ANDHRA KESARI UNIVERSITY ::ONGOLE

Model Syllabus for Physics (Minor) in consonance with Curriculum framework w.e.f. AY 2025-26

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	III	1	Mechanics and Properties of Matter	3	3
			Mechanics and Properties of Matter-Practical	2	1
	IV	2	Waves and Optics	3	3
			Waves and Optics-Practical	2	1
III	V	3	Heat and Thermodynamics	3	3
			Heat and Thermodynamics-Practical	2	1
		4	Atomic, Molecular & Nuclear-Practical Physics	3	3
			Atomic, Molecular & Nuclear Physics-Practical	2	1
	VI	5	Electricity, Magnetism and Electromagnetic Theory	3	3
			Electricity, Magnetism and Electromagnetic Theory-Practical	2	1
		6	Electronic Devices and Digital Electronics	3	3
			Electronic Devices and Digital Electronics-Practical	2	1

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T.R.R. Govt. Degree College
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SEMESTER-III

COURSE 1: MECHANICS AND PROPERTIES OF MATTER

Theory **Credits: 3** **3 hrs/week**

COURSE OBJECTIVE:

The course on Mechanics and Properties of Matter aims to provide students with a fundamental understanding of the behavior 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 apply the laws of motion, solve equations of motion for variable mass systems.
2. Students will be able to define central forces and provide examples, understand the characteristics and conservative nature of central forces, to derive equations of motion under central forces.
3. Students will be able to define and relate elastic constants, interpret stress-strain relationships, and analyze bending in beams.
4. Students will be able to apply the basic principles of fluid dynamics including Bernoulli's theorem, viscosity, and surface tension in practical contexts.
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 MECHANICS OF PARTICLES (9 hrs)

Newton's 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-II CENTRAL FORCES (9 hrs)

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 central force, derivation of Kepler's laws, motion of satellites, Geo-stationary satellites

UNIT III: ELASTICITY AND BENDING OF BEAMS (9 hrs)

Stress and strain, Hooke's Law, Elastic moduli – Young's, bulk, and shear modulus, Poisson's ratio – Physical meaning, bending of beams – Types, point and distributed load, Cantilever and uniform bending – Qualitative treatment, Torsional pendulum – working principle and uses.

UNIT IV: FLUID MECHANICS (9 hrs)

Fluids: Properties and classification, Streamline vs. turbulent flow, Reynolds number, Bernoulli's theorem – Statement, simple derivation and applications (Venturimeter, airplane lift), Equation of continuity – Concept, Viscosity – Poiseuille's law (statement and qualitative explanation), Surface tension – Examples and qualitative ideas

UNIT V: SPECIAL THEORY OF RELATIVITY (9 hrs)

Galilean relativity, absolute frames, Michelson-Morley experiment, 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. Mechanics-EM Purcell, Mc Graw Hill
8. University Physics-FW Sears, MW Zemansky & HD Young, Narosa Publications, Delhi
9. College Physics-I. T. Bhima sankaram and G. Prasad. Himalaya Publishing House.
10. Mechanics, S. G. Venkata chalapathy, Margham Publication, 2003.
11. Fluid Mechanics – Frank M. White, McGraw Hill.
12. Textbook of Fluid Dynamics – M. D. Raisinghania, S. Chand & Co.

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SEMESTER-III

COURSE 1: MECHANICS AND PROPERTIES OF MATTER

Practical | **Credits: 1** | **2 hrs/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. Young's modulus by uniform bending
2. Young's modulus by non-uniform bending
3. Rigidity modulus using torsional pendulum
4. Viscosity of liquid by Poiseuille's method
5. Surface tension by capillary rise method
6. Flywheel – Determination of moment of inertia
7. Viscosity of liquid by Searle's viscometer method
8. Bifilar suspension – moment of inertia of a rectangular body
9. Radius of capillary tube by Hg thread method
10. Optional Simulation-based activity: Time dilation or projectile simulation.

STUDENT ACTIVITIES

Unit I: 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 II: 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 III: Elasticity and Bending of Beams

Activity: Beam Bending Experiment

Use rulers or meter sticks on supports to apply loads and measure deflection. This hands-on demo helps visualize how elasticity and loading affect real-world structures.

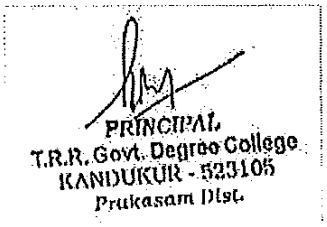
Unit IV: Fluid Mechanics

Activity: Water Jet Speed Measurement

Students can measure the range and height of a water jet to relate fluid velocity with pressure (Bernoulli principle). They can also explore streamlines using ink in water.

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



SEMESTER-IV

COURSE 2: WAVES AND APPLIED OPTICS

Theory **Credits: 3** **3 hrs/week**

COURSE OBJECTIVE:

This course introduces the physical principles of oscillatory motion, interference, and polarization of light, and explores modern optical phenomena including lasers, optical fibers, and holography. The objective is to build a deep conceptual understanding of wave behavior in mechanical and optical systems and their technological applications.

LEARNING OUTCOMES:

On successful completion of this course, the students will be able to:

1. Describe the basic characteristics of waves such as frequency, wavelength, amplitude, period, and speed and utilize mathematical relationships related to wave characteristics.
2. Understand the phenomenon of interference of light and its formation in Thin films and Newton's rings and Distinguish between Fresnel's diffraction and Fraunhoffer diffraction and observe the diffraction patterns in the case of single slit.
3. Explain the various methods of production of plane, circularly and polarized light and their detection and the concept of optical activity.
4. Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their applications in different fields.
5. Understand the basic principles of fibre optic communication and explore the field of Holography and Nonlinear optics and their applications.

UNIT-I: SIMPLE HARMONIC, DAMPED & FORCED OSCILLATIONS (9hrs)

Simple Harmonic Oscillator: Solution of differential equation, and physical characteristics, Principle of superposition, Combination of two mutually perpendicular SHMs (1:1 and 1:2 frequencies), Lissajous figures. Damping, Damped Harmonic Oscillator: Solution of differential equation, Energy considerations, Logarithmic decrement, relaxation time, quality factor, Forced Oscillations: Solution of differential equation.

UNIT-II: INTERFERENCE AND DIFFRACTION (9 hrs)

Interference: Principle of superposition – coherence Conditions for interference of light. Fresnel's biprism determination of wavelength of light, change of phase on reflection, Oblique

incidence of a plane wave on a thin film due to reflected light (cosine law) –Newton's rings in reflected light. Determination of wavelength of monochromatic light using Newton's rings.

Diffraction: Introduction, distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction – Diffraction due to single slit, Difference between interference and diffraction.

UNIT-III: POLARIZATION **(9 hrs)**

Polarized light: methods of polarization by reflection, refraction, double refraction, Brewster's law, Mauls law, Nicol prism polarizer and analyser, Quarter wave plate, Half wave plate, optical activity - Determination of specific rotation by Laurent's half shade Polarimeter. Idea of elliptical and circular polarization

UNIT-IV: LASERS **(9 hrs)**

Lasers: Introduction, Spontaneous emission, Stimulated emission, Population Inversion, Laser principle, Einstein coefficients, Types of lasers: He-Ne laser, Ruby laser, Semiconductor laser, Applications of laser.

UNIT-V: OPTICAL FIBERS AND HOLOGRAPHY **(9 hrs)**

Principle of Optical fibers, Acceptance angle, Acceptance cone, Numerical aperture, Types of optical fibers - Graded and Stepped index, Types Signal attenuation mechanisms in optical fibers, Applications of Optical fibers - Sensors, Imaging, Communication.

Holography: Basic principle of holography-Gabor hologram and its limitations, Applications of holography.

REFERENCE BOOKS:

1. BSc Physics Vol.1, Telugu Academy, Hyderabad.
2. Fundamentals of Physics. Halliday/Resnick/Walker, Wiley India Edition 2007.
3. Waves & Oscillations. S. Badami, V. Balasubramanian and K.R. Reddy, Orient Longman
4. BSc Physics, Vol .2, Telugu Academy, Hyderabad
5. A Text Book of Optics-N Subramanyam, L Brijlal, S. Chand& Co.
6. Unified Physics Vol. II Optics & Thermodynamics – Jai Prakash Nath & Co. Ltd., Meerut
7. Optics, F.A. Jenkins and H.G. White, Mc Graw-Hill 5. Optics, Ajay Ghatak, Tata Mc Graw-Hill. Introduction of Lasers – Avadhanulu, S. Chand & Co.
8. Principles of Optics- BK Mathur, Gopala Printing Press, 1995

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SEMESTER-IV

COURSE 2: WAVES AND APPLIED OPTICS

Practical **Credits: 1** **2 hrs/week**

COURSE OBJECTIVE:

This course provides students with a broad understanding of the physical principles of the oscillations, to help them develop critical thinking and aims to provide students with a fundamental understanding of the behavior and properties of light and its interaction with matter.

LEARNING OUTCOMES:

1. Perform experiments to analyze oscillatory systems and visualize resonance and damping.
2. Use optical instruments to study interference and polarization.
3. Measure the wavelength of light using Newton's rings and biprism methods.
4. Understand laser characteristics and fiber optic transmission through practical demonstration.
5. Record, analyze, and interpret experimental data with precision.

Minimum of 6 experiments to be done and recorded

1. Determination of 'g' by compound/bar pendulum
2. Simple pendulum normal distribution of errors-estimation of time period and the error of the mean by statistical analysis Verification of inverse square law of light using photovoltaic cell.
3. Determination of radius of curvature of a given convex lens-Newton's rings.
4. Resolving power of grating.
5. Study of optical rotation – polarimeter.
6. Dispersive power of a prism.
7. Determination of wavelength of light using diffraction grating-minimum deviation method.
8. Determination of wavelength of light using diffraction grating-normal incidence method.
9. Determination of thickness of a thin wire by wedge method
10. Refractive index of liquid using laser and rectangular container
11. Optical fiber - Numerical Aperture.

STUDENT ACTIVITIES

UNIT-I: Simple harmonic, damped & forced oscillations

Activity: Measuring the period of a simple pendulum and verifying the relationship between the period and the length of the pendulum. Students can use a stopwatch and a ruler to measure the time for a fixed number of oscillations and calculate the period.

Activity: Measuring the damping coefficient of a mass-spring system and calculating the quality factor. Students can measure the amplitude of the system as it undergoes damped oscillations and use the logarithmic decrement formula to calculate the damping coefficient. They can then use the formula for the quality factor to evaluate the quality of the system.

UNIT-II: Interference and Diffraction

Ask students to measure the diameter of the central bright spot and the diameter of the nth ring for different values of n, and then calculate the wavelength of light.

Build a simple diffraction grating using a piece of cardboard and some sewing needles. Ask students to measure the distance between the needles, count the number of lines per unit length, and then calculate the grating spacing and the wavelength of light.

UNIT-III: Polarization

Ask students to measure the angle of rotation of the polarized light before and after passing through the sample, and then calculate the specific rotation of the sample.

Unit-IV: Lasers

Activity: Laser Communication Demo – Group project to transmit voice using a laser beam and photodiode.

Unit-V: Optical fibers and Holography

Demonstrate the principle of holography using a laser beam, a beam splitter, and a photographic plate. Ask students to record a hologram of a simple object and then reconstruct the image using a laser beam.

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