

Course Title:	Applied Physics for ME Stream		
Course Code:	BPHYM102/202	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:2:0	Total Marks	100
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Exam Hours	03
		Credits	04
Course objectives <ul style="list-style-type: none"> To understand the types of oscillation, shock waves & its generation, and applications. To Study the elastic properties of materials and failures of engineering materials To understand the fundamentals of thermoelectric materials and devices and their application. To understand the Concepts in Low temperature phenomena and generation of low temperature. To study the various relevant material characterization techniques. 			
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 <ol style="list-style-type: none"> 1. Flipped Class 2. Chalk and Talk 3. Blended Mode of Learning 4. Simulations, Interactive Simulations and Animations 5. NPTEL and Other Videos for theory topics 6. Smart Class Room 7. Lab Experiment Videos 			
Module-1 (8 Hours)			
Module -I: Oscillations and Shock waves: Oscillations: Simple Harmonic motion (SHM), Differential equation for SHM (No derivation), Springs: 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. 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.			
Pre-requisites: Basics of Oscillations Self-learning: Simple Harmonic motion, Differential equation for SHM			
Module-2 (8 Hours)			
Elasticity Stress-Strain Curve, Stress 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. Beams, Bending moment and derivation of expression, Cantilever and I section girder and their Engineering Applications, Elastic materials (qualitative). Failures of engineering materials - Ductile fracture, Brittle fracture, Stress concentration, Fatigue and factors affecting fatigue (only qualitative explanation), Numerical problems.			
Pre requisites: Elasticity, Stress & Strain Self-learning: Stress-Strain Curve			
Module-3 (8 Hours)			
Thermoelectric materials and devices: Thermo emf and thermo current, Seeback effect, Peltier effect, Seeback and Peltier coefficients, figure of merit (Mention Expression), laws of thermoelectricity. Expression for thermo emf in terms of T_1 and T_2 , Thermo couples, thermopile, Construction and Working of Thermoelectric generators (TEG) and Thermoelectric coolers (TEC), low, mid and high temperature thermoelectric materials, Applications: Exhaust of Automobiles, Refrigerator, Space Program (RTG), Numerical Problems			
Pre requisites: Basics of Electrical conductivity Self-learning: Thermo emf and thermo current			

Module-4 (8 Hours)**Cryogenics:**

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, Linde's air liquefier, Liquefaction of Helium and its properties, Platinum Resistance Thermometer, Applications of Cryogenics, in Aerospace, Tribology and Food processing(qualitative), Numerical Problems

Pre requisites: Basics of Heat and Thermodynamics

Self-learning: Application of Cryogenics in Food Processing

Module-5 (8 Hours)**Material Characterization and Instrumentation Techniques:**

Introduction to nano materials: Nanomaterial and nanocomposites. Principle, construction and working of X-ray Diffractometer, Crystallite size determination by Scherrer equation, Atomic Force Microscopy (AFM): Principle, construction, working and applications, X-ray photoelectron spectroscopy(XPS), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Numerical Problems.

Pre requisites: Quantum Mechanics

Self-learning: Crystallites

Course outcome (Course Skill Set)

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

CO1	Elucidate the concepts in oscillations, waves, elasticity and material failures
CO2	Discuss the fundamentals of Thermoelectric materials and their application
CO3	Summarize the low temperature phenomena and generation of low temperature
CO4	Explain the various material characterization techniques
CO5	Practice working in groups to conduct experiments in physics and perform precise and honest measurements.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and 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):

The CIE marks for the theory component of the IC shall be **30 marks** and for the laboratory component **20 Marks**.

CIE for the theory component of the IC

- Three Tests each of 20 Marks; after the completion of the syllabus of 35-40%, 65-70%, and 90-100% respectively.
- Two Assignments/two quizzes/ seminars/one field survey and report presentation/one-course project totalling 20 marks.

Total Marks scored (test + assignments) out of 80 shall be scaled down to **30 marks**

CIE for the practical component of the IC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test (**duration 03 hours**) at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to **05 marks**.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IC/IPCC for **20 marks**.

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks) in the theory component and 08 (40% of maximum marks) in the practical component. The laboratory component of the

IC/IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 05 questions is to be set from the practical component of IC/IPCC, the total marks of all questions should not be more than 25 marks.

The theory component of the IC shall be for both CIE and SEE.

Semester End Examination(SEE):

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

- The question paper shall be set for 100 marks. The medium of the question paper shall be English/Kannada). The duration of SEE is 03 hours.
- The question paper will have 10 questions. Two questions per module. Each question is set for 20 marks. The students have to answer 5 full questions, selecting one full question from each module. The student has to answer for 100 marks and **marks scored out of 100 shall be proportionally reduced to 50 marks.**

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

Suggested Learning Resources:

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

1. Vibrations and Waves (MIT introductory Physics Series), A P French, CBS, 2003 Edition
2. Timoshenko, S. and Goodier J.N. "Theory of Elasticity", 2nd Edition, McGraw Hill Book Co, 2001.
3. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, 1997
4. Mechanical Properties of Engineered Materials by Wole Soboyejo, CRC Press; 1st edition, 2002
5. Heat & Thermodynamics and Statistical Physics(XVIII-Edition) – Singhal, Agarwal & Satyaprakash – Pragati Prakashan, Meerut, 2006. 4
6. Heat and Thermodynamics (I-Edition) – D.S.Mathur - S. Chand & Company Ltd., New-Delhi, 1991
7. Heat and Thermodynamics, Brijlal & Subramanyam, S. Chand & Company Ltd., New-Delhi.
8. Physics of Cryogenics by Bahman Zohuri, Elsevier, 2018
9. Materials Characterization Techniques-Sam Zhang, Lin Li, Ashok Kumar, CRC Press, First Edition, 2008.
10. Characterization of Materials- Mitra P.K . Prentice Hall India Learning Private Limited.
11. Nanoscience and Nanotechnology: Fundamentals to Frontiers – M.S.Ramachandra Rao & Shubra Singh, Wiley India Pvt Ltd.
12. Nano Composite Materials-Synthesis, Properties and Applications, J. Parameswaranpillai, N.Hameed, T.Kurian, Y. Yu, CRC Press.
13. Shock waves made simple by Chintoo S Kumar, K Takayama and K P J Reddy: Willey India Pvt. Ltd, Delhi, 2014

Web links and Video Lectures (e-Resources):

Simple Harmonic motion:<https://www.youtube.com/watch?v=k2FvSzWeVxQ>

Shock waves:<https://physics.info/shock/>

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>

Stress curves:<https://www.youtube.com/watch?v=f08Y39UjC-o>

Fracture in materials:<https://www.youtube.com/watch?v=x47nky4MbK8>

Thermoelectricity:<https://www.youtube.com/watch?v=2w7NBuu5w9c&list=PLtkeUZItwHK5y6qy1GFxa4Z4RcmzUaaz6>

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

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning<http://nptel.ac.in><https://swayam.gov.in>https://virtuallabs.merlot.org/vl_physics.html<https://phet.colorado.edu><https://www.myphysicslab.com>**Laboratory Component:**

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

Note: The experiments have to be classified into

- Exercise
- Demonstration
- Structured Inquiry
- Open Ended

Based on the convenience classify the following experiments into above categories. Select at least one simulation /spreadsheet activity.

List of Experiments

- Determination of Young's modulus of the material of the given bar Uniform Bending.
- Determination of Rigidity modulus of the Material of the wire using Torsional Pendulum.
- Study of Forced Mechanical Oscillations and Resonance.
- Study of the frequency response of Series & Parallel LCR circuits.
- Determination of Fermi Energy of the given Conductor.
- Determination of Resistivity by Four Probe Method.
- Determination of effective spring constant of the given springs in series and parallel combinations.
- Determination of Young's modulus of the material of the given bar Single Cantilever.
- Determination of the Moment of Inertia of the given irregular body using torsional pendulum.
- Determination of Wavelength of Laser using Diffraction Grating.
- Determination of Acceptance angle and Numerical Aperture of the given Optical Fiber.
- Determination of the Radius of Curvature of the given Plano Convex Lens by setting Newton's Rings.
- Step Interactive Physical Simulations.
- Study of motion using spread Sheets
- Application of Statistics using Spread Sheets.
- PHET Interactive Simulations

:(<https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype>)

COs and POs Mapping (Individual teacher has to fill up)

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

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

Note : The CO-PO mapping values are indicative. The course coordinator can alter the mapping using **Competency and Performance Indicators** mentioned in the **AICTE Exam reforms**



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