Engineering Physics (2025)
Course code 25PY101
Unit 1: Metals and Semiconductors

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 U-1 (6), U-2 (9)

Module	Unit	Topic
Module 1	Unit 1	Metals, Semiconductors
	Unit 2	Quantum Mechanics
Module 2	Unit 3	Quantum free electron theory
	Unit 4	p-n junction diode
	Unit 5	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 Tunnelling Scanning tunnelling microscope, tunnelling diode (Qualitative)

Course Lectures: Module 2

Module 2	
Unit 3	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 4	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
	Tunnelling diode
Unit 5	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

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

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 V-I 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.