Exam.Code:0940
Sub. Code: 6716

2053
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.

x-x-x

1. (a) Explain sum rule for the addition of approximate numbers. Find the sum of the numbers 143.3, 15.45, 0.1734. List any three sources of errors.

(b) State Newton's formula for finding the roots of the equations:

$$f(x, y) = 0, g(x, y) = 0.$$

(c) Explain the concept of curve fitting. How it is different from interpolation. Write the normal equations to fit a quadratic $y = a + bx + cx^2$ to the data $(x_i, y_i), i = 1,2, ---n.$

(d) Explain numerical differentiation. What is the fundamental concept employed in numerical differentiation? Why should numerical differentiation be avoided as for as possible?

(e) State the explicit and implicit formulae for the solution of the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial t^2}$.

PART-A

2. (a) Discuss the truncation error in the Taylor series expansion. Find the number of terms of the Taylor series expansion of the function e^x required to compute the value of e correct to six decimal places.

(b) Derive Newton's iterative formula for computing the value of $\sqrt{M}$, where M is a positive real number. Hence compute $\sqrt{40}$.

3. (a) Solve the system with the aid of Gauss-Seidel iteration method:

$$0.23x + 1.78y - 8.23z = 15.7821; \quad -1.20x - 5.03y + 2.91z = 9.63028;$$

$$5.13x - 1.70y + 2.83z = 11.3569.$$

(b) Explain well-conditioned and ill-conditioned linear system. Examine whether the system $2x + y = 2;\ 2x + 1.01y = 2.01$ is well conditioned or ill-conditioned.

P.T.O.

4. (a) Fit a curve of the form $y = a e^{bx}$ to the following data:

x	1	3	5	7	8
y	15	18	21	23	22

Estimate y for $x = 6$.

(b) Estimate the minimum weight of a bib taps when bore is 20mm using the following tabular information:

Bore (mm)	8	10	15	25	32	40	50	
Weight (kg)	0.25	0.30	0.40	1.25	1.70	2.15	3.65	

PART-B

5. (a) Use Trapezoidal formula to compute $\int_1^2 e^{-x^2}\,dx$ with $n = 2, 4, 8$. Then use the Romberg integration to improve the result.

(b) Find $\sec 31^\circ$ from the following data:

θ°	31	32	33	34
tan θ	0.6008	0.6294	0.6494	0.6745

6. (a) Given $\frac{d^2y}{dx^2} - y^3 = 0, y(0) = 10; \frac{dy}{dx}(0) = 5$. Evlauate $y(0.1)$ using Runge-Kutta method.

(b) Solve the BVP: $\frac{d^2y}{dx^2} = x + y$ with the boundary conditions $y(0) = y(1) = 0$.

7. Solve by finite difference method: $\frac{\partial^2 u}{\partial x^2} = 2\frac{\partial u}{\partial t}, u(0,t) = 0 = u(4,t)$ and $u(x, 0) = x(4 - x)$ choosing $h = k = 1$ and using Bender-Schmidt formula, find the values up to $t = 5$.

x-x-x