	P.R.Government College (Autonomous) **KAKINADA**	**Program&Semester** III B.Sc. Mathematics Major (V Sem)			
CourseCode **MAT- 503 T**	**TITLEOFTHECOURSE** **Advanced Numerical Methods & Problem Solving Sessions**				
Teaching	HoursAllocated:60(**Theory**)	L	T	P	C
Pre-requisites:	Basic Mathematics Knowledge on Integration	3	-	-	3

Course Objectives:

This course will cover the particular mathematical functions that have more or less established names and notations due to their importance in mathematical analysis, functional analysis, geometry, physics, or other applications.

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Find derivatives using various difference formulae
CO2	Understand the process of Numerical Integration
CO3	Solve Simultaneous Linear systems of Equations
CO4	Understand Iterative methods
CO 5	Find Numerical Solution of Ordinary Differential Equations

Course with focus on employability/entrepreneurship /Skill Development modules

Skill Development			Employability			Entrepreneurship	

Syllabus:

Unit – 1: Numerical Differentiation.

Derivatives using Newton's forward difference formula - Newton's backward difference formula- Derivatives using central difference formula - Stirling's interpolation formula - Newton's divided difference formula.

Unit– 2: Numerical Integration

General quadrature formula on errors - Trapezoidal rule – Simpson's 1/3 rule - Simpson's 3/8 rule- Weddle's rule - Euler-Maclaurin formula of summation and quadrature.

Unit – 3: Solution of Simultaneous Linear systems of Equations – I

Solution of linear systems - Direct Methods - Matrix inversion method – Gaussian elimination method-Gauss Jordan Method.

Unit – 4: Solution of Simultaneous Linear systems of Equations – II

Method of factorization - solution of Tridiagonal systems - Iterative methods - Jacobi's method - Gauss - Siedal method.

Unit – 5: Numerical Solution of Ordinary Differential Equations

Introduction – solution of Taylor's series – Picard's method of successive approximations – Euler's method – Modified Euler's method – Runge-Kutta methods.

II. Reference Books:

Text Book

Numerical Analysis by G. Shanker Rao, New Age International Publications

Reference Books

1.Applied Numerical Analysis by Curtis F. Gerald and Patrick O. Wheatley, Pearson Publications.

2. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S .R. K. Iyengar and R. K. Jain, New Age International Publishers.

III. Co-Curricular Activities:

Seminar/ Quiz/ Assignments/ Applications of Numerical methods to Real life Problem /Problem Solving Sessions.

BLUE PRINT FOR QUESTION PAPER PATTERN,

Skill Enhancement Course: XIV

Paper –XIV : **Advanced Numerical Methods & Problem Solving Sessions**

UNIT	TOPIC	S.A.Q	E.Q	Marks Allotted
I	Numerical Differentiation.	02	01	20
II	Numerical Integration	01	02	25
III	Solution of Simultaneous Linear systems of Equations – I	01	01	15
IV	Solution of Simultaneous Linear systems of Equations – II	01	01	15
V	Numerical Solution of Ordinary Differential Equations	02	01	15
Total		07	06	95

S.A.Q. = Short answer questions (5 marks)
E.Q . = Essay questions (10 marks)

Short answer questions : 4 x 5 M = 20
Essay questions : 3 x 10 M = 30

Total Marks : = 50

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Pithapur Rajah's Government College (Autonomous), Kakinada

III Year B.Sc., Degree Examinations - V Semester

Mathematics Course: Major - XIV : Advanced Numerical Methods & Problem solving sessions

Paper -XIV (Model Paper w.e.f. 2025-26)

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Time: 2Hrs **Max. Marks: 50**

SECTION-A

Answer Any Three Questions, Selecting At Least One Question From Each Part

Part – A **3 X 10 = 30**

1.Essay question from Unit - I.

2. Essay question from Unit – II

3. Essay question from Unit - II.

Part – B

4.Esay question from Unit - III .

5.Essay question from Unit - IV.

6.Essay question from Unit - V .

SECTION-B

Answer any four questions **4 X 5 M = 20 M**

8. Short answer question from Unit - I.
9. Short answer question from Unit - I .
10. Short answer question from Unit – II.
11. Short answer question from Unit - III.
12. Short answer question from Unit - IV.
13. Short answer question from unit – V.
14. Short answer question from Unit – V.

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PITHAPUR RAJAH'S GOVERNMENT COLLEGE (AUTONOMOUS), KAKINADA

DEPARTMENT OF MATHEMATICS

Question Bank for

PAPER–MAJOR - XIV : ADVANCED NUMERICAL METHODS

Short Answer Questions

Unit-I

1. Find the first order derivative of √x at x = 15 from the following .

x	15	17	19	21	23	25
f(x)	3.8773	4.123	4.359	4.583	4.796	5.000

2. Find $f^1(1)$ for $f(x) = \frac{1}{1+x^2}$ using the following table .

x	1.0	1.1	1.2	1.3	1.4
f(x)	0.5000	0.4524	0.4098	0.3717	0.3378

3. Find $f^1(1.5)$ from the following table .

x	0.0	0.5	1.0	1.5	2.0
f(x)	0.3989	0.3521	0.2420	0.1245	0.0540

4. Find $f^1(2.5)$ from the following table .

x	1.5	1.9	2.5	3.2	4.3	5.9
f(x)	3.375	6.059	13.625	29.368	73.907	196.579

5. Find $f^1(5)$ from the following table .

x	1	2	4	8	10
f(x)	0	1	5	21	27

Unit – II

6. Evaluate $\int_0^1 (4x - 3x^2)\, dx$ taking 10 intervals by Trapezoidal rule.

7. Calculate the approximate value of $\int_{-3}^{3} x^4 dx$ by using Trapezoidal Rule.

8. Evaluate $I = \int_0^1 \frac{dx}{1+x}$ correct to three decimal places by Trapezoidal rule with h = 0.25
9. Evaluate the integral $\int_1^2 \sqrt{(1 - \frac{1}{x})}\, dx$ by Simpson's 1/3 rule with five ordinates.
10. Use Euler – Maclaurin's formula to prove that $\sum_1^n x^2 = \frac{n(n+1)(2n+1)}{6}$.

Unit – III

11. Solve the following equations by matrix inversion method.
    3x + y + 2z = 3, 2x – 3y – z = -3, x + 2y + z = 4.
12. Solve the system of equations 2x + y + Z = 10, 3x + 2y + 3z = 18, x + 4y + 9z = 16 by Gauss Elimination method.
13. Solve the equations x + 2y + z = 3, 2x + 3y + 3z = 10, 3x – y + 2z = 13 by Gauss Elimination method.

Unit – IV

14. Solve the equations 10x – y + z = 12, x – 10y + z = 12, x + y -10z = 12 by Gauss – Jacobi method.
15. Solve the equations 10x + 2y + z = 9, x + 10y – z = -22, -2x + 3y + 10z = 22 by Gauss – Jacobi method.
16. Solve the equations 5x + 2y + z = 12, x + 4y + 2z = 15, x + 2y + 5z = 20 by Gauss – Seidel method.

Unit – V

17. Solve the differential equations $\frac{dy}{dx} = x + y$, with y(0) = 1 , $x \in [0,1]$ by Taylor series expansion to obtain y for x = 0.1 .
18. Using the Taylor's series for y(x) , find y(0.1) correct to four decimal places if y(x) satisfies $y^1 = x - y^2$, $y_0 = 1$ where $x_0 = 0$.
19. Solve $\frac{dy}{dx} = 1 + y^2$, $y(0) = 0$ by Picard's method .
20. Given $\frac{dy}{dx} = y + x^3$, $y(0) = 1$, compute y(0.02) by Euler's method taking h = 0.01 .

Essay Questions

Unit – I

1. Using the following table , compute $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at x = 1 .

x	1	2	3	4	5	6
y	1	8	27	64	125	216

2. Using the following table , compute $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at x = 1.2 .

x	1.0	1.2	1.4	1.6	1.8	2.0	2.2
y	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250

3. Using the following table , compute $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at x = 2.2 .

x	1.0	1.2	1.4	1.6	1.8	2.0	2.2
f(x)	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250

4. Find $f^1(0.6)$ and $f^{11}(0.6)$ from the following table .

x	0.4	0.5	0.6	0.7	0.8
f(x)	1.5836	1.7974	2.0442	2.3275	2.6510

UNIT - II

5. State and prove Simpson's 1/3 rule .
6. Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by using Simpson's 1/3 rule .
7. State and prove Simpson's 3/8 rule .
8. Evaluate $\int_0^1 \frac{dx}{1+x^2}$ by using Simpson's 1/3 and 3/8 rule . Hence obtain the approximate value of π in each case .
9. Evaluate $\int_3^7 x^2 \log x \, dx$ by using Simpson's 3/8 rule. Take h = 1
10. Integrate numerically $\int_4^{5.2} \log x \, dx$ by Weddle's rule .

Unit – III

11. Solve the equations 3x + 2y + 4z = 7, 2x + y + z = 7, x + 3y + 5z = 2 by Matrix inversion method.

12. Solve the equations 5x – y – 2z = 142, x – 3y – z = - 31, 2x – y – 3z = 5 by gauss elimination method.
13. Solve the equations 5x + 2y + z = 12, x + 4y + 2z = 15, x + 2y + 5z = 20 by Gauss – Jordan method.
14. Solve the equations 2x + y + z = 10, 3x + 2y + 3z = 18, x + 4y + 9z = 16 by Gauss – Jordan method.

Unit – IV

15. Solve the equations 2x + 3y + z = 9, x + 2y + 3z = 6, 3x + y + 2z = 8 by LU decomposition method.
16. Solve the equations x + 2y + 3z = 14, 2x + 5y + 2z = 18, 3x + y + 5z = 20 by factorization method.
17. Solve the equations 10x + 2y + z = 9, 2x + 20y – 2z = -44, -2x + 3y + 10z = 22 by Gauss – Seidel method.
18. Solve the equations 10x + y = z = 12, 2x + 10y + z = 13, 2x + 2y + 10z = 14 by Gauss – Seidel method.

Unit - V

19. Determine the value of y when x = 0.1 given that y(0) = 1 and $y^1 = x^2 + y$ by Euler's modified method .
20. Find y(0.2) by using Euler's modified method for $\frac{dy}{dx} = log_{10}(x + y)$ with initial condition y = 1 for x = 0 .
21. Solve $\frac{dy}{dx} = xy$ using Runge – Kutta method for x = 0.2 given that y(0) = 1 taking h = 0.2
22. Given $\frac{dy}{dx} = y - x$ with y(0) = 2 find y(0.1) and y(0.2) correct to four decimal place by R – K method .

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