

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN PHYSICS
SYLLABUS WITH EFFECT FROM 2020-2021

BPS-DSC05

CORE-V: MECHANICS

Lecture: 60 Hours

Tutorial: 15 Hours

Credits:4

Course Objective:

To make the students understand the basic principles of mechanics and enable them to analyze and solve problems

Learning Outcomes:

At the end of the course the student will be able to

- Understand the Newton's law of motion
- Know the motion of a particle in a Gravitational, electric and magnetic fields
- Acquire knowledge on the conservation law
- Gain knowledge on the basics of dynamics of linear and rotational motion.
- Realize the basic principles behind planetary motion
- Understand the space - time concept through relativity

UNIT I: NEWTON'S LAWS OF MOTION

(12 Hours)

Newton's Laws of Motion- Forces and Equations of Motion- Motion of a Particle in a Uniform Gravitational Field- Newtonian law of Universal Gravitation-Examples-Electric and Magnetic Forces on a Charged Particle-The Magnetic Field and Lorentz Force-Examples- Motion of Charged Particle in a Uniform Electric and Magnetic Field-Conservation of Momentum-Contact Forces: Friction- Problems

UNIT II : CONSERVATION LAWS

(12 Hours)

Definition of concepts-Conservation of Energy-Work-Kinetic and Potential energy- Examples- Conservative Forces-Potential Energy and Conservation of Energy in Gravitational and Electric field- Examples.

Conservation of Linear and Angular Momentum: Internal forces and Momentum conservation- Center of mass- Examples- General Elastic Collision of Particles of Different Masses- System with Variable Mass-Examples- Conservation of Angular Momentum-Torque due to Internal Forces-Torque due to Gravity- Angular momentum about Center Of Mass- Proton scattering by heavy nucleus.

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UNIT III: HARMONIC OSCILLATOR AND INVERSE SQUARE LAW OF FORCE

(12 Hours)

Mass on spring-Simple Pendulum (Force, energy and torque method)-Compound Pendulum-LC circuit- Motion of systems displaced from position of stable equilibrium-Average kinetic energy and potential energy.

Inverse Square Law of Forces and Static Equilibrium- Orbits: Equation and Eccentricity-Circular orbit-Kepler's laws- Examples

UNIT IV: ELEMENTARY RIGID BODY DYNAMICS

(12 Hours)

The Equation of Motion-Angular Momentum and Kinetic Energy-Moment of inertia-Parallel Axis Theorem- Perpendicular Axis Theorem- Examples-Rotation about fixed axis: Time Dependence of Motion- Examples- Rolling without slipping (three methods)-Torque about Center of Mass-Examples.

UNIT V: SPECIAL RELATIVITY

(12 Hours)

Constancy of Speed of light-Michelson-Morley Experiment-Invariance of 'c' – Basic assumptions- Lorentz Transformation- Length Contraction-Examples- Time Dilation of Moving Clocks-Examples-Velocity Transformation- Velocity Addition-Variation of Mass with Velocity-Aberration of light-Longitudinal Doppler Effect

Book for study:

1. Mechanics (in SI units) - (Berkley Physics course-volume 1), Charles Kittel, Walter D knight etc, Tata McGraw Hill publication, 2017,second edition.

Books for reference:

1. Newtonian Mechanics ,A.P.French, Viva Books Private, (2011).
2. Introduction to mechanics , Kleppner and Kolenkow, McGraw Hill Publishers (Special Indian edition), first edition (2010)
3. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/115101011/lec1.pdf
4. <https://nptel.ac.in/courses/115101011/>