Course Title: Fundamentals of Mechanics

Course Code: MATH-205

Course Type: Major Math

Prerequisites: Introduction to Physics

Credit Hours: 3 (3 + 0)

Course Objectives: This course will provide students with a solid foundation in mechanics, essential for advanced studies in mathematics and physics. After completion of this course, the students will be able to:

- Develop an understanding of vector algebra and calculus as applied to mechanics.
- Analyze rectilinear and curvilinear motion of particles.
- Comprehend the concepts of work, power, energy, and conservation principles in kinetics.
- Study the principles and various forms of simple harmonic motion.
- Explore the dynamics of central forces and planetary motion.

Course Contents:

Preliminaries: Introduction to vector algebra, Scalar and vector products, Triple products, Derivatives and integrals of vectors.

Kinematics: Rectilinear motion of particles, Uniform rectilinear motion, Uniformly accelerated rectilinear motion, Curvilinear motion of particles, Rectangular components of velocity and acceleration, Tangential and normal components, Radial and transverse components, Projectile motion.

Kinetics: Work, Power, Kinetic and potential energy, Conservative force fields, Conservation of energy, Impulse, Torque, Conservation of linear and angular momentum, Non-conservative forces.

Simple Harmonic Motion: The simple harmonic oscillator, Amplitude, Period, Frequency, Resonance and energy, The damped harmonic oscillator, Over damped, Critically damped and underdamped motion, Forced vibrations, The two and three dimensional harmonic oscillators.

Central Forces and Planetary Motion: Central force fields, Equations of motion, Potential energy of a particle in a central field, Orbits, Kepler's laws of planetary motion, Apsides and apsidal angles for nearly circular orbits, Motion in an inverse square field.

Recommended Books:

1. Aruldhas, G., *Classical Mechanics*, PHI Learning Private Limited, 2009.
2. Fowles, G. R., and Cassiday, G. L., *Analytical Mechanics*, Thomson Brooks/Coley, 7th edition, 2005.
3. Goldstein, H., *Classical Mechanics*, Addison-Wesley Publishing Co., 1980.

4. Greiner, W., *Classical Mechanics- Systems of Particles and Hamiltonian Dynamics*, Springer-Verlag, 2004.

5. Spiegel, M. R., *Theoretical Mechanics*, McGraw Hill Book Company, 1980.

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