DAYANANDA SAGAR UNIVERSITY
SCHOOL OF ENGINEERING
DEPARTMENT OF PHYSICS

Course: Engineering Physics - ME Cluster

School	**School of Engineering**
Department	**Physics**
Programme	**B. Tech., (common to ME and AE Branches)**
Course Title	**Engineering Physics**
Course Code	**25ENXXXX**
Year	**2025-2026**
Semester	**I/II SEM**
Chief Course Coordinator	**Dr. K. Vijaya Kumar**
e-mail id	**chairman-phy@dsu.edu.in**

1. Course Size and Instruction Method

Credits	L	P	Hours/Week
4	3	1	5

Total Semester hours: 5x13= 65 Hours (Theory:39 hr+ Lab:26 hr)

Conduction of Classes: **As per Timetable**

2 Course Details:

2.1 Course learning objectives: This course (25 ENXXXX) will enable students to learn the basic concepts in Physics which are very much essential in understanding and solving problems in engineering.

2.2 Course Aim and Summary:

The course '**Engineering Physics'** aims at introducing principles of physics to understand the working and behaviour of engineering systems. To begin with, the course emphasises upon the basics of different mechanical engineering materials and understanding of the structure, properties, and selection criteria of mechanical and aerospace materials, including composites and alloys. subsequently deals with different crystalline systems with XRD techniques. Followed by different waves such as SHM, Damped and shock waves in aerospace engineering. Likewise, Semiconductor properties of materials. Semiconductor Physics, devices like, LED, photodiode, Solar cell and BJT. Finally, the course concludes with thin-Film deposition techniques and Nano science & technology. During the course virtual lab and physical tools/models will be used to demonstrate the behaviour of different engineering systems.

2.3. Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.

2.4 Course Objectives:

The Objectives of the Course are:

1. Develop an understanding of the structure, properties, and selection criteria of mechanical and aerospace materials, including composites and alloys.
2. Impart knowledge of crystallography, Miller indices, and X-ray diffraction techniques essential for material characterization.
3. Equip students with a clear understanding of oscillations and wave phenomena, including damped, forced oscillations, and shock waves relevant to mechanical systems.
4. Provide foundational concepts in semiconductor physics and devices, emphasizing their operation, characteristics, and applications in engineering.
5. Introduce thin film technology and nanotechnology, including fabrication methods and the unique properties of nanomaterials, for modern engineering applications.

2.5 Course Outcomes (COs)

At the end of this course, students will be able to:

	Outcomes	**Bloom's Taxonomy Level**
CO 1	Identify and evaluate suitable engineering materials for mechanical and aerospace applications based on their mechanical properties and composite structures.	1- *Understand, 4-Evaluate*
CO 2	Apply crystallographic principles to analyse crystal structures and interpret X-ray diffraction data for material characterization	3-Apply,4-*Analyze*
CO 3	Analyse mechanical oscillations and wave behaviour, including resonance and shock waves, and apply them to engineering problems.	1- *Understand, 3-Apply, 4-Evaluate*
CO 4	Explain semiconductor behaviour, derive carrier concentration expressions, and evaluate the working of devices like LEDs, photodiodes, and solar cells.	1- *Understand, 3-Apply*
CO 5	Understand and compare thin film deposition techniques and assess the applications of nanomaterials based on their size-dependent properties.	1- *Understand, 3-Apply,*

SYLLABUS

MODULE – I	8 Hours

Introduction to Mechanical & Aerospace Materials

- **Composite Materials:** Overview of metallic and non-metallic materials and their structural characteristics, Composite materials- Types – Alloys - Criteria and methods for choosing appropriate materials for Aerospace applications. [**4 hours**]
- **Mechanical Engineering Materials:** Mechanical properties: stress- strain curve for different materials. Introduction to Tensile strength, Compressive strength, Ductility, Toughness, Brittleness, Impact strength, Fatigue, Creep. Testing of engineering materials: Hardness Tests: Brinell and Vickers hardness test & Numericals- [**4 hours**]

MODULE – II	08 Hours

Crystallography

- **Crystallography:** Lattice, Unit cell, Lattice parameters, Crystal systems, Bravais lattices, Packing fraction for SCC, BCC and FCC crystal systems. Introduction to Miller Indices, Determination of Crystal structure by Miller Indices. Expression for Inter-planar distance (Qualitative), X-ray diffraction, Bragg's law and Determination of Crystal structure by Powder method, Applications of XRD in Science and technology, Defects in crystals, Numericals. [**8 hours**]

MODULE – III	08 Hours

Oscillations and Waves:

- **Free Oscillations**: Basics of SHM, Derivation of differential equation for SHM, Mechanical simple harmonic oscillators (spring constant by series and parallel combination), Equation of motion for free oscillations, Natural frequency of oscillations. [**3 hours**]
- **Damped Oscillations:** Theory of damped oscillations (Derivation), over damping, critical & under damping (only graphical representation), Quality factor. [**2 hours**]
- **Forced Oscillations:** Theory of forced oscillations (Qualitative) and resonance, sharpness of resonance. [**1 hour**]
- **Shock waves:** Mach number, Properties of Shock waves, Construction and working of Reddy shock tube, applications of shock waves, Numericals. [**2 hours**]

MODULE – IV	09 Hours

Semiconductor Physics and Devices:

- **Semiconductor Physics:** Classification of Solids, Band structure, Fermi level in intrinsic and extrinsic semiconductors, Fermi-Dirac distribution function - Expression for concentration of electrons in conduction band (Derivation), Intrinsic carrier concentration, Conductivity of semiconductors, Hall effect, Derivation of Hall Coefficient, Introduction to Quantum Hall effect, Numerical. [**6 hours]**

- **Semiconductor Devices:** Zener diode: breakdown mechanisms and applications**,** Light Emitting Diode (LED): working principle and characteristics. Photodiode and Solar Cell: basic operation and I-V characteristics. [**3 hours**]

MODULE – V	06 Hours

Thin films & Nanotechnology:

- **Thin films technology:** Introduction to thin films-Advantages of thin films over bulk materials. Thin film deposition processes- Physical vapor deposition (Thermal evaporation technique, and sputtering technique) process, Applications of Thin films. [**3 hours**]

- **Nano Science & technology**: Introduction to Nano materials, Classification of nano materials, Size dependent properties of materials, Top-down and Bottom-up approach- Ball-milling and Photolithography & Applications of Nano technology in science and Engineering. [**3 hours**]

TEXTBOOKS:

1. S. O. Pillai (2018), Solid State Physics, revised edition, New Age International Publishers, New Delhi.
2. "Waves and Oscillations" by N.K. Bajaj, Publisher: Tata McGraw-Hill Education
3. "Shock Waves and Explosions" by Sergey M. Frolov and Anatoly A. Borisov Publisher: Springer (for advanced reading)
4. T Pradeep "A Textbook of Nano Science and Nano Technology"- Tata McGraw Hill Company Ltd, 2013**.**
5. K.L. Chopra, Thin film Phenomena, McGraw Hill, New York.

REFERENCE BOOKS:

1. M. Young (1977), Optics & Lasers An Engineering Physics approach, Springer
2 M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy (2018), A textbook of Engineering Physics, S Chand, New Delhi.
3 K Thyagarajan "Engineering Physics", - McGraw Hill Publishing Company Ltd, 2016
4 Engineering Physics, V. Rajendran, Tata McGraw Hill Education (1 January 2017)

Course: Engineering Physics Laboratory

School	**School of Engineering**
Department	**Physics**
Programme	**B. Tech., (common to ME and AE Branches)**
Course Title	**Engineering Physics Laboratory**
Course Code	25ENXXXX
Year	**2025-2026**
Semester	**I/II Semester**
Faculty-in-Charge	**Dr. K. Vijaya Kumar/ Dr Manikandan D**
E-mail id	chairman-phy@dsu.edu.in

1. Course Size and Instruction Method

Credits	**L**	**T**	**P**	**Hours/Week**
1.0	**0**	**0**	**2**	**2**

Total Semester hours: 2 x13= 26 Hours
Mentoring Hours: As per Timetable

2 Course Details

2.1 Course Aim and Summary

The Engineering Physics laboratory's course aims at training students for conducting physics experiments in laboratory and report writing on the experiments conducted. The course includes experiments like Newton's rings and a diffraction grating to expose the students to the basic principles of optics. The course also involves experiments for studying the characteristics of semiconductor devices like Zener diode, LED and transistor. In addition, it also has experiments to study material properties like resistivity, band gap energy and dielectric property. The course also exposes the students to the working principle of LCR circuit and its characterization. The fundamentals of mechanics are introduced through an experiment on calculation of moment of inertia of a torsional pendulum.

2.2 Course Objectives

The objectives of the Course are:

- Understand the importance of Physics in practical applications
- Able to calculate all the relevant physical parameters and represent any characteristic variation graphically
- Gaining hands-on expertise in working with various semiconductor devices
- Understanding the relation between the dielectric constant of a dielectric and the charging-discharging of a capacitor
- Understanding the optical principles of diffraction and interference
- Understand the concepts of quanta of energy and correlate it with the working principle of a light emitting diode
- Understanding the concept of frequency response, bandwidth and quality factor in electrical circuits
- Understand the concept of moment of inertia and estimate it for a rigid body

2.3 Course Outcomes

After undergoing this course students will be able to:

	Outcomes	Bloom's Taxonomy Level
CO1	**Illustrate** the various characteristics of semiconductor materials and different semiconductor devices	3-Apply
CO2	**Demonstrate** the optical principles of diffraction and interference	3-Apply
CO3	**Estimation** of moment of inertia for a rigid body	2 Understand
CO4	**Demonstrate** the frequency response curve for a LCR circuit	3-Apply
CO5	**Illustrate** the characteristics of a dielectric material	3 - Apply
CO6	**Interpret** the variation of physical parameters graphically and derive conclusions	3 - Apply

2.4 Course Content (List of Experiments):

1. **I-V characteristics of a Zener Diode**
   I–V Characteristics of a Zener diode in forward and reverse bias condition (Module 4)
2. **Four probe techniques**
   Measurement of resistivity of a semiconductor using Four probe technique (Module 4)
3. **Dielectric constant**
   Determination of dielectric constant of a dielectric material (Module 1)
4. **Torsional Pendulum**
   Determination of moment of inertia of a circular disc using torsional pendulum (Module 1)
5. **Band gap energy**
   Determination of energy gap of an intrinsic semiconductor (Module 4)
6. **Diffraction grating**
   Determination of wavelength of a laser light using diffraction grating (Module 3)
7. **Planck's constant**
   Measurement of Planck's constant using LED (Module 4)
8. **LCR series and parallel resonance**
   Study the frequency response of a series and parallel LCR circuit (Module 4)
9. **Transistor characteristics**
   Input and output characteristics of an NPN transistor in C-E configuration (Module 4)
10. **Hall-effect**
    Determination of concentration, mobility and conductivity of a Semiconductor (Module 4)

2.5 Textbook and References

1. Engineering Physics Laboratory manual, DSU
2. **Principles of Quantum Mechanics** – *R. Shankar*
3. **Quantum Computation and Quantum Information** – *Michael A. Nielsen & Isaac L. Chuang*
4. **Quantum Information Theory** – *Mark M. Wilde*
5. **Quantum Optics** – *Mark Fox*
6. **Lasers: Fundamentals and Applications** – *K. Thyagarajan & A.K. Ghatak*
7. **Optical Fiber Communications** – *Gerd Keiser*
8. **Introduction to Fiber Optics** – *Ajoy Ghatak & K. Thyagarajan*
9. S.O. Kasap, ***Principles of Electronic Materials and Devices***
10. B.G. Streetman & S. Banerjee, ***Solid State Electronic Devices***
11. Beiser, ***Concepts of Modern Physics*** (for band theory background)

Online resources: NPTEL lectures on Waves and Oscillations &Semiconductor Physics and Devices