**[Total No. of Questions - 9] [Total No. of Printed Pages - 4] (2125)**

**15089**

**B. Tech 4th Semester Examination**

**Computer Based Numerical Analysis (OS)**

**AS/ME-4004**

**Time : 3 Hours** **Max. Marks : 100**

*The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.*

**Note :** Attempt Five questions selecting one question from each section A, B, C and D. Section E is compulsory.

## SECTION - A

1. (a) Derive Lagrange's Interpolation formula. (10)

   (b) By means of Newton's divided difference formula, find the values of f(8) and f(15) from the following table:

| x: | 4 | 5 | 7 | 10 | 11 | 13 |
|---|---|---|---|---|---|---|
| f(x): | 48 | 100 | 294 | 900 | 1210 | 2028 |

(10)

2. (a) Use Gauss's forward formula to find a polynomial, which takes the following values of the function f(x):

| x: | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| f(x): | 1 | –1 | 1 | –1 | 1 |

(10)

   (b) Show that $\Delta^n e^{ax+b}=(e^a-1)^n e^{ax+b}$ where the interval of differencing taken to be unity. (10)

**[P.T.O.]**



## SECTION - B

3. (a) Solve the following system of equations using Gauss-Seidel method:

$$10x + y + 2z = 44$$
$$2x + 10y + z = 51$$
$$x + 2y + 10z = 61$$

(10)

   (b) Using Newton-Raphson method, find the real root of the equation $3x = \cos x + 1$ correct to three decimal places. (10)

4. (a) Explain Jacobi's method to solve system of linear equations. (10)

   (b) Using Relaxation method, solve the system of equations

$$10x - 2y - 3z = 205$$
$$-2x + 10y - 2z = 154$$
$$-2x - y + 10z = 120$$

(10)

## SECTION - C

5. (a) Find the first and second derivatives of the function y=f(x) from the following table at the point x=1 using Newton's forward difference interpolation formula:

| x: | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| y=f(x): | 1 | 8 | 27 | 64 | 125 | 216 |

(10)

   (b) Evaluate $\int_0^6 \frac{dx}{1+x^2}$ using

(i) Simpson's 3/8th rule (ii) Trapezoidal rule (iii) Weddle's rule. (4+3+3=10)

6. (a) Write a computer program in C or C++ for Simpson's 1/3 rule. (10)

(b) Evaluate $\int_0^3 \frac{dx}{x^4+4}$ using Romberg's Integration method. Also approximate the value of $\pi$. (10)

## SECTION - D

7. (a) Solve the partial differential equation $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=-10(x^2+y^3+10)$ over the square with sides x = 0, y = 0, x = 3, y = 3 with u = 0 on the boundary and mesh length = 1 unit. (10)

(b) Use Crank-Nicholson method to solve $\frac{\partial u}{\partial t}=\frac{\partial^2 u}{\partial x^2}$ subject to u(x,0) = 0, u(0,t)=0 and u(1,t)=t, taking $h=\frac{1}{4}, k=\frac{1}{8}$ for one time step. (10)

8. (a) Solve $\frac{\partial u}{\partial t}=2\frac{\partial^2 u}{\partial x^2}$, using Schmidt' method given u(0,t) =0, u(4,t)=0, u(x,0) = x(4-x), assume h=1 find the value u up to t = 5. (10)

(b) Find Dufort-Frankel scheme to solve one dimensional heat equation using finite differences. (10)



## SECTION - E

9. (a) What are the assumptions, we make when Lagrange 's formula is used?

(b) Find the divided difference table for the following data.

| x | 2 | 5 | 10 |
|---|---|---|---|
| y | 5 | 29 | 109 |

(c) Distinguish Algebraic equations and Transcendental equations.

(d) What is meant by Diagonally Dominant system?

(e) Gauss - Seidal method is better than Gauss Jacobi method why?

(f) Define Numerical Differentiation and Numerical Integration.

(g) Write down standard five point formula for Laplace Equation $\nabla^2 u=0$.

(h) From the following table find the area bounded by the curve and the x-axis from x = 2 to x = 7 using trapezoidal rule.

| x: | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| f(x): | 8 | 27 | 64 | 125 | 216 | 343 |

(i) State the five point formula to solve the Poisson equation $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=100$.

(j) Find the third divided difference with arguments 2, 4, 9, 10 of the function $f(x) = x^3 - 2x$. (10×2=20)