Course Code	Course Name	Credits
26PH610	ULTRSONIC AND ITS APPLICATIONS	04

Course Objectives

- Make student familiar to Ultrasonic sounds and its properties.
- Make familier to applications and different testing of it.

Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Understand the basic knowledge of ultrasonic sound.
- Learn how to use the ultrasonic instruments
- Gain the knowledge testing using it.

Unit 1 – Fundamentals of Ultrasonics (12 Hrs.)

Introduction - Brief Early History - Underwater Sound (SONAR) - Medical and Biological Ultrasonics - Industrial Ultrasonics - Nondestructive Testing/Evaluation - Ultrasonics in Electronics - Physical Acoustics - Ultrasonic Systems: Transmitters and Receivers - Low- Intensity Applications - High-Intensity Applications - Modern Ultrasonics: An Interdisciplinary Field - Velocity of Sound in Solids - Velocity of Sound in Liquids - Velocity of Sound in Gases - Wave Incident on a Liquid - Solid Plane Interface, Semi-Infinite Media - Reflection, Refraction.

Unit 2 – Basics of Ultrasonic Transducers (12 Hrs.)

Piezoelectric Transducers - equivalent circuit of a simple piezoelectric transducer - efficiency of a simple piezoelectric transducer - maximum power transfer between Electronic Power Source and Simple Piezoelectric Transducers - Determining Transformation Factor (α) for the Piezoelectric Transducer Material - Quality Factor (Q) of Piezoelectric Transducers - Piezoelectric Transducers for High-Intensity Applications - Pulse-Type Transducers for Low-Intensity Applications Sensing - Piezoelectric Polymers for Transducers.

Unit 3 - Measurement Techniques of Ultrasonics (12 Hrs.)

Measurement of Velocity and Attenuation in Isotropic Solids - Measurement of Velocity and Attenuation in Fluids - Methods of Measuring Velocity of Sound - Interferometer Method - Resonance Method - "SingAround" Method - Pulse-Superposition Method - Pulse-Echo-Overlap Method - Measurements in Materials of High Attenuation - Measurements at High Temperatures - Measurements at High Pressures - Measuring Torsional Resonant Frequencies of Isotropic Bars.

Unit 4 – Applications of Ultrasonics (12 Hrs.)

Electron Acoustic Image Converter - Schlieren Imaging - Liquid Levitation Imaging - Ultrasonic Imaging with Liquid Crystals - Photographic Methods of Imaging by Ultrasonics - Ultrasonic Holography - Acoustic Microscopy - Ultrasonic Arrays - Ultrasound in Process Industries - Monitoring Solidification (Interface Sensing) - Acoustic Time Domain Reflectometry - Three-Phase Reactors - Process Tomography Using Ultrasonic Methods - Ultrasonic Transducers. Process Industry Applications - Sonochemistry - Depolymerization - Polymerization – Precipitation - Metallurgical Effects.

Unit 5 - Ultrasonic Non-Destructive Testing (12 Hrs.)

Resonance Methods - Pulse Methods - Acoustic Emission Technique - Factors Affecting Resolution and Sensitivity - Near-Field Effects - Properties of the Materials - Eddy Sonic Inspection Method - Sonic Analysis - Acoustic Impact Technique - Ultrasonic Spectroscopy - Critical Angle Analysis - Instrumentation - Resonance Methods - Pulse Methods - Acoustic Emission Methods - Phased Arrays Systems - Methods Used to Determine Flaw Size.

Reference Books:

1. David, J., &Cheeke, N. (2002). Fundamentals and Applications of Ultrasonic Waves, CRC Press.
2. Dale, E., & Bond, L.J. (2011). Ultrasonics Fundamentals, Technologies and Applications, (3rd Ed.). CRC Press, Taylor & Francis Group.

Websites and eLearning Sources:

1. https://onlinecourses.nptel.ac.in/noc25_ge45/preview
2. https://youtu.be/p3skjxnbbeQ?si=Fihwz5Go_cmqt3Pn
3. https://youtu.be/arNAMxCgVKs?si=IDO3GTmnOOCS3VDa

COs and Bloom's Taxonomy Mapping – 26PH610		
Course Outcomes	**On successful completion of this course, students will be able to**	**BTL**
CO1	Recall and explain the fundamentals of ultrasonics, wave propagation, and acoustic properties in solids, liquids, and gases.	K1, K2
CO2	Apply measurement techniques to determine ultrasonic velocity, attenuation, and material properties.	K3
CO3	Analyze imaging and industrial applications of ultrasonics including acoustic microscopy and process monitoring.	K4
CO4	Analyze non-destructive testing methods including resonance, pulse techniques, and acoustic emission methods.	K5
CO5	Evaluate and design ultrasonic testing systems and instrumentation for flaw detection and industrial applications.	K6

BTL (Bloom's Taxonomy Level) - K1 – Remembering, K2 – Understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6 - Create

Relationship Matrix – 26PH610													
Course Outcomes	**Programme Outcomes (POs)**						**Programme Specific Outcomes (PSOs)**						**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	
CO1	3	2	1	1	1	1	3	2	1	1	1	1	1.58
CO2	3	3	2	2	1	1	2	3	2	2	2	1	2.00
CO3	3	3	3	2	1	1	2	3	3	2	2	2	2.25
CO4	3	3	3	2	2	1	2	3	3	2	2	2	2.33
CO5	3	3	3	3	2	2	3	3	3	3	2	2	2.58
												Total	2.15

Mean Score: 3- High, 2- Medium/Moderate, 1-Low