

	P.R.Government College (Autonomous) KAKINADA	Program&Semester IIIB.Sc. (VSem)			
CourseCode MAT-601A / 5231	TITLEOFTHECOURSE 6A- Numerical Methods				
Teaching	HoursAllocated:60(Theory)	L	T	P	C
Pre-requisites:	Basic Mathematics Knowledge on theory of equations	5	1	-	5

Course Objectives:

This course will cover the classical fundamental topics in numerical methods such as, approximation, numerical integration, numerical linear algebra, solution of nonlinear algebraic systems and solution of ordinary differential equations.

Course Outcomes:

On Completion of the course, the students will be able o-	
CO1	Understand various finite difference concepts and interpolation methods.
CO2	Work out numerical differentiation and integration whenever and wherever routine methods are not applicable.
CO3	Find numerical solutions of ordinary differential equations by using various numerical methods.
CO4	Analyze and evaluate the accuracy of numerical methods.

Course with focus on employability/entrepreneurship /Skill Development modules

Skill Development		Employability		Entrepreneurship	
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Unit – 1: Finite Differences and Interpolation with Equal intervals (15h)

1. Introduction, Forward differences, Backward differences, Central Differences, Symbolic relations, nth Differences of Some functions,
2. Advancing Difference formula, Differences of a Polynomial.
3. Newton's formulae for interpolation. Central Difference Interpolation Formulae.

Unit – 2: Interpolation with Equal and Unequal intervals (15h)

1. Gauss's Forward interpolation formulae, Gauss's backward interpolation formulae, Stirling's formula, Bessel's formula.
2. Interpolation with unevenly spaced points, divided differences and properties, Newton's divided differences formula.
3. Lagrange's interpolation formula, Lagrange's Inverse interpolation formula.

Unit – 3: Numerical Differentiation (15h)

1. Derivatives using Newton's forward difference formula, Newton's backward difference formula,
2. Derivatives using central difference formula, Stirling's interpolation formula,
3. Newton's divided difference formula, Maximum and minimum values of a tabulated function.

Unit – 4: Numerical Integration (15h)

1. General quadrature formula one errors, Trapezoidal rule,
2. Simpson's 1/3– rule, Simpson's 3/8 – rule and Weddle's rules,
3. Euler – McLaurin Formula of summation and quadrature, The Euler transformation.

Unit – 5: Numerical solution of ordinary differential equations (15h)

1. Introduction, Solution by Taylor's Series,
2. Picard's method of successive approximations,
3. Euler's method, Modified Euler's method, Runge – Kutta methods.

III. References:

1. S.S.Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi-110001, 2006.
2. P.Kandasamy, K.Thilagavathy, Calculus of Finite Differences and Numerical Analysis. S. Chand & Company, Pvt. Ltd., Ram Nagar, New Delhi-110055.
3. R.Gupta, Numerical Analysis, Laxmi Publications (P) Ltd., New Delhi.
4. H.C Saxena, Finite Differences and Numerical Analysis, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
5. S.Ranganatham, Dr.M.V.S.S.N.Prasad, Dr.V.Ramesh Babu, Numerical Analysis, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
6. Web resources suggested by the teacher and college librarian including reading material.

IV. Co-Curricular Activities: A) Mandatory:

1. **For Teacher:** Teacher shall train students in the following skills for 15 hours, by taking relevant outside data (Field/Web).
1. Applications of Newton's forward and backward difference formulae.

2. Applications of Gauss forward and Gauss back ward, Stirling's and Bessel's formulae.
3. Applications of Newton's divided differences formula and Lagrange's interpolation formula.
4. Various methods to find the approximation of a definite integral.
5. Different methods to find solutions of Ordinary Differential Equations.

2. For Student: Fieldwork/Project work; Each student individually shall undertake Fieldwork/Project work and submit a report not exceeding 10 pages in the given format on the work done in the areas like the following, by choosing any one of the aspects.

1. Collecting the data from the identified sources like Census department or Electricity department, by applying the Newton's, Gauss and Lagrange's interpolation formula, making observations and drawing conclusions. (Or)
2. Selection of some region to find the area by applying Trapezoidal rule, Simpson's $1/3$ – rule, Simpson's $3/8$ – rule, and Weddle's rules. Comparing the solutions with analytical solution and concluding which one is the best method. (Or)
3. Findingsolutionof the ODE by Taylor's Series, Picard's method of successive approximations, Euler's method, Modified Euler's method, Runge–Kutta methods. Comparing the solutions with analytical solution, selecting the best method.

3. Max. Marks for Fieldwork/Project work Report: 05.

4. Suggested Format for Fieldwork/Project work Report: Title page, Student Details, Index page, Stepwise work-done, Findings, Conclusions and Acknowledgements.

5. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Assignments/collection of data, Seminar, Quiz, Group discussions/Debates
2. Visits to research organizations, Statistical Cells, Universities, ISI etc.
3. Invited lectures and presentations on related topics by experts in the specified area .

CO-PO Mapping:

(1:Slight[Low]; 2:Moderate[Medium]; 3:Substantial[High], '-':NoCorrelation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
CO1	3	3	2	3	3	3	1	2	2	3	2	3	2
CO2	3	2	3	3	2	3	3	1	3	3	3	2	1
CO3	2	3	2	3	2	3	2	2	2	3	2	2	3
CO4	3	2	3	2	3	2	3	3	2	1	3	1	2

**BLUE PRINT FOR QUESTION PAPER PATTERN
SEMESTER-V PAPER-VI A**

Unit	TOPIC	S.A.Q	E.Q	Marks allotted to the Unit
I	Finite Differences and Interpolation with Equal intervals	2	2	26
II	Interpolation with Equal and Unequal intervals	2	2	26
III	Numerical Differentiation	2	2	26
IV	Numerical Integration	1	2	21
V	Numerical solution of ordinary differential equations	1	2	21
Total		8	10	120

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

E.Q = Essay questions (8 marks)

Short answer questions : 4 X 5 = 20

Essay questions : 5 X 8 = 40

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Total Marks = 60

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P.R. Government College (Autonomous), Kakinada
III year B.Sc. Degree Examinations : V Semester - Mathematics
Skill Enhancement Course (Elective) : Numerical Methods
Paper VI A: MODEL PAPER (w.e.f. 2020-21)

Time: 2 Hrs 30 Min

Max. Marks : 60 M

PART – I

Answer any FOUR of the following questions. Each question carries 5 marks.

4 x 5 = 20 M

1. Given $y_0 = 3$, $y_1 = 12$, $y_3 = 200$, $y_4 = 100$. Find $\Delta^4 y_0$ without forming difference table.
2. Find the missing term in the following data.

x	0	1	2	3	4
y	1	3	9	—	81

3. Given that $\sqrt{12500} = 111.803399$, $\sqrt{12510} = 111.848111$, $\sqrt{12520} = 111.892806$, $\sqrt{12530} = 111.937483$. Show by gauss backward formula that $\sqrt{12516} = 111.874930$

4. Show that $f(x_0, x_1, x_2, \dots, x_n) = \frac{\Delta^n f(x_0)}{n!h^n}$.

5. 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
Y	0.5000	0.4524	0.4098	0.3717	0.3378

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

X	1.5	1.9	2.5	3.2	4.3	5.9
Y	3.375	6.059	13.625	29.368	73.907	196.57

7. Evaluate $\int_0^1 (4x - 3x^2) dx$ taking 10 intervals byn trapezoidal rule.
8. Using Taylor's series method, find $y(0.1)$ correct to four decimal places if $y' = x - y^2$ and $y(0) = 1$.

SECTION – B**Answer ALL questions. Each question carries Eight marks.****5 X 8 = 40 M**

9. a) State and prove Newton – Gregory formula for forward interpolation with equal intervals .

(OR)

b) From the following table , find the number of students who obtain less than 45 marks .

Marks	30-40	40-50	50-60	60-70	70-80
No.of students	31	42	51	35	31

10. a) Apply Gauss forward formula to find the value of u_9 if $u_0 = 14$, $u_4 = 24$, $u_8 = 32$, $u_{16} = 40$.

(OR)

b) State and prove Newton's divided difference formula .

11. a) Find $f'(0.6)$ and $f''(0.6)$ 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

(OR)

b) Find the maximum and the minimum values of the function $y = f(x)$ from the following data .

x	0	1	2	3	4	5
f(x)	0	0.25	0	2.25	16	56.25

12.a) Find the value of the integral Evaluate $\int_0^1 \frac{dx}{1+x^2}$ by using Simpson's $\frac{3}{8}$ th - rule taking $h = \frac{1}{6}$. Hence obtain an approximate value of π .

(OR)

b) Evaluate the integral $\int_4^{5.2} \log x \, dx$ using Weddle's rule.13. a) Find the value of y at $x = 0.1$ by Picard's method, given that $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$.

(OR)

b) Given $\frac{dy}{dx} = y - x$ with $y(0) = 2$, find $y(0.1)$ and $y(0.2)$ correct to four decimal places by using Runge – Kutta method .