

# POKHARA UNIVERSITY

Level: Bachelor  
Programme: BE  
Course: Numerical Methods

Semester: Spring

Year : 2024  
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 the equation  $\cos x + e^x + x^2 = 3$  correct to three decimal places by using Newton Raphson method.  
b) Find the root of the equation  $f(x) = x^2 - 4x - 10$  correct to three decimal places by using False Position method.

2. a) The following table gives the displacement,  $x$ (cms.) of an object at various time,  $t$ (seconds). Find the displacement of this object at  $t=1.3$  second and  $t=1.5$  second, using any suitable interpolation formula.

$t$	1.0	1.2	1.4	1.7
$x$	9.0	9.5	10.2	11.0

- b) The growth of bacteria( $N$ ) in a culture after  $t$  hours is given by the following table:

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

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.

3. a) Find  $\int_0^3 \frac{x^2}{1+x^2} dx$  by using:  
i. Trapezoidal rule  
ii. Simpson's 1/3 rule  
iii. Simpson's 3/8 rule  
b) Use the Romberg integration to find the solution correct upto three decimal places.

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

4. a) Find the inverse of the square matrix,  $A = \begin{bmatrix} 4 & 1 & 2 \\ 2 & 3 & -1 \\ 1 & -2 & 2 \end{bmatrix}$  by using Gauss-Jordan elimination method.

- b) Find the solution of the given simultaneous linear equation using Gauss Seidel method.

$$6x - 2y + z = 11$$

$$-2x + 7y + 2z = 5$$

$$x + 2y - 5z = -1$$

5. a) solve the following differential equation within  $0 \leq x \leq 0.5$  using Rk 4<sup>th</sup> order method  $10d^2y/dx^2 + 2dy/dx - 3y = 5$ ,  $y(0)=0$ ,  $y'(0)=0$ .

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

6. a) Torsion on a square bar of size  $15\text{cm} \times 15\text{cm}$ . If two of the sides are held at  $100^\circ\text{C}$  and the other two sides are held at  $0^\circ\text{C}$ . Calculate the steady state temperature at interior points. Assume a grid size of  $5\text{cm} \times 5\text{cm}$ .

- 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  $y$ ,  $h=k=1$ .

7. Write short notes on: (Any two)

- a) Applications of Numerical Methods in Engineering  
b) Error in Numerical Method  
c) Ill condition and well-conditioned system