

BSc. Physical Sciences

Multidisciplinary

DISCIPLINE SPECIFIC CORE COURSE – 1 (PHYSICS DSC - 1) MECHANICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Mechanics Physics DSC 1	4	2	0	2	Class XII pass with Physics and Mathematics as main subjects	Physics and Mathematics syllabus of class XII

Learning Objectives

This course reviews the concepts of mechanics learnt at school from a more advanced perspective and goes on to build new concepts. It begins with dynamics of a system of particles and ends with the special theory of relativity. Students will appreciate the concept of rotational motion, gravitation and oscillations. The students will be able to apply the concepts learnt to several real world problems.

Learning outcomes:

Upon completion of this course, students are expected to understand the following concepts.

- Laws of motion and their application to various dynamical situations.
- Conservation of momentum, angular momentum and energy. Their application to basic problems.
- Particle collision (elastic and in-elastic collisions)
- Motion of simple pendulum
- Postulates of special theory of relativity, inertial and non-inertial frame of reference and their transformation, relativistic effects on the mass and energy of a moving body.

In the laboratory course, after acquiring knowledge of how to handle measuring instruments (like screw gauge, vernier calliper and travelling microscope) student shall embark on verifying various principles and associated measurable quantities.

SYLLABUS OF PHYSICS DSC – 1

THEORY COMPONENT

Unit 1: Review of vectors and ordinary differential equation (4 Hours)

Gradient of a scalar field, divergence and curl of vectors field, polar and axial vectors
Second order homogeneous ordinary differential equations with constant coefficients
(Operator Method Only).

Unit 2: Fundamentals of Dynamics (7 Hours)

Dynamics of a system of particles, centre of mass, determination of centre of mass for discrete and continuous systems having spherical symmetry
Conservation of momentum and energy, Conservative and non-Conservative forces, work – energy theorem for conservative forces, force as a gradient of potential energy.
Particle collision (Elastic and in-elastic collisions)

Unit 3: Rotational Dynamics and Oscillatory Motion (8 Hours)

Angular momentum, torque, conservation of angular momentum, Moment of inertia, Theorem of parallel and perpendicular axes (statements only). Calculation of moment of inertia of discrete and continuous objects (1-D and 2-D).
Idea of simple harmonic motion, differential equation of simple harmonic motion and its solution, Motion of simple pendulum, damped harmonic oscillator

Unit 4: Gravitation (3 Hours)

Newton's Law of Gravitation, Motion of a particle in a central force field, Kepler's Laws (statements only)

Unit 5: Special Theory of Relativity (8 Hours)

Frames of reference, Galilean transformations, inertial and non-inertial frames, Michelson Morley's Experiment, postulates of special theory of relativity, length contraction, time dilation, relativistic transformation of velocity, relativistic variation of mass.

References:

Essential Readings:

- 1) Vector Analysis – Schaum's Outline, M.R. Spiegel, S. Lipschutz, D. Spellman, 2nd Edn., 2009, McGraw- Hill Education.
- 2) An Introduction to Mechanics (2/e), Daniel Kleppner and Robert Kolenkow, 2014, Cambridge University Press.
- 3) Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw Hill Education
- 4) Mechanics, D. S. Mathur, P. S. Hemne, 2012, S. Chand.
- 5) Intermediate Dynamics, Patrick Hamill, 2010, Jones and Bartlett Publishers.

Additional Readings:

- 1) Feynman Lectures, Vol. 1, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
- 2) University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- 3) University Physics, H. D. Young, R. A. Freedman, 14/e, 2015, Pearson Education.
- 4) Fundamentals of Physics, Resnick, Halliday and Walker 10/e, 2013, Wiley.
- 5) Engineering Mechanics, Basudeb Bhattacharya, 2/e, 2015, Oxford University Press.
- 6) Physics for Scientists and Engineers, Randall D Knight, 3/e, 2016, Pearson Education.