PARVATHANENI BRAHMAYYA
SIDDHARTHA COLLEGE OF ARTS & SCIENCE
Autonomous
Siddhartha Nagar, Vijayawada–520010
Re-accredited at 'A+' by the NAAC

23PHMIL121: MECHANICS, WAVES AND OSCILLATIONS

Offered to: All UG Programs **Semester – II**

Max. Marks: 100 (CIA: 30 + SEE: 70) **60Hrs** **Credits: 04**

Course Objectives:

1. provide an in-depth understanding of the principles of Newtonian mechanics and apply them to solve problems involving the dynamic motion of classical mechanical systems
2. explain the limitations of Newtonian mechanics for motion at very high velocities, and thus introduce the special theory of relativity
3. provide hands-on experience to perform experiments to study some properties of matter and oscillations
4. By Learning Fourier analysis, students can analyze different mechanical, optical, and electromagnetic waves
5. To attain knowledge of Ultrasonic waves and apply it to different fields

Course outcomes:

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

CO1: Application of basic laws of motion to solve various problems related to day-to-day life

CO2: Understand the applications of mechanics and waves in day-to-day life.

CO3: Utilize mathematical models to represent and solve problems related to real-world applications

CO4: Ability to recognize the suitable solution with necessary equations, and derive these equations for certain systems

CO5: Foster the development of a scientific mindset that includes questioning assumptions and seeking deeper understanding.

CO-PO MATRIX								
23PHMIL 121	**CO-PO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
	CO1					2		
	CO2						2	
	CO3						2	
	CO4							2
	CO5						3	

Unit	Learning Units	Lecture Hours
I	A. **Mechanics of Particles** (5 hrs) Review of Newton's Laws of Motion, Motion of variable mass system, Multistage rocket, Concept of impact parameter, scattering cross-section, Rutherford Scattering-Derivation. B. **Mechanics of Rigid bodies** (7 hrs) Rigid body, rotational kinematic relations, Equation of motion for a rotating body, Angular momentum, Euler equations, Precession of a spinning top, Precession of the equinoxes	12
II	A. **Celestial mechanics** Central force - definition and examples, characteristics of central forces, conservative nature of central forces, Equation of motion under a central force B. **Orbital mechanics** Kepler's laws of planetary motion- Proofs, Motion of satellites – escape velocity, orbital velocity	12
III	A. **Frames of reference and transformation** (5 hrs) Galilean transformations, Michelson-Morley experiment & negative result. Postulates of Special theory of relativity, B. **Consequences of relativistic transformations** (7 hrs) Lorentz transformation, time dilation, length contraction, Einstein's mass-energy relation	12
IV	A. **Undamped, Damped, and Forced oscillations**: (07 hrs) Simple harmonic oscillator, damped harmonic oscillator, forced harmonic oscillator - differential equations and its solutions, Resonance, Logarithmic decrement, Relaxation time and Quality factor. B. **Fourier analysis (05 hrs)** Fourier theorem (Statement & limitations), evaluation of the Fourier coefficients using Fourier's theorem, analysis of periodic wave functions - square wave	12
V	A. **Vibrating Strings**: (07 hrs) Transverse wave propagation along a stretched string, General solution of the wave equation and its significance, Modes of vibration of stretched string clamped at ends, Overtones, and	12

	Harmonics. B. **Ultrasonics**: (05 hrs) Ultrasonics, General Properties of ultrasonic waves, Production of ultrasonics by piezoelectric and magnetostriction methods, Applications of ultrasonic waves	

TEXT BOOKS

1. B. Sc. Physics, Vol.1, Telugu Academy, Hyderabad

REFERENCE BOOKS:

1. Fundamentals of Physics Vol. I - Resnick, Halliday, Krane, Wiley
2. Waves and Oscillations. N. Subramanyam and Brijlal, Vikas Pulications.
3. Science and Technology of Ultrasonics- Baldevraj, Narosa, New Delhi,2004

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Model Question Paper

23PHMIL121:Mechanics, Waves and Oscillations

Max.Time: 3 hours Maximum Marks: 70

SECTION-A

Answer the following: 5 x 10 = 50 M

1 A) What is Rutherford scattering? Obtain an expression for the number of particles scattered per unit area. (L1, CO1).

(OR)

B) What is precessional motion? Find the angular velocity of the precession of a spinning top. Show that the rate of precession is independent of mass but depends on the distribution of mass. (L1, CO2).

2. A) What is conservative force? Show that central forces are conservative. (L2, CO2).

(OR)

B) State Kepler's third law of motion. And prove that the square of period of revolution of a planet moving in a circular orbit round the sun is proportional to the cube of its distance from the sun. (L2, CO2)

3 A) State the fundamental postulates of special theory of relativity and deduce the Lorentz transformations. (L2, CO3)

(OR)

B) Describe the Michelson-Morley experiment and explain the physical significance of negative results. (L2, CO3)

4 A) What are damped oscillations? Derive the differential equation of the damped Harmonic oscillator and discuss the case of under-damping. (L2, CO3).

(OR)

B) State the Fourier Theorem and evaluate Fourier coefficients. (L2, CO4).

5 A) What are transverse waves? Obtain the equation of velocity of a transverse wave in a wire kept under tension. (L3. CO5).

(OR)

B) What are ultrasonics? Describe the Magnetostriction method of producing ultrasonics (L3, CO5).

SECTION-B

Answer the following questions: 3x4=12M

6. A) State Newton's laws of motion and give two examples each. (CO1, L1)

(OR)

B) Explain central forces with examples. (CO2, L1)

7. A) Explain time dilation. (CO3, L1)

(OR)

B) What is logarithmic decrement and relaxation time? (CO4, L1)

8. A) Explain overtones and harmonics. (CO5, L1)

(OR)

B) Write any four applications of Ultrasonics

Section – C

Answer the following: 2X4=8M

9. A) The kinetic energy of a metal disc rotating at a constant speed of 5 revolutions per second is joules. Find the angular momentum of the disc. (CO2, L3)

(OR)

B) If the Earth is one-half of its present distance from the sun, what will be the number of days in a year (CO2, L3)

10. A) If the energy note of frequency 100Hz decreases to one-half of its original value in one second, calculate the Q-factor, (CO4, L3)

(OR)

B). A piezoelectric crystal has a thickness of 0.002m. If the velocity of the sound wave in crystal is 5750m/s, calculate the fundamental frequency of the crystal. (CO5, L3)

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