Government PG College, Ambala Cantt

Session: 2023-2024 (Odd semester)

Name of Assistant Professor: Dr. Samiksha Kumari

Class: B.Sc Ist year (Sem-I) Non-Med

Subject: Physics (Paper: Mechanics, PHY-101)

SYLLABUS

Max. Marks:100 Minimum Pass Marks: 35

Internal Assessment Marks:30

End Term Exam Marks: 70

Time: 3 hours

Note: Nine questions will be set in total. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 20% numerical problems are to be set. Use of scientific (non-programmable) calculator is allowed.

Unit -I

Fundamentals of Dynamics: Rigid body, Moment of Inertia, Radius of Gyration, Theorems of perpendicular and parallel axis (with proof), Moment of Inertia of ring, Disc, Angular Disc, Solid cylinder, Solid sphere, Hollow sphere, Rectangular plate, Square plate, Solid cone, Triangular plate, Torque, Rotational Kinetic Energy, Angular momentum, Law of conservation of angular momentum, Rolling motion, condition for pure rolling, acceleration of body rolling down an inclined plane, Fly wheel, Moment of Inertia of an irregular body.

Unit-II

Elasticity: Deforming force, Elastic limit, stress, strain and their types, Hooke’s law, Modulus of rigidity, Relation between shear angle and angle of twist, elastic energy stored/volume in an elastic body, Elongation produced in heavy rod due to its own weight and elastic potential energy stored in it, Tension in rotating rod, Poisson’s ratio and its limiting value, Elastic Constants and their relations. Torque required for twisting cylinder, Hollow shaft is stiffer than solid one. Bending of beam, bending moment and its magnitude, Flexural rigidity, Geometrical moment of inertia for beam of rectangular cross-section and circular cross-section. Bending of cantilever (loaded by a weight W at its free end), weight of cantilever uniformly distributed over its entire length. Dispersion of a centrally loaded beam supported at its ends, determination of elastic constants for material of wire by Searle’s method.

Unit - III

Special Theory of Relativity: Michelson’s Morley experiment and its outcomes, Postulates of special theory of relativity, Lorentz Transformations, Simultaneity and order of events, Lorentz contraction, Time dilation, Relativistic transformation of velocity, relativistic addition of velocities, variation of mass-energy equivalence, relativistic Doppler effect, relativistic kinematics, transformation of energy and momentum, transformation of force, Problems of relativistic dynamics.

Unit - IV

Gravitation and central force motion: Law of gravitation, Potential and field due to spherical shell and solid sphere. Motion of a particle under central force field, Two body problem and its reduction to one body problem and its solution, compound pendulum or physical pendulum in form of elliptical lamina and expression of time period, determination of g by means of bar pendulum, Normal coordinates and normal modes, Normal modes of vibration for given spring mass system, possible angular frequencies of oscillation of two identical simple pendulums of length (l) and small bob of mass (m0 joined together with spring of spring constant (k).

Recommended Books/e-resources/LMS:

1. Mechanics “Berkeley Physics Course Vol. I”, Charles Kittel, Tata McGraw-Hill

2. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000

3. Elements of Properties of Matter, D.S. Mathur, S .Chand & Com. Pt. Ltd., New Delhi

4. Physics, Resnick, Halliday & Walker, Wiley

5. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010,

Cengage Learning

6. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.

7. Properties of Matter, R. Murgeshan, S. Chand & Com. Pt. Ltd., New Delhi

8. Classical Mechanics, J.C. Upadhyaya, Himalaya Publishing House.

9. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi

10. Advanced Level Practical Physics, M. Nelkon and Ogborn, Henemann Education Books

Ltd., New Delhi

11. Practical Physics, S.S. Srivastava and M.K. Gupta, Atma Ram & Sons, Delhi

12. Practical Physics, S.L. Gupta and V. Kumar, Pragati Prakashan Meerut

13. Modern Approach to Practical Physics, R.K. Singla, Modern Publishers, Jalandhar

14. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing

House.

Course Objective:

1. Able to develop the understandings of fundamental principles of Mechanics.

2. Students will demonstrate knowledge of classical mechanics, electromagnetism and modern physics and be able to apply this knowledge to analyze a variety of physical phenomena

3. Understand the Relative motion, Inertial and non-inertial reference frames.

4. Able to understand about the interaction of forces between solids in mechanical systems, Centre of mass and inertia tensor of mechanical systems.

6. Able to understand the vector theorems of mechanics and interpretation of their results.

7. Understand the motion of the objects in different frame of references.

8. Develop understanding of special theory of relativity and its applications to understand length contraction, time dilation, relativistic momentum, relativistic energy, mass- energy relationship and Michelson Morley experiment.

Course Learning Outcomes:

After completing this course, the learner will be able to:

1. Understand the dynamics of system of particles, conservation of energy and momentum application of both translational and rotational dynamics motions simultaneously in analyzing rolling with slipping.

2. Differentiate between elastic and plastic body. Elastic constants, determination and their physical significance. Torque and its significance.

3. Familiar about the special theory of relativity and its applications. Michelson’s Morley experiments and its finding.

4. Analyze the two body Central Force problem and its applications.

5. Learn to present observations, results, analysis and different concepts related to experiments of Mechanics.

Lesson Plan

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| **Week** | **Dates** | **Topics to be covered** |
| **1** | 24th July 23 – 29 July 23 | **Unit I: Fundamentals of Dynamics**: Fundamentals of Dynamics: Rigid body, Moment of Inertia, Radius of Gyration, Theorems of perpendicular and parallel axis (with proof), |
| **2** | 31st July 23 – 5th August 2023 | Moment of Inertia of ring, Disc, Angular Disc, Solid cylinder, Solid sphere, Hollow sphere, Rectangular plate, Square plate, Solid cone, Triangular plate, Torque, |
| **3** | 7th August 2023-12 August 2023 | Rotational Kinetic Energy, Angular momentum, Law of conservation of angular momentum, Rolling motion, condition for pure rolling, |
| **4** | 14th August 2023-19 August 2023 | acceleration of body rolling down an inclined plane, Fly wheel, Moment of Inertia of an irregular body. **Doubts and Discussions** |
| **5** | 21st August 2023 – 26th August 2023 | **Unit II: Elasticity:** Deforming force, Elastic limit, stress, strain and their types, Hooke’s law, Modulus of rigidity, Relation between shear angle and angle of twist, elastic energy stored/volume in an elastic body |
| **6** | 28th August 2023-2nd September 2023 | Elongation produced in heavy rod due to its own weight and elastic potential energy stored in it, Tension in rotating rod, Poisson’s ratio and its limiting value, Elastic Constants and their relations. Torque required for twisting cylinder, Hollow shaft is stiffer than solid one. |
| **7** | 4th September 2023 – 9th September 2023 | Bending of beam, bending moment and its magnitude, Flexural rigidity, Geometrical moment of inertia for beam of rectangular cross-section and circular cross-section. Bending of cantilever (loaded by a weight W at its free end), |
| **8** | 11th September 2023 – 16th September 2023 | weight of cantilever uniformly distributed over its entire length. Dispersion of a centrally loaded beam supported at its ends, determination of elastic constants for material of wire by Searle’s method. **Doubts and Discussions** |
| **9** | 18th September 2023 – 23th September 2023 | **Unit III (Special Theory of Relativity) :** Michelson’s Morley experiment and its outcomes, Postulates of special theory of relativity, Lorentz Transformations, |
| **10** | 25th September 2023 – 30th September 2023 | Simultaneity and order of events, Lorentz contraction, Time dilation, Relativistic transformation of velocity, |
| **11** | 2nd October 2023- 7th October 2023 | relativistic addition of velocities, variation of mass-energy equivalence, relativistic Doppler effect, relativistic kinematics, |
| **13** | 9th October 2023- 14th October 2023 | transformation of energy and momentum, transformation of force, Problems of relativistic dynamics. Numericals & Doubts and Discussions |
| **14** | 16th October 2023- 21st October 2023 | **Unit IV (Gravitation and central force motion):** Law of gravitation, Potential and field due to spherical shell and solid sphere. |
| **15** | 23rd October 2023- 28th October 2023 | Motion of a particle under central force field, Two body problem and its reduction to one body problem and its solution, |
| **16** | 30th October 2023- 4th November 2023 | compound pendulum or physical pendulum in form of elliptical lamina and expression of time period, determination of g by means of bar pendulum, Normal coordinates and normal modes, |
| **17** | 6th November 23 to 9th November 23 | Normal modes of vibration for given spring mass system, possible angular frequencies of oscillation of two identical simple pendulums of length (l) and small bob of mass m0 joined together with spring of spring constant (k). |
| **18** | 10-16 November 23 | **Diwali Break** |
| **19** | 17-18 Nov | **Revision & Tests** |
| **20** | 20th November 23 – 25th November 23 | **House exam, Revision & Tests** |