M. Sc. Mathematics
First Semester
NUMERICAL ANALYSIS
(MSM - 103)

Duration: 3Hrs. **Full Marks: 70**

Part-A (Objective) =20
Part-B (Descriptive) =50

(PART-B: Descriptive)

Duration: 2 hrs. 40 mins. **Marks: 50**

1. Answer (any four) questions out of the seven questions below : 10×4=40

(i) By means of Lagrange's formula prove that approximately 5+5=10

$$y_0 = \frac{1}{2}(y_1 + y_{-1}) - \frac{1}{8}[\frac{1}{2}(y_3 - y_1) - \frac{1}{2}(y_{-1} - y_{-3})]$$

Also prove that $y_1 = y_3 - .3(y_5 - y_{-3}) + .2(y_{-3} - y_{-5})$

(ii) Prove that Divided differences are symmetric function of their arguments. Also write the nth order divided difference for the arguments $x_0, x_1, x_2, \dots \dots \dots . . x_n$. 8+2=10

(iii) State fundamental theorem of difference calculus. A third degree polynomial passes through the points (0,-1), (1,1),(2,1) and (3,-2). Find the polynomial. 2+8= 10

(iv) Deduce Newton Raphson method. Obtain the cube root of 12. 5+5= 10

(v) Find the solution of the system:

83x+11y-4z = 95
7x+52y+ 13 z = 104
3x+8y+29z = 71

using Jacobi and Gauss iterative method. 5+5=10

(vi) Given $\frac{dy}{dx} = y - x, y(0) = 2$. Find using Runge Kutta fourth order formula y(0.1) and y(0.2) correct to four decimal. 10

(vii) Calculate the value of the integral $\int_4^{5.2} logx\, dx$ by Trapezoidal rule, Simpson's one -third rule and Simpson's three- eighth rule. 10

2. If log 2=0.30103, log 3= 0.47712, log 5= 0.62897, log 7=0.84510.
Find the value of log 4.7 to four places of decimal.
Also given $\log_{10} 654 = 2.8156, \log_{10} 658 = 2.8182, \log_{10} 659 = 2.8189, \log_{10} 656 = 2.8156$ find the value of $\log_{10} 656$. **5+5=10**

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M.Sc. MATHEMATICS
First Semester
NUMERICAL ANALYSIS
(MSM - 103)

Duration: 20 minutes **Marks – 20**

(PART A - Objective Type)

I. Choose the correct answer: **1×20=20**

1. What is the degree of the interpolated polynomial (1,5), (2,18),(3,37), (4,62) and (5,93) ?
   (i) 3 (ii) 4 (iii) 5 (iv) 2

2. If f(x) be a polynomial of nth degree in x , then the nth difference of f(x) is constant and ____________
   (i) $\Delta^{(n+1)}f(x) = 0$ (ii) $\Delta^n f(x) = 0$ (iii) f(x)=0 (iv) real

3. The relation between differential operator D and difference operator Δ is
   (i) $D = \frac{1}{h}[\Delta + \frac{\Delta^2}{2} + ..]$ (ii) $D = \frac{1}{h}[\Delta - \frac{\Delta^2}{2} + \frac{\Delta^3}{3} - \ ...]$
   (iii) D=0 (iv) $D = \Delta$

4. Which one of the following is not a method of interpolation?
   (i) Graphic Method (ii) Algebraic method
   (iii) Cauchy Method (iv) None of these

5. The value of any divided difference is ______ of the order of the arguments.
   (i) Dependent (ii) Independent
   (iii) Optional (iv) None of these

6. The system of equations AX=B is consistent i.e possesses a solution if the coefficient matrix A and the augmented matrix [AB] are of the same
   (i) rank (ii) determinant
   (iii) matrix (iv) solution

7. Problems in which all the conditions are specified at the initial point only are known as
   (i) Initial value problem (ii) Boundary value problem
   (iii) Fermat's problem (iv) Taylor's problem

8. The problem defined by $\frac{dy}{dx} = f(x, y), y(x_0) = y_0$ is
   (i) Initial value problem (ii) Boundary value problem
   (iii) Jacobi's problem (iv) None of these

9. Picard's method of successive approximation is

(i) $y^{(n-1)} = y_0 + \int_{x_0}^{x} f(x_n, y_n)dx$ (ii) $y^n = y_0 + \int_{x_0}^{x} f(x, y^{(n-1)})dx$

(iii) $y^{\frac{n}{2}} = y_n + \int_{x_0}^{x} f(x_n, y_n)dx$ (iv) $y = y_n + \int_{x_0}^{x} f(x_n, y_n)dx$

10. The value of the integral $\int_4^{5.2} logx\, dx$ by Simpson's $\frac{1}{3}$rd rule is

(i) 1.82 (ii) 3.46 (iii) 7.23 (iv) 5.27

11. The formula $I = h[ny_0 + \frac{n^2}{2}\Delta y_0 + \left(\frac{n^3}{3} - \frac{n^2}{2}\right)\frac{\Delta^2 y_0}{2!} + \cdots$ is a form of

(i) Newton Raphson method (ii) Regular Falsi method
(iii) Gauss's method (iv) General quadrature method

12. The formula $\int_{x_0}^{x_0+nh} ydx = \frac{h}{6}[2(y_0 + y_n) + 8(y_1 + y_3 + \cdots + y_{n-1}) + 4(y_2 + y_4 + \cdots + y_{n-2})$ is a form of

(i) Trapezoidal rule (ii) Simpson's $\frac{3}{8}$th rule

(iii) Simpson's $\frac{1}{3}$rd rule (iv) Weddle's rule

13. The Newton's method for finding the root of an equation f(x)=0 converges if $f^1(x_n)$ is

(i) 1 (ii) 0 (iii) large (iv) small

14. The value of F(5) using Lagrange's interpolation formula given by

x	0	1	4	6
F(x)	1	-1	1	-1

Is (i) $\frac{-3}{2}$ (ii) -1 (iii) 1 (iv) $\frac{3}{2}$

15. Let f(x) be continuous whose values are known at -2,-1,1 and 2.If the Lagrange's formula $f(x) = L_1 f(-2) + L_2 f(-1) + L_3 f(1) + L_4 f(2)$ is used to approximate f(0) , then L_3 is

(i) 0 (ii) $\frac{1}{3}$ (iii) $\frac{2}{3}$ (iv) $\frac{4}{3}$

16. The iterative formula to compute cube root of a number x using Newton Raphson method is

(i) $y_{n+1} = \frac{1}{3}(2y_n + \frac{x}{y_n^2})$

(ii) $y_{n+1} = \frac{1}{3}(4y_n + \frac{x}{y_n^2})$

(iii) $y_{n+1} = \frac{1}{3}(2y_n + \frac{x}{y_n^3})$

(iv) $y_{n+1} = \frac{1}{3}(3 + \frac{x}{y_n^2})$

17. Newton's iterative formula to find $\sqrt{N}$ is

(i) $x_{n+1} = x_n(2 - Nx_n)$ (ii) $x_{n+1} = x_n(2 + Nx_n)$

(iii) $x_{n+1} = (2x_n + \frac{N}{x_n})$ (iv) None of these

18. A square matrix A can be inverted if and only if it is.....
   (i) Identity   (ii) null   (iii) non-singular   (iv) singular

19. The value of E in calculus of finite difference is
   (i) $I \div \Delta$ (ii) $I - \Delta$ (iii) $I \times \Delta$ (iv) $I + \Delta$

20. The value of Δy in Runge Kutta fourth order formula for second interval is
   (i) $\Delta y = \frac{1}{6}(k_1 - 2k_2 - 2k_3 + k_4)$ (ii) $\Delta y = \frac{1}{6}(k_1 + k_2 + k_3 + 2k_4)$

   (iii) $\Delta y = \frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4)$ (iv) $\Delta y = \frac{1}{6}(k_1 + k_2 - k_3 + k_4)$

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