



COMPUTATIONAL MATHEMATICS WITH SAGEMATH

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TYPE OF COURSE : New | Both | UG/PG**COURSE DURATION** : 8 weeks (18 Jan' 21 - 12 Mar' 21)**EXAM DATE** : 21 Mar 2021**PRE-REQUISITES** : Basic knowledge of Calculus, Linear Algebra and ODE and Numerical Methods.**INTENDED AUDIENCE** : UG and PG students of Mathematics and BE Students, Teachers teaching in Degree colleges.**INDUSTRIES APPLICABLE TO** : Any industry dealing with Data Science and Numerical Computations.**COURSE OUTLINE :**

Computational Mathematics with SageMath: This eight week course aims to use SageMath, a Python based free and open source computer algebra system (CAS) to explore concepts in Calculus, Applied Linear Algebra and Numerical Methods. The course will begin with the introduction of basic Python programming language in the first two weeks. Next we shall provide a quick introduction to SageMath software along with plotting 2D and 3D objects. The main focus will be on using SageMath to explore topics in Calculus, Applied Linear Algebra and Numerical Method along with several applications.

ABOUT INSTRUCTOR :

Dr. Ajit Kumar is an Associate Professor and the Head, Department of Mathematics, Institute of Chemical Technology. He did his Masters and Ph.D. from the University of Mumbai. His current areas of interest are Optimization Techniques, Data Analysis, and Mathematical Pedagogy. He has been a prolific user of various mathematical software such as SageMath, Python, R, Mathematica, MatLab etc. Due to this expertise, he has been invited to give talks on these topics at several national and international events and has conducted numerous training programmes for students and teachers. He has been associated with one of the most popular and significant training programmes in Mathematics known as "Mathematics Training and Talent Search" (MTTS) Programme for the last several years in various capacities. Currently he is the managing trustee of the MTTTS TRUST, which organizes all the programmes under the MTTTS umbrella.

COURSE PLAN :

Week 1: Installation of Python; Getting Started with Python; Python as an advanced Calculator ; Lists in Python; Tuples sets and dictionary in Python; Functions and Branching; For loop in Python; While loop in Python

Week 2: Creating Modules and Introduction to NumPy; Use of NumPy module; Python Graphics using Matplotlib; Use of SciPy and SymPy in Python; Classes in Python; Classes in Python

Week 3: Introduction and Installation of SageMath; Exploring integers in SageMath; Solving Equations in SageMath; 2d Plotting with SageMath; 3d Plotting with SageMath; Calculus of one variable with SageMath Part 1; Calculus of one variable with SageMath Part 2

Week 4: Applications of derivatives; Integrals in SageMath; Applications of Integrals; Partial Derivatives and gradients, jacobians; Local maximum-minimum; Application of local maximum and minimum; Applications to least square problems

Week 5: Lagrange Multipliers; Working with vectors in SageMath; RREF and Solving system of linear Equations; Vector Spaces in SageMath; Vector Spaces in SageMath (cont.); Linear Transformations with SageMath; Linear Transformations with SageMath (cont..)

Week 6: Eigenvalues and Eigenvectors with SageMath; Eigenvalues and Eigenvectors with SageMath (cont.); Inner Product Spaces in SageMath; Inner Product Spaces in SageMath (cont.); Gram-Schmidt Process and QR-factorization; Singular Value Decomposition (SVD)

Week 7: Applications of SVD & Least Square Methods; Applications of linear algebra with SageMath; Numerical Solution of algebraic equations; Numerical Solutions of system linear equations; Interpolations; Numerical Integration; Numerical Integration (Cont..)

Week 8: Numerical Eigenvalues; Solving ODE with SageMath; Initial Value ODE with SageMath; Initial Value ODE with SageMath (cont.); Solving system of ODE; Solving ODE with Laplace Transforms; Applications of ODE with SageMath; What next with SageMath?