



# ARSD College, University of Delhi

## Lesson Plan

<b>Course Name : B.Sc. (H) Physics</b>						
Semester	Course Code	Course Title	Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
I	DSC – 3	Waves and Oscillations	2	0	2	4
<b>Teacher/Instructor(s)</b>		<b>Dr. Ashutosh Vishwa Bandhu ( for Theory)</b>				
<b>Session</b>		<b>2022-23</b>				

### Course Objective:

- This course reviews the concepts of waves and oscillations learnt at school from a more advanced perspective and goes on to build new concepts.
- It begins with explaining ideas of free oscillations and superposition of harmonic motion leading to physics of damped and forced oscillations.
- The course will also introduce students to coupled oscillators, normal modes of oscillations and free vibrations of stretched strings.

### Course Learning Outcomes:

On successful completion of this course, the students will have the skill and knowledge to,

- Understand simple harmonic motion
- Understand superposition of N collinear harmonic oscillations
- Understand superposition of two perpendicular harmonic oscillations
- Understand free, damped and forced oscillations
- Understand coupled oscillators and normal modes of oscillations
- Understand travelling and standing waves, stretched strings

### Lesson Plan:

Unit No.	Section Heading	Lecture No.	Topics to be covered
Unit 1	Simple Harmonic Motion (12 Hours)	1-2	Differential equation of simple harmonic oscillator, its solution and characteristics
		3-4	Energy in simple harmonic motion, linearity and superposition principle,
		5-6	Rotating vector representation of simple harmonic oscillation,

		7-8	Motion of simple and compound pendulum (Bar and Kater's pendulum), loaded spring
		9-10	Superposition of N collinear harmonic oscillations with (1) equal phase differences and (2) equal frequency differences, Beats
		11-12	Superposition of two perpendicular harmonic oscillations: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequencies, effect of variation of phase
<b>Unit 2</b>	<b>Damped and Forced Oscillations (8 Hours)</b>	13-14	Damped Oscillations: Equation of motion, dead beat motion, critically damped system
		15-16	Lightly damped system: relaxation time, logarithmic decrement, quality factor
		17-18	Forced Oscillations: Equation of motion, complete solution, steady state solution
		19-20	Resonance, sharpness of resonance, power dissipation, quality factor
<b>Unit 3</b>	<b>Coupled Oscillations (6 Hours)</b>	21-22	Coupled oscillators, normal coordinates and normal modes,
		23-24	energy relation and energy transfer, di-atomic molecules,
		25-26	representation of a general solution as a linear sum of normal modes, normal modes of N coupled oscillators.
<b>Unit 4</b>	<b>Wave Motion (4 Hours)</b>	27-28	One dimensional plane wave, classical wave equation, standing wave on a stretched string (both ends fixed)
		29-30	normal modes. Travelling wave solution

**Evaluation Scheme for theory (Tentative):**

No.	Component	Duration	Marks
1.	Internal Assessment		20
	Class Test		
	Attendance		
	Assignment		
2.	End Semester Examination	2 hr	60

**Suggested Books:**

Sl. No.	Name of Authors/Books/Publishers	Year of Publication/Reprint
1.	Vibrations and Waves by A. P. French. (CBS Pub. and Dist.)	1987

2.	The Physics of Waves and Oscillations by N.K. Bajaj (Tata McGraw-Hill)	1988
3.	Fundamentals of Waves and Oscillations By K. Uno Ingard (Cambridge University Press)	1988
4.	An Introduction to Mechanics by Daniel Kleppner, Robert J. Kolenkow (McGraw-Hill,)	1973
5.	Waves: BERKELEY PHYSICS COURSE by Franks Crawford (Tata McGrawHill)	2007
<b>Mode of Evaluation:</b>		Internal Assessment / End Semester Exam