Course Code PHY1003	Introduction to computational physics	Course Type	LTP
		Credits	**4**

Course Objectives:

- Familiarizing students with computational methodologies and techniques to solve the problems in physics
- Teaching scientific programming tactics, numerical techniques and their implementation
- Developing the ability to scientifically analyze the data and interpret the results

Course Outcomes:

CO1. Utilize computers to formulate and solve basic problems in physics
CO2. Use the computational tools and methodology to communicate ideas and explanations
CO3. Numerically solve the linear and non-linear system of equations
CO4. Develop the basics understanding of scientific simulation and modeling.

Mod. No.	Module Description	Lect. Hrs	CO
1	**Basic data operations** Fundamentals of computations, Data visualization in 2 and 3-dimension, Plotting and data interpretation in 2 and 3 dimension, data interpolation and fitting	**5**	**2**
2	**Mathematical Physics I** Scalars, Vector, Col linear vectors, Addition and subtraction of vectors, Scalar products, Vector products, Vector triple product, Gradient, Divergence, Curl, Matrix methods, Matrix operations, Arrays	**8**	**1,2,3**
3	**Mathematical Physics II** Sequential and random numbers, Concept of randomness, Measures of central tendency and dispersion, Frequency distribution, Error analysis, Root finding, Simple functions, Derivatives and integrals, Forward and backward difference, Central difference, Ordinary differential equations, Partial diffrential eqations	**10**	**1,2,3**
4	**Particle dynamics**; **a computational approach I** Newton's equation of motions, Work energy theorem, conservative forces, Linear motion, non-linear motions, Uniform and non uniform motion, Collision of particles, Elastic collision, Inelastic collision, Conservation laws, Algorithm development and problem solving	**8**	**1,2,3,4**
5	**Particle dynamics**; **a computational approach II** Simple harmonic motion Simple harmonic oscillator : energy and phase of simple harmonic oscillator, Two body harmonic oscillator, An-harmonic oscillations, Motion in a frictional or drag environment, Algorithm development and problem solving	**7**	**1,2,3,4**

	Guest Lecture on Contemporary Topic	**2**	
	Total Lecture Hours:	**40**	

Mode of Teaching and Learning: Flipped class room, activity based teaching/learning, tutorials for the technical details, , development of the computational codes, if possible a 2 hours lecture by experts on contemporary topics

Mode of Evaluation: The assessment and evaluation components may consist of quizzes, assignments, tutorials and any other innovative assessment practices followed by faculty, in addition to the Continuous assessment tests (CAT) and Term end examination. (TEE)

Text Book(s):

1.	Basic Concepts in Computational Physics, B. A. Stickler, E. Schachinger, Springer (2016)
2.	Computational Physics: Problem solving with python, R. H. Landau, M. J. Paez, and C. C. Bordeianu, Wiley-VCH (2015)

Reference Books:

1.	Computational Physics: Simulation of Classical and Quantum Systems, P. O. J. Scherer, Springer (2017)
2.	Computation in Modern Physics, W. R. Gibbs, World Scientific (2006)
3.	Computer Simulation Methods, Application to Physical Systems, H. Gould, J. Tobochnik and H. Christian, Addison Wesley (2007).

Hands-on Session : Experimental part of this course work will consist of a hands-on session. Here, students will be developing the various codes relevant to the physics problems. A few examples are given below

1. Integration and differentiation of the simple functions
2. Matrix operation and vectors
3. Formulations of the Newton’s law
4. Simple harmonic oscillator
5. Dammped harmonic oscillator

Recommendation by the Board of Studies on	17/10/2020
Approval by Academic council on	20/10/2020
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