Exam. Code: 0940
Sub. Code: 33860

2015

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. Each question carries equal marks. Use of a simple calculator is allowed.***

x-x-x

1. (a) Define significant figures and explain their importance in scientific measurements. Describe the rules for determining the number of significant figures in a given value.

   (b) Discuss the convergence criteria for root finding method. How do you determine when to stop iterating?

   (c) Compare and contrast the Gauss elimination method with LU decomposition. In what situations would you prefer one method over the other?

   (d) Explain Simpson's rules for numerical integration. How does it differ from the trapezoidal rule, and under what conditions is it more accurate?

   (e) Discuss the finite difference method for solving partial differential equations.

PART-A

2. (a) What is the importance of series approximation in numerical analysis? What is truncation error in series approximation? How can it be minimized?

   (b) Given $U = xy + yz + zx$, find the relative percentage error in the computation of U at $x = 2.104, y = 1.935, z = 0.845$. (3 + 3 + 4)

   (c) Apply fixed point iteration method to approximate the value $\sqrt{42}$ correct to three decimal places.

3. (a) Define the condition number of a linear system of equations. Explain how it is computed and what it signifies about the stability of the system. Calculate the condition number of the matrix : $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ 6 \end{bmatrix}$, using norm 2.

   (b) Solve the following linear system using the Gauss-Seidel iteration method:

$$x + y + 3z = 5;\ 10x + y + z = 12;\ 2x + 10y + z = 13.$$

P.T.O.

4. (a) Suppose you have a dataset with two predictor variables X_1, X_2 and one outcome variableY:

X_1	10	20	30	40	50
X_2	5	10	15	20	25
Y	100	200	300	400	500

Build a multiple linear regression model to predict Y based on X_1 *and* X_2. Also estimate the coefficients for each predictor variable.

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

PART-B

5. (a) Determine the volume of the solid obtained by rotating the region bounded by $y = e^x, x = 0, x = 2$ and the $x-$ axis around the $x-$ axis. Use Simpson one-third rule with nine nodes.

(b) Using Richardson extrapolation formula to evaluate $\frac{dy}{dx}(1.6)$ for the following data:

x	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4
y	1.3	1.7	2.3	3.2	4.7	6.2	8.1	9.2	9.8

6. (a) Use Runge-Kutta method to obtain $y(1.1)$ given that $y(1) = 1.2$ and

$$\frac{dy}{dx} = 3x + y^2.$$

(b) Solve the BVP: $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 3y = 0, y(0) = 1, y(1) = 0,$ using the second order finite difference method with $h = \frac{1}{4}$.

7. Solve the Laplace equation: $u_{xx} + u_{yy} = 0$ in $0 \le x \le 4, 0 \le y \le 4$, given that $u(0,y) = 0, u(4,y) = 8 + 2y, u(x,0) = \frac{x^2}{2}$ and $u(x,4) = x^2$. Take $h = k = 1$ and obtain the result correct to two decimal places.

x-x-x