SEMESTER S1

PHYSICS FOR ELECTRICAL SCIENCE

Course Code	**A103PHT02**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	**ESE Marks**	60
Credits	4	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory + Lab

Course Objectives:

1. To provide students with a solid background in the fundamentals of Physics and to impart this knowledge in Electrical Science disciplines.
2. To develop scientific attitudes and enable students to correlate Physics concepts with their core programs.
3. To equip students with practical knowledge that complements their theoretical studies and develop their ability to create practical applications and solutions in engineering based on their understanding of Physics.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Semiconductor Physics** Intrinsic semiconductor, Derivation of density of electrons in conduction band and density of holes in valence band, Intrinsic carrier concentration, Variation of Intrinsic carrier concentration with temperature, Extrinsic semiconductor (qualitative) Formation of p-n junction, Fermi level in semiconductors-intrinsic and extrinsic, Energy band diagram of p-n junction - Qualitative description of charge flow across a p-n junction - Forward and reverse biased p-n junctions, Diode equation (Derivation), V-I Characteristics of p-n junction	9

2	**Semiconductor Devices** Semiconductor devices - Rectifiers- Full wave and Half wave, Zener diode - V-I characteristics - Zener breakdown and Avalanche breakdown, Tunnel diode - V-I characteristics, Applications of Zener and Tunnel diodes. Photonic devices (qualitative) - Photo detectors (Junction and PIN photodiodes), Applications, Solar cells- V-I Characteristics, Efficiency, Stringing of Solar cells to solar panel, Light Emitting Diode, Applications of LED	**9**
3	**Superconductivity & Dielectrics** Super conductivity, Transition temperature, Critical field, Meissner effect, Type I and Type II Super conductors, Applications of superconductors. Dielectric constant, Polarization, Permittivity- relative permittivity, Relation between polarization and dielectric constant, Types of Polarization, Internal fields in liquids and solids, Clausius Mossotti Relation, Dielectric loss(qualitative), Dielectric breakdown (qualitative)	**9**
4	**Laser & Fiber Optics** Optical processes - Absorption, Spontaneous emission and stimulated emission, Properties of laser, Principle of laser - conditions for sustained lasing – Population inversion, Pumping, Metastable states, Basic components of laser - Active medium- Optical resonant cavity, Construction and working of Ruby laser, Semiconductor Laser (Qualitative), Applications of laser. Optical fiber-Principle of propagation of light, Types of fibers-Step index and Graded index fibers, Numerical aperture –Derivation, Applications of optical fibers - Fiber optic communication system (block diagram)	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination- 3 (Lab Examination)	Total
5	10	10	10	5	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the fundamentals of Semiconductor Physics.	**K2**
CO2	Describe the behaviour of semiconductor materials in semiconductor devices.	**K2**
CO3	Explain Superconductivity and the basic theory of dielectrics	**K2**
CO4	Apply the comprehended knowledge about lasers and fibre optics in various engineering applications	**K3**
CO5	Apply basic knowledge of principles and theories in physics to conduct experiments.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M									H
CO2	H	H	H		H			H	H		H
CO3	H	M									H
CO4	H	H	H		H			H	H		H
CO5	H	H		L	H			H	H		H

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Concepts of Modern Physics	Arthur Beiser	Tata McGraw Hill Publications	6th Edition, 2003
2	Engineering Physics	H K Malik and A K Singh	McGraw Hill	2nd Edition, 2017
3	A Textbook of Engineering Physics	MN Avadhanulu, P G Kshirsagar, TVS Arun Murthy	S. Chand	11th Edition, 2018

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Semiconductor Devices Fundamentals	Robert F Pierret	Pearson Education	1995
2	Advanced Semiconductor Fundamental	Robert F Pierret	Pearson Education	2nd Edition, 2002
3	Solid State Electronic Devices	Ben G Streetman and Sanjay Kumar Banerjee	Pearson Education 6/e	2010
4	Solid State Physics	S.O. Pillai	New age international publishers	10th Edition, 2022
5	Introduction to Solid State Physics	Charles Kittel	Wiley India Edition	2019
6	Advanced Engineering Physics	Premlet B	Phasor Books	10th Edition ,2017
7	A Text Book of Engineering Physics	I. Dominic and. A. Nahari,	Owl Books Publishers	Revised Edition, 2016

Video Links (NPTEL, SWAYAM etc)	
Module No.	**Link ID**
1	https://nptel.ac.in/courses/108106181
2	https://nptel.ac.in/courses/108108112
3	https://nptel.ac.in/courses/115103108
4	https://nptel.ac.in/courses/115102124

1. Continuous Assessment (10 Marks)

i. Preparation and Pre-Lab Work (2 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

ii. Conduct of Experiments (2 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

iii. Lab Reports and Record Keeping (3 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

iv. Viva Voce (3 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

2. Evaluation Pattern for Lab Examination (5 Marks)

1. **Procedure/Preliminary Work/Conduct of Experiments (2 Marks)**
    - Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
    - Preliminary Work and Planning: Thoroughness in planning and organising materials/equipment.
    - Setup and Execution: Proper setup and accurate execution of the experiment or programming task
2. **Result (2 Marks)**
    - Accuracy of Results: Precision and correctness of the obtained results.
3. **Viva Voce (1 Marks)**
    - Proficiency in answering questions related to theoretical and practical aspects of the subject.

Experiment List
(Minimum 10 Experiments)

Experiment No.	Experiment
1	Diode characteristics
2	Zener diode- V-I characteristics
3	Tunnel diode –V-I characteristics
4	Half wave rectifier
5	Full wave rectifier
6	Hall effect in semiconductors
7	Determination of band gap energy of a semiconductor
8	Characteristics of LED
9	Solar Cell- V-I and Intensity Characteristics

10	Laser – Determination of wavelength using a diffraction grating
11	Laser- To measure the wavelength using a millimetre scale with a grating
12	Compare the variation of current with potential difference for a metal, a filament bulb and a semiconductor diode.
13	Determination of the dielectric constant
14	CRO -Measurement of frequency and amplitude of waveforms
15	Photodiode- V-I Characteristics
16	Numerical aperture of optical fibre