

Lecture Plan		
Name of the College: Government College of Arts, Science and Commerce, Sanquelim-Goa		
Name of Faculty: Aaron Alphonso	Subject: Mathematics	
Paper code: MAT-141 Numerical Analysis using Python/SageMath	Program: B.Sc. (Mathematics)	Division: -
Academic year: 2026-27	Semester: I	Total Lectures: 15 (Theory) + 60 (Practical)
Course Objectives:		
1. To make students aware of numerical methods that can be employed to obtain good approximate numerical solutions to problems that may not be able to be solved in a closed form and to effectively use software in these computations.		
Expected Course Outcome:		
1) Find the roots of algebraic and transcendental equations.		
2) Apply Interpolation to solve real life problems.		
3) Make use of the techniques of numerical differentiation and integration.		
4) Determine the best line/quadratic curve/exponential curve to fit the given data.		
5) Utilize Python/SageMath software to aid mathematical pursuits.		
6) Prove various results in Riemann integration.		
7) Analyze and compare various number theoretic functions.		
8) Examine the convergence of improper integrals.		
Student Learning Outcome: Student will be able to		
1) Apply various numerical methods to obtain approximate solutions to algebraic, transcendental, interpolation, differentiation, integration and curve-fitting problems.		
2) Implement and execute these numerical methods using Python/SageMath software.		

3) Apply the theory of Riemann integration in evaluating integrals.

Month	Lecture From	Lecture To	No. of lectures allotted	Topic, Subtopic to be covered	Exercise/ Assignment	ICT Tools	Reference books
June	22/06/2026	27/06/2026	1	Numbers: Exact and Approximate; Significant digits; Errors: Absolute, Relative and Percentage errors		Smart Board PDF	B. S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers, 2010.
	29/06/2026	04/07/2026	1	Solution of Algebraic and Transcendental Equations: Bisection Method; Regula–Falsi Method		Smart Board PDF	B. S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers, 2010.
	06/07/2026	11/07/2026	1	Secant Method; Newton–Raphson Method			B. S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers, 2010.
July	13/07/2026	18/07/2026	1	Special Cases of Newton–Raphson Method: finding the qth root of a positive real number 'd' and the reciprocal of a positive real number 'd' without using division		Smart Board	B. S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers, 2010.

	20/07/2026	25/07/2026	1	Bairstow's Method; remarks on convergence			B. S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers, 2010.
Jul/Aug	27/07/2026	01/08/2026	1	Calculus of Finite Differences: Operators Δ , ∇ and E ; Difference Tables			S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India Pvt. Ltd., 2012.
August	03/08/2026	08/08/2026	1	Properties of Δ , ∇ and E ; Fundamental Theorem of Difference Calculus; expression of any value of a function in terms of leading term and leading differences of a difference table		Smart Board PDF	S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India Pvt. Ltd., 2012.
	10/08/2026	15/08/2026	1	Interpolation and Extrapolation: Newton's Forward and Backward Interpolation formulae			S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India Pvt. Ltd., 2012.
	17/08/2026	22/08/2026	1	Central Difference Interpolation formula; Lagrange's Interpolation formula			S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India Pvt. Ltd., 2012.
	24/08/2026	29/08/2026	1	Newton's Divided Difference formula		Smart Board PDF	S. S. Sastry, Introductory Methods of Numerical Analysis,

							Prentice Hall India Pvt. Ltd., 2012.
August/Sep t	31/08/2026	05/09/2026	1	Numerical Differentiation: differentiation formulae for equidistant arguments			B. S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers, 2010.
Sep	07/09/2026	12/09/2026	1	Numerical Integration: general quadrature formula for equidistant ordinates (Newton–Cotes Formula or Gauss–Legendre quadrature formulae); Trapezoidal rule and its geometrical interpretation		Smart Board	B. S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers, 2010.
	14/09/2026	19/09/2026	0	Ganesh Chaturthi Break (14–19 Sep)			B. S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers, 2010.
	21/09/2026	26/09/2026	1	Simpson's one-third rule; Simpson's three-eighth rule; Weddle's rule			B. S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers, 2010.
Sep/Oct	28/09/2026	03/10/2026	1	Method of Least Squares: fitting of a straight line		Smart Board	B. S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers, 2010.

Oct	05/10/2026	10/10/2026	1	Fitting of a quadratic curve; fitting of an exponential curve			B. S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++, Khanna Publishers, 2010.
		Practical Component (60 Hours)					
Month	Lecture From	Lecture To	No. of lectures allotted	Topic, Subtopic to be covered	Exercise/ Assignment	ICT Tools	Reference books
June	22/06/2026	27/06/2026	4	Manual practice: absolute, relative and percentage error computations; solving equations by the Bisection method. Computational (Practical 1): implementing the Bisection method in Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.
June/July	29/06/2026	04/07/2026	4	Manual practice: Regula–Falsi and Secant methods. Computational (Practicals 2 & 3): implementing the Regula–Falsi and Secant methods in Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.
July	06/07/2026	11/07/2026	4	Manual practice: Newton–Raphson method and its special cases (qth root, reciprocal). Computational (Practical 4): implementing the Newton–Raphson method, including qth roots and reciprocals, in Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.

July	13/07/2026	18/07/2026	4	Manual practice: finding polynomial roots using Bairstow's method. Computational (Practical 5): implementing Bairstow's method in Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.
Jul/Aug	20/07/2026	25/07/2026	4	Manual practice: constructing difference tables; Newton's Forward and Backward Interpolation. Computational (Practicals 6 & 7): Newton–Gregory's Forward and Backward Difference Interpolation in Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.
August	27/07/2026	01/08/2026	4	Manual practice: Central Difference Interpolation formula. Computational (Practical 8): Central Difference Interpolation in Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.
August	03/08/2026	08/08/2026	4	Manual practice: Newton's Divided Difference formula and Lagrange's Interpolation formula. Computational (Practicals 9 & 10): Newton's Divided Difference and Lagrange Interpolation in Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.
August	10/08/2026	15/08/2026	4	Manual practice: first and second order numerical differentiation. Computational (Practical 11): computing the first and second order numerical derivative in Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill

							Education, 2017; SAGE Documentation.
August	17/08/2026	22/08/2026	4	Manual practice: numerical integration using the Trapezoidal rule. Computational (Practical 12): calculating the numerical integral using the Trapezoidal rule in Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.
August/Sep t	24/08/2026	29/08/2026	4	Manual practice: Simpson's 1/3rd and 3/8th rules, and Weddle's rule. Computational (Practical 13): calculating the numerical integral using Simpson's 1/3rd and 3/8th rule in Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.
August/Sep t	31/08/2026	05/09/2026	4	Manual practice: fitting a straight line by the Method of Least Squares. Computational (Practical 14): fitting a straight line to given data in Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.
Sep	07/09/2026	12/09/2026	4	Manual practice: fitting quadratic and exponential curves by the Method of Least Squares. Computational (Practical 15): fitting quadratic and exponential curves to given data in Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.
Sep	21/09/2026	26/09/2026	4	Consolidation practical: revisiting root-finding methods and comparing their rates of convergence, using Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with

							Python, McGraw Hill Education, 2017; SAGE Documentation.
Sep/Oct	28/09/2026	03/10/2026	4	Consolidation practical: revisiting interpolation formulae and comparing their accuracy on sample data sets, using Python/SageMath		Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.
Oct	05/10/2026	10/10/2026	4	Review and consolidation: revisiting numerical differentiation, integration and curve-fitting techniques; preparation for the practical examination	Practical record/journal submission	Computer Lab	A. N. Kamthane and A. A. Kamthane, Programming and Problem Solving with Python, McGraw Hill Education, 2017; SAGE Documentation.

*** Assessment Rubrics**

Component	Max Marks
ISA 1(Theory)	5
ISA 2(Theory)	5
ISA 1(Practical)	5
ISA 2(Practical)	5
ISA 3(Practical)	5
Semester End Exam(Practical)	40
Project	Nil

Semester End Exam(Theory)	20
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