**Government PG College, Ambala Cantt**

**Course File (Session: 2023-2024)**

**Class: BSC-Computer science 1st Semester**

**Subject Code: B23-PHY-101 Course Type: CC/MCC**

**Subject Name: Mechanics**

**SYLLABUS**

**Maximum Marks: 100 External Marks:70**

**Minimum Pass Marks: 35 Internal marks:30**

**Time: 3 Hours**

**Note:**

1**.Nine questions will be set in total.**

**2. 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.**

**3. 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.**

**4. 20% numerical problems are to be set. 5. Use of scientific (non-programmable) calculator is allowed.**

**UNIT-1**

**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-** **2**

**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-** **3**

**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-** **4**

**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).

**TEXT BOOK:**

1. Mechanics, Prof D.S. Mathur,DR. P.S. Hemne,2000.

2. Mechanics1, M.S. Raman Chadha and Dr. swati Khatta,2021.

3. Mechanics, Prof. M.P. Saxena, Dr. S.S. Rawat, Dr. P.R. Singh,2023.

**REFERENCE BOOK:**

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 OBJECTIVES:**

* understand the Einstein’s postulates and their consequences.
* Students will gain knowledge regarding various types of forces and reactions.
* Study the fundamental concept of special theory of relativity.
* To introduce the concept of space and time.
* Understand the force systems and draw free body diagram.
* Understand how to model length contraction and time Dilation.

**Course Outcomes:**

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

* 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.
* Differentiate between elastic and plastic body. Elastic constants, determination and their physical significance. Torque and its significance.
* Familiar about the special theory of relativity and its applications. Michelson’s Morley experiments and its finding.
* Analyze the two body Central Force problem and its applications.
* Learn to present observations, results, analysis and different concepts related to experiments of Mechanics.

**LESSON PLAN**

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| **Week No.** | **Scheduled Dates** | **Topics to be covered** |
| **1** | **24-26 July** | **Fundamentals of Dynamics:** Rigid body, Moment of Inertia, Radius of Gyration, Theorems of perpendicular and parallel axis (with proof), |
| **2** | **1-3 August** | Moment of Inertia of ring, Disc, Angular Disc, Solid cylinder, Solid sphere, Hollow sphere, Rectangular plate, Square plate, Solid cone, |
| **3** | **7-9 August** | Solid cone, Triangular plate, Torque, Rotational Kinetic Energy, Angular momentum, Law of conservation of angular momentum, Rolling motion, |
| **4** | **14-16 August** | condition for pure rolling, acceleration of body rolling down an inclined plane, Fly wheel, Moment of Inertia of an irregular body. |
| **5** | **21-23 August** | **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** | **28-30 August** | 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, |
| **7** | **4-6 September** | 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** | **11-13 September** | 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. |
| **9** | **18-20 September** | **Special Theory of Relativity:** Michelson’s Morley experiment and its outcomes, Postulates of special theory of relativity, Lorentz Transformations |
| **10** | **25-27 September** | Lorentz Transformations, Simultaneity and order of events, Lorentz contraction, Time dilation, Relativistic transformation of velocity |
| **11** | **2-4 October** | 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. |
| **12** | **9-11 October** | **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, |
| **13** | **16-18 October** | Two body problem and its reduction to one body problem and its solution, |
| **14** | **23-25 October** | compound pendulum or physical pendulum in form of elliptical lamina and expression of time period, determination of g by means of bar pendulum, |
| **15** | **6-8 October** | Normal coordinates and normal modes, Normal modes of vibration for given spring mass system, |
| **16** | **20-22October** | 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). |