Major-1 - PHY

2

# SEMESTER-I

## PHY-MJ-1: MECHANICS AND PROPERTIES OF MATTER

**(Credits: Theory-04, Practicals-02)**

**Theory: 60 Lectures**

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**Full Marks:**
15 (Semester Internal Examination: 1Hr) + 60 (End Semester Examination: 3Hrs) =**75**
**Pass Marks:**
Semester Internal Examination = **06**
End Semester Examination = **24**

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**Instruction for evaluation:**

Semester Internal Examination (marks:15)

The Semester Internal Examination will have two components:

(a) One Semester Internal Assessment Test of 10 Marks - There will be two groups of questions.

- Group A is compulsory which will contain very short answer type consisting of five questions of 1 mark each. (**5×1=5**)
- Group B will contain descriptive type two questions of five mark each, out of which any one to answer. (**1×5=5**)

(b) Class Attendance Score of 5 marks - Conversion of Attendance into score may be as follows:

| Attendance | Marks |
|---|---|
| less than 45% | 1 |
| upto 55% | 2 |
| upto 65% | 3 |
| upto 75% | 4 |
| More than 75% | 5 |

End Semester Examination (marks: 60)

There will be two groups of questions.

- Group A is compulsory which will contain three questions.
  - Question No.1 will be very short answer type consisting of five questions of 1 mark each. (**5×1=5**)
  - Question No.2 & 3 will be short answer type of 5 marks. (**2×5=10**)
- Group B will contain descriptive type five questions of fifteen marks each, out of which any three are to answer. (**3×15=45**)

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**Motive of PHY-MJ-1:** The objectives of major paper of semester-1 are as follows:

1. Enables the students to acquire the key concepts of the general properties of matter, the motion of a particle under central force field, oscillations and special theory of relativity.
2. Develop the analytical thinking on Mechanics in order to understand the response of the classical systems to external forces.
3. Extend the idea of mechanics to other branches of physics.

**Outcome of PHY-MJ-1:** Upon completion of the mentioned topics, students will be able to

1. Learn about the behaviour of physical bodies around us in daily life.
2. Understand the dynamics of planetary motion.
3. Build a foundation of various applied field in science and technology.

## SYLLABUS OF PHY-MJ-1

**General Properties of Matter:** Hooke's law. Stress-strain diagram. Elastic moduli. Poisson's Ratio-expression for Poisson's ratio in terms of elastic constants. Relation between Elastic constants. Work done in stretching and work done in twisting a wire-Twisting couple on a cylinder. Bending moment. Cantilevers, beam supported at the end and loaded at middle and its application to determine Young's modulus. Searle's experiments. Kinematics of Moving Fluids: Viscous fluid, Poiseuille's Equation for Flow of a Liquid through a Capillary Tube with correction, Flow of compressible fluid through a capillary tube, Rankine's methods for measurement of viscosity of gas. Effect of temperature and pressure onviscosity. Surface tension and surface energy. Angle of contact. Expression for excess pressure. Principal of virtual work. Ripples and Gravity waves. Effect of temperature and pressure on surface tension. **(20 Lectures)**

**Central Force Motion:** Motion of a particle under a central force field. Two bodies problem. Conservation of angular momentum. Kepler's Laws of planetary motion and their deduction. Satellite in circular orbit and applications. Weightlessness. **(10 Lectures)**

**Oscillations:** SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, Potential energy, Total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, Sharpness of resonance, Power dissipation and Quality Factor. **(14 Lectures)**

**Special Theory of Relativity:** Inertial and Non-inertial frames. Centrifugal force and Coriolis force and its applications. Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Lorentz contraction. Time dilation. Simultaneity and order of events. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler Effect. **(16 Lectures)**

**Reference Books:**


1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, D. S. Mathur.
3. Physics, Resnick, Halliday and Walker, 2008, Wiley.
4. Feynman Lectures, Vol. I, R.P. Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education.
5. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

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# PRACTICAL: PHY-MJ-1-LAB

**Full Marks:**
End Semester Examination: 3Hrs =**25**
**Pass Marks: 10**

**Instruction for evaluation:**
There will be one practical examination of 3Hrs duration. Evaluation of practical examination may be as follows:

| | |
|---|---|
| Experiment | : 15 marks |
| Practical record notebook | : 05 marks |
| Viva-voce | : 05 marks |

**Motive of PHY-MJ-1-LAB:** The objectives of laboratory part of major course of semester-1 are as follows:

1. To get familiar with various measuring tools and learn the importance of accuracy of measurements.
2. To know the limitations of measuring device and check the suitability of the equipment, tools regarding their functioning.
3. To identify the factors that influences the observations in order to perform precise measurement.

**Outcome of PHY-MJ-1-LAB:** Upon completion of the mentioned topics, students will be able to

1. Develop the proficiency in the handling of laboratory instruments.
2. Estimate uncertainty in the measured value.
3. Analyse and interpret the recorded observations, calculation and graphs to draw conclusion.

**List of Practical: 60 Lectures**

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To study errors: Truncation and round off errors, Absolute and relative errors.
3. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
4. To determine the elastic Constants of a wire by Searle's method.
5. To determine the value of g using Bar Pendulum.
6. To determine the value of g using Kater's Pendulum.

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References:


1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edition , 2012, PHI Learning Pvt. Ltd.
2. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
4. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
5. Numerical Methods, E Balagurusamy, McGraw Hill Education.