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

23PHMAL122: WAVES AND OSCILLATIONS **Major 4(Th)**
Offered to: B.Sc. Honours (Physics) **Semester – II**
Max. Marks: 100 (CIA: 30+ SEE: 70) **60 Hrs** **Credits: 04**

Course objectives

CO1 Define and explain the basic concepts of waves and oscillations, including terms such as amplitude, frequency, wavelength, and phase.

CO2 Gain the knowledge of wave propagation and oscillatory motion

CO3 Demonstrate an understanding of wave propagation by solving real-world problems.

CO4 Relate the principles of waves and oscillations to practical applications in fields such as physics, engineering, and communication

CO5 Critically assess the applications of wave and oscillation principles in various scientific and technological contexts

CO-PO MATRIX								
	CO-PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
23PHMAL122	**CO1**						2	
	CO2							2
	CO3					2		
	CO4						2	
	CO5						3	

Unit	Learning Units	Lecture Hours
I Simple Harmonic oscillations	**A**) Simple harmonic oscillator and solution of the differential equation- Physical characteristics of SHM, Torsion pendulum-measurements of rigidity modulus, Compound pendulum- measurement of 'g', **B**) Principle of superposition, the combination of two mutually perpendicular simple harmonic vibrations of the same frequency and different frequencies, applications of Lissajous figures	12
II Damped and forced oscillations	**A**) Simple harmonic oscillator, damped harmonic oscillator - differential equations and its solutions Logarithmic decrement, Relaxation time, and Quality factor. **B**) forced harmonic oscillator - differential equations and its solutions, amplitude resonance.	12
III Complex vibrations	**A**) Fourier theorem (Statement & limitations), evaluation of the Fourier coefficients using Fourier's theorem **B**) Analysis of periodic wave functions - square wave, saw tooth wave.	12
Strings and Bars	**A**) Transverse wave propagation along a stretched string, Velocity of a transverse wave along a stretched string, modes of vibration of stretched string clamped at ends, overtones and harmonics. **B**) General solution of the Longitudinal wave equation. Special cases (i) bar fixed at both ends (ii) bar fixed at the midpoint (iii) bar fixed at one end.	12
v Ultrasonics,	Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezo-electric and magnetostriction methods, detection of ultrasonics, Applications and uses of ultrasonic waves.	12

TEXTBOOKS

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

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Model Question Paper

23PHMAL122: Waves and Oscillations

MAX.MARKS : 70 **MAX.TIME : 3Hrs**

SECTION-A

Answer the following: 5 x 10 = 50 M

1. A) Define simple harmonic motion. Derive the equation of a simple harmonic oscillator and obtain its solution (L3. CO1)

(OR)

B) Discuss the combination of two mutually perpendicular simple harmonic vibrations (L3, CO1)

2. A) What are damped oscillations? Derive the equation of motion of a forced oscillator and find its solution (L3, CO3)

(OR)

B) What are forced oscillations? Derive the equation of motion of a forced oscillator and obtain its solution (L3, CO2)

3 A) State Fourier's theorem and evaluate the Fourier coefficients. (L3, CO3).

(OR)

B) Analyse a square wave using the Fourier theorem. (L3, CO3)

4. A) Derive an expression for the velocity of a transverse wave along a stretched string. (L3, CO4).

(OR)

B) Deduce the modes of vibration of a rod clamped at one end and free at the other end (L2, CO4)

5 A) Describe the Magnetostriction method of producing ultrasonic waves. (L2, CO5)

(OR)

B) Describe the Piezo-electric method of producing ultrasonic waves (L2, CO5)

SECTION-B

Answer the following questions: 3x4=12M

6. A) Explain briefly the physical characteristics of simple harmonic motion (L1, CO1)

(OR)

B) Define relaxation time and drive an expression for it. (L2, CO2)

7. A) Mention the limitations of Fourier's theorem (L1, CO3)

(OR)

B) Explain overtones and harmonics. (L1, CO4)

8. Write any five applications of ultrasonics. (L1, CO2)

(OR)

Write any four applications of Lissajou's Figures(L1, CO2)

Section – C 2X4=8M

Answer the following questions

9. A) A spring of force constant $20NM^{-1}$ is loaded with a mass of 0.1 kg and allowed to oscillate. Calculate the time period and frequency of oscillation of the string (L4, CO1)

(OR)

B) The amplitude of an oscillator of frequency 200Hz falls to $1/10^{th}$ of its initial value after a time of 10s. Calculate its relaxation time and Q-factor. (L4, CO2)

10. A) A steel wire of length 50cm has a mass of 5gm. It is stretched with a tension of 400N. Calculate the frequency of the wire in the fundamental mode of vibration (L3, CO4)

(OR)

B) Calculate the fundamental frequency of a quartz crystal of thickness 0.003m given Y-$8X10^{10}$Pa and density is $2500kgm^{-3}$ for quartz (L3, CO5)

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