ANDHRA KESARI UNIVERSITY

MINOR

Subject: Physics

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	II	1	Mechanics and Properties of Matter	3	3
			Mechanics and Properties of Matter Practical Course	2	1

COURSE 1: MECHANICS AND PROPERTIES OF MATTER

Theory   Credits: 3   3hrs/week

COURSE OBJECTIVE:

The course on Mechanics and Properties of Matter aims to provide students with a fundamental understanding of the behaviour of physical systems, both in terms of mechanical motion and in terms of the properties of matter

LEARNING OUTCOMES:

1. Students will be able to understand and apply the concepts of scalar and vector fields, calculate the gradient of a scalar field, determine the divergence and curl of a vector field.
2. Students will be able to apply the laws of motion, solve equations of motion for variable mass systems
3. Students will be able to define a rigid body and comprehend rotational kinematic relations, derive equations of motion for rotating bodies, analyze the precession of a top and gyroscope, understand the precession of the equinoxes
4. Students will be able to define central forces and provide examples, understand the characteristics and conservative nature of central forces, derive equations of motion under central forces.
5. Students will be able to differentiate between Galilean relativity and the concept of absolute frames, comprehend the postulates of the special theory of relativity, apply Lorentz transformations, understand and solve problems

UNIT-I VECTOR ANALYSIS   9hrs

Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and curl of a vector field with derivations and physical interpretation. Vector integration (line, surface and volume), Statement and proof of Gauss and Stokes theorems.

UNIT-II MECHANICS OF PARTICLES   9hrs

Laws of motion, motion of variable mass system, Equation of motion of a rocket. Conservation of energy and momentum, Collisions in two and three dimensions, Concept of impact parameter, scattering cross-section, Rutherford scattering-derivation.

UNIT-III MECHANICS OF RIGID BODIES AND CONTINUOUS MEDIA   9hrs

Definition of rigid body, rotational kinematic relations, equation of motion for a rotating body, Precession of a top, Gyroscope, Precession of the equinoxes. Elastic constants of isotropic solids and their relations, Poisson's ratio and expression for Poisson's ratio. Classification of beams, types of bending, point load, distributed load.

UNIT-IV CENTRAL FORCES   **9hrs**

Central forces, definition and examples, characteristics of central forces, conservative nature of central forces, conservative force as a negative gradient of potential energy, equations of motion under a . Derivation of Kepler's laws. Motion of satellites

UNIT-V SPECIAL THEORY OF RELATIVITY   **9hrs**

Galilean relativity, Absolute frames. Michelson-Morley experiment, The negative result. Postulates of special theory of relativity. Lorentz transformation, time dilation, length contraction, addition of velocities, mass-energy relation.

REFERENCE BOOKS:

1. BSc Physics -Telugu Akademy, Hyderabad

2. Mechanics - D.S. Mathur, Sulthan Chand & Co, New Delhi

3. Mechanics - J.C. Upadhyaya, Ramprasad & Co., Agra

4. Properties of Matter - D.S. Mathur, S.Chand & Co, New Delhi ,11th Edn., 2000

5. Physics Vol. I - Resnick-Halliday-Krane ,Wiley, 2001

6. Properties of Matter – Brijlal & Subrmanyam, S. Chand &Co. 1982

7. Dynamics of Particles and Rigid bodies– Anil Rao, Cambridge Univ Press, 2006

8. Mechanics-EM Purcell, Mc Graw Hill

9. University Physics-FW Sears, MW Zemansky & HD Young, Narosa Publications, Delhi

10. College Physics-I. T. Bhima sankaram and G. Prasad. Himalaya Publishing House.

11. Mechanics, S. G. Venkata chalapathy, Margham Publication, 2003.

COURSE 1: MECHANICS AND PROPERTIES OF MATTER

Practical   Credits: 1   2hrs/week

COURSE OBJECTIVE:

To develop practical skills in the use of laboratory equipment and experimental techniques for measuring properties of matter and analyzing mechanical systems.

LEARNING OUTCOMES:

1. Mastery of experimental techniques: Students should become proficient in using laboratory equipment and experimental techniques to measure properties of matter and analyze mechanical systems.
2. Application of theory to practice: Students should be able to apply theoretical concepts learned in lectures to real-world situations, and understand the limitations of theoretical models.
3. Accurate recording and analysis of data: Students should be able to accurately record and analyze experimental data, including understanding the significance of error analysis and statistical methods.
4. Critical thinking and problem solving: Students should be able to identify sources of error, troubleshoot experimental problems, and develop critical thinking skills in experimental design and analysis.
5. Understanding of physical principles: Students should develop an understanding of the physical principles governing mechanical systems and the properties of matter, including elasticity, viscosity, and thermal expansion.

Minimum of 6 experiments to be done and recorded

1. Viscosity of liquid by the flow method (Poiseuille's method)

2. Young's modulus of the material of a bar (scale) by uniform bending

3. Young's modulus of the material a bar (scale) by non- uniform bending

4. Surface tension of a liquid by capillary rise method

5. Determination of radius of capillary tube by Hg thread method

6. Viscosity of liquid by Searle's viscometer method

7. Bifilar suspension –moment of inertia of a regular rectangular body.

8. Determination of moment of inertia using Fly-wheel

9. Determination of the height of a building using a sextant.

10. Rigidity modulus of material of a wire-dynamic method (torsional pendulum)

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SEMESTER-II
COURSE 1: MECHANICS AND PROPERTIES OF MATTER

STUDENT ACTIVITIES

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Unit I: Vector Analysis
Activity: Field Mapping

Students can choose a physical field (e.g., temperature, magnetic field) and create a field map by taking measurements at different points. They can then calculate the gradient of the field and analyse the variations. This activity helps them understand the concept of gradient in a scalar field.

Unit II: Mechanics of Particles
Activity: Collision Experiments

Students can set up simple collision experiments using marbles, carts, or other objects. They can measure the initial and final velocities, masses, and analyze the momentum conservation. By varying the conditions (e.g., masses, initial velocities), they can observe the effects on the collision outcomes.

Unit III: Mechanics of Rigid Bodies and Continuous Media
Activity: Balancing Act

Students can experiment with balancing various objects (e.g., rulers, books) on different points to understand the concept of center of mass and stability. They can analyse the equilibrium conditions and explore how the position of the center of mass affects the stability.

Unit IV: Central Forces
Activity: Pendulum Motion

Students can investigate the motion of a simple pendulum by varying its length and measuring the time period. They can analyze the relationship between the period and the length, and discuss the concept of centripetal force and its role in circular motion.

Unit V: Special Theory of Relativity
Activity: Time Measurement

Students can perform a time measurement experiment using simple devices like water clocks or sand timers. They can compare the measured time between two events at different relative speeds and discuss the concept of time dilation

ANDHRA KESARI UNIVERSITY
I Year II Semester End Examinations
B.Sc. Physics (Minor)
Mechanics and Properties of Matter
[With effect from AY: 2023-24]
MODEL QUESTION PAPER

Time: 3 Hours   *Max. Marks: 75*

SECTION- A

Answer any *FIVE* out of the following. Each question carries 10 marks... 5X10 = 50 Marks

1. State and prove Gauss's divergence theorem.

2. Define scalar and vector fields. Give examples. State and prove Stoke's theorem.

3. Derive an expression for Rutherford scattering formula of alpha particle collision with a heavy nucleus.

4. Derive an expression for the velocity of a rocket at any given instant of time.

5. What is precessional motion of a symmetric top? Obtain an expression for the precessional velocity of a symmetric top.

6. Define the three moduli of elasticity. Obtain the relationship between them.

7. State Kepler's laws of planetary motion. Derive Kepler's second and third laws of motion.

8. Obtain an expression for the angular velocity of a satellite orbiting the earth.

9. Describe Michelson-Morley experiment and discuss its result.

10. Derive Lorentz transformation equations from special theory of relativity.

SECTION - B

Answer any *FIVE* out of the following. Each question carries 5 marks ...5X5 = 25 Marks

11.	Prove that the curl of a gradient is zero.
12.	What is curl of vector field? Explain its physical significance.
13.	A body of mass m_1 moving with velocity v_1 collides with another body of mass m_2 at rest. After collision the velocity of m_1 becomes ¾ times of the velocity. Find the ratio of their masses.
14.	Explain the concepts : Impact parameter and scattering cross section.
15.	Explain the principle of working of gyroscope

16.	Obtain the equation of motion for a rotating body.
17.	What are central forces? Show that the central force is conservative in nature.
18.	If the earth be one-half of its present distance from the sun, what will be the number of days in a year?
19.	Deduce Einstein's mass-energy relation.
20.	Explain about time dilation.

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