Engineering Physics (2025)
Course code 25PY101
Course Plan

Course Instructor:
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Course Structure and Outline

1. Number of credits 4
2. Number of hours per week 8
3. Decomposition of hours L(3), T(0), P(2), SL(3)
4. Number of Modules 2
5. Number of weeks per Module M1 (6), M2 (9)

Module	Unit	Topic
Module 1	Unit 1	Classical Free Electron Theory
	Unit 2	Quantum Mechanics
Module 2	Unit 1	Quantum Free Electron Theory
	Unit 2	Optoelectronics
	Unit 3	Laser

Table: Course Outline.

Course Lectures: Module 1

Module 1	
Unit 1	Introduction to metals, expression for electrical conductivity Introduction to semiconductors–intrinsic, n-type and p-type Elec. conductivity of s.c. – intrinsic, n-type and p-type Hall effect- applications.
Unit 2	Introduction to Quantum Mechanics, Dual nature of radiation de Broglie's concept of matter waves, Uncertainty principle Schrödinger's time-independent wave equation Particle confined in a one-dimensional infinite potential well Quantum dots Finite potential well- Quantum Tunneling Scanning tunneling microscope, tunneling diode (Qualitative)

Table: Topics of Module 1.

Course Lectures: Module 2

Module 2	
Unit 1	Quantum free electron theory, Fermi-Dirac distribution Electronic specific heat of solids, Density of states (qualitative) Success and Failures of quantum free electron theory of solids E-k diagram- classification of materials based on bands in solids Fermi level in semiconductors- intrinsic and extrinsic.
Unit 2	p-n junction diode- forward and reverse bias conditions Solar cell-construction, working-characteristics, applications Direct and indirect bandgap semiconductors LED-construction, working characteristics, applications. Photodiode, construction, working characteristics, applications Tunneling diode
Unit 3	Introduction to lasers Normal light vs. laser light – characteristics of laser light Stimulated absorption, Spontaneous and Stimulated emission population inversion, pumping Optical resonator-lasing mechanism Diode laser – construction,working and applications Optical fibre communications

Table: Topics of Module 2.

Course Self-Learning

Atleast **three hours per week** of self-learning.

Textbooks

1. M. N. Avadhanulu, "Engineering Physics", S. Chand publications 2010.
2. Donald A. Neamen, "Semiconductor Physics and Devices: Basic principle", 4th edition, McGraw-Hill, New York, 2012.

References

1. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", 6th edition, John Wiley and Sons, New York, 2001.
2. M. N. Avadhanulu, "Engineering Physics", S. Chand publications 2010.
3. Charles Kittel, "Introduction to solid state physics", 7th edition , Wiley, Delhi, 2007.
4. David J. Griffiths, "Introduction to Electrodynamics", 3rd edition, Prentice Hall of India, New Delhi, 2012.
5. Ashcroft and Mermin, "Solid State Physics", International student edition, 2008.

Course Practices – Module 1

1. Determination of Energy Band gap of p-n junction diode.
2. Hall effect – Determination of Hall effect.
3. Photoelectric effect – Determination of Planck's constant.
4. Seebeck effect – To study the variation of thermoemf of a copper-constantan thermocouple with temperature.
5. Tunneling effect – Demonstration of tunneling effect in tunnel diode.

Course Practices – Module 2

1. Study the characteristics of diode.
2. Determination of efficiency and Fill factor of a solar cell.
3. Determine the efficiency and fill factor of solar cells in Parallel and series combinations.
4. Study the $I - V$ characteristics of LED.
5. Optical fibre – Determination of Numerical aperture – Acceptance angle.
6. Determination of attenuation in Optical fiber.
7. Laser - Determination of wavelength.
8. Determination of the slit width from Fraunhofer diffraction pattern using LASER beam.
9. Demonstration of monochromatic nature of laser light comparing with ordinary light by the principle of dispersion by using Prism.

Course Outcomes

1. Comprehend the nature of metals and semiconductors under different conditions.
2. Apply the principles of quantum mechanics to unravel the latest technical developments.
3. Categorize the solids based on band theory.
4. Appraise the significance of P-N junction diodes in opto-electronic devices.

Sustainable development goals

Assessment Pattern

- **Formative Assessment (60%)**: Continuous evaluation through tests, assignments, labs.
- **Summative Assessment (40%)**: End-semester exam.
- Passing criteria: $\geq$35% in both formative and summative.
- Relative grading system (final GPA based on distribution).
- Minimum 75% attendance required.