DAYANANDA SAGAR UNIVERSITY

SCHOOL OF ENGINEERING
DEPARTMENT OF PHYSICS

Course: Engineering Physics - CSE Cluster

School	**School of Engineering**
Department	**Physics**
Programme	**B. Tech., (common to all CSE 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 Quantum Information, computing, and Quantum optics including the operation and applications of lasers and optical fibre communication systems in engineering. subsequently deals with engineering materials such as 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 Course Objectives

The Objectives of the Course are:

- Understand the fundamental principles of quantum mechanics and apply them to analyse and solve engineering problems in science and technology.
- Explore the foundational concepts of quantum information and their applications in the emerging field of quantum computing.
- Learn the principles of quantum optics, including the operation and applications of lasers and optical fiber communication systems in engineering.
- Comprehend the band structure of solids and analyse the electrical properties and device applications of semiconductors.
- 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 and apply them to simple physical systems relevant to engineering applications.	1- *Understand, 3-Apply*
CO 2	Analyse basic concepts of quantum information, quantum bits (qubits), and evaluate simple quantum processing and their computational advantages.	4-*Analyze, Evaluate*
CO 3	Illustrate the working principles of lasers and optical fibers, and apply them to modern communication systems and other engineering fields.	1- *Understand, 3-Apply*
CO 4	Interpret the band theory of solids and characterize the electrical behaviour of semiconductors and their applications in devices.	*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*

2.5 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.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

<table>
<tr><th colspan="2">SYLLABUS</th></tr>
<tr><td>MODULE – I</td><td>8 Hours</td></tr>
<tr><td colspan="2">Introduction to Quantum mechanics:
Failure of Classical mechanics, Planck's hypothesis - Principles of quantum Mechanics (Wave-Particle Duality and Uncertainty Principle), Wave function, Eigen function and Eigen values, Schrodinger time independent wave Equation in 1D (Derivation), Application - Particle in a potential well (Derivation), Numericals (8 hours).</td></tr>
<tr><td>MODULE – II</td><td>6 Hours</td></tr>
<tr><td colspan="2">Quantum Information and Computing
• Introduction to Quantum information, Qubit, Bloch sphere, Superposition, Entanglement, Quantum Gates, Quantum Measurement, Quantum parallelism, Quantum supremacy, Applications: Quantum Key Distribution (QKD), Quantum Sensors.
(8 hours)</td></tr>
<tr><td>MODULE – III</td><td>9 Hours</td></tr>
<tr><td colspan="2">Quantum Optics and Fibre Optic Communication
• Quantum Optics: Process of absorption, spontaneous and stimulated emission Einstein coefficients (qualitative), Pumping, population inversion, resonators, Laser characteristics, beam quality, characteristics of laser, Types of lasers: construction and working of solid-state (Nd:YAG) and semiconductor laser - Applications of Lasers in engineering. (5 hours)
• Fiber Communication: Basics of optical fibers and light propagation, Numerical aperture, acceptance angle, Step-index and graded-index fibers, Fiber losses: attenuation, dispersion, bending, Applications in communication and sensing. (4 hours)</td></tr>
<tr><td>MODULE – IV</td><td>10 Hours</td></tr>
<tr><td colspan="2">• 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, Solar Cell and BJT: basic operation and I-V characteristics. (4 hours)</td></tr>
<tr><td>MODULE – V</td><td>6 Hours</td></tr>
<tr><td colspan="2">Thin films and Nano technology
• Thin Films Technology: Introduction to thin films-Advantages of thin films over bulk materials. Introduction to 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 (Quantum confinement), Top-down and Bottom-up approach- Ball-milling, and Photolithography Process. Applications of Nano technology in medicine and Engineering. [3 hours]</td></tr>
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Course: Engineering Physics Laboratory

School	**School of Engineering**
Department	**Physics**
Programme	**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 basic principles of Optic fiber phenomena and their characteristics, optical fiber losses and communication system
- 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 4)**
4. **Fiber Optic system**
   Determination of Acceptance angle, NA and Losses in Optical fibers **(Module 3)**
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& output characteristics of an NPN transistor in CE configuration **(Module 4)**
10. **Hall-effect**
    Determination of concentration, mobility and conductivity of a Semiconductor **(Module 4)**

2.5 Textbook and References:

Suggested Textbooks & 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 Quantum Computing & Semiconductor Physics and Devices