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B.Sc. Honours (Mathematics) (Sem.–5) NUMERICAL METHODS Subject Code : UC-BSHM-503-19 M.Code : 91061 Date of Examination : 16-12-22

Time: 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

- 1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
- 2. SECTION B & C. have FOUR questions each.
- 3. Attempt any FIVE questions from SECTION B & C carrying EIGHT marks each.
- 4. Select atleast TWO questions from SECTION B & C.

SECTION-A

I. Write short notes on :

- a) How are integers represented on a computer?
- b) Find the relative error if $\frac{2}{3}$ is approximated to 0.667.
- c) Discuss the consequence of Intermediate Value Theorem by considering an example.
- d) What do you mean by order of convergence of an iterative method?
- e) Write the procedure of Gauss elimination method to solve a system of linear equations.
- f) Define interpolation and extrapolation.
- g) What do you mean by numerical differentiation?
- h) What is the restriction on the number of nodal points, required for using Simpson's 1/3 rule for integrating $\int_{a}^{b} f(x) dx$?

i) How is Taylor series method used to solve
$$\frac{dy}{dx} = f(x, y); y(x_0) = y_0, x \in [x_0, x_n]$$
?

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j) Differentiate between one-step methods and multi-step methods for solving

$$\frac{dy}{dx} = f(x, y); \ y(x_0) = y_0, \ x \in [x_0, x_n]$$

SECTION-B

- 2. a) Find the relative error if the number X = 0.004997 is
 - i) truncated to three decimal digits
 - ii) rounded off to three decimal digits.
 - b) If $r = h(4h^5 5)$, find the percentage error in r at h = 1 if the error in h is 0.04.
- 3. a) Find a root of the equation $x^3 4x 9 = 0$ using bisection method correct to two decimal places.
 - b) Find the order of convergence of Newton-Raphson's method.
- 4. a) Solve the following system of equations using Gauss-elimination method

10x + y + z = 12x + 10y + z = 12x + y + 10z = 12

- b) Let Ax = b be a system of linear equations written in matrix form. If the coefficient matrix A is diagonally dominant, then Gauss-Seidel method converges for any initial vector.
- 5. a) The following table gives the viscosity of an oil as a function of temperature. Use Lagrange's interpolation to find viscosity of oil at a temperature of 140°

Temperature ^o	110	130	160	190
Viscosity	10.8	8.1	5.5	4.8

b) Construct Newton's forward Interpolating polynomial for the following data

Х	4	6	8	10
у	1	3	8	16

Hence, evaluate *y* for x = 5.

SECTION-C

6. From the following table below, for what values of x, y is minimum? Also find this value of v

Х	3	4	5	6	7	8
у	0.205	0.240	0.259	0.262	0.250	0.224

7. Given that

x	4.0	4.2	4.4	4.6	4.8	5.0	5.2
log*	1.3863	1.4351	1.4816	1.5261	1.5686	1.6094	1.6487

Evaluate $\int_{40}^{5.2} \log x \, dx$ using

a) Trapezoidal rule and b) Simpson's 1/3-rule. Also find the error in each case.

a) Solve $y' = y^2 + x$, y(0) = 1 using Taylor series method and compute y(0.1) and y(0.2). 8.

- b) Given that $\frac{dy}{dx} = 2 + \sqrt{|xy|}$, y(1) = 1. Using modified Euler method, find approximate value of y at x = 1.1 and x = 1.2.
- a) Use Runge-Kutta method of fourth order, 9. find y(0.1)given that $\frac{dy}{dr} = 3x + \frac{y}{2}$, y(0) = 1 by taking step-size h = 0.1.
 - b) Using Adams-Bashforth method and Adams-Moulton method, evaluate y (0.4) given that

$$\frac{dy}{dx} = x^2 - y, y(0) = 1, y(0.1) = 0.90516, y(0.2) = 0.82127, y(0.3) = 0.74918.$$

NOTE : Disclosure of Identity by writing Mobile No. or Marking of passing request on any paper of Answer Sheet will lead to UMC against the Student.