K. S. INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU, Approved by AICTE

Department of Physics

FIRST / SECOND SEMESTER SYLLABUS

Course : Applied Physics for ME Stream: PHYSICS OF MATERIALS		Semester	I/II
Course Code	25BPHME102/202	CIE Marks	50
Teaching Hours/Week(L:T:P:S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	04	Exam Hours	03
Examination type(SEE)	**Theory**		

Course Objectives (Course Skill Set): The students will be able

- To understand the types of oscillation, shock waves and its applications.
- To Study the elastic properties of materials.
- To understand the fundamentals of thermoelectric materials and devices and their application.
- To understand the concepts of low temperature phenomena and the methods used for its generation.
- To study the basics of nanomaterials and various relevant material characterization techniques.

Module-1: Oscillations and Shock waves

Oscillations: Simple Harmonic motion (SHM), Differential equation for SHM (No derivation), Sprigs: Stiffness Factor and its Physical Significance, Series and Parallel combination of springs (Derivation), Types of Springs and their applications. Theory of Damped oscillations (Qualitative), Types of Damping (Graphical Approach). Engineering applications of Damped oscillations, Theory of Forced oscillations (Qualitative), Resonance, Sharpness of resonance, Resonance in LCR circuits (Qualitative), Numerical Problems.

Shock waves: Mach number and Mach Angle, Mach Regimes, Definition and Characteristics of Shock waves, Construction and working of Reddy Shock tube, Applications of Shock Waves. Numerical problems.(8 hours)

Text 1:Ch 1 and Ch 2

Module-2: Elasticity

Review Stress-Strain Curve, Strain hardening and softening. 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. Static and dynamic loading, Beams, Bending moment and derivation of expression, Cantilever, Torsion and Expression for couple per unit twist, Elastic materials (qualitative). Failures of engineering materials - Ductile fracture, Brittle fracture, Stress concentration, Fatigue and factors affecting fatigue (only qualitative explanation), S-N Curve, Numerical problems. **(8 hours)**

Text 1: Ch 3

Module-3: Cryogenics

Introduction to Thermodynamics, Carnot's principle, Efficiency, Production of low temperature - Joule Thomson effect (Derivation with 3 cases), Porous plug experiment with theory, Thermodynamical analysis of Joule Thomson effect, Liquefaction of Oxygen by cascade process, Lindey's air liquefier, Liquefaction of Helium and its properties (superfluidity), Platinum Resistance Thermometer, Applications of Cryogenics: Aerospace, Tribology and Food processing(qualitative), Numerical Problems. **(8 hours)**

Ref 3: Ch 1,Ch 4-6, Ch 13, Ch 16

Module-4: Thermoelectric and energy conversion materials

Thermo emf and thermo current, Seeback effect, Peltier effect, Seebeck and Peltier coefficients, figure of merit (Mention Expression), laws of thermoelectricity. Expression for thermo emf in terms of T1 and T2, Thermo couples, thermopile, Construction and Working of Thermoelectric generators (TEG), Thermoelectric coolers (TEC), Low, mid and high temperature thermoelectric materials, Applications: Exhaust of automobiles, Refrigerator, Space program(Radioisotope Thermoelectric Generator- RTG), Numerical Problems. **(8 hours)**

Text 2: Ch 17

Module-5: Nanomaterials and Characterization Techniques

Nanomaterials: Nanotechnology, Length Scales, Variation of physical properties from bulk to thin films to nanomaterials, mesoscopic state, Confinement of electron in 0D, 1D, 2D and 3D systems, Surface to Volume Ratio, Carbon nano tubes: Types, Properties & its applications.

Characterization Techniques: Principle, construction and working of X-ray Diffractometer, Crystallite size determination by Scherrer equation, Principle, X-ray photoelectron spectroscopy (XPS), construction and working of Scanning electron microscopy (SEM) and Atomic force microscopy (AFM), Numerical Problems. **(8 hours)**

Text 1:Ch 10

Text 2:Ch 39

List of Laboratory experiments (2 hours/week per batch/batch strength 15) 10 lab sessions + 1 repetition class + 1 Lab Assessment.

Title of the experiment

1. Determination of effective spring constant of the given springs in series and parallel combinations.
2. Study the frequency response of Series & Parallel LCR circuits.
3. Demonstration of Reddy Shock Tube.
4. Determination of Moment of Inertia of an irregular body.
5. Determination of Rigidity modulus of the Material of the wire using Torsional Pendulum.
6. Determination of Young's modulus of the material of the given bar by uniform bending.
7. Verification of Newton's Law of Cooling.
8. Simulate coupled thermal and electrical transport in thermoelectric materials.
9. Determination of See beck Coefficient.
10. Verify Peltier Effect using thermocouples.
11. Simulate the Study flow characteristics of cryogenic fluids (LN_2, LHe) through vacuum-jacketed pipes.
12. Determination of wavelength of LASER using Diffraction Grating.

Course outcome (Course Skill Set)

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

CO1 Illustrate the various types of waves, oscillations and their implications.

CO2 Make use of the concepts of Elasticity to determine physical quantities.

CO3 Apply the fundamentals of Thermo electric materials and their experimental applications.

CO4 Apply the concepts of low temperature phenomena for various engineering applications.

CO5 Illustrate the various instrumentation techniques for nano material characterization.

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)

Text Books:

1. Engineering Physics, **S P Basavaraj**, 2018 Edition, Subhash Stores.
2. A Textbook of Engineering Physics- **M.N. Avadhanulu and P.G. Kshirsagar**, 10th revised

Ed, S. Chand. & Company Ltd, New Delhi.

Reference Books:

1. **Sadhu Singh**, “Theory of Elasticity”, Khanna Publishers, 1997.
2. Heat and Thermodynamics (I-Edition) – **D. S. Mathur** - S. Chand & Company Ltd., New-Delhi, 1991.
3. Physics of Cryogenics by **Bahman Zohuri**, Elsevier, 2018
4. Nanoscience and Nanotechnology: Fundamentals to Frontiers – **M. S. Ramachandra Rao & Shubra Singh**, Wiley India Pvt Ltd.
5. Characterization of Materials- **Mitra P. K**. Prentice Hall India Learning Private Limited.

Web links and Video Lectures (e-Resources):
Simple Harmonic motion: https://www.youtube.com/watch?v=k2FvSzWeVxQ
Shock waves and its applications: https://www.youtube.com/watch?v=tz_3M3v3kxk
Stress- strain curves: https://web.mit.edu/course/3/3.11/www/modules/ss.pdf
Fracture in materials: https://www.youtube.com/watch?v=x47nky4MbK8
Thermoelecticity:https://www.youtube.com/watch?v=2w7NBuu5w9c&list=PLtkeUZItwHK5y6qy1GFxa4Z4Rc mzUaaz6
Activity-Based Learning (Suggested Activities in Class)/ Practical-Based Learning
Thermoelectric generator and coolers: https://www.youtube.com/watch?v=NruYdb31xk8
Cryogenics: https://cevgroup.org/cryogenics-basics-applications/
Liquefaction of gases: https://www.youtube.com/watch?v=aMelwOsGpIs
Virtual lab:https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham
Material characterization :https://onlinecourses.nptel.ac.in/noc20_mm14/preview
https://www.encyclopedia.com/science-and-technology/physics/physics/cryogenics
https://www.usna.edu/NAOE/_files/documents/Courses/EN380/Course_Notes/Ch10_Deformation.pdf

Teaching-Learning Process Pedagogy
Teaching-Learning Process: These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Flipped Class
2. Chalk and Talk
3. Blended Mode of Teaching and Learning
4. Simulations, Interactive Simulations and Animations
5. NPTEL and Other Videos for theory topics
6. Smart Class Room
7. Lab Experiment Videos

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.
Continuous Internal Evaluation:
CIE for the theory component of the IC:

- The internal Assessment Test component of the CIE carries 25 marks.
- Each test shall be conducted for 25 marks. The first test will be administered after 35-40% of the coverage of the syllabus, second test will be administered after 65-70%, and the third test will be administered after 90-100% of the coverage of the syllabus. The average of the three tests shall be considered for 25 marks.

- Three assignments (average is scaled down to 5 marks)/mini project/Quiz/Seminar are conducted for 5 marks.
- To qualify and become eligible to appear for SEE, in the CIE theory component, a student must score at least 40% of 30 marks, i.e., 12 marks.

CIE for the Lab component of the IC*:*

Every experiment in the laboratory will be evaluated for 15 marks, comprising marks for conducting the experiment and for laboratory record. An additional 05 marks shall be for the test conducted at the end of the semester. To qualify and become eligible to appear for SEE, in the CIE Practical component, a student must secure a minimum of 40% of 20 marks, i.e., 08 marks.

CIE for the theory 30 MARKS + CIE for the practical 20MARKS = Total CIE 50 MARKS

Semester End Exam (SEE):50 marks