ESTD: 1946

THE NATIONAL INSTITUTE OF ENGINEERING

An Autonomous Institution under Visvesvaraya Technological University, Belagavi), Recognized by AICTE, New Delhi, Grant-in-Aid by Government of Karnataka, Accredited by NAAC, New Delhi

Curriculum Structure and Syllabus 2025-26

I Year B.E.

Mechanical Engineering

Manandavadi Road, Mysuru-570 008
Phone; 0821 - 4004900, 2481220; Fax: 0821 - 2485802
E-mail: info@nie.ac.in; Website: http://www.nie.ac.in

Code: 1BPHME202
Credits: 3
SEE: 50 Marks
SEE Hours: 3

Course: Applied Physics for Mechanical Engineering
L:T:P:S- 2:2:0:0
CIE: 50 Marks
Max. Marks:100

Learning objectives	**1.** To understand the fundamental principles of oscillations, ultrasonics, elasticity, modern physics, quantum mechanics, and photonics. **2.** To develop the ability to apply theoretical concepts to analyze physical systems, materials behaviour, and technological applications. **3.** To gain knowledge of advanced materials characterization and instrumentation techniques for investigating structural, optical, and mechanical properties of materials.

Course Outcomes:

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Discuss the principles of crystal structure, oscillations, ultrasonics and acoustics and apply them to engineering systems.	Understand
CO2	Apply concepts of modern physics and quantum mechanics to analyze microscopic phenomena and emerging technologies.	Apply/Analyze
CO3	Demonstrate understanding of photonic principles including lasers and optical fibers, and evaluate their applications in communication and industry.	Apply/Analyze

Mapping with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	2											3			
CO2	3	2											3			
CO3	3	3											3			
CO4	3	1											3			

Mapping Strength: Strong– 3 Medium – 2 Low – 1

Course Structure

Module 1: Crystal Physics		No. of Lecture Hours	No. of Tutorial Hours
1.1	**Crystal physics:** Space lattice, Bravais lattice – unit cell, primitive cell, Lattice parameters, seven crystal systems,	1	0
1.2	Direction and planes in a crystal, Miller indices – procedure, features, and sketches for different planes	1	1
1.3	coordination number, atomic packing factor, relation between density and lattice constant	1	0
1.4	Crystal structures of NaCl and Diamond	1	0
1.5	X-ryas, Bragg's law, Determination of crystal structure by Bragg's spectrometer	1	1
1.6	numericals	0	1
Module 2: Vibrations and Ultrasonics			
2.1	**Oscillations:** Vibration of spring mass system (Derivation), series and parallel combination of springs (Derivation), numerical problems, Free vibration	1	1
2.2	Theory of damped vibration (Derivation), Types of damping.	1	0
2.3	Theory of forced vibration (Derivation), amplitude Resonance	1	0
2.4	**Ultrasonics:** Ultrasonic waves, Production of Ultrasonic waves using piezoelectric oscillator, Properties and Applications of Ultrasonic waves - Non destructive testing (detection of flaws in metals).	1	1
2.5	**Acoustics:** Introduction to acoustics,Types of acoustics, reverberation and reverberation time, Sabine's formula	1	0
2.6	absorption coefficient, measurement of absorption coefficient, factors affecting the acoustics and remedial measures, requisites for acoustics in auditorium,	1	0
Module-3: Modern Physics & Quantum Mechanics			
3.1	**Modern Physics:** de Broglie Hypothesis and Matter waves, de Broglie wavelength and derivation of expression by analogy, Phase velocity, group velocity.	1	0
3.2	Expression for group velocity, Relation between group velocity and particle velocity (relativistic method), Characteristic properties of Matter-waves, numerical problems.	1	1
3.3	Heisenberg's uncertainty principle and its physical significance (no derivation), Application of uncertainty principle (Non - existence of electron in the nucleus), numerical problems.	1	1
3.4	**Quantum Mechanics:** Wave function, Properties and Physical significance of a wave function, Setting up of a one dimensional time independent Schrödinger wave equation, Eigen values and Eigen function.	1	0
3.5	Application of Schrödinger wave equation - Energy Eigen values and Eigen functions of a particle in a potential well of infinite depth, Numerical problems on Eigen values.	1	1

Module-4: Photonics			
4.1	**Lasers:** Interaction of radiation with matter: absorption, spontaneous emission and stimulated emission, Basic properties of laser, Einstein's coefficients (expression for energy density)	1	1
4.2	Requisites of a Laser system, Condition for Laser action, Construction and working of Ruby laser	1	0
4.3	Applications of Laser - LIDAR (measurement of pollutants), Cutting, Welding and Drilling using laser. Numerical Problems	0	1
4.4	**Optical fibers:** Principle and structure of optical fibers, Angle of acceptance, Numerical aperture. Modes of propagation, V-number, Types of optical fibers, Attenuation, fiber losses	1	1
4.5	Applications – Temperature sensor, Displacement sensor	1	0
4.6	Numerical problems	0	1
Module-5: Materials Characterization and Instrumentation Techniques			
5.1	Introduction to nanomaterials, Classification of nanomaterials, Properties and applications of nanosystems, Carbon nanotubes (CNTs) & their Applications,	1	1
5.2	Graphene - Synthesis methods, Mechanical Properties & Applications.	1	1
5.3	Principle, construction and working of Atomic Force Microscopy (AFM), Fourier transform infrared spectroscopy (FTIR)	2	0
5.4	Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Numerical Problems.	2	0
	Total No. of Lecture Hours	**26**	
	Total No. of Tutorial sessions		**14**
	Total No. of Hours/ session		**40**

Textbooks:

1. Concepts of Modern Physics by Arthur Beiser, Shobhit Mahajan & S. Rai Choudhury, TataMc-Graw–Hill Publication, 7thEdition, 2017
2. Engineering Physics by R. K. Gaur and S. L. Gupta, 2010 edition, Dhanpat Rai Publications Ltd., New Delhi-110002.
3. A textbook of Engineering Physics by M .N. Avadhanulu, P G. Kshirsagar and T V S Arun Murthy, Eleventh edition, S Chand and Company Ltd. New Delhi-110055.

Reference books / Manuals:

1. Waves and Oscillations – By N Subramanyam and Brijlal, Vikas Publishing house Pvt. Ltd.
2. Materials Characterization Techniques-Sam Zhang, Lin Li, Ashok Kumar, CRC Press, First Edition, 2008.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_ph01/preview (for LASER)
2. https://onlinecourses.nptel.ac.in/noc21_ce45/preview (for Elasicity)