	70	100	120

- b) If P is pull required to lift a load W by means of a Pulley, Find the law of form 7

$P = mW + C$, (where m and C are constants) using least square method for the following data:

P	12	15	21	25
W	50	70	100	120

OR

Use the suitable method to fit a curve $y = ax^b$ for the following data

x	-2	-1	0	1	2	3	4
y	38	6	0	-5	-41	130	300

3. a) Compute the following using Simpson's 1/3 rule for $n= 8$ with an accuracy to five decimal places. 7

$$\int_{-1}^{5} e^{-x^2} dx$$

b) Evaluate the following using Gaussian three point Integration formula; 8

$$\int_{-2}^4 (x^4 + 1) dx$$

4. a) Solve the following system of Linear equations using partial pivoting method. 7

$$x + y + z = 4, x + 4y + 3z = 8, x + 6y + 2z = 6$$

b) Solve the following system of equations using Gauss Jacobi's method. 8

$$3x + 2y + z = 10, 2x + 3y + 2z = 14, x + 2y + 3z = 14$$

5. a) Find the largest Eigen value and Corresponding Eigen vector of given matrix using power method. 7

$$A = \begin{bmatrix} 2 & 5 & 1 \\ 5 & -2 & 3 \\ 1 & 3 & 10 \end{bmatrix}$$

b) Solve the following differential equation for $y(0.4)$ using Heun's method. 8

$$\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 3y = 6x ; \text{ with } y(0) = 0 \text{ and } y'(0) = 1 \text{ (take } h=0.2\text{)}.$$

6. a) Use Euler's method to solve the following equation for $y(1)$ using $h = 0.25$. 7

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

b) Solve the Poisson equation $\nabla^2 f = -10(x^2 + y^2 + 10)$ over the square with $0 \leq x \leq 3$; $0 \leq y \leq 3$ and $f = 0$ on boundary. Use $h = 1$. 8

7. Write short notes on: (Any two) 2×5

a) Initial Value problems and Boundary value problems

b) Algorithm for secant method

c) Schmidt method for one dimensional heat equation

POKHARA UNIVERSITY

Level: Bachelor

Semester: Fall

Year : 2013

Programme: BE

Full Marks: 100

Course: Numerical Method

Pass Marks: 45

Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Find a positive root of the equation $f(x)=\cos x - 3x + 1$ correct up to 3 decimal places using Bisection Method. 7
 - b) Calculate the root of non-linear equation $3x=\cos x + 1$ using Secant Method. 8
 2. a) Find a real root of the equation: $x \log_{10} x = 1.2$ by using Newton-Raphson (NR) method such that the root must have error less than 0.0001%. 7
 - b) Use appropriate method of interpolation to get $\sin \theta$ at 45° from the given table 8
- | θ | 10 | 20 | 30 | 40 | 50 |
|---------------|--------|--------|--------|--------|--------|
| $\sin \theta$ | 0.1736 | 0.3420 | 0.5000 | 0.6428 | 0.7660 |
3. a) From the following data 7
- | X | 1 | 2 | 3 | 4 | 5 |
|---|-----|---|-----|---|------|
| y | 0.5 | 2 | 4.5 | 8 | 12.5 |
- Fit a power function model of the form $y=ax^b$
- b) Evaluate the integral $I=\int_0^{\pi/2} \sqrt{\sin x} dx$ compare the result in both condition for Simpson 1/3 and 3/8 rule. 8
 4. a) Find the inverse of the given matrix by applying Gauss Elimination Method (GEM) with partial pivoting technique. 8

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

- b) Solve the following system of equations by applying Gauss-Seidel interative method. Carry-out the interactions upto 6th stage. 7

$$\begin{aligned}28x+4y-z &= 32 \\x+3y+10z &= 24 \\2x+17y+4z &= 35\end{aligned}$$

5. a) The voltage 'V' across a capacitor at a time 'T' seconds is given by the following table. Use the principle of least squares to fit the curve of the form: $V = \alpha e^{\beta T}$ to the data. 7

T	0	2	4	6	8
V	150	63	28	12	5.6

- b) Solve: $\frac{dy}{dx} = y - 2x/y$, $y(0) = 1$ in the range $0 \leq x \leq 0.2$ by using (1) Euler's method and (2) Heun's method. Comment on the results. Take $h=0.2$. 8

6. a) Using Runge Kutta method of order 4, solve the equation: 7

$\frac{d^2y}{dx^2} = 6xy^2 + y$, $y(0) = 1$ and $y'(0) = 0$ to find $y(0.2)$ and $y'(0.2)$. take $h=0.2$.

- b) The steady-state two dimensional heat flow in a metal plate of size $30 \times 30\text{cm}$ is defined by $\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$. Two adjacent sides are placed at 100°C and other side at 0°C . Find the temperature at inner points, assuming the grid size of $10 \times 10\text{cm}$. 8

7. Write short notes on: (Any two) 2×5

- a) Romberg Integration.
- b) Laplacian Equation.
- c) Advantage of pivoting over Gauss Elimination method.

POKHARA UNIVERSITY

Level: Bachelor
Programme: BE
Course: Numerical Methods

Semester: Spring

Year : 2013
Full Marks: 100
Pass Marks: 45
Time : 3 hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

- | | | |
|----|---|---|
| 1. | a) Find the root of $\sin x = 1/x$ up to 2 decimal places using bracketing method. | 7 |
| b) | Solve $f(x) = 3x + \sin x - e^x$ by secant method up to 5 th iteration. | 8 |
| 2. | a) If P is pull required to lift a load W by means of a pulley, find a linear law of the form $P = mW + c$, using the following data | 7 |

P	12	15	21	25
W	50	70	100	120

Where P and W are taken in Kg.

- | | | |
|----|--|---|
| b) | Estimate the value of $\sin \theta$ at $\theta = 25$ using Newton- Gregory divide difference formula with the help of the following table. | 8 |
|----|--|---|
- | | | | | | |
|---------------|--------|--------|--------|--------|--------|
| θ | 10 | 20 | 30 | 40 | 50 |
| $\sin \theta$ | 0.1736 | 0.3420 | 0.5000 | 0.6428 | 0.7660 |
- | | | |
|----|---|---|
| 3. | a) Evaluate the integral $I = \int_0^6 \frac{1}{1+x^2} dx$. Compare the absolute error in both conditions for Simpson $\frac{1}{3}$ rule and Simpson's $\frac{3}{8}$ rule. | 8 |
|----|---|---|
- | | | |
|----|---|---|
| b) | Find the Integral value ' I ' = $\int_0^1 \frac{dx}{1+x^2}$ correct to three decimal place using Romberg Integration. | 7 |
|----|---|---|
- | | | |
|----|--|---|
| 4. | a) Solve the following system of equations using Gauss elimination | 7 |
|----|--|---|

method

$$\begin{aligned}10x_1 - 7x_2 + 3x_3 + 5x_4 &= 6 \\-6x_1 + 8x_2 - x_3 - 4x_4 &= 5 \\3x_1 + x_2 + 4x_3 + 11x_4 &= 2 \\5x_1 - 9x_2 - 2x_3 + 4x_4 &= 7\end{aligned}$$

- b) Determine the highest Eigen value and its corresponding eigen vector

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

5. a) Use the Runge - Kutta 4th order method to estimate $y(0.2)$ of the following equation with $h = 0.1$.

$$y'(x) = 3x + \frac{1}{2}y, \quad y(0) = 1$$

7

- b) Solve the following equation by picards method

$$y'(x) = x^2 + y^2, \quad y(0) = 0 \text{ and estimate } y(0.1), y(0.2) \text{ and } y(1)$$

8

6. a) . Solve the Poisson equation $\nabla^2 f = 2x^2y^2$ over the square domain $0 \leq x \leq 3$ and $0 \leq y \leq 3$ with $f = 0$ on the boundary and $h = 1$.

7

- b) Using Factorization method, solve the following system of linear equations:

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

$$2x + 3y + z = 5$$

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

2×5

7. Write short notes on: (Any Two)

- a) Error in numerical calculations
- b) Cubic spline
- c) Laplacian Equation.

POKHARA UNIVERSITY

Level: Bachelor
 Programme: BE
 Course: Numerical Methods

Semester: Spring

Year : 2014
 Full Marks: 100
 Pass Marks: 45
 Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) The equation: $\alpha \tan\alpha = 1$ occurs in theory of vibrations. 8
 - i. How many roots does it have in the interval (-6,6)? What is the assumption being made?
 - ii. Find one of the positive real roots by using any close-end method, correct to at least three decimal places.
- b) Find a root of the equation $f(x) = x^2 - 3x + 2$ in the vicinity of $x=0$, using Newton Raphson method. 7
2. a) Find the square root of 7 using Newton Raphson method and Fixed Point Iteration method Correct Up to 4- decimal digit. 7

b) The following table gives the population of a town during the last six censuses. Estimate the increase in the population during the period from 1976 to 1978. 8

year:	1941	1951	1961	1971	1981	1991
pop ⁿ :	12	15	20	27	39	52
3. a) The pressure and volume of a gas are related by the equation $PV^Y=C$, where Y and C being constants. Fit this equation to the following set of observations. 7

$P(\text{kg/cm}^2)$:	0.5	1.0	1.5	2.0	2.5	3.0
$V(\text{litres})$:	1.62	1.00	0.75	0.62	0.52	0.46

 b) Evaluate the integral $\int_0^{\pi} (1 + 3 \cos^2 x) dx$ by 8
 - i. Trapezoidal rule.
 - ii. Simpson's 3/8 rule, taking number of intervals (n)= 6.
4. a) Use Gauss Elimination Method to solve the equation. Use partial pivoting method where necessary 7

$$4x_1 + 5x_2 - 6x_3 = 28$$

$$2x_1 - 7x_3 = 29$$

$$-5x_1 - 8x_2 = -64$$

- b) Solve the following by Gauss Siedal method.

8

$$b+3c+2d=19$$

$$3b+2c+2d=20$$

$$a+4b+2d=17$$

$$-2a+2b+c+d=9$$

5. a) Find the largest eigenvalue λ and the cooresponding eigen vector X of the matrix.

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

- b) Using R-K fourth order method solve the given differential equation $d^2y/dx^2 + 2dy/dx - 3y = 6$, $y(0) = 0$, $y'(0) = 1$, with $h = 0.2$ for $y(0.4) = ?$

8

6. a) Given the boundary value problem: $y'' = 6x$ with $y(1) = 2$ and $y(2) = 9$. Solve it in the interval $(1, 2)$ by using RK method of second order (take, $h = 0.5$ and guess value = 3.25).

7

- b) Solve the Poisson's equation $\nabla^2 u = 2x^2 y^2$ over the square domain $0 \leq x \leq 3$ and $0 < y < 3$ with boundary condition of $u(x, y) = 0$ and $h = 1$ using Gauss-Seidel method.

8

7. Write short notes on: (Any two) 2×5

- a) Errors in numerical calculations.
b) Ill conditioned system.
c) An algorithm for NR-method.

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POKHARA UNIVERSITY

Level: Bachelor
Programme: BE
Course: Numerical Methods

Semester: Fall

Year : 2015
Full Marks: 100
Pass Marks: 45
Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Define root with example. Determine the root of $e^x = x^3 + \cos 25x$ using Secant method correct to four decimal place. 7
 - b) The current i in an electric circuit is given by $i = 10e^{-x} \sin 2\pi x$ where x is in seconds. Using N-R method, find the value of x correct up to 3 decimal places for $i = 2$ amp. 8
 2. a) Solve the equation $\log x - \cos x = 0$ correct to three significant digits after decimal, using Bracketing Method. 7
 - b) The following table gives the population of a town during the last six censuses. Estimate the increase in the population during the period from 1976 to 1978. 8
- | | | | | | | |
|--------------------|------|------|------|------|------|------|
| year: | 1941 | 1951 | 1961 | 1971 | 1981 | 1991 |
| pop ⁿ : | 12 | 15 | 20 | 27 | 39 | 52 |
3. a) The pressure and volume of a gas are related by the equation $PV^Y=C$, Y and C being constants. Fit this equation to the following set of observations. 7
- | | | | | | | |
|-------------------------|------|------|------|------|------|------|
| P(kg/cm ²): | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 |
| V(litres): | 1.62 | 1.00 | 0.75 | 0.62 | 0.52 | 0.46 |
- b) Evaluate the integral $I = \int_0^{\frac{\pi}{2}} \sin x dx$ for n=6 and Compare the result in both conditions for Simpson 1/3 and 3/8 rule. 8

4. a) Solve the following set of equation using LU factorisation method.

$$3x + 2y + z = 10$$

$$2x + 3y + 2z = 14$$

$$x + 2y + 3z = 14$$

b) Use Gauss-Seidal iterative method to solve given equations.

$$40x - 20y - 10z = 390$$

$$10x - 60y + 20z = -280$$

$$10x - 30y + 120z = -860$$

5. a) Using Euler's method solve the given differential equation

$$\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 3y = 6, \quad y(0) = 0, \quad y'(0) = 1, \quad \text{with } h=0.2 \text{ for } y(0.4) = ?$$

b) Solve the following differential equation within $0 \leq x \leq 0.5$ using RK 4th order method. $20\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 4y = 5, y(0) = 0, y'(0) = 0$. Take $h=0.25$.

6. a) Solve the Poission equation $\nabla^2 f = (2+x^2)y$, over the square domain of $0 \leq x \leq 3$ and $0 \leq y \leq 3$ with $f=0$ on the boundary and $h=1$.

b) Find the eigen value and corresponding eigen vector of given matrix

$$\begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$$

7. Write short notes on: (Any two)

2x5

a) Convergence of Newton Raphson methods

b) Linear Interpolation

c) Romberg Integration Method

POKHARA UNIVERSITY

Level: Bachelor

Programme: BE

Course: Numerical Methods

Semester: Spring

Year : 2015

Full Marks: 100

Pass Marks: 45

Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Find the root of the equation $x - 1.5 \sin x - 2.5 = 0$ using Newton Raphson's Method so that relative error is less than 0.01%. 8
 b) Find the root of the equation $xe^x = \cos x$ using the secant method correct to four decimal places. 7
2. a) Using the bisection method, find an approximate root of the equation $\sin x = 1/x$, that lies between $x=1$ and $x=1.5$ (in radians). Carry out computations up to 7th stage. 7
 b) For the following set of data, fit a parabolic curve using Least Square Method and find $f(2)$. 8

x_i	0.5	1	1.5	4.5	6.5	7.5
$f(x_i)$	2.5	2.7	3.5	6.5	8.4	9.5

3. a) The following table gives the population of a town during the last six censuses. Estimate the increase in the population during the period from 1976 to 1978. 7

Year:	1941	1951	1961	1971	1981	1991
Pop ⁿ :	12	15	20	27	39	52

- b) Use following table of data to estimate velocity at $t = 7\text{ sec}$ 8

Time, $t(\text{s})$	5	6	7	8	9
Distance Travelled, $s(t)(\text{km})$	10.0	14.5	19.5	25.5	32.0

Hint: Velocity is first derivative of $s(t)$

4. a) Find the largest Eigen-value and the corresponding Eigen-vector of the following square matrix using Power method. 7

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

- b) Solve the following system of equation by the process of Gauss elimination (Use partial pivoting if necessary) 8

$$\begin{aligned} 3x+2y+z &= 10 \\ 2x+3y+2z &= 14 \\ x+2y+3z &= 14 \end{aligned}$$

5. a) Use Gauss-Seidel iteration method to solve 7

$$\begin{aligned} 2x + y + z &= 5 \\ 3x + 5y + 2z &= 15 \\ 2x + y + 4z &= 8 \end{aligned}$$

- b) Solve the following differential equation within $0 \leq x \leq 0.5$ using RK 4th order method. $10\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 4y = 5$, $y(0)=0, y'(0)=0$. Take $h=0.25$. 8

6. a) How can shooting method be used to solve boundary value problems. Explain each steps of the algorithm with a suitable example. 8

- b) Solve the Poisson equation $\nabla^2 f = 2x^2 + y$, over the square domain $1 \leq x \leq 3, 1 \leq y \leq 3$, with $f=1$ on the boundary. Take $h=k=1$ 7

7. Write short notes on: (Any two) 2×5

- a) Romberg integration formulas
- b) Taylor Series for solving ordinary differential equations
- c) Hyperbolic equations

POKHARA UNIVERSITY

Level: Bachelor

Programme: BE

Course: Numerical Methods

Semester: Fall

Year : 2016

Full Marks: 100

Pass Marks: 45

Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) What is the fixed point of a non-linear equation? Find a real root of the equation: $xe^x=3$ by using any bracketing method correct to three decimal places (Take $x_1=1$ and $x_2=1.5$). 8
- b) Obtain a real root of the equation: $\sin x+1=2x$ by using Secant method such that the real root must have relative error less than 0.0001. 7
2. a) Find the root of the equation $xs \in x + \cos x = 0$ using Newton Raphson's Method so that relative error is less than 0.1. 7
- b) The following table gives the population of a town during the last six censuses. Estimate the increase in the population during the period from 1976 to 1978. 8

Year:	1941	1951	1961	1971	1981	1991
Pop ⁿ :	12	15	20	27	39	52

3. a) Evaluate the integral $I = \int_0^{10} \exp\left(\frac{-1}{1+x^2}\right) dx$, using Gauss quadrature formula with $n = 2$ and $n = 3$. 7
- b) What is pivot element? Solve the following system of equations by using Gauss-elimination method with partial pivoting technique.

$$x+y+z+w=2$$

$$x+y+3z-2w=-6$$

$$2x+3y-z+2w=7$$

$$x+2y+z-w=-2$$

4. a) Solve the following system of equations by using Crout's algorithm. 7

$$2x-3y+10z=3$$

$$-x+4y+2z=20$$

$$5x+2y+z=-12$$

- b) Find the largest eigen value and corresponding eigen vector of given matrix using power method.

$$\begin{bmatrix} 4 & 6 & 0 \\ 0 & 5 & 3 \\ 2 & 0 & 3 \end{bmatrix}$$

5. a) Solve the given differential equation by RK-4th order method 8
 $y'' - xy' + y = 0$ with initial condition $y(0) = 3, y'(0) = 0$, for $y(0.2)$ taking $h = 0.2$.

- b) Solve the differential equation $y' = x + y$ using appropriate method 7
 within $0 \leq x \leq 0.2$ with initial condition $y(0) = 1$ and step size $h=0.1$.

6. i) Given the Poisson's equation: $\Delta^2 f = -10(x^2+y^2+10)$ over the square 8
 domain: $0 \leq x \leq 3$ and $0 \leq y \leq 3$ with Dirichlet boundary condition of
 $f(x, y)=0$ and $h=1$. Calculate the steady state temperatures at the interior nodes by using Gauss-Seidel method..

- b) The pressure and volume of a gas are related by the equation $PV^\gamma=C$, 7
 γ and C being constants. Fit this equation to the following set of observations.

$P(\text{kg/cm}^2)$:	0.5	1.0	1.5	2.0	2.5	3.0
$V(\text{litres})$:	1.62	1.00	0.75	0.62	0.52	0.46

7. Write short notes on: (Any two) 2×5

- a) Solution of 2nd order differential equation
 b) numerical Differentiation
 c) Laplacian equation.

POKHARA UNIVERSITY

Level: Bachelor

Programme: BE

Course: Numerical Methods

Semester: Spring

Year : 2016

Full Marks: 100

Pass Marks: 45

Time : 3 hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) What are the limitations of New-Raphson method? Using Newton-Raphson method find a root of the equation $xe^x = 2$. 3+5
- b) Find a real root of the $\cos x = 3x - 1$, correct to three decimal places, 7 using fixed point method.
2. a) Use Newton's divided difference formula to find $f(3)$ from the following data: 8

x:	0	1	2	4	5	6
$f(x)$	1	14	15	5	6	19
- b) By the method of least square methods, find the straight line that best fits the following data: 7

x:	1	2	3	4	5
y:	14	27	401	55	68
3. a) Using forward interpolation formula derive differentiation formula for the first and second derivative of a function $f(x)$. 7
- b) Evaluate the integral $\int_0^{0.6} e^{x^2} dx$, using Simpson 1/3 rule and Simpson 3/8 rule, dividing the interval into six parts. 8
4. a) Using Gauss Seidel method solve the following system of linear equations: 7

$$10x_1 + 6x_2 - 5x_3 = 27$$

$$3x_1 + 8x_2 + 10x_3 = 27$$

$$4x_1 + 10x_2 + 3x_3 = 27$$

- b) Find the largest eigen value and corresponding eigen vector of the matrix:
$$\begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$$
5. a) Employ Taylor's method to obtain approximate value of y at $x = 0.2$ for the differential equation:
 $y' = 2y + e^x, y(0) = 0.$
- b) Using Runge-Kutta second order method solve the differential equation $y'' = xy' - y; y(0) = 3, y'(0) = 0$ for $x = 0(0.2)0.4.$
6. a) Write an algorithm to find a real root of a non linear equation using secant method.
- b) Write a program in any high level language (C or C++) to solve a system of linear equation, using Gauss elimination method.
7. Write short notes on: (Any two) 2×5
- a) Ill-Conditioned systems
 - b) Errors in numerical calculation
 - c) Laplace equation

सुगम स्टेसनरी सलायर्स एण्ड फोटोकपी सर्भिस
 बालकुमारी, ललितपुर ९८४९५९५९२
NCIT College

POKHARA UNIVERSITY

Level: Bachelor

Semester: Fall

Year : 2017

Programme: BE

Full Marks: 100

Course: Numerical Methods

Pass Marks: 45

Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Find a positive root of the equation $x \sin x - 1 = 0$ using any closed end method up to four decimal place. 8
- b) Solve $f(x) = 3x + \sin x - e^x$ by secant method. 7
2. a) Find the number of students securing marks between 50-55 using appropriate interpolation technique. 8

Mark Obtained	20-30	30-40	40-50	50-60
No. of students	10	20	30	40

- b) The voltage v across a capacitor at time t seconds is given by following table. 7

Time t (sec)	0	2	4	6	8	4
voltage v	150	63	28	12	5.6	124

If the relationship between voltage v and time t is of the form $v = e^{kt}$. Using least-square approximation estimate the temperature at $t=2.6$ minute. 8

3. a) Estimate the following Integrals by
 - i. Simpson's 3/8 method
 - ii. Simpson's 1/3 method and compare the result.

$$\int_{2}^{x} \frac{e^x}{x} dx \quad (\text{Assume } n=4)$$

- b) Apply Romberg's method to evaluate 7

$$\int_{0}^{\frac{\pi}{2}} \frac{\cos x}{\sqrt{1+\sin x}} dx$$

4. a) Solve the system $3x_1 + 2x_2 + x_3 = 10$

$$2x_1 + 3x_2 + 2x_3 = 14$$

$$x_1 + 2x_2 + 3x_3 = 14$$

By using Do-Little method.

- b) Find the inverse of the matrix by using Gauss Jorden method.

$$A = \begin{pmatrix} 1 & -1 & 2 \\ 3 & 0 & 1 \\ 1 & 0 & 2 \end{pmatrix}$$

5. a) Determine the largest eigenvalue and the corresponding eigenvector

of the matrix: $A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ using the power method.

- b) Solve the differential equation $y' = y + \sin x$ using appropriate method within $0 \leq x \leq 0.2$ with initial condition $y(0) = 2$ and step size $h=0.1$.

6. a) Apply R-K-4 method to solve $y(0.2)$ for the given equation

$\frac{d^2y}{dx^2} + x \frac{dy}{dx} - y$ given that $y=1$ and $\frac{dy}{dx} = 0$ when $x=0$. (Assume $h=0.2$.)

- b) Solve the parabolic equation $2f_{xx}(x,t) = f_t(x,t)$ $0 \leq t \leq 1.5$ and given initial condition $f(x,0) = 50(4-x)$, $0 \leq x \leq 4$ with boundary condition $f(0,t) = 0 = f(4,t)$ $0 \leq t \leq 1.5$

7. Write short notes on: (Any two)

a) Gauss Seidel Method of Iteration

b) Cubic Spline

c) Laplace method for partial Differential

7

8

7

8

7

2×5

POKHARA UNIVERSITY

Level: Bachelor
 Programme: BE
 Course: Numerical Methods

Semester: Spring

Year : 2017
 Full Marks: 100
 Pass Marks: 45
 Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Discuss the application of Numerical methods in the field of science and engineering. Find a real root of $e^{\cos x} - \sin x - 1 = 0$ correct to 4 decimal places using False position method. 8
- b) Find the root of the equation $3x = \cos(x) + 1$ using NR method with the tolerance is $10E-5$. 7
2. a) The Growth of bacteria (N) in a culture after t hours is given by the following table. 8

Time t(hr.)	0	1	2	3	4	4
Bacteria(N)	32	47	65	92	132	124

If the relationship between bacteria N and time t is of the form $N = ab^t$. Using least-square approximation estimate the N at $t=5$ hr.

- b) The following table give the percentage of criminals for different age groups. Using interpolation formula, find the percentage of criminals under the age of 35. 7

Under age	25	30	40	50
% of Criminals	52	67.3	84.1	94.4

3. a) A slider in a machine moves along a fixed straight rod. Its distance x (cm) along the rod is given below for various values of time t seconds. Find the velocity and the acceleration of the slider when $t=0.2$. 8

t	0	0.1	0.2	0.3
x	30.13	31.62	32.87	33.95

- b) The velocity 'v' of a particle at a distance 's' from a point on its path is given by the following table. 7

s(metre)	0	10	20	30	40	50	60
v(metre/sec)	47	58	64	65	61	52	38

Estimate the time taken to travel 60 metres by using Simpson's 1/3 rule and Simpson's 3/8 rule.

4. a) Solve the following set of equation using LU factorization method 8

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

$$7x + y - 5z = 8$$

$$3x + 7y + 4z = 10$$

7

- b) Solve the equation by Gauss-Jacobi method:

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

5. a) Determine the largest eigenvalue and the corresponding eigenvector 8

of the matrix: $A = \begin{bmatrix} 15 & -4 & -3 \\ -10 & 12 & -6 \\ -20 & 4 & -2 \end{bmatrix}$ using the power method.

- b) Use RK-4 Method to find $y(0.2)$ for $\frac{d^2y}{dx^2} = x \frac{dy}{dx} - y$ given that 7
 $y=1$ and $\frac{dy}{dx} = 0$ when $x=0$.

6. a) Given the Poisson's equation: $\nabla^2 u = -10(x^2 + y^2 + z^2)$ over the square domain such that $0 \leq x \leq 3$ and $0 \leq y \leq 3$ with Dirichlet boundary condition of $u(x,y) = 0$. Calculate the steady state temperatures at interior points by using Successive over relaxation method upto 5th iteration. Assume, $h=k=1$.

- b) Write a program in any higher level language for solution of ordinary differential equation using Euler's method. 7

7. Write short notes on: (Any two) 2×5

a) Boundary Value problem

b) Parabolic equation

c) Elliptical equations

सुमाम स्टेसनरी सञ्चायर्स एण्ड फ्लोवरी सर्विस
बालकुमारी, ललितपुर १८-२५९५९२
NCIT College

POKHARA UNIVERSITY

Level: Bachelor

Semester: Fall

Year : 2018

Programme: BE

Full Marks: 100

Course: Numerical Methods

Pass Marks: 45

Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Derive an iterative formula for NR-method Find a positive real root of the equation $x \times \log_{10}(x) = 1.2$ by using this formula correct to four significant digits.
- b) Using Secant method find a root of the equation $e^x \sin x - x^2 = 0$ correct to three decimal places.
2. a) Generate a Lagrange's interpolating polynomial for the function:
 $y = \cos \pi x$, taking the pivotal points 0, $\frac{1}{4}$ and $\frac{1}{2}$.
- b) Fit a curve of the form: $y=1/(a+bx)$ by using the method of Least Square with the following data points.

x	1	2	3	4	5
f(x)	3.33	2.20	1.52	1.00	.91

3. a) Evaluate the integral $I = \int_0^{\frac{\pi}{2}} (1 + 3 \cos 2x) dx$. Compare the result in both conditions for Simpson 1/3 and 3/8 rule.
- b) The following data gives corresponding values of pressure 'P' and specific volume 'V' of stem.

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

Find the rate of change of volume when pressure is 105 and 13.

4. a) Find the inverse of matrix using gauss Jordan method.

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

- b) Find the largest Eigen-value and the corresponding Eigen-vector of the following square matrix using Power method. 7

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

5. a) Solve the given differential equation by RK-4th order method 8

$y'' - x^2 y' - 2xy = 0$ with initial condition $y(0) = 1, y'(0) = 0$, for $y(0.1)$ taking $h = 0.1$

- b) Solve the differential equation $y' = y - \frac{2x}{y}$ using appropriate 7

method within $0 \leq x \leq 0.2$ with initial condition $y(0) = 1$ and step size $h=0.1$

6. a) Solve the equation $\nabla^2 u = -10(x^2 + y^2 + 10)$ over the square mesh 8

$0 \leq x \leq 3, 0 \leq y \leq 3$ with $u = 0$ on the boundary and mesh length $h = k = 1$

- b) Solve the following system of equation 7

$$6x_1 - 2x_2 + x_3 = 4$$

$$-2x_1 + 7x_2 + 2x_3 = 5$$

$$x_1 + 2x_2 - 5x_3 = -1$$

Using gauss factorization method.

7. Write short notes on: (Any two)

2×5

- a) Importance of Numerical Methods in Engineering
- b) Algorithm for Lagrange's Interpolation method
- c) Laplace method for partial Differential

POKHARA UNIVERSITY

Level: Bachelor

Programme: BE

Course: Numerical Methods

Semester: Spring

Year : 2018

Full Marks: 100

Pass Marks: 45

Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Find the root of $e^x \tan x = 1$ by creating iterative formula of Newton - Raphson method. 7

- b) Solve $f(x) = xe^x - 1$ by secant method for tolerance value 0.0001. 8

2. a) Determine the constants a and b by the method of least squares such that $y = ae^{bx}$ 7

X	2	4	6	8	10
Y	4.077	11.084	30.128	81.897	222.62

- b) From the following table, find the number of students who obtained less than 45 marks 8

Marks	30-40	40-50	50-60	60-70	70-80
No. of students	31	42	51	35	31

3. a) From the following table of values of x and y, obtain $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for $x = 1.2$ 8

x	1.0	1.2	1.4	1.6	1.8
y	2.7183	3.3201	4.0552	4.9530	6.0496

- b) Find the Integral value $I = \int_0^1 \frac{dx}{1+x^2}$ correct to three decimal place 7

using Romberg Integration.

4. a) Solve the following system of equations using Factorization method
 $2x + 3y + z = 9$ 7

$$x + 2y + 3z = 6$$

$$3x + y + 2z = 8$$

- b) Determine the highest Eigen value and its corresponding eigenvector 8

for the following matrix using power method. $A = \begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$

5. a) Use the Runge - Kutta 4th order method to solve $10 \frac{dy}{dx} = x^2 + y^2$, 8

$y(0) = 1$ for the interval $0 \leq x \leq 0.4$ with $h = 0.1$

- b) Solve the boundary value problem

$$y''(x) = y(x),$$

$y(0) = 0$ and $y(1) = 1.1752$ by shooting method, taking $m_0 = 0.8$ and $m_1 = 0.9$ 7

6. a) Solve the Poisson equation $\nabla^2 f = 2x^2 y^2$ over the square domain $0 \leq x \leq 3$ and $0 \leq y \leq 3$ with $f=0$ on the boundary and $h=1$. 8

- b) Write a program to solve a system of linear equations by Gauss seidal method. 7

7. Write short notes on: (Any two) 2×5

a) Convergence of fixed point iteration method

b) Cubic spline

c) Algorithm of Euler Methods.

POKHARA UNIVERSITY

Level: Bachelor

Semester: Fall

Year : 2019

Programme: BE

Full Marks: 100

Course: Numerical Methods

Pass Marks: 45

Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Find where the graph of $y = x - 3$ and $y = \ln(x)$ intersect using bisection method. Get the intersection value correct to four decimal places.
- b) Find value of $\sqrt{18}$ using Newton Raphson method.
2. a) The function $y = f(x)$ is given at the points $(7, 3), (8, 1), (9, 1)$ and $(10, 9)$ Find the value of y for $x = 9.5$ using Lagrange Interpolation formula.
- b) The following table shows pressure and specific volume of dry saturated steam.

V	38.4	20	8.51	4.44	3.03
P	10	20	50	100	150

Fit a curve of the form: $PV^\alpha = \beta$ by using least square method.

3. a) Evaluate $\int_{-2}^2 \frac{x}{x + 2e^x} dx$ by using Trapezoidal, Simpson's 1/3 and 3/8 rule with $n = 6$.
- b) Using three-point Gaussian Quadrature formula, evaluate $\int_0^1 \frac{dx}{(1+x)}$
4. a) Find inverse of the matrix, using Gauss Jordan method.

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

- b) Determine the largest eigenvalue and the corresponding eigenvector

of the matrix: $A = \begin{bmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 5 \end{bmatrix}$ using the power method.

5. a) Use Picard's method to approximate the value of y when $x=0.1$, 7
 $x=0.2$ and $x=0.4$, given that $y=1$ at $x=0$ and $dy/dx=1+xy$ correct
 to three decimal places (Use upto second approximations).
- b) Using Runge- Kutta method of second order (RK-2), obtain a solution 8
 of the equation $y'' = y + xy'$ with initial condition $y(0) = 1$, $y'(0) = 0$
 to find $y(0.2)$ and $y'(0.2)$, taking $h=0.1$
6. a) Use Relaxation method to solve the given systems of equations: 8
- $$20x+y-2z=17$$
- $$3x+20y-z=18$$
- $$2x-3y+20z=25$$
- b) Given the Poisson's equation: $\Delta^2 f = 4x^2 y^2$ over the square domain: 7
 $0 \leq x \leq 3$ and $0 \leq y \leq 3$ with Dirichlet boundary condition of $f(x, y) = 100$
 and $h=k=1$. Calculate the steady state temperatures at the interior
 nodes by using Gauss-Seidel method. Iterate until the successive
 values at any point is correct to two decimal places.

7. Write short notes on: (Any two) 2×5
- a) Errors in numerical computations
- b) Obtain divided difference table for the given data set:

X	-1	2	5	7
Y	-8	3	1	12

- c) Write an algorithm for Romberg's integration method

POKHARA UNIVERSITY

Level: Bachelor
 Programme: BE
 Course: Numerical Methods

Semester: Spring

Year : 2019
 Full Marks: 100
 Pass Marks: 45
 Time : 3 hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Using Secant method, find the zero of function $f(x) = 2x - \log_{10} x - 7$ correct up to three decimal places. 8
- b) Find the root of the equation $\log x - \cos x = 0$ correct to three decimal places by using N-R method. 7
2. a) The voltage v across a capacitor at time t seconds is given in following table. 8

Time t (sec)	0	2	4	6	8	10
voltage v	150	63	28	12	5.6	1.24

If the relationship between voltage v and time t is of the form $v = ae^{kt}$. Using least-square approximation estimate the temperature at $t=2.6$ minute.

- b) From the following table, estimate the number of students who obtained marks between 40 and 45. 7
- | Marks: | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 |
|-----------------|-------|-------|-------|-------|-------|
| No. of students | 31 | 42 | 51 | 35 | 31 |
3. a) The following table gives the velocity of a vehicle at various points of time. 7

Time, t (seconds)	1	2	4	5
Velocity, v (m/sec)	0.25	1	2.2	4

Find the acceleration of the vehicle at $t = 1.1$ second and $t = 2.5$ second using any suitable differential formula.

- b) Evaluate $\int_0^2 \frac{\sin u}{u} du$ by using Trapezoidal, Simpson's 1/3 and 3/8 rule with $n=6$ 8

4. a) Determine the largest Eigen value and corresponding Eigenvector for the matrix using power method correct up-to 3-decimal places. 7

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

- b) Obtain the solution of the following system using the Dolittle LU decomposition method. 8

$$\begin{aligned} 3x_1 + 2x_2 + x_3 &= 10 \\ 2x_1 + 3x_2 + 2x_3 &= 14 \\ x_1 + 2x_2 + 3x_3 &= 14 \end{aligned}$$

5. a) Solve the given differential equation by Heun's method 8
 $y'' - y' - 2y = 3e^{2x}$ with initial condition $y(0) = 0, y'(0) = -2$,
 for $y(0.2)$ taking $h = 0.1$

- b) Solve: $y' = y + e^x, y(0) = 0$ for $y(0.2)$ and $y(0.4)$ by RK-4th order method. 7

6. a) Solve the poison's equation $U_{xx} + U_{yy} = 243(x^2 + y^2)$ over a square domain $0 \leq x \leq 1, 0 \leq y \leq 1$ with step size $h = \frac{1}{3}$ with $u = 100$ on the boundary. 8

- b) Use Gauss-Legendre 2-point and 3-point formula to evaluate 7

$$\int_{0.5}^{1.5} e^{x^2} dx$$

7. Write short notes on: (Any two) 2×5

- a) Ill conditioned Method
 b) Algorithm of bisection method
 c) Cubic splines

POKHARA UNIVERSITY

Level: Bachelor
 Programme: BE
 Course: Numerical Methods

Semester: Fall

Year : 2020
 Full Marks: 100
 Pass Marks: 45
 Time : 3 hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Find the positive real root of the equation $\cos x + e^x + x^2 = 3$ using False position method, correct to 3 decimal places. 7
- b) Discuss the drawbacks of Newton – Raphson method. Find the real root of the equation $x \sin x - \cos x = 0$ using Newton – Raphson method, correct to 3 decimal places. 8
2. a) From following experimental data, it is known that the relation connects v and t as $v = at^b$. Find the possible values of a and b. 8

V	350	400	500	600
T	61	26	7	2.6
- b) The following table gives the viscosity of oil as the function of temperature. Use Lagrange's interpolation formula to find the viscosity of oil at a temperature of 140 degree Celsius. 7

T(deg Celsius)	110	130	160	190
Viscosity	10.8	8.1	5.5	4.8
3. a) Integrate the given integral using Romberg integration. 8

$$\int_1^2 \frac{1}{1+x^3} dx$$

b) Compute the integral using Gaussian 3 - point formula.

$$\int_2^5 \frac{e^x + \sin x}{1+x^2} dx$$

4. a) Solve the equation by Relaxation method:

$$9x - y + 2z = 9, x + 2y - 2z = 15, 2x - 2y - 13z = -17$$

b) Determine the largest eigenvalue and the corresponding eigenvector of

$$\text{the matrix: } A = \begin{bmatrix} 1 & 4 & 4 \\ 4 & 1 & 8 \\ 4 & 8 & 1 \end{bmatrix} \text{ using the power method}$$

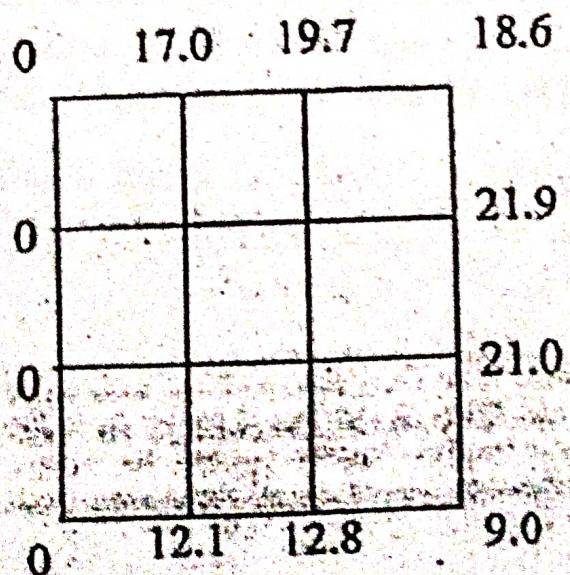
5. a) Apply Runge - Kutta fourth order method to find an approximate value of y when x = 0.3 give that: $y' = 2.5y + e^{0.3x}$; with an initial $y(0) = 1$, taking h= 0.3

b) Solve the Boundary Value Problem (BVP) using Shooting method by dividing into four sub-interval employing Euler's method.

$$y'' + 2y' - y = x$$

subject to boundary condition $y(1) = 2$ and $y(2) = 4$

6. a) Solve the Poisson equation $\nabla^2 f = 4x^2 y + 3xy^2$, over the square domain $x \leq 3, 1 \leq y \leq 3$, with f on the boundary is given in figure below. Take h=k=1



b) Solve the following set of equations by using LU decomposition 7
method.

$$3x + 2y + 7z = 32, 2x + 3y + z = 40, 3x + 4y + z = 56$$

7. Write short notes on: (Any two) 2×5

- a) Finite differences
- b) Picard's iterative formula.
- c) Algorithm for second order Runge – Kutta (RK-2) method

NM-2020 Fall

POKHARA UNIVERSITY

Level: Bachelor

Semester - Spring

Year: 2020

Program: BE

Full Marks: 70

Course: Numerical Methods

Pass Marks: 31.5

Time: 2 hrs.

*Candidates are required to answer in their own words as far as practicable.
The figures in the margin indicate the marks.*

Attempt all the questions.

Group - A: (5×10=50)

Q. N. 1 Which one do you prefer: bracketing or non bracketing methods for solving nonlinear equations? Using a root bracketing method, find a positive real roots of the equation $x^3 - 3x + 1 = 0$, correct to 4 decimal places.

Q. N. 2 Monthly faculty salary in three universities is given below: Assuming that the salary for particular category is same in all the universities, calculate the salary of each category of faculty by using appropriate method

Department	Number of Faculty			Total Salary (in thousands)
	Professor	Asst. Professor	Lecturer	
P	2	2	4	60
Q	3	1	2	50
R	1	4	3	60

OR

Using an iterative method, solve the system correct to three decimal places:

$$-3x_1 + 22x_2 + 2x_3 = 47$$

$$5x_1 + x_2 + 20x_3 = 67$$

$$45x_1 + 2x_2 + 3x_3 = 58$$

Given a reason for the choice of your method. Write name of any two other iterative methods which can be used to solve the given system.

Q. N. 3 The angular displacement θ of simple pendulum is given by equation $\frac{d^2\theta}{dt^2} + \frac{g}{l} \sin \theta = 0$

where $l = 98\text{cm}$ and $g = 980\text{cm/sec}^2$. If $\theta = 0.2$ and $\frac{d\theta}{dt} = 4.47$ at $t=0$, use any numerical

method to find θ and $\frac{d\theta}{dt}$ when $t = 1$ with step size $h=0.2$.

Q. N. 4 What Gauss Legendre integration? How does it improve the accuracy of integration? Using 3-point formulas evaluate:

$$\int_{-1}^1 (x^2 + 1) dx$$

Q. N. 5 Consider a steel plate of size 15cm×15cm. If two of the sides are held at 100°C and the other adjacent sides are held at 0°C. What is the steady state temperature at interior points, assuming a grid size of 5cm×5cm.

Group - B: (1×20=20)

- Q. N. 6 a) Solve the initial value problem $y'' + 3y' + 2y = e^{2t}$, $y(0) = 1$ and $y'(0) = 1$ in the interval [0,1] using Runge-Kutta method of order four with $h=0.5$.
b) Write an iteration formula to find the reciprocal of a natural number N using Newton's method. Using the formula find the reciprocal of 17 correct to 3 decimal places.

Best of Luck!

POKHARA UNIVERSITY

Level: Bachelor
Programme: BE
Course: Numerical Methods

Semester: Fall

Year : 2021
Full Marks: 100
Pass Marks: 45
Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Solve $x^3+x^2-3x-3=0$ by secant method up to 8th iteration. Assume that the error should be less than 10^{-4} .

- b) Find the root of the equation $\log x - \cos x = 0$ correct to three decimal places by using N-R method.

2. a) Define interpolation. From the following table, estimate the number of students who passed marks between 40 and 45:

Marks	: 30-40	40-50	50-60	60-70	70-80
-------	---------	-------	-------	-------	-------

No. of students	: 30	40	50	38	31
-----------------	------	----	----	----	----

- b) Fit cubic polynomial equations to the given data set and find the value of $f(3.7)$ and $f'(7.5)$.

X	2	4	7	9
$f(X)$	1	2	1	2

3. a) Integrate the following function by using Trapezoidal Rule, Simpson's $\frac{1}{3}$ rule and Simpson 3/8 rule. Take $n = 6$. $\int_0^{\frac{\pi}{2}} \sin x dx$

- b) Integrate the given integral $\int_0^{\pi/2} \frac{\cos x}{\sqrt{1+\sin x}} dx$

Using Gauss quadrature Formula for $n=2$ and $n=3$

4. a) Find the inverse of the matrix, using Gauss Jordan method..

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

- b) Find the largest Eigen-value and the corresponding Eigen-vector of the following square matrix using Power method.

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

5. a) Solve the following set of equations by using LU Crout method

7

$$3x + 2y + z = 10$$

$$2x + 3y + 2z = 14$$

$$x + 2y + 3z = 14$$

- b) Apply R-K-4 method to solve $y(0.2)$ for the given equation

8

$$\frac{d^2y}{dx^2} + x \frac{dy}{dx} - y \text{ given that } y=1 \text{ and } \frac{dy}{dx} = 0 \text{ when } x=0.$$

6. a) In a square bar with dimension of 3 inch \times 3 inch, torsion function, ϕ ,

8

can be obtained from the following P.D.E: $\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = -2$ where

$\phi = 0$ on the outer boundary of the bar's cross-section. Subdivide the region into nine equal squares to form a mesh and find the values of ϕ in the interior nodes.

- b) Consider second order initial value problem $y'' - 4y' + 2y = e^t \sin(t)$ with $y(0) = 0.4$ and $y'(0) = -0.6$, using Heun's find value of $y(0.2)$ and $y'(0.2)$.

7

7. Write short notes on: (Any two)

2×5

- a) Taylor's series for solving ODE
- b) Ill-Conditioned System
- c) Classify the partial differential equation $U_{xx} + 2U_{xy} + U_{yy} = 0$

POKHARA UNIVERSITY

Level: Bachelor
 Programme: BE
 Course: Numerical Methods

Semester: Spring

Year : 2021
 Full Marks: 100
 Pass Marks: 45
 Time : 3 hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) What is the difference between the bisection method and false position even though both are bracketing methods? Find the real root of the given non-linear equation correct up to three decimal place using Newton Raphson method.
- b) Define error and write its different types in numerical methods with examples. If $x = 1.350253$ is rounded off to four significant digits, find the absolute and relative errors.
2. a) By using Least square method find the straight line that best fit the following data:

x:	1	2	3	4	5
y:	14	27	40	55	68

- b) Find the cubic spline interpolation formula for the following data:

x	1	2	-	3	4	5
f(x)	1	0	.	1	0	1

3. a) Evaluate $\int_4^{5.2} \log x \, dx$ from the following data

x	4.0	4.2	4.4	4.6	4.8	5.0	5.2
y	1.3863	1.4351	1.4816	1.5261	1.5686	1.6094	1.6487

by using

- i) Trapezoidal Method
- ii) Simpson 1/3 Method
- iii) Simpson 3/8 Method

- b) Evaluate $\int_0^2 \frac{x^2+2x+1}{1+(x+1)^4} dx$ by using Gaussian Integration formula for n=2, n=3 and compare their values with exact solution.

4. a) Solve the following system of equations by using relaxation method correct to two decimal places. 8

$$9x - y + 2z = 9$$

$$x + 10y - 2z = 15$$

$$2x - 2y - 13z = -17$$

- b) Using Dollittle LU decomposition method, solve the following system equations: 7

$$3x + 2y + z = 10$$

$$2x + 3y + 2z = 14$$

$$x + 2y + 3z = 14$$

5. a) Use Runge-kutta of order four to find the solution of the given differential equation at x=1.5 taking a step size of h=0.25. 8

$$\frac{dy}{dx} + 2y = x^2, y(1) = 5$$

- b) Find the solution of the given ordinary differential equation at x=0.5 using the step size of h=0.25 using Heun's method. 7

$$\frac{dy}{dx} + 0.4y = 3e^{-x}, y(0) = 5$$

6. a) Determine the steady-state heat distribution in a thin square metal plate with dimensions 0.5 m by 0.5 m using n = m = 4. Two adjacent boundaries are held at 0°C, and the heat on the other boundaries increases linearly from 0°C at one corner to 100°C where the sides meet. 7

- b) The following table gives the corresponding values of pressure and specific volume of superheated steam. 8

V	2	4	6	8
P	105	42.07	25.3	16.7

- (i) Find the rate of change of pressure with respect to volume when V= 2.
(ii) Find the rate of change of volume with respect to pressure when P= 105.

7. Write short notes on: (Any two) 2×5

a) Ill-conditioned systems

b) Laplacian equation

c) Classification of Second Order Partial Differential Equation

POKHARA UNIVERSITY

Level: Bachelor
Programme: BE
Course: Numerical Methods

Semester: Fall

Year : 2022
Full Marks: 100
Pass Marks: 45
Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Find the root of the equation $f(x) = x^2 - 4x - 10$ correct to three decimal places by using False Position method.
b) Estimate the root of the equation $f(x) = xe^x - \cos x$ using Newton Raphson method correct to three decimal places .
2. a) From the following table estimate the number of student who obtained marks between 40 and 45.

Marks	30-40	40-50	50-60	60-70
No of Students	31	42	51	35

2. b) From the following data given in the table below evaluate $f(2.5)$ by using Lagrange method.

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

3. a) Evaluate $\int_1^5 \frac{1}{x} dx$ by using Gaussian Integration formula for n=3 and compare the value with exact solution.
b) Use the Romberg integration to find the solution correct upto three decimal places.

$$I = \int_0^1 \frac{1}{1+x^2} dx$$

4. a) Find the solution of the given simultaneous linear equation using Gauss Seidel method.

$$6x_1 - 2x_2 + x_3 = 11$$

$$-2x_1 + 7x_2 + 2x_3 = 5$$

$$x_1 + 2x_2 - 5x_3 = -1$$

b) Solve the following system of equations using Crout method.

$$x + y + z = 4, x + 4y + 3z = 8, x + 6y + 2z = 6$$

5. a) Using the Euler's(R-K 1st order method) find an approximate value 8
of y corresponding to x=1, given that $dy/dx = X+Y$ and y= 1. When
x=0, h = 0.1.

b) Apply Euler's method to approximate value of y(0.3) for the 7
differential equation:

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

6. a) Torsion on a square bar of size 15cm* 15cm. If two of the sides are 8
held at 100^0C and the other two sides are held at 0^0C . Calculate the
steady state temperature at interior points. Assume a grid size of 5cm
* 5cm.

b) Solve the Poisson equation $\nabla^2 f = 2x^2 + y$, over the square domain 1 $\leq x \leq 4$, 1 $\leq y \leq 4$, with $f=0$ on the boundary. Take step size in x and y, 7
 $h=k=1$.

7. Write short notes on: (Any two) 2x5

a) Ill-conditioned and Well-conditioned systems

b) Error in Numerical method

c) Cubic Spline.

POKHARA UNIVERSITY

Level: Bachelor

Semester: Spring

Year : 2013

Programme: BE

Full Marks: 100

Course: Numerical Methods

Pass Marks: 45

Time : 3hrs.

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Explain in brief the errors in numerical calculations.
b) Find a root of $3x + \sin x - e^x = 0$ using
 - i. One of the bracketing methods and
 - ii. One of the non-bracketing methods
2. a) From the data given below, find the number of students whose weight is between 60 to 70.

Weight in lbs	0-40	40-60	60-80	80-100	100-120
No. of students	250	120	100	70	50

- b) Using the method of least squares, fit the curves $ax^2 + \frac{b}{x}$ to the following data.
- | x | 1 | 2 | 3 | 4 |
|---|-------|------|------|------|
| y | -1.52 | 0.96 | 8.88 | 7.66 |
3. a) Use Romberg's method, to compute $\int_0^2 \frac{e^x + \sin x}{1+x^2} dx$ correct up to two decimal places.
b) Estimate approximate derivative of $f(x) = x^2$ at $x=1$ for $h=0.1, 0.2, 0.05, 0.01$. Use first order difference method and find the respective error.

4. a) Apply the factorization method to solve the equation $3x+2y+7z=4$; 8
 $2x+3y+z=5$; $3x+4y+z=7$
- b) Using SOR method, solve the following system of 7
 $4x+y+2z=4$; $3x+5y+z=7$; $x+y+3z=3$.
5. a) Find the largest eigen value and the corresponding eigen vector of the 8 matrix

$$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$
 using power method
- b) Using the R-K 1st order method, find an approximate value of y 7 corresponding to $x=1$, given that $\frac{dy}{dx} = \frac{y-x}{y+x}$ and $y=1$. When $x=0$, and $h=0.02$.
6. a) Using the R-K method of fourth order, solve for y at $x=1.2, 1.4$, from 8
 $\frac{dy}{dx} = \frac{2xy+e^x}{x^2+xe^x}$ given $x_0=1, y_0=0$.
- b) Solve the elliptic equation $U_{xx} + U_{yy} = 0$ over a square mesh of side 7 four units satisfying the following boundary conditions; $u(0, y) = 0$ for $0 \leq y \leq 4$, $u(4, y) = 12 + y$ for $0 \leq y \leq 4$; $u(x, 0) = 3x$ for $0 \leq x \leq 4$, $u(x, 4) = x^2$ for $0 \leq x \leq 4$
7. Write short notes on: (Any two) 2×5
- a) Shooting Method
- b) Algorithm of Gauss Jordan method
- c) Algorithm of fixed point iteration method

POKHARA UNIVERSITY

Level: Bachelor
Programme: BE
Course: Numerical Methods (Old)

Semester: Fall

Year : 20
Full Marks: 10
Pass Marks: 4
Time : 3h

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

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Find where the graph of $y = x - 3$ and $y = \ln(x)$ intersect using bisection method. Get the intersection value correct to four decimal places.
- b) Find value of $\sqrt{18}$ using Newton Raphson method.
2. a) Find the root of the equation $3x + \sin x - e^x = 0$ corrected up to 3 decimal places using Secant Method.
- b) Given populations of a city in different year as shown in table below.

x (in year)	1891	1901	1911	1921	1931
f(x)(population of that year in 0000)	46	66	81	93	101

Observe the data carefully and answer the following questions:

- i. Which method is applicable for finding population in the year 1860 and why? Also find the population of that year.
- ii. If you are asked to find the change in population between the year 1925 to 1930, how will you find? (mention formula and steps)
3. a) Fit a power function model of the form $y = ax^b$ from the given data points.

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

- b) Use Romborg method to evaluate:

$$\int_0^{3\pi/2} e^x \sin x \, dx$$

4. a) Solve the following system of equations using partial pivoting method.

$$x + y + z = 4, \quad x + 4y + 3z = 8, \quad x + 6y + 2z = 6$$

- b) Obtain the solution of following system using Gauss-Seidel iteration method. 7

$$2x_1 + x_2 + x_3 = 5$$

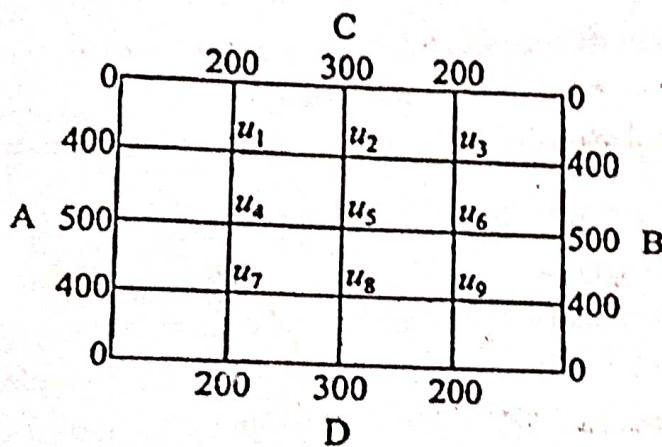
$$3x_1 + 5x_2 + 2x_3 = 15$$

$$2x_1 + x_2 + 4x_3 = 8$$

5. a) Determine the largest eigenvalue and the corresponding eigenvector of the matrix: 7

$$A = \begin{bmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 5 \end{bmatrix} \text{ using the power method.}$$

- b) Solve the Laplace equation $U_{xx} + U_{yy} = 0$ for the square mesh with boundary values as shown in the figure. 8



6. a) Solve the following equation for $y(0.2)$ using shooting method: 9

$$\frac{d^2y}{dx^2} + 2 \frac{dy}{dx} - 3y = 6x \text{ Given } y(0) = 0, y'(0) = 1.$$

- b) Use Picard's method to approximate the value of y when $x=0.1, x=0.2$ and $x=0.4$, given that $y=1$ at $x=0$ and $dy/dx = 1+xy$ correct to three decimal places (Use upto second approximations). 6

7. Write short notes on: (Any two) 2×5

- a) Newton's backward differentiation formulas
- b) Partial differential equation and their examples
- c) Algorithm of fixed point iteration method