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(2064)

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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  $\pi$  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.

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- (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 <sup>x</sup>	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.

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- (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<sup>th</sup> 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  $\frac{dy}{dx} = 2y + 3e^x$ ,  $y(0) = 0$ .  
 (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)