Dr. Ambedkar Institute of Technology, Bengaluru - 56

Department of Physics

Scheme and Syllabus – 2025 - 2026

Course Title	Physics for Sustainable Structural Systems						
Course Code	1BPHU202A (CV Stream)						
Category	Applied Science Course (ASC) (Integrated Course)						
Scheme and Credits	No. of Hours / Week					Total teaching hours	Credits
	L	T	P	SS	Total		
	02	02	02	00	06	40 + 10 – 12 labs	04
CIE Marks: 50	**SEE Marks: 50**		**Total Max. Marks =100**		**Duration of SEE: 03 Hours**		

Course Objective: To introduce the Engineering students to the basics of oscillations, Waves and their role in structural behavior, Acoustics, Radiometry and Photometry, Smart Materials for Sustainable Structures with an emphasis on inculcating strong analytical skills among them so that they can understand and analyze complex engineering problems with relative ease.

Unit No.	Syllabus Content	No. of Teaching Hours
1	**Oscillations:** Simple harmonic motion (SHM), Differential equation for SHM, Theory of free vibrations, theory of damped vibration types of damping (Graphical Approach). Engineering applications of damped oscillations, theory of forced vibrations, Resonance: condition for resonance, sharpness of resonance. Resonance in LCR Circuits (Qualitative), Numerical Problems.	8
2	**Elasticity** Review of Stress-Strain Curve, Hooke's law and its limits. Elastic Moduli, Poisson's ratio, Relation between Y, n and σ (with derivation), mention relation between K, Y and σ, limiting values of Poisson's ratio. Torsion: Expression for couple per unit twist of Cylindrical wire	8

	(derivation). Torsional Pendulum: Expression for time period of oscillation and Rigidity modulus (Derivation), Beams, Bending of beams: neutral surface and neutral axis. Expression for bending moment beam (derivation), Cantilever, Expression for depression in loaded cantilever (Derivation): Applications of beams in Engineering. Numerical problems.	
3	**Waves and their role in structural behavior:** Types of waves, Wave propagation in beams, rods, and slabs, Boundary effects, Wave dispersion, Damping in structures, Energy dissipation techniques in structures, Introduction to earthquakes, General characteristics, P-waves, S-waves, Love waves, and Rayleigh waves, Ground motion and structural response, Site effects and soil-structure interaction, Physics of earthquakes, Richter scale of measurement and earthquake-resistant measures, Tsunami (causes for tsunami, characteristics, adverse effects, risk reduction measures, engineering structures to with stand tsunami), Seismometer and Seismograph.	**8**
4	**Acoustics, Radiometry and Photometry:** **Acoustics:** Introduction to Acoustics, Types of Acoustics, Reverberation and reverberation time, Absorption power and Absorption coefficient, Requisites for acoustics in auditorium, Sabine's formula (Qualitative), Measurement of absorption coefficient, Factors affecting the acoustics and remedial measures, Sound insulation and its measurements. Noise and its measurements, Impact of noise in multi-storied buildings. **Radiometry and Photometry:** Radiation quantities, Spectral quantities, Relation between luminance and Radiant quantities, Reflectance and Transmittance, Photometry (cosine law and inverse square law).	**8**
5	**Smart Materials for Sustainable Structures:** Types of smart materials, Piezo, Magnetostrictive, Electrostrictive, Electro-rheological, Magneto-rheological, Shape memory alloys, Phase transformation in shape memory alloys, Overview of sensor technology,	**8**

	uses of sensors in intelligent structures, Classification of sensors, Temperature sensor, Vibration Sensor, Strain Gauge sensors, Basic concepts of structural health monitoring.	

Experimental Components:

Any Ten Experiments have to be completed from the list of experiments

1. Series & Parallel resonance LCR Circuits.
2. Determination of Fermi energy of a copper.
3. Determination of Wavelength of LASER using Grating.
4. Determination of Numerical Aperture using Optical Fiber.
5. Determination of Planck's constant using LEDs.
6. Determination of Radius of curvature of Plano convex lens using Newton's rings.
7. Determination of Young's Modulus of the given Beam by Single Cantilever.
8. Determination of Rigidity Modulus of the wire using Torsional Pendulum.
9. Determination of Acceleration due to Gravity by Bar Pendulum.
10. Determination of Moment of Inertia of the given irregular body Using Torsional Pendulum.
11. Energy Gap of the given Semiconductor
12. GNU Step Interactive Simulations
13. Study of Electrical quantities using spreadsheet
14. Online Circuit Simulator (https://www.partsim.com/simulator)
15. PHET Interactive Simulations (https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototyp)

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Analyze the principles of simple harmonic, damped, and forced oscillations, and apply them to solve problems involving mechanical and electrical oscillatory systems. Apply the concepts of stress, strain, and elastic moduli to evaluate the elastic behavior of solids under various loading conditions.

2. Evaluate the principles of thermoelectric effects and assess the performance of thermoelectric materials and devices for energy conversion and thermal management.

3. Explain the core concepts of quantum mechanics such as matter waves, uncertainty principle, wave functions, and quantization of energy, with relevance to computational applications.

4. Explain the material characterization techniques and instrumentation to analyze the macroscopic and microscopic properties of engineering materials.

5. Practice working in groups to conduct basic Physics experiments, record, observations and arrive at appropriate conclusions.

Suggested Learning Resources:

1. A Textbook of Engineering Physics- M.N. Avadhanulu and P.G. Kshirsagar, 10th revised Ed, S. Chand. & Company Ltd, New Delhi.

2. An Introduction to Lasers theory and applications by M.N. Avadhanulu and P.S. Hemne revised Edition 2012. S. Chand and Company Ltd-New Delhi.

3. Engineering Physics-Gaur and Gupta Dhanpat Rai Publications -2017.

4. Concepts of Modern Physics-Arthur Beiser: 6th Ed; Tata Mc Graw Hill Edu Pvt. Ltd. New Delhi 2006.

5. Fundamentals of Fibre Optics in Telecommunication & Sensor Systems, B..P. Pal, New Age International Publishers.

6. Lasers and Non - Linear Optics – B.B.Laud, 3rd Ed, New Age International Publishers 2011.

7. LASERS Principles, Types and Applications by K.R.Nambiar New Age International Publishers

8. Solid State Physics - S O Pillai, 8th Ed-New Age International Publishers-2018.

9. Quantum Physics and Applications, Dr. Geethanjali H. S., Dr. Nagaraja D., Jeevith Publications. (Unit – IV)

Web links and Video Lectures(e-Resources):

1. Laser: https://Laser:https://nptel.ac.in/courses/115/102115102124/
2. Quantum Mechanics: https://nptel.ac.in/courses/115/104/115104096/
3. Physics: http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

4. Numerical Aperture of fiber: https://bop-iitk.vlabs.ac.in/exp/numerical-aperture-measurement
5. NPTELSuperconductivity:https://archive.nptel.ac.in/courses/115/103/115103108/

Activity-Based Learning (Suggested Activities in Class)/ Practical-Based Learning

1. http://nptel.ac.in
2. https://swayam.gov.in
3. https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham
4. https://vlab.amrita.edu/index.php?sub=1&brch=189&sim=343&cnt=1
5. https://virtuallabs.merlot.org/vl_physics.html
6. https://phet.colorado.edu
7. https://www.myphysicslab.com

Scheme for Examinations

1. Two full questions to be set from each unit with internal choice
   - Minimum number of sub-questions: 2.
   - Maximum number of sub-question: 3.
2. Each full question shall be for a maximum of 20 marks

Answer any five full questions choosing at least one full question from each unit

Note: 1. Questions from Experiments shall be included in the SEE question paper

2. Questions from Self-study component will not be asked for CIE and SEE

COs	**POs**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO2	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO3	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO4	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO5	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

Level-3: Highly Mapped, Level-2: Moderately Mapped, Level-1: Low Mapped