

Course Title	Course Code	Number of Study Hours			Year	Level	Prerequisites
		Theoretical	Laboratory	Credit			
Classical Mechanics	251PHYS	3	---	3	2 <sup>nd</sup>	3 <sup>rd</sup>	---

(1) **Brief Course Description**

This course is a rigorous introduction to classical mechanics, which is the study of forces and motion. The emphasis will be the Newtonian formalism and the application of its principles in one dimension as well as in higher dimensions. The concepts of work and energy will be covered and used to solve dynamic problems. The course will also review Kepler's laws and will provide the underlying physics which explain these laws based on Newton's principles. The classical mechanics course is calculus based, and hence will start with a review of the necessary mathematical background

(2) **Course Objectives**

**The course is designed to provide students with:**

- A review of the fundamentals of calculus
- Newton laws and principles.
- Application of Newton's laws in one dimension as well as in higher dimensions
- The concepts of work and energy and their application for dynamic problems
- The essential concepts of circular and rotational motion
- The physics of planetary motion.

(3) **Course Contents**

- **Vectors:** Equality of vectors, vector addition, multiplication by a scalar, vector subtraction, commutative law, associative law, distributive law, magnitude of a vector, Scalar product, cross product, physical examples of products, triple product, derivative of a vector, position vector, velocity and acceleration.
- **Newtonian Mechanics:** Newton laws of motion: first, second, and third law. Linear momentum, motion of a particle, rectilinear motion: uniform acceleration under a constant force. Derivation of Newton equations of motion, motion on inclined surface, forces that depend on position: the concepts of kinetic and potential energy. Motion of a body with variable mass: rocket motion
- **Energy:** Kinetic and potential energy, dynamic systems and the laws of conservation of energy
- **Circular and Rotational Motion:** Angular displacement, angular velocity, angular acceleration, rotational kinematics: Rotational motion with constant angular acceleration, rotational acceleration, rotational energy, moment of inertia, angular momentum and torque.
- **Newton Gravitation:** Newton's law of gravitation, Kepler's Laws: Newton's law of universal gravitation, Kepler's Laws of Planetary Motion: Kepler's First Law: The Law of Ellipses, Kepler's Second Law: Equal Areas and Conservation of Angular Momentum, Kepler's Third Law: The Harmonic Law and their mathematical derivations.

(4) **Assessment Criteria**

- Periodic Exams: 40%
- Oral, Student Activity and Essay: 10%
- Final Exam: 50%

(5) **Course Teaching Strategies**

- Lectures, Reports and Essay Assignments, Homework, and Web-based Assignments.

(6) **Text Book**

- Analytical Mechanics; Grant R. Fowles and George L. Cassiday – 7<sup>th</sup> edition, Brooks, Cole, publishing, (2004).

(7) **Reference Books**

- Classical Mechanics; Vernon D. Barger and Martin G. Olsson, McGraw Hill (1994).
- Classical Mechanics; Tai L. Chow, CRC Press; 2<sup>nd</sup> edition (2013).