

Anekant Education Society's  
**TuljaramChaturchand College, Baramati**  
**Department of Mathematics**  
Class: M.Sc -I  
**Numerical Analysis (MSc1) [MAT4104]**  
**Question Bank:-**

**Q. 1]Objective questions :-**

- 1) In Simpson's one-third rule the curve  $y=f(x)$  is assumed to be a .....
- 2) In the Gauss elimination method for solving a system of linear algebraic equations, triangularization leads to ..... matrix.
- 3) A second degree polynomial passes through (0,3) , (1,6) , (2,11) , (3,18) , (4,27).The polynomial is.....
- 4) The first term of the series whose second and subsequent terms are 8,3,0,-1,0 is ....
- 5) The second degree polynomial passes through (0,1),(1,6),(2,7)and (3,13).The polynomial is....
- 6) The order of convergence in Newton-Raphson method is...
- 7) The cubic polynomial which takes the following values  $y(0)=1,y(1)=0,y(2)=1$ and  $y(3)=10,y(4)=\dots$
- 8) The value of  $\Delta^n (a^x)$  is .....
- 9) If  $y_1 =4 ,y_2 =12 ,y_3 =19$  and  $y_x =7$ , then x will be. ....
- 10) The order of error in the Simpson's rule for numerical integration with a step size h is.....
- 11) The Newton divided difference polynomial which interpolate the data  $f(0)=1, f(1)=3, f(3)=55$  is. ....
- 12) Backward Euler method for solving differential equation  $y'=f(x,y)$  is.....
- 13) The Total number of divisions and multiplications required for solving a system of 5 equations using Gauss elimination method are.....
- 14) Bisection method is based on ..... theorem
- 15) Convergence of secant method is.....

**Q.2] Answer in one sentence :-**

- 1) What is non-linear equation ? Give its example.
- 2) What is an algebraic equation ? Give two examples.
- 3) What is transcendental equation ? What are its characteristics?
- 4) Give two drawbacks of Bisection method.
- 5) What is meant by direct analytical method of solution?
- 6) What is aitken's  $\Delta^2$  process?
- 7) What is iterative technique ?
- 8) What is principle of false position method.

- 9) What is Horner's rule?
- 10) What is deflation?
- 11) State the Descartes rule to estimate the number of real roots of the polynomial.
- 12) What is synthetic division?
- 13) Write down Lagrange's interpolation formula.
- 14) What is meant by Numerical Integration?
- 15) Write down Simpson's 1/3 rule.
- 16) Write down Simpson's 3/8 rule.
- 17) Write down Euler's algorithm.
- 18) What is Chebyshev Polynomials.
- 19) What is meant by tabulated function.
- 20) Write down iterative formula for  $y^{i+1}$  in Picard's Method.

**Q.3]Write Short notes on :-**

- 1) Types of Errors in computation
- 2) Rounding of numbers to n Significant Digits
- 3) Bisection Method
- 4) False Position method
- 5) N-R Method
- 6) Secant Method
- 7) Fixed Point Method
- 8) Existence of solutions of system of Linear equations
- 9) Gauss Elimination Method with Pivoting
- 10) Gauss Jordan Method
- 11) Triangular Factorization methods
- 12) Gauss -Seidel Method
- 13) Jacobi Iterative method
- 14) Newton Interpolation polynomial
- 15) Interpolation with equidistant points
- 16) Central Difference method
- 17) Newton-Cotes Methods
- 18) Taylor Series Method for ordinary differential equation
- 19) Shooting Method
- 20) Power method eigen values.

**Q.4]Answer the following question in short:-**

- 1) Find first four approximations of roots of  $f(x) = x^6 - x - 1$  in interval  $[1,2]$  by Bisection method.
- 2) Calculate  $x_4$  by Aitken's  $\Delta^2$  process for equation  $2x - 3 = \cos x$  in the interval  $[3/2, \pi/2]$  Take  $x_1 = 1.5$ .
- 3) Derive the criterion for the convergence in Newton Raphson method.
- 4) Find first 5 approximations of the equation  $x e^x = 1$  Take  $x_0 = 0.5$ .
- 5) Write down forward difference table for

X	1	3	5	7
Y	24	120	336	720

- 6) Write down backward difference table the values of  $\tan x$  between 0.10 to 0.30
- 7) Calculate divided difference table for

x	-1	0	3	6	7
f(x)	3	-6	39	822	1611

- 8) Derive error of the trapezoidal rule.
- 9) Compute the integral.  $\int_{-1}^1 e^x dx$

$$\int_{-1}^1 e^x dx$$

Using trapezoidal rule for  $n=2$

- 10) Compute the integral.  $\int_0^{\pi/2} \sqrt{\sin x} dx$

Applying Simpson's 1/3 rule for  $n=4$  with the accuracy of 5 digits.

- 11) Calculate root estimates  $x_3$  and  $x_4$  of equation  $x^2 - 4x - 10 = 0$  With initial estimates  $x_1 = 4$ ,  $x_2 = 2$ .

**Q.4]Answer the following Long question :-**

- 1) Explain Regula falsi method in detail.
- 2) Derive Newton's algorithm for finding the  $p^{\text{th}}$  root of a number  $N$ .
- 3) Write the iterative formula of Newton Raphson method.
- 4) John measures the size of metal ball as 3.97 cm but the actual size of it is 4 cm. Calculate the absolute error and relative error.
- 5) State the principle used in Gauss- Jordan method.

6) Solve the following system of equations by Gauss- Jordan method

$$5x+4y=15, 3x+7y=12$$

7) Write a sufficient condition for Gauss- Seidel method to converge.

8) Give two indirect methods to solve a system of linear equations.

9) Find the dominant eigen value of  $A = \begin{vmatrix} 1 & 2 \\ 3 & 4 \end{vmatrix}$

by Power method.

Define Eigen value and Eigen vector.

10) By Gauss Elimination method solve  $x + y = 2$  and  $2x + 3y = 5$ .

11) Find the approximate real root of  $xe^x - 3 = 0$  in  $1 < x < 1.1$  by method of False position.

12) Find inverse of  $A = \begin{vmatrix} 1 & 3 \\ 2 & 7 \end{vmatrix}$

by Gauss-Jordan method

13) When shall we not use Newton-Raphson method?

14) Determine the largest eigen value and corresponding eigen vector of the matrix

$$\begin{vmatrix} 1 & 1 \\ 1 & 1 \end{vmatrix}$$

15) Write down the condition for convergence in the iteration method.

16) Obtain the positive root of  $2x^3 - 3x - 6 = 0$  that lies between 1 and 2 by using Newton-Raphson method.

17) By using Gauss-Seidel method, solve the following system of Equations

$$6x+3y+12z=35, 8x-3y+2z=20, 4x+11y-z=33$$

18) Find the real root of the equation  $x \log x - 1.2 = 0$  correct to four decimal places using false position method.

19) Using Gauss-Jordan method, solve the following system of Equations

$$2x-y+3z=8, -x+2y+z=4, 3x+y-4z=0.$$

20) Solve by Gauss-Jacobi method, the following equations

$$4x_1 + x_2 + x_3 = 6, x_1 + 4x_2 + x_3 = 6, 4x_1 + x_2 + 4x_3 = 6.$$

21) Use Newton's method to find the real root of  $3x - \cos x - 1 = 0$ .

22) Apply Gauss Jordan method to solve the equations

$$x+y+z=9, 2x-3y+4z=13, 3x+4y+5z=40.$$

23) Solve by Jacobi iteration method correct to two decimal places

$$10x+y-z= 11.19$$

$$x+10y+z=28.08$$

$$-x+y+10z=35.61$$

24) Solve the following system by Gauss-Seidel method:

$$28x+4y-z=32$$

$$x+3y+10z=24$$

$$2x+17y+4z=35.$$

25) Apply Gauss-Jordon method to find the solution of the system -

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

$$2x+10y+z=13$$

$$x+y+5z=7$$

26) Solve for a positive root of  $x - \cos x=0$  by Regula Falsi method.

27) What are the two types of errors involving in the numerical computation?

28) State the iterative formula for regula falsi method to solve  $f(x)=0$  .

29) Give an example of (a) algebraic (b) transcendental equation •.

30) Compute the value of the definite integral  $\log x$  between 4 and 5.2 using trapezoidal rule.

31) What is Gauss elimination method.

32) Derive the Simpson's 3/8 rule.

33) Derive the Simpson's 1/3 rule.

34) What is Taylor series method?

35) Give the formula for second order Runge-Kutta methods.

36) Explain the Taylor series algorithms for the first order differential equation.

37) Write down Euler and modified Euler algorithm for solving a first order differential equation.

38) Explain Secant method to find root of Nonlinear Equations.

39) Give four types of curve fitting.

40) Write down formula for Lagrange's interpolation

41) Use Lagrange's interpolation formula to fit a polynomial to the data

<b>X</b>	<b>0</b>	<b>1</b>	<b>3</b>	<b>4</b>
<b>Y</b>	<b>-12</b>	<b>0</b>	<b>6</b>	<b>12</b>

Find the value of Y when X=2

42) Find  $y(10)$  given that  $y(5)=12, y(6)=13, y(9)=14, y(11)=16$  using Newton's Divided difference interpolation.

43) Find  $\Delta \log x$

44) Find  $f(x)$  as a polynomial in  $x$  for the following data by Newton's divided difference formula

<b>X</b>	<b>-4</b>	<b>-1</b>	<b>0</b>	<b>2</b>	<b>5</b>
<b>Y</b>	<b>1245</b>	<b>33</b>	<b>5</b>	<b>9</b>	<b>1335</b>

45) Prove that  $E\Delta = \Delta E$ .

46) Find the cubic polynomial which takes the following values

<b>X</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>
<b>Y</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>10</b>

47) Find the first term of the series whose second and subsequent terms are 8,3,0,-1,0,...

48) Explain the term Shift operator and D operator.

49) Derive Regula falsi method .

50) Derive the Newton-Raphson Method.

51) Evaluate  $\sqrt{12}$  applying Newton Raphson formula.

52) Find a root of the equation  $x \sin x + \cos x = 0$

53) Explain the types of errors .

54) Explain Bisection method step by step.

55) Prove that  $f(4)=f(3)+\Delta f(2)+\Delta^2 f(1)+\Delta^3 f(1)$ .

56) Find a root, correct to three decimal places and lying between 0 and 0.5 of the equation by

Bisection method  $4e^{-x} \sin x - 1 = 0$

57) Explain the **LU** Decomposition of a Matrix.

58) Find a real root of the equation  $x = e^{-x}$ , using Newton's Raphson method take  $x_0 = 1$ .

59) Values of  $x$  (in degrees) and  $\sin x$  are given in the following table :-

$x$ (in degrees)	$\sin x$
15	0.2588190
20	0.3420201
25	0.4226183
30	0.5

35	0.5735764
40	0.6427876

Determine the value of  $\sin 38^\circ$

60) Explain Central difference operator.

61) Using Newton's Raphson method, find a iterative formula to compute the cube root of a natural number N.

62) Explain Cubic Spline

63) Decompose the matrix

$$A = \begin{vmatrix} 4 & 3 & 2 \\ 2 & 3 & 4 \\ 1 & 2 & 1 \end{vmatrix}$$

into the form LU, where L is a lower triangular matrix and U is unit upper triangular.

64) Solve the system by Jacobi's method.

$$10x + 2y + z = 9$$

$$2x + 20y - 2z = -44$$

$$-2x + 3y + 10z = 22$$

65) Find the inverse of the following matrices using Gauss-Jordan elimination techniques

a)  $\begin{vmatrix} 2 & 3 & 4 \\ 4 & 2 & 3 \\ 3 & 4 & 2 \end{vmatrix}$

Obtain the solution of the following system using the Jacobi iteration method

$$2x_1 + x_2 + x_3 = 5, \quad 3x_1 + 5x_2 + 2x_3 = 15, \quad 2x_1 + x_2 + 4x_3 = 8$$

66) Obtain the solution of the following system using the Gauss-Seidel iteration method

$$2x_1 + x_2 + x_3 = 5, \quad 3x_1 + 5x_2 + 2x_3 = 15, \quad 2x_1 + x_2 + 4x_3 = 8$$

67) Solve the equations by the Gauss-Seidel method

$$3x_1 + x_2 = 5, \quad x_1 - 3x_2 = 5$$

68) The table below gives square roots for integers And Determine the square root of 2.5.

x	1	2	3	4	5
f(x)	1	1.4142	1.7321	2	2.2361

69) Find the Lagrange interpolation polynomial to fit the following data.

i	0	1	2	3
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$x_i$	0	1	2	3
$e^{x_i}$	0	1.7183	6.3891	19.0855

Use the polynomial to estimate the value of  $e^{1.5}$

- 70) Using Newton's Raphson method, find an iterative formula to compute the reciprocal of a natural number N.
- 71) Using Newton's Raphson method, find the an iterative formula to compute the square root of N.
- 72) Write down Stirling's Formula.

73) From the table given below

x	1	2	3	4	5
y	0	1	5	6	8

Find  $f'(x)$  and  $f''(x)$  at  $x=1.2$  By Newton's forward difference formula.

74) Using Newton's divided difference table find  $f(2)$  and  $f'(2)$

x	-1	0	1	3
f(x)	2	1	0	-1

75) Using shooting method ,solve the equation

$$y''(x) = 6x, \quad y(1)=2, \quad y(2)=9$$

in the interval (1,2).

76) Find the eigenvectors of the following system

$$8x_1 - 4x_2 = \lambda x_1$$

$$2x_1 + 2x_2 = \lambda x_2$$

77)

Find the largest eigenvalue  $\lambda_1$  and the corresponding eigenvectors  $V_1$  of the matrix

1	2	0
2	1	0
0	0	-1

Using the power method.

78) Use classical Runge-Kutta method to estimate  $y(0.4)$

$$\text{When } y'(x) = x^2 + y^2 \text{ with } y(0)=0$$

Assume  $h=0.2$ .

79) Explain fourth order Runge-Kutta method.