Exam.Code:0940
Sub. Code: 6716

2014
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. 1 which is compulsory and selecting two questions from each Part. Use of simple calculator is allowed. All questions carry equal marks.

x-x-x

1. (a) Discuss the sources and consequences of truncation error in iterative methods. Explain method (s) of minimizing them.

   (b) Explain the convergence criteria used to determine the convergence of iterative methods for solving nonlinear equations. Also, discuss its importance.

   (c) Write down different interpolation formulas. Enumerate their limitations.

   (d) Explain the trapezoidal rule for numerical integration. How is it derived and what is its order of accuracy?

   (e) Explain Euler's method for the numerical solutions of Odes. What are its advantages and limitations?

PART-A

2. (a) Prove that the relative error in a product of two nonzero numbers does not exceed the sum of the relative errors of the given numbers.

   (b) Find the maximum absolute error in the value of $p + q + r + s$, if $p = 10.00 \pm 0.02$, $q = 0.0495 \pm 0.001$, $r = 12391 \pm 3.55$, $s = 31250 \pm 101$.

   (c) Find the cube root of 48 correct to four decimal places by using the iteration method. $(3 + 3 + 4)$

3. (a) Apply Muller's method to find the root of the equation: $\cos x - x e^x = 0$.

   (b) Explain the differences between direct and iterative methods for linear system of equations. Solve the following system by method of LU decomposition:

   $$2x + y + 4z = 12;\ 8x + 3y + 2z = 20;\ 4x + 11y - z = 23.$$

4. (a) Fit a straight line by the method of least squares to the following data:

x	1	2	3	4	5
y	15	70	140	250	380

P.T.O.

(b) Using the following table, find f(x) as a polynomial in x and find f(5):

x	f(x)
-1	3
0	-6
3	39
6	822
7	1611

PART-B

5. (a) Find $y^1(x)$ from the table given below and hence find $y^1(0)$ and $y^{11}(0)$:

x	0	1	2	3	4
y	4	8	15	7	6

(b) Use Simpson's one-third rule to find $\int_0^{0.6} e^{-x^2}\,dx$ by taking seven ordinates.

6. (a) Apply Runge-Kutta method to solve: $\frac{dy}{dx} = -2x - y, y(0) = -1$ and find $y(0.2)$ with $h = 0.1$.

(b) Solve the boundary value problem for $x = 0.5$ by finite difference method:

$$\frac{d^2y}{dx^2} + y + 1 = 0, y(0) = y(1) = 0.$$

7. Why is Crank-Nicolson's scheme called an implicit scheme? Using Crank-Nicolson's implicit method, solve $16\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}, 0 < x < 1, t > 0$, given that $u(x, 0) = 0, u(0, t) = 0, u(1, t) = 100\,t$, compute u for a one-time step.

x-x-x