DAYANANDA SAGAR UNIVERSITY
SCHOOL OF ENGINEERING
DEPARTMENT OF PHYSICS

Course: Engineering Physics - ECE Cluster

School	**School of Engineering**
Department	**Physics**
Programme	**B. Tech., (common to all ECE 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 (25ENXXXX) 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 Quantum mechanics, principles of Semiconductor Physics, devices like, LED, photodiode, Solar cell and BJT And also, emphasis on the magnetic, di-electric and Novel semi electronic materials and optical fibre communication systems in science and technology. 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 Course Objectives

The Objectives of the Course are:

- To provide a foundational understanding of quantum mechanics and quantum computing concepts such as superposition, entanglement, and qubits, along with semiconductor physics covering band theory, carrier concentration, and the Hall effect.
- To understand the fundamental properties of magnetic and dielectric materials, their classification, behaviour under external fields, and their applications in engineering systems, including magnetic storage, transformers, and electrical insulation.
- To introduce semiconducting and novel electronic materials, their working principles, fabrication methods, and applications in optoelectronic and advanced electronic devices.
- To provide an understanding of optical fibre principles, types, and losses, and to explain the working of fibre optic communication systems and their applications in various engineering fields
- Understand thin-film phenomena, examine various thin-film fabrication techniques, and distinguish between top-down and bottom-up approaches for synthesizing nanomaterials, with emphasis on their applications in engineering and medicine

2.4 Course Outcomes (CO's):

On completion of the Course the Students are able to

	Outcomes	**Bloom's Taxonomy Level**
CO 1	Explain the fundamental postulates of quantum mechanics, Semiconductor Principles and apply them to simple physical systems relevant to engineering applications.	1- *Understand, 3-Apply*
CO 2	Understand the different magnetic and Di-electric materials and their characteristics, Hysteresis effect and Applications of magnetic, dielectric materials in Engineering,	4-*Analyze, Evaluate*
CO 3	Interpret the construction and working of SC devices for Opto-electronic devices. Subsequently understand basic structural characterization of some Novel 2-D and Electronic materials for device applications	1- *Understand, 3-Apply*
CO 4	Illustrate the working principles of optical fibres and apply them to modern communication systems and other engineering fields.	*1-Understand, 4-Analyze*)
CO 5	Compare various thin-film fabrication techniques, explain nanoscale material synthesis approaches, and evaluate their applications in engineering and medical fields.	*4-Analyze, Evaluate*

SYLLABUS	
MODULE – I	**9 Hours**

Quantum mechanics and Semiconductor Physics

- **Quantum Mechanics:** Foundations of quantum theory, Wave function and its properties, de-Broglie hypothesis, Heisenberg Uncertainty principle. One dimensional time independent Schrodinger wave equation, Eigen values and Eigen functions. Applications: one dimensional motion of an electron in a potential well. Basics of Quantum computing - Concepts of Superposition, Entanglement, Interference and Qubit. [**5 hours**]
- **Semiconductor Physics**: Classification of Solids, Band structure, Fermi level in intrinsic and extrinsic semiconductors, Density of energy states in conduction and valence bands of a semiconductor (Mention the expression), Expression for concentration of electrons in conduction band (Derivation), Intrinsic carrier concentration, Conductivity of semiconductors, Hall effect, Derivation of Hall Coefficient, Numerical. [**4 hours**]

MODULE – II	**08 Hours**

Engineering materials

- **Magnetic Materials:** - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability - Classification of magnetic materials: Dia, Para, Ferro, Anti-ferro & Ferri magnetic materials – Hysteresis effect - soft and hard magnetic materials – Applications of magnetic materials in Engineering, Numerical [**4 hours**]
- **Dielectrics**: Introduction-Polarization and Dielectric Constant-Dielectric Susceptibility-Electric Field inside a Dielectric- macroscopic and Microscopic Electric Field-Polarization Mechanisms-Electronic, Ionic and Orientational Polarizations-Internal Fields in Solids-Clausius-Mosotti Equation-Dielectrics in alternating Fields- Applications of dielectric materials as electrical insulators. [**4 hours**]

MODULE – III	**08 Hours**

Introduction to Novel Electronic Materials:

- **Semiconducting devices for optoelectronic applications**: - Principle and working of PN-junction diode, Zener diode, Light Emitting Diode, Photodiode, Solar cell and BJT characteristics. [**3 hours**]

- **Novel materials**: Two-Dimensional (2D) Materials-Graphene and Transition Metal Dichalcogenides (TMDs – e.g., MoS_2, WS_2, Hexagonal Boron Nitride (h-BN); Growth/Preparation of 2D materials employing Chemical Vapor deposition, Topological Insulators (Materials: Bi_2Se_3, Bi_2Te_3) Perovskite Materials, Ferroelectric and Multiferroic Materials, Applications of Electronic materials for device applications [**5 hours**]

MODULE – IV	08 Hours

Introduction to Fiber Optic Communication

- **Introduction to Optical Fibers**: Optical Fiber and its components, Principle of Operation- Total Internal Reflection (TIR). Optical Parameters-Critical Angle: Acceptance Angle (θ_a), Numerical Aperture (NA), Types of Optical Fibers based on Materials (Glass Fibers and Plastic Fibers), Based on Modes and Based on Refractive Index Profile: Losses in Optical Fibers. [**3 hours**]
- **Fiber Optic Communication System**-Transmitter, Optical Sources-Light Emitting Diodes (LEDs), Laser Diodes, Transmission Medium, Receiver-Photodetectors (PIN Photodiodes and Avalanche Photodiodes) Fiber Optic Communication system (Basic elements, construction and working) Applications of Optical Fibers in Telecommunications, Medical Imaging, Industrial Automation, and Défense, Numerical Problems [**5 hours**]

MODULE – V	06 Hours

Thin Films and Nanotechnology

- **Thin films technology:** Introduction to thin films-Advantages of thin films over bulk materials. Introduction to thin film deposition processes (CVD & PVD) - 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, Solgel method, Top-down and Bottom-up approach- Ball-milling and Photolithography, Process. Applications of Nano technology in Biology and Engineering. [**3 hours**]

TEXTBOOKS:

1. Shatendra Sharma, Jyotsna Sharma, Engineering Physics (2019), Pearson, Noida, Uttar Pradesh, India.
2. P. S. Aithal, H. J. Ravindra, Textbook of Engineering Physics (2011), Acme learning Private Limited, New Delhi, India.
3. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning, 2012.
4. Optical Fiber Communications by Gerd Keiser, 4th Edition, McGraw-Hill, 2008.

REFERENCE BOOKS:

1. M. Young (1977), Optics & Lasers An Engineering Physics approach, Springer
2. K.L. Chopra, Thin film Phenomena, McGraw Hill, New York.
3. S. O. Pillai (2018), Solid State Physics, revised edition, New Age International Publishers, New Delhi
4. M N Avadhanulu, P G Kshirsagar, TVS Arun Murthy (2018), A textbook of Engineering Physics, S Chand, New Delhi.
5. K Thyagarajan “Engineering Physics”, - McGraw Hill Publishing Company Ltd, 2016
6. Engineering Physics, V. Rajendran, Tata McGraw Hill Education (1 January 2017)
7. Engineering Physics, P. K. Palanisamy, Scitech Publications (India) Pvt Ltd (2013)
8. T Pradeep “A Textbook of Nano Science and Nano Technology”- Tata McGraw Hill Company Ltd, 2013.

Course: Engineering Physics Laboratory

School	**School of Engineering**
Department	**Physics**
Program	**B. Tech. (all programs)**
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

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	**Demonstrate** the frequency response curve for a LCR circuit	3-Apply
CO4	**Illustrate** the characteristics of a dielectric material	3 - Apply
CO5	**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 3)
2. **Four probe techniques**
   Measurement of resistivity of a semiconductor using Four probe technique (Module 3)
3. **Dielectric constant**
   Determination of dielectric constant of a dielectric material (Module 2)
4. **Fiber Optic system**
   Determination of Acceptance angle, NA and Losses in Optical fibers (Module 4)
5. **Band gap energy**
   Determination of energy gap of an intrinsic semiconductor (Module 1)
6. **Diffraction grating**
   Determination of wavelength of a laser light using diffraction grating (Module 4)
7. **Planck's constant**
   Measurement of Planck's constant using LED (Module 2)
8. **LCR series and parallel resonance**
   Study the frequency response of a series and parallel LCR circuit (Module 3)
9. **Transistor characteristics**
   Input and output characteristics of an NPN transistor in C-E configuration (Module 3)
10. **Hall-effect**
    Determination of concentration, mobility and conductivity of a Semiconductor (Module 1)

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. A. Beiser, ***Concepts of Modern Physics*** (for band theory background)

Online resources: NPTEL Lectures on Semiconductor Physics and Devices