Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2019-2020

Course Handout Part-I

1/8/2019

In addition to part I (General handout for all courses appended to the timetable) this portion gives further details regarding the course.

Course Number **: PHY F111**

Course Title **: MECHANICS, OSCILLATIONS & WAVES**

Instructor-in-Charge **:** SWASTIK BHATTACHARYA

Instructors : Sashideep Gutti, Prashant Samantray, P.K.Thiruvikraman, Aravinda Raghavan and Asrarul Haque

Course Description**: "**Mechanics, Oscillations, and Waves" serves as a fundamental course in physics for science and engineering. This course, consisting of a series of lectures coupled with several demonstrations, provides a good, sound, working knowledge of the following topics: polar coordinates, angular momentum, rigid body motion, central force motion, Special theory of Relativity, harmonic oscillator, coupled oscillations, waves and wave equation.

Scope & Objective: Newtonian mechanics, the oldest branch of physics, is rather robust and possesses a very solid foundation**.** The phenomena of oscillations and waves have always been intriguing and are ubiquitous in the world around us. A course on "Mechanics, Oscillations, and Waves" is indispensable to understand other branches of science and engineering and serves as one of the stepping stones for scientific, engineering and medical research and development. The wide-ranging spectrum of subject matter of this course provides a foundation for advanced level physics courses. The objective of this course is to develop good physics problem-solving skills by building a deep conceptual understanding of the subject.

Text Books**:**

1. An Introduction to Mechanics, by D. Kleppner and R. Kolenkow, Tata McGraw-Hill Edition, 2007.
2. French, Anthony P French, Vibrations and Waves, CBS, 2003.

Reference Books:

1. The Physics of Vibrations & Waves, by H. J. Pain, 6th edition, John Wiley & Sons, Inc., 2005.
2. Physics Vol I & II, Halliday/Resnick/Krane 5th Edition, John Wiley, 2003.
3. Berkeley Physics Course Volume I, Tata-McGraw Hill.
4. Berkeley Physics course volume 3, Tata-McGraw Hill
4. Feynman lectures on Physics, Vol I

Learning Outcomes:

1. Ability to draw free body diagrams with knowledge of constraints and forces and solve the equation of motion.
2. Ability to tackle mechanics problems in non-inertial frame.
3. Application of Newton's laws to planetary motion.
4. Ability to analyze and understand oscillatory mechanical systems which are coupled.
5. To understand Interference and diffraction phenomena

Lecture Number	Learning Objectives	Topics to be covered	**Chapter in the Text Book**
Topics from Text Book 1 (Kleppner and Kolenkow)			
1-4	To understand the kinematical concepts in plane polar coordinates and use them to solve simple problems.	Motion in Plane Polar Co-ordinates	1.6-1.9
5-6	Understand torque equation and conservation of angular momentum	Torque equation, Angular momentum	CHAP 6
7-9	To understand the concept of angular momentum with regards to the rotation of a rigid body about the axis which is not fixed. Study the mathematical treatment of gyroscopic motion.	Vector nature of angular momentum, The Gyroscope, Angular Momentum	7.1-7.4
10-14	To understand the concept of central force motion and its manifestations in the motion of planets and satellites.	Central force motion, Energy diagrams, planetary motion, Kepler's laws	9.1-9.7
15-17	To understand the concept of non-inertial frames and the origin of fictitious forces in a rotating coordinate system.	The Galilean transformation, Uniformly accelerating systems, Physics in a rotating coordinate system	8.2,8.3, 8.5
18-23	To understand the basic ideas of special theory of relativity	Michelson-Morley experiment, Postulates of special relativity, Galilean and Lorentz transformations, Simultaneity, Length contraction, time dilation and relativistic transformation of velocity	11.1 – 11.4, 12.1, 12.2, 12.3 and 12.4
Topics from Text Book 2 (A.P.French)			
24-25	To learn how vibrations can be combined to give more general vibrations leading to beats.	Superposed vibrations in 1D, two superposed vibrations of equal and unequal frequencies, beats	Chapter 2
26-28	To analyze the behavior of undamped coupled harmonic oscillators. Define normal modes and describe how they	Coupled oscillators, normal modes, double pendulum	Chapter 5 Pages: 119-128

	may be combined.		
29-31	To find the normal modes of coupled pendulums. To determine the motion of coupled pendulums from their initial conditions.	Matrix method for finding normal mode frequencies, matrices, eigenvalues and eigenvectors, coupled oscillations of loaded string and wave equation	Class notes
32-36	To learn how to set up wave equation. To learn how a normal mode of vibration of a stretched string is describable as a combination of two progressive waves. To find the total energy associated with one complete wavelength of a sinusoidal wave on a stretched string. To distinguish between particle and wave/phase velocity.	The free vibrations of stretched string, Progressive Waves, the energy in a mechanical wave, phase and group velocity	Chapter 6 (Pages: 162-167) Chapter 7 (Pages: 201-212,230-234,237-241)
37-40	To describe interference from multiple sources. Define diffraction grating. Study diffraction by a single slit.	Interference from two and more than two sources, diffraction grating, diffraction by a single slit	Chapter 8 Pages: 267-294
41		Summary of course	

Evaluation Scheme:

S. No.	Evaluation Component	Duration	Weightage (%)	Date & Time	Nature of Component
1	Mid semester Test	90 mins.	35	3/10, 3.30 -- 5.00 PM	Open Book
2	Quizzes *	50 mins.	20		Closed Book
3	Comprehensive Examination	3 hours.	45	10/12 AN	Closed Book

** Two quizzes will be conducted and the best performance will be considered. No make-up for the quiz*

Chamber Consultation Hour: To be announced in class.

Notices: Notices will be displayed on the **physics department** notice board and on **CMS** website.

Make up Policy: (1) Make up for *Mid sem* and *Compre exam* may be considered provided a **make-up application** (for a genuine health issue) forwarded by the **Chief Warden** is produced.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-Charge – PHYF111