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B. Tech 4th Semester Examination

Numerical Methods for Engineers (N.S.)

NS-207

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 in all selecting one question from each of sections A, B, C and D. Question 9 in Section E is compulsory. All questions carry equal marks.

SECTION - A

1. (a) Find a root of an equation $x^3 + 2x - 2 = 0$ by using iteration method, correct up to three decimal places.

   (b) Discuss Newton Raphson method. Also show that the rate of convergence of Newton Raphson method is quadratic. (10+10=20)

2. (a) Solve the following system of equations by Gauss-Jordan elimination method
   $x_1 + x_2 + x_3 = 3$; $2x_1 + 3x_2 + x_3 = 6$; $x_1 - x_2 - x_3 = -3$.

   (b) Solve the following system of linear equations by Jacobi's method correct up to four decimal places:
   $27x + 6y - z = 54$; $6x + 15y + 2z = 72$; $x + y + 54z = 110$.
   (10+10=20)

SECTION - B

3. (a) If π is approximated as 3.14 instead of 3.1456, find the absolute, relative and percentage error. Also explain when relative error is a better indicator of the accuracy of a computer than the absolute error.

(b) For the following table, find the interpolation polynomial using Lagrange's formula:

x	0	2	4	8
f(x)	3	8	11	18

(10+10=20)

4. (a) From the following table of values of x and f(x) determine the value of f(0.29) using Newton's backward interpolation formula.

x	0.20	0.22	0.24	0.26	0.28	0.30
f(x)	1.6596	1.6698	1.6804	1.6912	1.7024	1.7139

(b) Use the central difference interpolation formula of Bessel to find the value of y at (i) x = 1.40 and (ii) x = 1.60 from the following table:

X	1.0	1.25	1.5	1.75	2.0
y	1.0000	1.0772	1.1447	1.2051	2.2599

(10+10=20)

SECTION - C

5. (a) From the following table find the value of $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at the point x = 1.5.

X	1.5	2.0	2.5	3.0	3.5	4.0
Y	3.375	7	13.625	24	38.875	59

(b) Use Newton's interpolation formula to find y when x = 1 .85 and 2.4 from the data:

x	1.7	1.8	1.9	2.0	2.1	2.2	2.3
$y = e^x$	5.474	6.050	6.686	7.389	8.166	9.025	9.974

(10+10=20)

6. (a) Evaluate the integral $\int_0^1 \frac{1}{1+x^2}\,dx$ using Simpson's 1/3 rule. Also compare the result with exact value.

(b) Use Newton's divided difference formula. Define f(x) as a polynomial in x from the following data:

x	–1	0	3	6	7
f(x)	3	–6	39	822	1611

(10+10=20)

SECTION - D

7. (a) Given $y' = x^2 - y$, $y(0) = 1$. Find y(0.1), y(0.2) using Runge-Kutta method of (i) second order, (ii) 4^{th} order.

(b) Solve by Predictor-Corrector method, the differential equation $\frac{dy}{dx} = \frac{1}{x+y}$, $y(0) = 2$ at x = 0.8, given that y(0.2) = 2.0933, y(0.4) = 2.1755, y(0.6) = 2.2493

(10+10=20)

8. (a) Use Taylor series method to obtain approximate value of y at x=0.2 for the differential equation $\frac{dy}{dx} = 2y + 3e^x$, $y(0) = 0$.

8. (b) Using Euler's method, solve for y at x=0.1 from $\frac{dy}{dx}$ = x + y + xy, y(0) = 1 taking step size h=0.025.

(10+10=20)

SECTION - E

9. (a) State intermediate value theorem.
(b) Write the Newton-Cotes Quadrature formula.
(c) Explain the rate of convergence.
(d) What are the limitations of iterative methods?
(e) Explain partial and complete pivoting.
(f) Give the difference between Regula-Falsi and Secant method.
(g) Write a short note on Romberg integration.
(h) Give the advantage of Bisection method.
(i) Prove that (i) $\Delta = E\nabla = \nabla E = \delta E^{\frac{1}{2}}$ (ii) $E = 1 + \Delta = e^{hD}$
(j) Define absolute, relative and percentage errors.

(10×2=20)