Exam.Code:0940
Sub. Code: 7099

2062

B.E. (Mechanical Engineering)

Fourth Semester

MEC-406: Numerical Analysis

Time allowed: 3 Hours

Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section. Use of simple calculator is allowed. All questions carry equal marks.*

x-x-x

1. (a) What is total numerical error? How do you avoid numerical error?

   (b) Define simple and multiple roots of a nonlinear equation mathematically. Which method do you find useful in multiple root and how?

   (c) Explain the difference between curve fitting and interpolation. What are the methods used in curve fitting and interpolation?

   (d) What are the disadvantages of the Simpson's $3/8^{th}$ rule compared with the Simpson's $1/3^{rd}$? When does the Simpson's $1/3^{rd}$ rule gives exact rule?

   (e) Write the second order difference approximation for first and second order derivatives based on central differences.

SECTION-A

2. (a) Given that $x = 10.00 \pm 0.05$; $y = 0.0356 \pm 0.0002$; $z = 15300 \pm 100$; $t = 62000 \pm 500$. Find the maximum value of the absolute error in

   (i) $x + y + z + t$; (ii) z^3.

   (b) Find the root of multiplicity 2 near 0.5 for the equation: $x^3 - x^2 - x + 1 = 0$.

3. (a) State the condition of convergence of Gauss-Seidel iterative method. Apply this method, to solve the system:

   $$x + 3y + 10z = 24,\ 2x + 17y + 4z = 25,\ 28x + 4y - z = 32.$$

   (b) Define norm of a matrix. List the different types of norms of a matrix. What is condition number of a matrix? Explain how the condition number is useful in determining whether the matrix is ill-conditioned. Compute it for $A = \begin{bmatrix} 9 & 8 \\ 1 & 1 \end{bmatrix}$.

4. (a) Fit a second degree parabola $y = a + bx + c\,x^2$ to the data (x_i, y_i):

   $(1, 0.63),\ (3, 2.05),\ (4, 4.08),\ (6,\ 10.78)$.

   (b) Lagrange's formula can be used to express a rational function as a sum of partial fractions. Express $f(x) = \frac{x^2+x-3}{x^3-2x^2-x+2}$ as a sum of partial fractions.

P.T.O.

SECTION-B

5. (a) Use trapezoidal rule to evaluate $\int_1^2 \int_1^2 \frac{dx\ dy}{x+y}$ taking four sub-intervals.

(b) Given the following values of $f(x) = \ln x$, find the approximate value of $f^1(2.0)$ *and* $f^{11}(2.0)$:

x	2.0	2.2	2.6
f(x)	0.69315	0.78846	0.95551

6. (a) State the difference between single step and multistep methods in solving ODEs.Use Adams-Basforth formula to find y(0.4) for the equation $\frac{dy}{dx} = \frac{1}{2}xy$ using the data:

x	0	0.1	0.2	0.3
y	1	1.0025	1.0101	1.00228

(b) Solve the BVP: $y^{11} - 64y + 10 = 0, y(0) = 0, y(1) = 0$ by finite difference method.

7. Using Crank-Nicolson implicit scheme to solve: $16\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$, $0 < x + 1, t > 0$, given that $u(x, 0) = 0, u(0, t) = 0, u(1, t) = 100t$, compute u for one time step.

x-x-x