

POKHARA UNIVERSITY

Level: Bachelor	Year : 2001
Programme: Computer/Elx./Civil Engineering	Full Mark : 100
Course: Numerical Methods	Pass Mark : 50
	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.*

Find all possible negative roots of the following equation using Secant method. Carry the iterations until the changes of root in subsequent iterations differ less than 0.0001. List the percentage error between successive iterations  $x^3 - 21x = -3500$  15

2. Fit a quadratic curve for the following data using the least square method, and then find  $z(2.5)$  from the fitted curve. Also find the absolute error at  $y = 2$ . 20

Z	10	12	18	22	20	30	26
Y	0	2	4	6	8	12	16

3. Evaluate the following using the three ordinate Gauss Legendre quadrature. Compare the result with three ordinates Newton Cotes quadrature.  $\int_1^2 e^{x^2} dx$  10

4. Find the inverse of the following matrix using the Gauss Elimination method.

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

5. In a L-R-C circuit, the voltage  $v(t)$  across the capacitor is given by the equation  $LC \frac{d^2v}{dt^2} + RC \frac{dv}{dt} + v = 0$  subject to the conditions  $t = 0, v = v_0$ , 20

$dv/dt = 0$ . Taking  $h = 0.01$  sec, user Runge Kutta fourth order method to calculate  $v$  and  $dv/dt$  when  $t = 0.01$ , for the data  $v_0 = 12$  volts,  $c = 0.15$  Farad,  $L = 0.6$  Henry, and  $R = 11$  Ohms.

6. Solve the Poisson's equation  $\nabla^2 u = x^2 y^2$  for the square mesh of figure given below with  $u(x,y) = 0$  on the boundary and mesh length = 1. 10

u1	u2
u2	u3

u1
u2

u3 u2 u1

10

7. Write short answers to the following questions

- Graphically illustrate at least four different situations in which the Newton Raphson method does not converge to a solution of a function.
- Give an example each of a symmetric matrix, diagonal matrix, identity matrix, lower triangular matrix, upper triangular matrix, banded matrix and tridiagonal matrix.

POKHARA UNIVERSITY

Level: Bachelor  
Programme: BE  
Course: Numerical Methods

Year : 2002  
Full Mark : 100  
Pass Mark : 50  
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. Find Newton Raphson method based formulas to find  $\sqrt{N}$  and  $N^{1/3}$ , where N is a positive number. Apply the methods to  $N = 10$  correct to three decimal places. 15
2. Find  $z(1.5)$  from the following tabulated data using the natural Cubic Spline method. 20

z :	1	-1	-1	0	.....
w :	0	1	2	3	.....

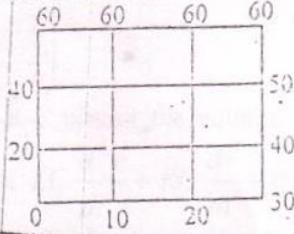
3. Integrate the following function using the two and four ordinates Newton Cotes quadrature formula, with at least five subintervals. Compare the results with three ordinate Gauss Legendre quadrature:  $\int_{-1}^1 e^x dx$ . 10

4. Solve the following system of equations by factoring the coefficient matrix into  $[L]$  and  $[L^T]$ , where  $[L]$  is lower triangular matrix and  $[L^T]$  is transpose of  $[L]$ . Perform partial pivoting if necessary. 15

$$\begin{bmatrix} 6 & 16.5 & 14 \\ 16.5 & 76.25 & 48 \\ 14 & 48 & 54 \end{bmatrix} \begin{Bmatrix} a_0 \\ a_1 \\ a_2 \end{Bmatrix} = \begin{Bmatrix} 54 \\ 243.5 \\ 100 \end{Bmatrix}$$

5. The angular displacement  $\theta$  of a simple pendulum is given by the equation  $\frac{d^2\theta}{dt^2} + \frac{g}{l} \sin \theta = 0$  where  $l = 98$  cm and  $g = 980$  cm/sec $^2$ . If  $\theta = 0$  and  $d\theta/dt = 4.472$  at  $t = 0$ , use Runge Kutta fourth order method to find  $\theta$  and  $d\theta/dt$  when  $t = 0.2$  sec. 20

6. Solve the Laplace's equation  $u_{xx} + u_{yy} = 0$  in the domain of figure given below by Gauss Seidel method. Obtain the solution correct to two decimal places. 10



7. Write short answers to the following questions. 10
- List at least four different types of computational errors. Give at least one example of each.
  - Explain with a numerical example an illconditioned system of equations. Show it graphically for a system of two unknown equations.

POKHARA UNIVERSITY

Level: Bachelor Semester - Fall Year : 2004  
Programme: BE Full Marks : 100  
Course: Numerical Methods 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) Write a pseudocode for the implementation of bisection method for solving a nonlinear algebraic equation. 7

b) Using Secant method, find the root of the equation  $x^6 - x^4 - x^3 - 1 = 0$ . 8

2. a) Use Lagrange's interpolation formula to find the value of Y when X=10 if the values of X and Y are given below: 7

X	5	6	9	11
Y	12	13	14	16

OR

The velocity distribution of the fluid near a flat surface is given below:

X(cm)	0.1	0.3	0.5	0.7	0.9
V(cm)	0.72	1.81	2.73	3.47	3.98

Where  $X$  is the distance from the surface using a suitable interpolation formula. Obtain the velocity at  $x = 0.2, 0.4$

- b) Find the missing value in the following table for a chemical dissolved in water. 8

Temperature	$10^{\circ}$	$15^{\circ}$	$20^{\circ}$	$25^{\circ}$	$30^{\circ}$	$35^{\circ}$
Solubility	20	22	23	?	26	27

3. a) Estimate the integral  $I = \int_0^{10} \exp\left(-\frac{1}{(1+x^2)}\right) dx$  by Gauss quadrature with  $n=2$  and  $n=3$ .

OR

Using Romberg's integration and taking  $h = 0.5$ , estimate the

$$\text{integral of } I = \int_0^1 \frac{1}{(1+x)} dx$$

- b) Estimate approximate derivative of

$f(x) = x^2$  at  $x = 1$  for  $h = 0.2, 0.1$  and  $0.05$  using 3-point formula.

4. Solve the following initial value problem over the interval from  $x = 0$  to  $1$  using Heun's method.

$$\frac{dy}{dx} = (1+x)\sqrt{y}, \text{ where } y(0) = 1, \text{ and } h = 0.5$$

5. a) Using Gauss-Jordan or Gauss elimination method; solve the following system of linear equation

$$\begin{array}{cccc|c} 8x_1 & x_2 & -2x_3 & -4x_4 & 15 \\ & 3x_2 & +5x_3 & +3x_4 & -5 \\ 2x_1 & 2x_2 & -3x_3 & -2x_4 & 9 \\ 4x_2 & +2x_3 & -3x_4 & & 5 \end{array}$$

- b) Use Power method to find the highest Eigen value of

$$\begin{matrix} -13 & 3 & -5 \\ 0 & -4 & 0 \\ 15 & -9 & 7 \end{matrix}$$

6. a) Solve the following heat flow equation knowing  $u(x,0) = x^2$  in the interior nodes (points) with  $h = k = 0.1, 10u_y = u_{xx}$

- b) What is pivoting? Distinguish between partial pivoting and complete pivoting. How does pivoting improve the accuracy of the solution?

7. Write Short notes on:

- a) Euler's method for solution of differential equations.  
b) Poisson's Equation

## POKHARA UNIVERSITY

Level: Bachelor Semester - Spring Year : 2004  
Programme: BE Full Marks : 100  
Course: Numerical Methods 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 the equation:  $x^2 - 5 = 0$  correct to 4 decimal places using fixed – point iteration method. 7  
 b) Solve the given equation:  $x \sin x + \cos x = 0$  correct to 4 decimal places using Newton – Raphson method. 8  
 2. Solve the following set of equations using LU decomposition method: 15

$$2 X_1 + 4 X_2 + 2 X_3 = 15$$

$$2 X_1 + X_2 + 2 X_3 = -5$$

$$4X_1 + X_2 - 2X_3 = 0$$

3. a) Estimate the square root of 2.5 using Newton interpolation based on the following data: 8

X	1	2	3	4
$X^2$	1	4	9	16

- b) Fit the exponential curve of the form:  $y = a x^b$  for the following data: 7

X	1	2	3	4	5
Y	0.5	2	4.5	8	12.5

4. a) From the given table, find  $y'(x)$  at  $x = 2.5$  using formula based on the Newton interpolation. 10

X	1.3	1.9	2.5	3.1	3.7	4.3	4.9
Y	3.669	6.686	12.182	22.198	40.447	73.700	134.29

- b) Evaluate the integration of  $(1 - x^2)^{3/2} \cos x$  with respect to x, for the interval  $(-1, 1)$  using 2-point Gauss-Chebyshev Quadrature formula. 5

5. Solve the given differential equation using Shooting method  $y''(x) = 6x$ , given boundary value conditions are  $y(1) = 0$  and  $y(2) = 9$  in the interval  $(1, 2)$  with the step size of 0.5. 15

6. Consider a metal plate of size  $15 \text{ cm} \times 15 \text{ cm}$  divided into 9 equal grids of size  $5 \text{ cm} \times 5 \text{ cm}$  each, whose two sides are kept at  $100^\circ\text{C}$  and other two sides are kept at  $0^\circ\text{C}$ . Find out the steady - state temperature at the interior points using Laplace's equation.
7. Write short note on:
- Interpolation and Curve fitting
  - Compare all the four methods used to solve non- linear equation.

Raj's  
POKHARA UNIVERSITY

Level: Bachelor Semester – Fall Year : 2005  
Programme: BE Full Marks: 100  
Course: Numerical Methods 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 real root of the equation  $x = e^{-x}$ , using Newton Rapson method to six decimal place.

b) Find a root of following equation using bisection method or Regula Falsi method to four decimal places

$$\log x - \cos x = 0$$

- a) Use the classical Runge-Kutta method to estimate  $y(0.5)$  of the following equation with  $h=0.25$  15

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

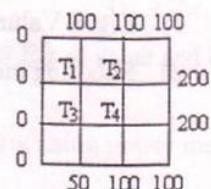
3. a) Find the missing value in the following table of a chemical dissolved in water using Least square approximation to straight line fitting.

Temperature	$10^{\circ}$	$15^{\circ}$	$20^{\circ}$	$25^{\circ}$	$30^{\circ}$	$35^{\circ}$
Solubility	20	22	23	?	26	27

- b) The steady-state two dimensional heat-flow in a metal plate is given by

$$\partial^2 T / \partial x^2 + \partial^2 T / \partial y^2 = 0$$

Given boundary conditions as shown in the figure below, find the temperature  $T_1$ ,  $T_2$ ,  $T_3$  and  $T_4$ .

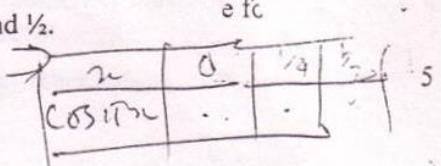


4. a) Generate a Lagrange interpolating polynomial for the function  $y = \sin x$  over the interval  $[0, \pi]$  using 4 points.

~~cosπx~~, taking the pivotal points 0,  $\frac{1}{4}$  and  $\frac{1}{2}$ .

- b) Use Romberg integration to evaluate

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



5. a) Find your own interpolatory quadrature formula at the nodes  $\{-1, -\frac{1}{2}, \frac{1}{2}, 1\}$  in the range  $[-1, 1]$  10

- b) Solve the following boundary value problem using finite differences. 5

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

6. a) Solve the following system of equation using Gauss Jordan Elimination method 8

$$2x_1 + x_2 + x_3 - 2x_4 = 0$$

$$4x_1 + 2x_3 + x_4 = 8$$

$$3x_1 + 2x_2 + 2x_3 = 7$$

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

- b) Determine the smallest eigen value and its corresponding eigenvector for the following matrix using Power method 7

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

7. Write short notes on (Any Two) 2x5

- a) Fixed point iteration method and its convergence
- b) Graphical representation of Euler's method for solving differential equation
- c) Eigen Value and Eigen Vector
- d) Shooting method

**POKHARA UNIVERSITY**

B.Sc. Engg.

Level: Bachelor

Semester - Spring

Year : 2005

Programme: BE

Full Marks : 100

Course: Numerical Methods

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. Find the real root of the function  $\tan x + \tanh x = 0$  by

- a) Bisection method with initial values 2.3 and 2.4. 5
- b) Newton-Raphson method with initial value 2.2. 5
- c) Secant method with initial values 2.3 and 2.4. 5

In each case, perform only five iterations.

2. Fit the second order polynomial  $a_1x^2 + a_2x + a_3 = 0$  from given data using least square method. Use Gauss Seidel method to solve the equation from the following data:

X	1	2	3	4
Y	6.0	11.0	18.0	27.0

3. a) Integrate  $\int_0^{\pi} (1 + 3\cos^2 x) dx$  by

- i) Trapezoidal rule
- ii) Simpson's 3/8 rule, taking number of intervals ( $n$ )= 6

- b) Use Romberg integration to evaluate  $\int_{0.2}^{1.5} e^{-x^2} dx$  correct to 3 significant digits.

4. a) Solve the following system of equations using Gauss elimination

$$x_1 + x_2 - x_3 = 2$$

method with partial pivoting.  $2x_1 + 3x_2 + 5x_3 = -3$

$$3x_1 + 2x_2 - 3x_3 = 6$$

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

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

5. Use the classical Runge-Kutta method to estimate  $y(0.4)$  of the following equation with  $h = 0.2$ .

$$y'(x) = x^2 + y^2, \quad y(0) = 0$$

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

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

- a) Convergence of Newton Raphson method
- b) Pivoting in solution of a set of Linear equations.
- c) Errors in Numerical computing.

**POKHARA UNIVERSITY**

Level: Bachelor	Semester – Fall	Year : 2006
Programme: BE		Full Marks: 100
Course: Numerical Method		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) By using Secant method, find a real root of  $x^3 + x^2 - 3x - 3 = 0$ . 8  
Correct to three decimal places.
- b) Using Newton-Raphson method, Solve  $f(x) = e^{x-1} - 5x^3$ . Correct 7  
to four decimal places.

2. 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) The table given below shows the temperatures T (in degree Celsius) and lengths L (in mm) of heated rod. Find the temperature at L = 800.8 mm, using Lagrange interpolation method. 8

T	30	40	50	60	70
L	800.4	800.6	800.7	800.9	801.0

3. a) What are the advantages of LU – Decomposition over Gaus-elimination method? Solve the following set of linear equation using Gauss Jordan with partial pivoting. 8

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

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

$$4x + 3y + 4z = 1$$

- b) Solve the equation by Iterative method: 7

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

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

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

4. a) Evaluate  $\int_3^5 \frac{1}{x^6 + 5} dx$  by using Gauss-Legendre two and three point formula. 8
- b) Apply Romberg's method to evaluate  $\int_4^{5.2} \log x dx$  7
5. a) Solve the differential equation by using 4th order R-K method for  $y(0.6)$  from  $\frac{dy}{dx} = x^2 + y^2$   $y(0) = 3$  taking  $h = 0.3$  8
- b) Use RK2 method to solve  $y'' = xy' - y$ ;  $y(0) = 3$ ,  $y'(0) = 0$  to approximate  $y(0.2)$ , take  $h = 0.1$  7
6. a) A steel plate is of size  $15 \text{ cm} \times 15 \text{ cm}$ . If two of the sides are held at  $100^\circ\text{C}$  and other two sides are held at  $0^\circ\text{C}$ , what is the steady state temperature at interior points assuming a grid size of  $5 \text{ cm} \times 5 \text{ cm}$ ? 8
- b) Determine the highest eigen value and its corresponding eigen vector for the following matrix by using power method 7

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

- 7 Write short notes on (Any Two): 2×5
- a) Cubic Splines  
 b) Shooting Method  
 c) Fixed Point iteration.

4  
Pokhara University

**POKHARA UNIVERSITY**

Level: Bachelor

Semester - Spring

Year : 2006

Programme: BE

Full Marks: 100

Course: Numerical Methods

~~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 real root of the equation  $x^3 - 4x + 1 = 0$  that lies between 1 and 4, correct to three decimal places by using the Newton-Raphson method. 8
- b) Use fixed point iteration method to evaluate root of the equation  $x^2 - x - 1 = 0$ , correct up to 3-decimal places. 7
2. a) The velocity distribution of the fluid near a flat surface is given below:- 8

X(cm)	0.1	0.3	0.5	0.7	0.9
V(cms)	0.72	1.81	2.73	3.47	3.98

X is the distance from the surface using a suitable interpolation formula, obtain the velocity at x=0.2

- b) Use the data linearization method and determine the exponential fit of  $y = C e^{Ax}$  for the following data: 7

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

3. a) Evaluate the following integral 10

$$\int_0^{\frac{\pi}{2}} \sin x \, dx$$

Using

1. Trapezoidal Rule
2. Simpson's  $\frac{1}{3}$  rule
3. Simpson's 3/8

Comment on the result.

- b) Using secant method, find the root of the equation  $x^6 - x^4 - x^3 - 1 = 0$ . Correct upto 2-significant digit. 5
4. a) Monthly faculty salary in three departments of an institute is given below. Assuming that the salary for a particular category is same in all the departments, calculate the salary of each category of faculty. Use any suitable method. 7

Department	Number of faculty			Total in thousands.
	Prof.	Asst.prof.	Lect.	
A	2	2	4	60
B	3	1	2	50
C	1	4	3	60

- b) Use L -U factorization method to solve the following system of equations. 8

$$x + y + z = 1$$

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

$$x - 2y - 5z = 10$$

5. a) Solve  $y' = y + e^x$ ,  $y(0) = 0$  for  $y(0.2)$  and  $y(0.4)$  by RK-4<sup>th</sup> order method. 7

- b) Use Heun's method to solve  $y'' - xy + 4y = 0$ ;  $y(0) = 3$ ;  $y'(0) = 0$  at  $x = 0.2$ . Take  $h = 0.1$  8

6. a) In a square bar with dimension of 3 inch  $\times$  3 inch, torsion function,  $\phi$ , 10

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  $\phi$  in the interior nodes.

- b) Find the largest eigen value using power method current up to 5 2-significant digit.

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

7. Write shorts notes on (Any Two):

5×2

- a) Ill-conditioned systems
- b) Shooting method for solving boundary value problem
- c) Cubic spline

**POKHARA UNIVERSITY**

Level: Bachelor

Semester - Fall

Year : 2007

Programme: BE

Full Marks : 100

Course: Numerical Methods

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  $f(x) = 3x + \sin x - e^x$  by secant method up to 5<sup>th</sup> iteration. 10

- b) Find one root of equation  $x^2 - 2x - 3 = 0$ . Using fixed point iteration method. 5

2. a) Fit the following data using least square method to estimate a and b for the relation  $y = a + bx$ . Also find  $f(15)$  from the fitted equation. 8

x	10	12	18	22	30
f(x)	0	2	4	8	10

7

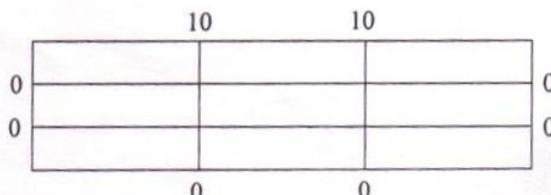
- b) Estimate  $f(2.5)$  and  $f(3.5)$  using second order interpolation polynomial.

x	1	2	3	4
f(x)	0	0.3010	0.4771	6.6021

3. a) Integrate the following function by sing Simpson 3/8 rule. Take n = 5. 8

$$\int_0^{\pi/2} \frac{\sin x}{x} dx.$$

- b) Solve Laplace equation  $U_{xx} + U_{yy} = 0$  in the domain given below. 7



4. Use Gauss-Jordan method to solve the following system of linear equation. 15

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

$$3x_2 - 4x_3 + 3x_4 = -5$$

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

$$x_1 - 3x_3 + x_4 = -5$$

5. a) Solve the differential equation by using 4<sup>th</sup> order R-K method for  $y(0.6)$  8

from  $\frac{dy}{dx} = x^2 + y$ ,  $y(0) = 3$  and taking  $h = 0.3$

b) Using shooting method solve the equation  $\frac{d^2y}{dx^2} = 6x$ ,  $y(1) = 2$ ,  $y(2) = 9$

in the interval  $(1, 2)$ . 7

6. a) Solve the following set of equations by using LU decomposition method. 8

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

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

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

b) Find a root of the equation  $\sin x - x + 2 = 0$  by False position method 7  
correct to three decimal places.

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

a) Cubic spline

b) Numerical Differentiation

c) Convergence of fixed point iteration

**POKHARA UNIVERSITY**

Level: Bachelor	Semester – Spring	Year : 2007
Programme: BE		Full Marks: 100
Course: Numerical Methods		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) Calculate the root of non-linear equation  $f(x)=3x+\sin x-e^x$  using secant method. The absolute error of functional value at our calculated root should be less than  $10^{-3}$ . 7

- b) Find out all the possible real roots of the equation  $x^3 - 2x - 5 = 0$  using Newton Raphson method to three decimal places. 8

2. a) Given the data table 8

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) Use suitable interpolation formula to find the value of  $y(10)$  from the following data: 7

x :	5	6	9	11
y :	12	13	14	16

3. a) Evaluate the integral  $I = \int_0^{\frac{\pi}{2}} \sin x \, dx$ . Compare the absolute error in both conditions for Simpson  $\frac{1}{3}$  rule and Simpson's  $\frac{3}{8}$  rule. 8

- b) Using Gauss-quadrature formula for  $n=3$ , evaluate  $\int_0^1 \frac{dx}{1+x^2}$ . 7

4. a) Solve the following set of equation using LU factorisation method. 7

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

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

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

- b) Using factorisation method, solve the following system of linear equations: 8

$$3x_1 + 2x_2 + 2x_3 = 10$$

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

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

5. a) Find the value of  $y(0.4)$  using Heun's method, given that 7  
 $y = y + \sin x$ ,  $y(0) = 1$ ,  $h = 0.2$

- b) The angular displacement  $\theta$  of a simple pendulum is given by the 8

equation  $\frac{d^2\theta}{dt^2} + \frac{g}{l} \sin \theta = 0$  where  $l = 98$  cm and  $g = 980$  cm/sec<sup>2</sup> if

$\theta = 0$  and  $\frac{d\theta}{dt} = 4.472$  at  $t = 0$ . Use Runge Kutta fourth order

method to find  $\theta$  and  $\frac{d\theta}{dt}$  when  $t = 0.2$  sec.

**OR**

Given that  $yy' = y^2 - 2x$  and  $y(0) = 1$ . Compute  $y(0.2)$  and  $y(0.4)$  using Runge-Kutta method of the fourth order with  $h = 0.2$ .

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

- b) Find the largest eigen values using power method ~~corrected~~ up to 7  
 2-significant digit.

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

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

- a) Convergence in fixed point iteration method

- b) Cubic splines

- c) Euler's method for solution of differential equation

**POKHARA UNIVERSITY**

Level: Bachelor  
Programme: BE  
Course: Numerical Methods

Semester – Fall      Year : 2008  
Full Marks: 100  
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 real root of  $x^3 + x^2 - 3x - 3 = 0$  by secant method correct to three decimal place. 7
- b) Find the real root of  $x \log x = 1.2$ , using Newton-Raphson method. 8
2. a) The following data gives the melting point of an alloy of lead and zinc, where  $t^{\circ} \text{C}$  is the temperature and P is the percentage of lead in the alloy 7

P	40	50	60	70	80
t	184	204	226	250	276

Using Newton's interpolation formula, find the melting point of an alloy containing 75% lead.

- b) Fit the exponential curve of the form  $y = ax^b$  for the following data. 8

X	1	2	3	4	5
Y	0.5	2	4.5	8	203

3. a) Evaluate the integral  $I = \int_{-1}^1 (1-x^2)^{\frac{3}{2}} \cos x dx$ , using Gauss Legendre method. 8
- b) Find the integral value of  $I = e^{-x^3}$ , correct to three decimal place using Romberg integration within the limit of (0.2, 1.5). 7
4. a) Solve the equation by Gauss -Jordan method: 7
 
$$\begin{aligned} x + 2y + z &= 8 \\ 2x + 3y + 4z &= 20 \\ 4x + 3y + 2z &= 16 \end{aligned}$$
- b) By an iterative method solve the following equations 8

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

$$-x - y + 10z - 2w = 27$$

$$-x - y - 2z + 10w = -9$$

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

5. a) Solve the differential equation  $\frac{dy}{dx} = x^3 + y^2$ ,  $y(0) = 0$  for  $y(0.5)$  by Euler's method. 7
- b) Use the classical 4<sup>th</sup> order RK method to estimate  $y(0.5)$  of the differential equation with  $h = 0.25$ ,  $\frac{dy}{dx} = y + \sin x$ ;  $y(0) = 2$  8
6. a) Solve the equation  $\nabla^2 u = -10(x^2 + y^2 + 10)$  over the square mesh with sides  $x = 0$ ,  $y = 0$ ,  $x = 3$ ,  $y = 3$  with  $u = 0$  on the boundary and mesh length  $h = 1$ . 10
- b) Find the largest eigen value and corresponding eigen vector of the following matrix using power method 5  
$$\begin{bmatrix} -1 & 0 & 0 \\ 1 & -2 & 3 \\ 0 & 2 & -3 \end{bmatrix}$$
7. Write Short notes on: (Any Two) 5x2
- a) Errors in numerical methods
  - b) Interpolation and Extrapolation
  - c) Convergence of fixed point iteration methods

**POKHARA UNIVERSITY**

Level: Bachelor	Semester – Spring	Year : 2008
Programme: BE		Full Marks: 100
Course: Numerical Methods		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 out at least one real root of  $x^3 + x^2 - x - 1 = 0$  using Secant method to three decimal places. 7
- b) Find out all real roots of the following non linear equation using Newton Raphson method. 8

$$x \log_{10} x = 1.2$$

2. a) The following set of data represent the position of a car in a road at specified time, Calculate the position of the car at  $T = 1.75$  hours. (You can use any method)

Time(hr)	0	0.5	1.0	1.5	2.0
Position(km)	0	0.25	1.0	2.25	4.0

- b) For the following set of data, fit a linear curve using Least Square Method and find  $f(2)$ .

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

3. a) Integrate the given integral 7

$$\int_1^3 \cos x dx$$

Using trapezoidal, simpson's  $\frac{1}{3}$  and  $\frac{3}{8}$  rule.

- b) Using two and three point Gauss Legendre formula. Evaluate 8

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

4. a) Solve the following system of linear equation using Gauss Elimination method. 8

$$2w + x + 3y - z = 9$$

$$-3w + x - 2y + z = -4$$

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

$$3w - x - y + 2z = 1$$

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

$$\begin{bmatrix} 3 & 1 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 5 \end{bmatrix}$$

5. a) Find the value of y at x = 2.0 for the following initial value problem by using RK - 4 method. 8

$$y' = x + y^2; y(1) = -0.8, \text{ step size } h = 0.5$$

- b) Solve  $\frac{d^2y}{dx^2} + \frac{2dy}{dx} + 6y = x$ , with  $y(0) = 0$ ,  $y'(0) = 1$  for  $y(0.2)$  7  
taking  $h = 0.2$  by RK2 method.

6. a) Solve the Poisson equation  $\nabla^2 f = 2x^2 + y$ , over the square domain 10  
 $1 \leq x \leq 4$ ,  $1 \leq y \leq 4$ , with  $f=0$  on the boundary. Take  $h=k=1$
- b) Using Gauss Jordan method, find the inverse of the matrix 5

$$A = \begin{bmatrix} 2 & 7 \\ 1 & 3 \end{bmatrix}$$

7. Write short notes on (*Any Two*)



2×5

- a) Errors in numerical computing
- b) Cubic spline interpolation
- c) Solution of differential equation by pi card's method



2

**POKHARA UNIVERSITY**

Level: Bachelor  
 Programme: BE  
 Course: Numerical Methods

Semester – Fall

Year : 2009

Full Marks : 100

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. Calculate the root of given equation using Bisection method; 8 correct to three decimal points.  $f(x) = \sin x - 2x + 1$ .
- b. Find the root of equation  $x^2 - 3x + 2 = 0$ , correct to four decimal digits, using NR method. 7
2. a. Find the polynomial using Langrange's method; also calculate the absolute and relative error at  $x=2.7$ . 7

x	3.2	2.7	1.0	4.8
f(x)	22.0	17.8	14.2	38.3

- b. The heat of water H (ft) and the quantity of water Q ( $\text{ft}^3$ ) flowing per second are related by the law  $Q = CH^\alpha$ . Find out the best fit values for coefficients C and  $\alpha$  for the following data: 8

H	5	10	15	20	25	30
Q	20	150	360	800	1500	2200

3. a. Integrate the given integral. 8

$$\int_1^3 \cos x dx, \text{ Using composite trapezoidal, Simpson's } \frac{1}{3} \text{ and } \frac{3}{8} \text{ rule}$$

(use equal interval for all method).

- b. Using three point Gauss Legendre formula, evaluate  $\int_{0.5}^{1.5} e^{x^2} dx$ . 7

4. a. Using Gauss Elimination method, solve the following system of linear equation. 8

$$\begin{array}{ccccccc}
 10x & - & 7y & + & 3z & + & 5u = 6 \\
 -6x & + & 8y & - & Z & - & 4u = 5 \\
 3x & + & y & + & 4z & + & 11u = 2 \\
 5x & - & 9y & - & 2z & + & 4u = 7
 \end{array}$$

- b. Find the largest eigen value and corresponding eigen vector by power method. 7

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

5. a. Find the value of  $x$  at 2.0, using Heun's Method. 7  
 $y' = x + y^2$ ;  $y(1) = -8$ , step size  $h = 0.5$ .
- b. Solve:  
 $y'' + 2y' + 6y = x$  using RK - 4<sup>th</sup> Method. Where  $y(0) = 0$ ,  $y'(0) = 1$  8  
are the initial condition and find it for  $y(0.2)$  taking  $h = 0.2$
6. a. A square metal sheet of side 30cm is floating in water such a way that two sides are in  $90^\circ$  and another two sides are in  $10^\circ$  celcius. Calculate the interior temperature of the grid of size 10cm. solve the necessary equation using Gauss Seidal method. 10
- b. Find the square root of 17 using Fixed point iteration Method. 5
7. Write short notes on (Any Two): 5×2
- a. Chowleskys' LU Decomposition Method
  - b. Least Square Approximation
  - c. Initial and Boundary Value Condition

**POKHARA UNIVERSITY**

Level: Bachelor	Semester – Spring	Year : 2009
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) Use False- position method to find the root of the following equation, 8  
correct upto two decimal places:

$$x^3 - 4x^2 + x + 6 = 0$$

- b) Find the root of the equation  $f(x) = x \sin x + \cos x$  using Newton-Raphson method, correct up to three decimal places. 7

2. a) The velocity distribution of the fluid near a flat surface is given by 8  
the table below:

X (cm)	0.1	0.3	0.5	0.7	0.9
V (cm/s)	0.72	1.81	2.73	3.47	3.98

Where x is the distance from the surface. Using a suitable interpolation method, obtain the velocity at  $x = 2.5$

- b) Use regression method to fit the geometrical curve  $y = ab^x$  to the 7  
data given below and obtain the value of y at  $x = 5.5$

X	0	1	2	3	4	5	6	7
Y	10	21	35	59	92	200	400	610

3. a) Evaluate the following integral using Simpson's 3/8 Rule: 8

$$\int_1^2 (x^3 + 1) dx, \text{ using } n = 3.$$

- b) Evaluate the integral  $\int_{-1}^1 e^x dx$  using two-point Gauss Legendre 7  
method.

4. a) Solve the following system of equation by Guass-Seidel method 8  
(upto 3 iterations only)

$$28x + 4y - z = 32$$

$$x + 3y + 10z = 24$$

$$2x + 17y + 4z = 35$$

- b) Solve the following system of equation by Jacobi-Iteration method

$$3x + 4y + 15z = 54.8$$

$$x + 12y + 3z = 39.66$$

$$10x + y - 2z = 7.74$$

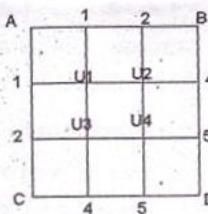
5. a) Use the Rk4 method to estimate  $y(0.5)$  of the following equations with  $h = 0.25$

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

- b) Solve the second order differential equation

$y'' - x^2 y' - 2xy = 0$  for  $y(0.1)$  and  $y'(0.1)$ , given that  $y(0) = 1$ ,  $y'(0) = 0$  using Heun's method Take step size  $h = 0.1$

6. a) Solve the elliptic equation  $U_{xx} + U_{yy} = 0$  for the following square mesh with boundary values as shown in the figure. Iterate until the maximum difference between two successive values at any point is less than 0.001.



- b) Determine the largest eigen value and corresponding eigen vector of the following matrix.

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

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

- a) Gaussian Quadrature method
- b) Lagrange's Interpolation method
- c) Errors in Numerical calculation

**POKHARA UNIVERSITY**

Level: Bachelor  
Programme: BE

Semester – Fall

Year : 2010

Course: Numerical Method

Full Marks : 100

Pass Mark : 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 a root of the equation  $\sin x + \cos x = 0$  using Newton's Method so that relative error is less than 0.1%. 7
- b. Find a real root of the equation  $x^3 - 2x - 5 = 0$  correct to three decimal places using secant method. 8
2. a. Find Newton's forward difference interpolating polynomial for the following data. Use the obtained formula to estimate the value of  $f(0.24)$ . 8

x	0.1	0.2	0.3	0.4	0.5
$f(x)$	1.40	1.56	1.76	2.00	2.28

- 5 b. Fit an exponential equation of the form  $y = ae^{bx}$  using the least square method from the following data. 7

x	1	2	3	4	5	6
y	1.65	2.70	4.50	7.35	12.2	15

3. a. Find the approximate value of  $y = \int_0^{\pi} \sin x dx$ , using
  - i. Trapezoidal Rule
  - ii. Simpson's 1/3 rule by dividing the range of integration into 6 equal parts.
- b. 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
4. a. Solve the following system of linear equations using Gauss Elimination Method. Use partial pivoting whenever necessary. 8

- d. Evaluate  $\int_0^{\pi} \int_0^{\sin x} y dy dx$
- e. Verify Euler's theorem for  $u = x^2 + y^2$

$$\begin{aligned}
 b+3c+2d &= 19 \\
 3b+2c+2d &= 20 \\
 a+4b+2d &= 17 \\
 -2a+2b+c+d &= 9
 \end{aligned}$$

- b. Use LU decomposition method and solve 7
- $$\begin{aligned}
 5x_1-2x_2+x_3 &= 4 \\
 7x_1+x_2-5x_3 &= 8 \\
 3x_1+7x_2+4x_3 &= 10
 \end{aligned}$$
5. a. Solve the differential equation for  $y$  (0.25) using RK 4<sup>th</sup> order 7
- method.  $10 \frac{d^2y}{dx^2} + \left( \frac{dy}{dx} \right)^2 + 6x = 0$ , with  $y(0) = 1$  and  $y'(0) = 0$ .  
  (take  $h = 0.25$ ).
- b. Solve the differential equation  $y' = x + y$  using appropriate 8  
  method within  $0 \leq x \leq 0.2$  with  $y(0) = 1$ .
6. a. Solve the Poisson equation,  $\nabla^2 f = 2x^2y^2$  over the square domain 10  
   $0 \leq x \leq 3$  and  $0 \leq y \leq 3$  with  $f = 0$  on the boundary with  $h=1$ . Show  
  the necessary steps for solving simultaneous equations by any of  
  the method known to you.
- b. Evaluate the square root of 3 using the equation  $x^2-3=0$  by 5  
  applying the fixed point iteration algorithm correct to three decimal places.
7. Write short notes (Any Two): 2×5
- a. pivoting
  - b. algorithm to use bisection method
  - c. cubic spline interpolation

**POKHARA UNIVERSITY**

Level: Bachelor	Semester – Spring	Year : 2010
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 $f(x) = \cos x - 1.3x$ by using Bisection method. | 7 |
| b) Solve $f(x) = 3x + \sin x - e^x$ by secant method up to 5 <sup>th</sup> iteration.        | 8 |
| 2. a) Use appropriate method of interpolation to get $f(0.475)$ from given table.            | 8 |

x	0	0.1	0.2	0.3	0.4	0.5
F(x)	1.0	1.1052	1.2214	1.3499	1.4918	1.6487

- |   |   |
|---|---|
| b) Use the suitable method to fit a quadratic curve $y = e^{ax+bx^2}$ for the following data: | 7 |
|---|---|

x	-5	-4	-3	-2	-1	0
y	12.96	6.94	4.63	2.11	0.67	0.09

- |  |    |
|--|----|
| 3. a) Evaluate the integral $I = \int_0^{\frac{\pi}{2}} \sin x dx$ . Compare the result in both conditions for Simpson 1/3 and 3/8 rule. | 10 |
| b) The following data gives corresponding values of pressure 'P' and specific volume 'V' of steam.                                       | 5  |

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) Using power method, find the smallest Eigen value of the following 8

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

- b) Find the determinant of given matrix using Gauss Elimination 7  
Method.

$$A = \begin{bmatrix} 1.2 & -2.1 & 3.2 \\ -1.4 & -2.6 & 3.0 \\ 1.1 & 3.6 & 5.0 \end{bmatrix}$$

5. a) Use the classical R.K. method to estimate  $y(0.4)$  when 8

$$y'(x) = x^2 + y^2 \text{ with } y(0) = 0. \text{ Assume } h = 0.2.$$

- b) Solve the following equation by Picard's method 7

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

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

- b) Solve the system by using Gauss- Jordan method: 7

$$2x_1 + 4x_2 - 6x_3 = -8$$

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

$$2x_1 - 4x_2 - 2x_3 = -12$$

7. Write short notes on **any two:** 2×5

- a) Ill Conditioned system  
b) Error in Numerical method  
c) Laplacian equation

# POKHARA UNIVERSITY

Level: Bachelor  
 Programme: BE  
 Course: Numerical Methods

Semester – Fall

Year : 2011  
 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  $x \sin x + \cos x = 0$  with accuracy 8  
 0.008, using False Position method.

- b) Using Secant method find a root of the equation 7  
 $x - e^x + 2 = 0$  correct to three decimal places.

2. a) Prove that the Newton Raphson method is quadratic convergent. 7

- b) Estimate the value of  $\sin \theta$  at  $\theta = 25$  using Newton- Gregory forward difference formula with the help of the following table: 8

$\theta$	10	20	30	40	50
$\sin \theta$	0.1736	0.3420	0.5000	0.6428	0.7660

0.220

3. a) Determine the constants a and b by the method of least square such 7  
 that  $y = ae^{bx}$  fits the following data:

$x :$	2	4	6	8	10
$y :$	4.077	11.084	30.128	81.897	222.62

- b) Evaluate the integral  $I = \int_0^{\frac{\pi}{2}} \sin x dx$ . Compare the result in both 8

conditions for Simpson 1/3 and 3/8 rule.

4. a) Solving the following system of Linear equations using L-U 8  
 factorisation method.

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

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

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

b) Using Gauss-Seidel iteration method solve:

$$2x - 7y - 10z = -17,$$

$$5x + y + 3z = 14$$

$$x + 10y + 9z = 7$$

7

5. a) Solve the following differential equation within  $0 \leq x \leq 0.5$  using 8

RK 4<sup>th</sup> order method.  $10 \frac{d^2y}{dx^2} + \left( \frac{dy}{dx} \right)^2 + 6x = 0$ , with  
 $y(0) = 1$  and  $y'(0) = 0$ . (take  $h=0.25$ )

8

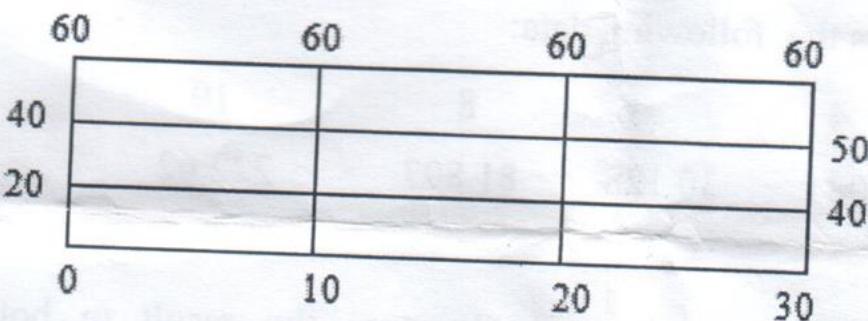
b) Solve the Poission equation  $\nabla^2 f = (1+x^2)y$ , over the square domain of  $0 \leq x \leq 3$  and  $0 \leq y \leq 3$  with  $f = 0$  and  $h = 1$ . 7

7

6. a) Use Power method to find the largest Eigen value and corresponding Eigen vector for the following matrix. 7

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

b) Solve the Laplace's equation  $U_{xx} + U_{yy} = 0$  in the domain of the figure given below: 8



8

7. Write short notes on **any two**:

2×5

a) Romberg Integration

b) Cubic spline Interpolation

c) Laplacian equation

# POKHARA UNIVERSITY

Level: Bachelor

Semester – Spring

Year : 2011

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) Solve the equation  $x^3 + 4x - 1 = 0$  correct to three significant digits after decimal, using False Position method. 8
- b) Find a root of the equation by using Bisection method upto three decimal places 7

$$f(x) = x^2 - 10 \log x$$

**OR**

Write a computer program to find the root of given equation using Bisection method. 7

2. a) Calculate the real root of non-linear equation  $f(x) = e^{x-1} - 5x^3$  using Newton Raphson method. Calculate the relative error in each iteration. 8
- b) Use appropriate method of interpolation to get  $f(0.375)$  from given table. Also calculate the absolute error at this point. 7

x	0.125	0.25	0.375	0.5	0.625	0.75
F(x)	0.7916	0.7733	0.7437	0.7041	0.6563	0.6022

**OR**

Write an algorithm for Lagrange's interpolation method to interpolate any functional value of x from given set of data points. 7

3. a) Given the data table; 8

i	0	1	2	3
$x_i$	1.0	3.0	4.0	7.0
$f(x_i)$	1.5	4.5	9.0	25.5

Estimate the function value at  $x = 1.5$  using cubic splines technique.

- b) Evaluate the integral  $I = \int_0^{\frac{\pi}{2}} (1 - 0.25 \sin^2 x)^{\frac{1}{2}} dx$  using Gaussian quadrature formula. Assume  $n = 3$ . 7

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

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

$$4x_1 + 2x_2 + 3x_3 = 4$$

$$x_1 + x_2 + x_3 = 0$$

- b) Solve the following linear equation by Gauss Jordan method. 7

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

$$4x + 2z + w = 8$$

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

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

5. a) Using power method, find the largest Eigen value of the following matrix. 7

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

- b) Solve for the steady-state temperature in a rectangular plate  $8\text{cm} \times 10\text{cm}$ , if one  $10\text{cm}$  side is held at  $50^\circ\text{Celsius}$ , and the other  $10\text{cm}$  side is held at  $30^\circ\text{ Celsius}$  and the other two sides are held at  $10^\circ\text{Celsius}$ . Assume the grids of size  $2\text{cm} \times 2\text{cm}$ . 8

6. a) Solve the following differential equation within  $0 \leq x \leq 0.5$  using RK 4<sup>th</sup> order method. 7

$$10 \frac{d^2y}{dx^2} + \left( \frac{dy}{dx} \right)^2 + 6x = 0, \quad \text{with } y(0) = 1 \text{ and } y'(0) = 0. \quad (\text{take } h=0.25)$$

- b) Solve the following equations by Picards method and estimate  $y$  at  $x = 0.25$  and  $0.5$ . 8

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

7. Write short notes on any two:  $2 \times 5$

- a) Laplace method for partial differential
- b) Romberg integration method
- c) Newton's interpolation method

POKHARA UNIVERSITY

Level: Bachelor  
Programme: BE  
Course: Numerical Methods

Semester – Fall

Year : 2012  
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.*

- |   |   |
|---|---|
| <p>1. a) Find the roots of the equation by using Newton Raphson method.<br/> <math>f(x) = x - 1.5 \sin x - 2.5 = 0</math></p> <p>b) Find the root of the equation <math>xe^x = \cos x</math> using the false position method, correct to 3 decimal places.</p>  | 7 |
| <p>2. a) Find a real root of <math>2x - \log_{10}x = 7</math> correct to four decimal places using fixed point iteration method.</p> <p>b) The following table gives the population of a town during the last six census. Estimate using Newton's interpolation formula, the increase in population during the period 1946 and 1948</p> | 8 |

Year	1911	1921	1931	1941	1951	1961
Population (in 000)	12	13	20	27	39	52

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

P(kg/cm <sup>2</sup> )	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

OR

Find the missing values of the following table

$x$	0	1	2	3	4	5	6
$F(x)$	-4	-2	-	-	220	546	1148

By Trapexoid and Simpson's rules

- b) Evaluate  $\int_0^3 x^3 \sin(x^2) e^{x-3} dx$  8

a) Break the following matrix into  $[L]$  and  $[L^T]$ , where  $[L]$  is a lower 7

triangular matrix and  $[L^T]$  is transpose of  $[L]$

$$\begin{bmatrix} 3 & 2 & 1 & : & 10 \\ 2 & 3 & 2 & : & 14 \\ 1 & 2 & 3 & : & 14 \end{bmatrix}$$

- b) Determine the largest eigenvalue and the corresponding eigenvector 8

of the matrix:  $A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$  using the power method.

5. a) Find the inverse of the matrix by using Gauss Jorden method. 7

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

- b) The mathematical model of an electrical circuit is given by 8

$$0.5 \frac{d^2Q}{dt^2} + \frac{6dQ}{dt} + 50Q = 24 \sin 10t \text{ with } Q(0)=0 \text{ and } Q'(0)=0,$$

then find  $Q(0.2)$  and  $Q'(0.2)$  by fourth order Runge-Kutta method

6. a) Using Euler's method. Find an approximation value of  $y$  7

corresponding to  $x=1.04$  given  $\frac{dy}{dx} = xy^{\frac{1}{2}}$  and  $y=1$  when  $x=1$ .

- b) Give the values of  $u(x,y)$  on the boundary of the square given in figure, evaluate  $u(x,y)$  satisfying Laplace equation  $\nabla^2 u=0$  at the pivoted points of this figure 8

1000	1000	1000	1000
2000	$u_1$	$u_2$	500
2000	$u_4$	$u_3$	0
1000	500	0	

7. Write short notes on **any two:** 2×5

- a) Romberg Integration Method
- b) Shooting method
- c) Laplician equation

POKHARA UNIVERSITY

Level: Bachelor Semester – Spring Year : 2012  
Programme: BE Full Marks: 100  
Course: Numerical Methods 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 at least one root of  $x^3 - 2x - 5 = 0$  with accuracy 0.008% using Bisection method. .8  
 b) Find a root of the equation  $3x + \sin x - e^x = 0$  using secant method so that the relative error is less than 0.01%. 7

2. a) Given the data points as below- .8

i	0	1	2	3
$X_i$	1	2	3	4
$F(X_i)$	0.5000	0.3333	0.2500	0.2000

Estimate F(2.5) by applying Cubic Spline technique.

- b) The velocity distribution of the fluid near a flat surface is given below 7

$$\begin{array}{ccccc} x & : & 0.1 & 0.3 & 0.5 \\ v & : & 0.72 & 1.81 & 2.73 \end{array}$$

Using suitable interpolation formula obtain the velocity at  $x = 0.2$  and  $0.4$ .

3. a) Evaluate the integral  $I = \int_0^1 \frac{dx}{1+x^2}$  using Gauss quadrature formula with  $n = 2$  and  $n = 3$ . 8

b) Evaluate  $\int_0^{0.6} xe^x$  using trapezoidal rule, Simpson's  $\frac{1}{3}$  rule and Simpson's  $\frac{3}{8}$  rule. Also state which method yields better result. 8

4. a) Solving the following system of Linear equations using L-U factorisation method. 8

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

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

$$3x + 7y + 4z = 11$$

- b) Using Gauss -elimination method solve the equations:

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

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

$$x - y + z = 0$$

5. a) Solve the following differential equation within  $0 \leq x \leq 0.5$  using RK.

4<sup>th</sup> order method.  $5 \frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 + 3x = 0$ , with  $y(0)=1$  and  $y'(0) = 0.25$   
 $(x_1=1, h=0.25)$

- b) Solve the Poisson equation  $\nabla^2 f = (1+y^2)x$ , over the square domain of  $0 \leq x \leq 3$  and  $0 \leq y \leq 3$  with  $f = 0$  and  $h = 1$

- 6 a) Using Rung-Kutta method of fourth order, solve

$$\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2} \text{ with initial condition } y(0)=1 \text{ at } x=0.2.$$

- b) Find the largest eigenvalue  $\lambda_1$  and the corresponding eigen vector  $V_1$  of the matrix.

$$\begin{pmatrix} 1 & 2 & 0 \\ 2 & 1 & 0 \\ 0 & 0 & -1 \end{pmatrix} \text{ Using power method}$$

- 7 Write short notes on any two:

- a) Write the algorithm for the implementation of bisection method.  
b) Error in Numerical method  
c) Shooting method .

# POKHARA UNIVERSITY

Level: Bachelor  
 Programme: BE  
 Course: Numerical Method

Semester: Fall

Year : 2013  
 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 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  $45^\circ$  from the given table 8

$\theta$	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 6<sup>th</sup> stage. 7

$$28x + 4y - z = 32$$

$$X+3y+10z=24$$

$$2x+17y+4z=35$$

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:  $dy/dx = y - 2x/y$ ,  $y(0) = 1$  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

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

- 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  $100^\circ \text{C}$  and other side at  $0^\circ \text{C}$ . 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      Semester: Spring      Year : 2013  
 Programme: BE      Full Marks: 100  
 Course: Numerical Methods      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<sup>th</sup> 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

$\theta$	10	20	30	40	50
$\sin \theta$	0.1736	0.3420	0.5000	0.6428	0.7660

3. a) Evaluate the integral  $I = \int_0^{\pi} \frac{1}{1+x^2} dx$ . 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' =  $\int_0^{\pi} \frac{dx}{1+x^2}$  correct to three decimal place using Romberg Integration. 7

4. a) Solve the following system of equations using Gauss elimination 7

$$10x_1 - 7x_2 + 3x_3 + 5x_4 = 6$$

$$-6x_1 + 8x_2 - x_3 - 4x_4 = 5$$

method  $3x_1 + x_2 + 4x_3 + 11x_4 = 2$

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

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

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

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

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

- b) Solve the following equation by picards method

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

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  $h = 1$ .
- b) Using Factorization method, solve the following system of linear equations:

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

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

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

7. Write short notes on: (Any Two)

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

**POKHARA UNIVERSITY**

Level: Bachelor      Semester: Fall      Year : 2014  
 Programme: BE      Full Marks: 100  
 Course: Numerical Method      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) The flux equation of an iron core electric circuit is given by :  
 $f(\Phi)=10-2.1\Phi-0.01\Phi^3$ . The steady state value of flux is obtained by solving the equation,  $f(\Phi)=0$ . By using any close-end method, estimate the steady state value of " $\Phi$ " correct to 3 decimal places.
- b) Evaluate one of the real roots of the given equation:  $x \cdot e^x - \cos(x) = 0$  by NR-method correct to at least 4 decimal places.

2. a) Find the missing term in the following table using suitable interpolation

X	0	1	2	3	4
Y	1	3	9	?	81

- b) The following table gives the heights, x(cm) and weights, y(kg) of five persons.

x	175	165	160	155	145
y	68	58	55	52	48

Assuming the "linear relationship" between x and y, obtain the regression line(x on y). Also obtain 'x' value for y=40.

3. a) The following table gives the displacement, x(cms) of an object at various of time, t(seconds). Find the velocity and acceleration of the object at t=1.6 sec. Using suitable interpolation method.

T	1.0	1.2	1.4	1.6	1.8
X	9.0	9.5	10.2	11.0	13.2

- b) Find the real root of the equation  $X \log_{10}X - 1.2 = 0$  correct to four

- places of decimal using Bracketing method.
- a) Solve the following system of equations by applying Gauss Elimination Method(GEM) with partial pivoting technique. And also determine the determinant value.

$$\begin{aligned} 2x+2y+z &= 6 \\ 4x+2y+3z &= 4 \\ x-y+z &= 0 \end{aligned}$$

- b) Find the largest eigen value and the corresponding eigen vector correct upto 3 decimal places using power method for the matrix  $A = \begin{pmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{pmatrix}$
- a) Solve the following system by using Gauss Seidel method:  
 $10x - 5y - 2z = 3; x + 6y - 10z = -3; 4x - 10y + 3z = -3$ .
- b) Given:  $\frac{dy}{dx} = \frac{2x+e^x}{x^2+xe^x}; y(1)=0$ . Solve for y at x=1.04, by using Euler's method(take h=0.01).
- a) Solve:  $\frac{dy}{dx} = 1 + xz, \frac{dz}{dx} = -xy$  for y(0.6) and z(0.6) given that y=0, z=1 at x=0 by using Heun's method. Assume, h=0.3.
- b) Torsion on a square bar of size 9cm\*9 cm subject to twisting is governed by:  $\nabla^2 u = -4$ , with Dirichlet boundary condition of  $u(x, y)=0$  and h=1. Calculate the steady state temperatures at interior points. Assume a grid size of 3cm\*3cm. Iterate until the minimum difference at any point is correct to two decimal places by applying Gauss-Seidel method.

7. Write short notes on: (Any Two)
- a) Monotonic and oscillatory divergence in fixed point iteration method
- b) An algorithm for Lagrange's interpolation polynomial
- c) Relaxation method.

**POKHARA UNIVERSITY**

Level: Bachelor      Semester: Spring      Year : 2014  
 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.**

- 2
- 2×5
7. a) Given the boundary value problem:  $y''=6x$  with  $y(1)=2$  and  $y(0)=1$ . Using R-K fourth order method solve the given differential equation  
 $\frac{dy}{dx} + 2\frac{d^2y}{dx^2} + 2\frac{d^3y}{dx^3} - 3y = 6$ ,  $y(0)=0$ ,  $y'(0)=1$ , with  $h=0.2$  for  
 $y(0.4)=?$
- b) Write short notes on: (Any two)  
 i) Gauss-Seidel method.  
 ii) Ill conditioned system.  
 iii) Errors in numerical calculations.
- c) An algorithm for NR-method.
8. a) Solve the Poisson's equation  $\nabla^2 u = 2x^2 y^2$  over the square domain  $0 \leq x \leq 3$  and  $0 \leq y \leq 3$  with boundary condition  $u(x, y) = 0$  and  $h = 0.5$  and guess value = 3.25.  
 b) 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. a) Find the largest eigenvalue  $\lambda$  and the corresponding eigenvector  $X$  of the matrix.  
 $A = \begin{bmatrix} 0 & 0 & -1 \\ 2 & 1 & 0 \\ 1 & 2 & 0 \end{bmatrix}$
- b) Solve the following by Gauss Seidel method.  
 $4x_1 + 5x_2 - 6x_3 = 28$   
 $2x_1 - 7x_2 = 29$   
 $-5x_1 - 8x_2 = -64$
8. a) Find the largest eigenvalue  $\lambda$  and the corresponding eigenvector  $X$  of the matrix.  
 $A = \begin{bmatrix} 0 & 0 & -1 \\ 2 & 1 & 0 \\ 1 & 2 & 0 \end{bmatrix}$
- b) Using R-K fourth order method solve the given differential equation  
 $\frac{dy}{dx} + 2\frac{d^2y}{dx^2} + 2\frac{d^3y}{dx^3} - 3y = 6$ ,  $y(0)=0$ ,  $y'(0)=1$ , with  $h=0.2$  for  
 $y(0.4)=?$

1. The equation:  $\alpha \tan \alpha = 1$  occurs in theory of vibrations.
- How many roots does it have in the interval  $(-6, 6)$ ? What is the assumption being made?
  - Find one of the positive real roots by using any close-end method, correct to at least three decimal places.
2. a) Find a root of the equation  $f(x) = x^2 - 3x + 2$  in the vicinity of  $x=0$ , using Newton Raphson method.
- b) Find the square root of 7 using Newton Raphson method and Fixed Point Iteration method. Correct Up to 4- decimal digit.
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.
- | year:              | 1941 | 1951 | 1961 | 1971 | 1981 | 1991 |
|--------------------|------|------|------|------|------|------|
| pop <sup>n</sup> : | 12   | 15   | 20   | 27   | 39   | 52   |
- b) The pressure and volume of a gas are related by the equation  $PV^r=C$ , where  $V$  and  $C$  being constants. Fit this equation to the following set of observations.
- | P(kg/cm <sup>2</sup> ): | 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 |
4. a) Evaluate the integral  $\int_0^\pi (1 + 3 \cos^2 x) dx$  by
- Trapezoidal rule.
  - Simpson's 3/8 rule, taking number of intervals ( $n$ ) = 6.
- b) Use Gauss Elimination Method to solve the equation. Use partial pivoting method where necessary

**POKHARA UNIVERSITY**

Level: Bachelor      Semester: Fall      Year : 2015  
 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) 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<sup>n</sup>: 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

$P(\text{kg/cm}^2)$ : 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  $I = \int_0^{\frac{\pi}{2}} \sin x dx$  for  $n=6$  and Compare the result in 8

both conditions for Simpson 1/3 and 3/8 rule.

4. a) Solve the following set of equation using LU factorisation method. 8
- $$\begin{aligned} 3x + 2y + z &= 10 \\ 2x + 3y + 2z &= 14 \\ x + 2y + 3z &= 14 \end{aligned}$$
- b) Use Gauss-Seidal iterative method to solve given equations. 7
- $$\begin{aligned} 40x - 20y - 10z &= 390 \\ 10x - 60y + 20z &= -280 \\ 10x - 30y + 120z &= -860 \end{aligned}$$
5. a) Using Euler's method solve the given differential equation 7
- $$dy/dx^2 + 2dy/dx - 3y = 6, y(0) = 0, y'(0) = 1, \text{ with } h=0.2 \text{ for } y(0.4) = ?$$
- b) Solve the following differential equation within  $0 \leq x \leq 0.5$  using RK 4<sup>th</sup> order method.  $20 \frac{d^2y}{dx^2} + 2 \frac{dy}{dx} - 4y = 5, y(0) = 0, y'(0) = 0$ . Take  $h=0.25$ . 8
6. a) Solve the Poisson 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  $h=1$ . 8
- b) Find the eigen value and corresponding eigen vector of given matrix 7
- largest* 
$$\begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$$
7. Write short notes on: (Any two) 2×5
- a) Convergence of Newton Raphson methods  
 b) Linear Interpolation  
 c) Romberg Integration Method

**POKHARA UNIVERSITY**

Level: Bachelor      Semester: Spring      Year : 2015  
 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 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
- 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 7<sup>th</sup> 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

- 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: 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  $s(t)$

- 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 4<sup>th</sup> 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      Semester: Spring      Year : 2015  
 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 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 7<sup>th</sup> 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<sup>n</sup>: 12 15 20 27 39 52
- b) Use following table of data to estimate velocity at  $t = 7\text{ sec}$  8

Time, t(s)	5	6	7	8	9
Distance Travelled, s(t)(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 4<sup>th</sup> 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) 2x5
  - a) Romberg integration formulas
  - b) Taylor Series for solving ordinary differential equations
  - c) Hyperbolic equations

**POKHARA UNIVERSITY**

Level: Bachelor      Semester: Spring      Year : 2016  
 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) What are the limitations of New-Raphson method? Using 3+5  
 Newton-Raphson method find a root of the equation  $xe^x = 2$ .
- 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 8  
 following data:

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 7  
 fits the following data:

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

3. a) Using forward interpolation formula derive differentiation formula for 7  
 the first and second derivative of a function  $f(x)$ .

- b) Evaluate the integral  $\int_0^{0.6} e^{x^2} dx$ , using Simpson 1/3 rule and Simpson 8  
 3/8 rule, dividing the interval into six parts.

4. a) Using Gauss Seidel method solve the following system of linear 7  
 equations:

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

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

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

- b) Find the largest eigen value and corresponding eigen vector of the 8  
 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  $x = 0.2$  7  
 for the differential equation:  
 $y' = 2y + e^x, y(0) = 0$ .
- b) Using Runge-Kutta second order method solve the differential 8  
 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 7  
 secant method.
- b) Write a program in any high level language (C or C++) to solve a 8  
 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

Level: Bachelor

Programme: BE

Course: Numerical Methods

Semester: Fall

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) 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  $f(x) = 3x + \sin x$  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 7 following table.

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.

3. a) Estimate the following Integrals by 8

- i. Simpson's 3/8 method
- ii. Simpson's 1/3 method and compare the result.

$$\int_{2}^{1} \frac{e^x \cdot dx}{x} \quad (\text{Assume } n=4)$$

- b) Apply Romberg's method to evaluate 7

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

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. 7

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

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

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  $h=0.1$ . 7

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  $h=0.2$ ). 7

- 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) 2x5

- a) Gauss Seidel Method of Iteration
- b) Cubic Spline
- c) Laplace method for partial Differential

**POKHARA UNIVERSITY**

Level: Bachelor

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  

$$\begin{aligned} 5x-2y+z &= 4 \\ 7x+y-5z &= 8 \\ 3x+7y+4z &= 10 \end{aligned}$$
- b) Solve the equation by Gauss-Jacobi method:  

$$20x + y - 2z = 17, 3x + 20y - z = -18, 2x - 3y + 20z = 25$$
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  $y=1$  and  $\frac{dy}{dx} = 0$  when  $x=0$ . 7
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,  $h=k=1$ . 8
- 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

**POKHARA UNIVERSITY**

Level: Bachelor

Programme: BE

Course: Numerical Methods

Semester: Fall

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) 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. 7

- b) Using Secant method find a root of the equation  $e^x \sin x - x^2 = 0$  correct to three decimal places. 8

2. a) Generate a Lagrange's interpolating polynomial for the function:  $y = \cos \pi x$ , taking the pivotal points 0,  $\frac{1}{4}$  and  $\frac{1}{2}$ . 8

- b) Fit a curve of the form:  $y = 1/(a+bx)$  by using the method of Least Square with the following data points. 7

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. 10

- b) The following data gives corresponding values of pressure 'P' and specific volume 'V' of stem. 5

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. 7

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

- 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-4<sup>th</sup> order method  $y'' - x^2 y' - 2xy = 0$  with initial condition  $y(0) = 1$ ,  $y'(0) = 0$ , for  $y(0.1)$  taking  $h = 0.1$  8

- b) Solve the differential equation  $y' = y - \frac{2x}{y}$  using appropriate method within  $0 \leq x \leq 0.2$  with initial condition  $y(0) = 1$  and step size  $h=0.1$  7

6. a) Solve the equation  $\nabla^2 u = -10(x^2 + y^2 + 10)$  over the square mesh  $0 \leq x \leq 3$ ,  $0 \leq y \leq 3$  with  $u = 0$  on the boundary and mesh length  $h = k = 1$  8

- 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 7  
 $2x + 3y + z = 9$

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

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

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

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

5. a) Use the Runge - Kutta 4<sup>th</sup> order method to solve  $10 \frac{dy}{dx} = x^2 + y^2$ ,  $y(0) = 1$  for the interval  $0 \leq x \leq 0.4$  with  $h = 0.1$  8

- 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

*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  

$$20x+y-2z=17$$
  

$$3x+20y-z=18$$
  

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

b) Find value of  $\sqrt{18}$  using Newton Raphson method. 7

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. 7

b) The following table shows pressure and specific volume of dry saturated steam. 8

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

Fit a curve of the form:  $PV^n = \beta$  by using least square method. 7

3. a) Evaluate  $\int_{-2}^2 \frac{x}{x + 2e^x} dx$  by using Trapezoidal, Simpson's 1/3 and 3/8 rule with  $n = 6$ . 7

b) Using three-point Gaussian Quadrature formula, evaluate  $\int_0^1 \frac{dx}{(1+x)}$  8

4. a) Find inverse of the matrix, using Gauss Jordan method. 8

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

b) Determine the largest eigenvalue and the corresponding eigenvector 7

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

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