



# ARSD College, University of Delhi

## Model Course Handout/Lesson Plan

<b>Course Name :</b>		<b>B.Sc. (Hons.) Physics</b>				
Semester	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
I		Core : Mechanics	4	0	0	4
Teacher/Instructor(s)		Dr. Avanish Pratap Singh Rajput				
Session		2021-22				

### Course Objective:

- 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 Newton's Laws of Motion and ends with the Fictitious Forces and Special Theory of Relativity.
- Students will also appreciate the Collisions in CM Frame, Gravitation, Rotational Motion and Oscillations.

### Course Learning Outcomes:

- The students will be able to apply the concepts learnt to several real world problems.
- Also, students will learn about laws of motion and their application to various dynamical situations
- Apply Kepler's laws to describe the motion of planets and satellite in circular orbit.
- Understand special theory of relativity - special relativistic effects and their effects on the mass and energy of a moving object.
- In the laboratory course, the student shall perform experiments related to mechanics:

Lesson Plan:

Unit No.	Learning Objective	Lecture No.	Topics to be covered
1.	<b>Vectors:</b>	1	Vector algebra.
		2	Scalar products.
		3	vector products.
		4	Derivatives of a vector with respect to a parameter.
2.	<b>Ordinary Differential Equations:</b>	8	1st order homogeneous differential equations.
		9	1st order homogeneous differential equations.
		10	1st order homogeneous differential equations.
		11	2nd order homogeneous differential equations with constant coefficients.
		12	2nd order homogeneous differential equations with constant coefficients.
3.	<b>Laws of Motion:</b>	13-14	Frames of reference.
		15-16	Newton's Laws of motion.
		17-20	Dynamics of a system of particles. Centre of Mass.
4.	<b>Momentum and Energy:</b>	21-23	Conservation of momentum.
		24-25	Work and energy.
		26	Conservation of energy.
		27	Motion of rockets.
5.	<b>Rotational Motion:</b>	28-29	Angular velocity and angular momentum. Torque.
		30-32	Conservation of angular momentum.
6.	<b>Gravitation: Newton's Law of Gravitation.</b>	29-30	Motion of a particle in a central force field
		31-32	(motion is in a plane, angular momentum is conserved, areal velocity is constant.).
		33	Kepler's Laws (statement only

		34-35	Satellite in circular orbit and applications.
7.	<b>Oscillations:</b>	36	Idea of SHM.
		37	Differential equation of SHM and its solution.
		38-39	Kinetic energy, potential energy, total energy and their time-average values.
		40	Compound pendulum. Damped oscillation.
		41-42	Forced oscillations: Transient and steady states, sharpness of resonance and Quality Factor
8.	<b>Elasticity:</b>	43-46	Hooke's law- Stress-strain diagram - Elastic moduli-Relation between elastic constants-
		47	Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants-
		48-52	Work done in stretching & work done in twisting a wire- Twisting couple on a cylinder- Determination of Rigidity modulus by static torsion- Torsional pendulum-Determination of Rigidity modulus and moment of inertia - $\eta$ & $\chi$ by Searles method.
9.	<b>Special Theory of Relativity</b>	53-54	Constancy of speed of light.
		55-58	Postulates of special theory of Relativity.
		59-60	Length contraction. Time dilation. Relativistic addition of velocities.

**Evaluation Scheme:**

No.	Component	Duration	Marks
1.	Internal Assessment		25
	• Quiz		
	• Class Test		
	• Attendance		
	• Assignment		
2.	End Semester Examination	3 hr	75

Details of the Course		
Unit	Contents	Contact Hours
I	<b>Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.</b>	4
II	<b>Ordinary Differential Equations: 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients.</b>	6
III	<b>Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass.</b>	10
IV	<b>Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.</b>	6
V	<b>Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum..</b>	12
VI	<b>Gravitation: Newton's Law of Gravitation. Motion of a particle in a central forcefield (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications.</b>	8
VII	<b>Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.</b>	6
VIII	<b>Speed Theory of Relativity: Constancy of speed of light. Postulates of special theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.</b>	7
	<b>Total</b>	<b>60</b>
<b>Suggested Books:</b>		
Sl. No.	Name of Authors/Books/Publishers	Year of Publication/Re print
1.	An Introduction to Mechanics , Daniel Kleppner & Robert Kolenkow, 2014, Cambridge University Press.	2014
2.	2. Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw Hill Education.	2017
3.	Theory and Problems of Theoretical Mechanics, Murray R. Spiegel, 1977, McGraw Hill Education.	1977

4.	Intermediate Dynamics, Patrick Hamill, 2010, Jones and Bartlett Publishers.	2010
5.	Analytical Mechanics, G. R. Fowles and G. L. Cassiday, 2005, Cengage Learning.	2005
<b>Mode of Evaluation:</b>	Internal Assessment / End Semester Exam	