Engineering Physics (2025)
Course code 25PY101-S2
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 and extrinsic
	Elec. conductivity of s.c. – intrinsic and extrinsic (Quantitatively)
	Hall effect- applications, Concept of Panchabhuta – five elements
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)
	Kanada's atomic theory (paramanu)

Table: Topics of Module 1.

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
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 – Total internal reflection, acceptance angle, numerical aperture, 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.

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. Thermistor – To study the characteristics of Thermistor and to find its type.

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 (COs)

1. Comprehend the characteristics of metals and semiconductors based on electrical properties.
2. Apply the principles of quantum mechanics to unravel the latest technical developments such as quantum dots and scanning tunneling microscope.
3. Categorize the solids based on band theory.
4. Evaluate p-n junction diodes in optoelectronic devices such as solar cells, LED's and photodiodes.
5. Apply the fundamental principles of Lasers and optical finer systems to explain lasing action in semiconducting laser diode laser and light propagation in optical fibers for communication.
6. Exhibit scientific communication skills by preparing structured laboratory reports, presenting experimental findings, and following standard documentation practices.

Program Outcomes (POs)

PO code	PO title
PO1	Engineering Knowledge
PO2	Problem Analysis
PO3	Design/Development of Solutions
PO4	Conduct investigations of Complex problems
PO5	Engineering Tool Usage
PO6	The Engineer and the World
PO7	Ethics
PO8	Individual and Collaborative Team work
PO9	Communication
P10	Project Management and Finance
P11	Life-long learning

Table: Program outcomes.

Mapping of COs to POs

CO	BT	Module	Mapping with PO (Level)
1	Understand	1	1(3), 2(3), 3(2),4(2), 9(3),10(3),11(2)
2	Applye	1	1(3), 2(3), 3(3), 4(2), 9(3),10 (3)
3	Analyze	2	1(3), 2(3), 3(3), 4(2), 11(2)
4	Evaluate	2	1(3), 2(3), 3(3), 4(2), 9(3),10 (3),11(2)
5	Apply	2	1(3), 2(3), 3(3), 4(2),5 (2), 9(3),10 (3),11(2)
6	Create	2	2(2), 4(3), 9(2), 10(3), 11(1)

Table: CO-to-PO mapping.

Sustainable development goals