## SEMESTER 1 / 2

## PHYSICS FOR INFORMATION SCIENCE

## (Common To Group A)

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|---|---|---|---|
| **Course Code** | **GAPHT121** | **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 equip students with a strong foundation in the fundamentals of Physics, impart this knowledge within the context of Information Science disciplines, cultivate scientific attitudes and critical thinking skills, and enable students to integrate Physics concepts with their core Information Science programs.
2. To make the students gain practical knowledge to correlate the theoretical studies and to develop practical applications of engineering.

## SYLLABUS

| Module No. | Syllabus Description | Contact Hours |
|---|---|---|
| 1 | **Electrical conductivity**<br>Classical free electron theory, Electrical conductivity in metals, Fermi Dirac distribution, Variation of Fermi function with temperature, Fermi Energy, Energy bands, Classification of materials into conductor, semiconductor and insulator.<br>Superconductivity, Transition temperature, Critical field, Meissner effect, Type I and Type II Super conductors. BCS Theory, Applications of superconductors. | 9 |

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|---|---|---|
| **2** | **Quantum Mechanics**<br><br>Introduction, Concept of uncertainty and conjugate observables (qualitative), Uncertainty principle (statement only), Application of uncertainty principle- Absence of electron inside nucleus - Natural line broadening, Wave function – properties - physical interpretation, Formulation of time dependent and time independent Schrodinger equations, Particle in a one- dimensional box - Derivation of energy eigen values and normalized wave function, Quantum Mechanical Tunnelling (Qualitative) | **9** |
| **3** | **Semiconductor Physics**<br><br>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)<br><br>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), I-V Characteristics of p-n junction | **9** |
| **4** | **Semiconductor Devices**<br><br>Semiconductor devices- Rectifiers- Full wave and Half wave. Zener diode-VI characteristics, Tunnel diode-VI characteristics, SemiconductorLaser (Construction and working), Applications<br><br>Photonic devices (Qualitative treatment only) - Photo detectors (Junction and PIN photodiodes), Solar cells- IV Characteristics, Efficiency, Stringing of Solar cells to solar panel, Light Emitting Diode, Applications | **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 fullquestion out of two questions*

| Part A | Part B | Total |
|---|---|---|
| • 2 Questions from each module.<br>• Total of 8 Questions, each carrying 3 marks<br>**(8x3 =24marks)** | • Each question carries 9 marks.<br>• Two questions will be given from each module, out of which 1 question should be answered.<br>• Each question can have a maximum of 3 sub divisions.<br>**(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 electrical conductivity and Superconductivity. | **K2** |
| **CO2** | Explain the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics. | **K2** |
| **CO3** | Apply the fundamentals of Semiconductor Physics in engineering. | **K3** |
| **CO4** | Describe the behaviour of semiconductor materials in semiconductor devices. | **K2** |
| **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 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **3** | | | | | | | | | | | **3** |
| **CO2** | **3** | | | | | | | | | | | **3** |
| **CO3** | **3** | **3** | | | | | | | | | | **3** |
| **CO4** | **3** | | | | | | | | | | | **3** |
| **CO5** | **3** | **3** | | | **3** | | | | | | | **3** |

| **Text Books** | | | | |
|---|---|---|---|---|
| **Sl. No** | **Title of the Book** | **Name of the Author/s** | **Name of the Publisher** | **Edition and Year** |
| 1 | Engineering Physics | H K Malik and A K Singh | McGraw Hill | 2nd Edition, 2017 |
| 2 | Concepts of Modern Physics | Arthur Beiser | Tata McGraw Hill Publications | 6th Edition, 2003 |
| 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…) | |
|---|---|
| **Module No.** | **Link ID** |
| **1** | https://nptel.ac.in/courses/115103108 |
| **2** | https://nptel.ac.in/courses/115101107<br>https://nptel.ac.in/courses/115102023 |
| **3** | https://nptel.ac.in/courses/108106181 |
| **4** | https://nptel.ac.in/courses/108108112 |

**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 ofthe upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of thetheoretical 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 ofexperiments, 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 aviva 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.*

## 1. 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 organizing 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 |

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|---|---|
| **8** | Characteristics of LED |
| **9** | Solar Cell- V-I and Intensity Characteristics |
| **10** | Laser – Determination of wavelength using diffraction grating |
| **11** | Laser- To measure the wavelength using a millimetre scale as a grating |
| **12** | Compare the variation of current with potential difference, for a metal, filamentbulb and semiconductor diode. |
| **13** | Determination of dielectric constant |
| **14** | CRO -Measurement of frequency and amplitude of wave forms |
| **15** | Photo diode - V-I Characteristics |
| **16** | Numerical aperture of optical fiber |