CS201- Introductory Computational Physics

Course Placement
Introductory Computational Physics is a core course offered to second year students of B.Tech Hons. ICT (Minor in Computational Science) program. It is a pre-requisite for course on Modeling and Simulation.

Course format
- 3 hours lecture per week.
- 3 hours lab per week. LAB 207. (Software : MATLAB)

Course content
This is a calculus based introductory computational physics course aimed to develop insight into solving problems using Newton's laws of motion and basics principles of mechanics. Course focuses on topics such as fundamental concepts of classical mechanics, oscillations, dynamics of system of particles and rigid bodies.

Approach to be followed:
problem→theory→model→**Compuational implementation (MATLAB)**→ assessment and analysis

Text Books
Classical Dynamics of Particles and Systems, 5th edition, S. T. Thornton and J. B. Marion, Cengage Learning, 2012.
Classical Mechanics, 3rd Edition, H. Goldstein, C. Poole, and J. Safko, Pearson India, 2011.
Any MATLAB book.

Assessment method/ Grading
Theoretical/Exam: Two mid-semester examinations and a final examination: 70% (15+25+30)
Lab207: Lab Assignment/ report submission: 25% + 5% (attendance)

Grading scheme is relative and depends on both: class performance and minimum expectation from a student.

Course Outcomes
Introductory Computational Physics course will help the students to analyze and model simple mechanical systems using both Newtonian mechanics and, Lagrangian and Hamiltonian approaches. The course will also prepare the students to **build computational models to investigate dynamical system**.

After completing this course a student will have the ability
- To understand and analyze motion in real world surroundings using a small set of powerful fundamental principles. The course will enhance the student's problem solving skills.
- To design, model and investigate complex engineering problems.

Course content/ Lecture Schedule (not necessarily in the following order)

Introduction to MATLAB required for this course: 2 lectures

Sl. No.	Description	
1	**Review of important Mathematical Concepts**	
	1.1	Matrices
	1.2	Vector Algebra Vector Calculus
	1.3	Problem Solving : examples; Uranium decay
2	**Elementary Mechanics**	
	2.1	Newtonian Mechanics: Single Particle
	2.2	Basic Kinematic Quantities.
	2.3	Conservation Theorems, Energy, Potential concept
	2.4	Problem Solving + Computational implementation
3	**Oscillations and Motion**	
	3.1	Simple harmonic oscillator (undamped, damped, driven cases), Resonance
	3.2	Phase diagrams
	3.3	Gravitation
	3.4	Motion of charged particles
	3.5	Solar system; Kepler's Laws
	3.6	Applications and Problem Solving + Computational implementation
4	**Lagrangian and Hamiltonian Dynamics**	
	4.1	Lagrangian approach to Mechanics
	4.2	Variational calculas , Eulers Equations
	4.3	Hamiltonian Dynamics
	4.4	Configuration and phase space, Generalized coordinates
	4.5	Examples and Problem Solving + Computational implementation
5	**Rotational Motion and Rigid Bodies**	
	5.1	Central Force Motion. Rotating frames
	5.2	Dynamics of a System of Particles
	5.3	Dynamics of Rigid bodies
	5.6	Random systems (optional)
	5.7	Problem Solving and Discussion.