FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science *(Degree/ Honors)*		Semester: VI	Session: 2024-25
1	Course Code	PHSC-06 T	
2	Course Title	Solid State Physics and Solid State Devices	
3	Course Type	Discipline Specific Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: ➢ To give knowledge of some basic electronic components and circuits. Understand the basic principles and industrial applications of semiconductor diode, Zener diode and transistor ➢ Use diodes and transistors in electronic circuits ➢ Understand the construction working and applications of transistor ➢ Understand the construction and working principles of various instruments that are used in the physics laboratory ➢ Gain knowledge on importance of filter a circuit. Describe the working of oscillators	
6	Credit Value	03 Credits	1 Credit = 15 Hours- Learning & Observation
7	Total Marks	Maximum Marks: 100	Minimum Pass Marks:40

PART – B: CONTENTSOF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) – 45 Periods (45 Hours)

Unit	Topics	No. of Period
I	**India Semiconductor Mission** Vision, objectives and schemes of India Semiconductor Mission (ISM). **Crystallography** Amorphous and crystalline solids, Elements of symmetry, seven crystal system, Cubic lattice, crystal planes, Miller indices, Laue's equation for X-ray diffraction, Bragg's law, Bonding in solids, Classification, Cohesive energy of solids, Madelung constant, evaluation of parameters, vibrational modes of one-dimensional monoatomic lattice, Dispersion relation, Brillouin Zone.	11
II	**Introduction to semiconductors** Intrinsic and extrinsic semiconductors, concept of Fermi level, generation and recombination of electron hole pairs in semiconductors, Mobility of electrons and holes, drift and diffusion currents, Carrier Concentration at Normal Equilibrium inIntrinsic Semiconductors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations. **Semiconductor Diodes** p and n type semiconductors, Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode, PN junction and its characteristics, depletion width and potential barrier, junction capacitance, Structure and working of Zener diode and Tunnel diode.	12

10/6/24 10.06.24

III	**Opto-electronic devices** Construction, working and applications of LEDs, Photodiode and Solar cell. **Power Supply** Half-wave Rectifier, Full-wave Rectifiers, Central-tapped and Bridge rectifier, Calculation of Ripple Factor and Rectification Efficiency,Zener diode as voltage regulator. Basic idea about capacitor filter, L-section filter and π-section filter.	10
IV	**Transistors:** n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff, and Saturation Regions. Current gains α, β and γ. Relations between α, β and γ. Load Line analysis of Transistors. DC Load line and Q-point, FET, **Bipolar transistor as amplifier**: h-parameters (low frequency), h-parameter equivalent circuit (CE small signal amplifier), Classification of Amplifiers: Class A, B, and C **Sinusoidal Oscillator** Barkhausen's criterion for Self-sustained oscillations, Determination frequency of RC oscillator. Wein Bridge Oscillator, Hartley oscillator and Phase shift oscillator.	12
Keywords:	Crystalline solids, Miller indices, Bragg's law, semiconductors, Fermi level, junction diodes, transistors, filter circuits, amplifiers, oscillators	

Signature of Convener & Members (CBoS) :

10.06.24

10/6/24

PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Basic electronics (Solid state), B L Thareja
2. Electronics: Fundamentals and Applications, D Chattopadhyay, PC Rakshit
3. Basic Electronics A Simplified Approach, Raghunandan G. H, Chaithanya G. H.
4. Basic Electronics, D.P. Kothari, I. Nagrath
5. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
6. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.

Reference Books Recommended-

1. Fundamentals of Solid State Physics by B.S. Saxena, R.C. Gupta, P.N. Saxena
2. Solid State Physics by S.O. Pillai
3. Semiconductor Physics and Devices by K. Purushothaman
4. Electronic Devices and Circuits by S. Salivahanan, N. Suresh Kumar
5. Optoelectronics and Optical Communication by B.P. Singh, Rekha Singh
6. Basic Electronics and Linear Circuits by N.N. Bhargava, D.C. Kulshreshtha, S.C. Gupta
7. Electronic Devices and Circuits by J.B. Gupta
8. Principles of Electronics by V.K. Mehta, Rohit Mehta

Online Resources (e-books/ learning portals/ other e-resources)

1. https://nptel.ac.in/courses/122106025
2. https://archive.nptel.ac.in/courses/108/101/108101091/
3. http://www.digimat.in/nptel/courses/video/117103063/L31.html
4. https://archive.nptel.ac.in/courses/117/103/117103063/

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Examination (ESE) : 70 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test/ Quiz (2): **20+20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type, **1 out of 2** from each unit- **4x10 =40 Marks**	

Name and Signature of Convener & Members of CBoS:

10/6/24

10.06.24

FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Degree/ Honors)	Semester: VI	Session: 2024-25

1	Course Code	**PHSC- 06 P**	
2	Course Title	**Solid State Physics and Solid State Devices**	
3	Course Type	**Discipline Specific Course**	
4	Pre-requisite (if any)	**As per Program**	
5	Course Learning Outcomes (CLO)	After the completion of the course, the students are expected to: ➢ Assemble required parts/devices and arrange them to perform experiments. Record/ observe data as required by the experimental objectives. ➢ Analyse recorded data and formulate it to get desired results. ➢ Interpret results and check for attainment of proposed objectives related to theory of semiconductors. ➢ Apply theory and principle of semiconductors for various device applications ➢ Verify various I/P, O/P and other characteristics of various semiconductor (solid state) devices and interpret the phenomena.	
6	Credit Value	**01 Credit**	**1 Credit = 30 Hours Laboratory Work**
7	Total Marks	**Maximum Marks: 50**	**Minimum Pass Marks: 20**

PART – B: CONTENT OF THE COURSE

Total No. of learning-Training/performance Periods - 30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Periods
1	To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150°C) and to determine its band gap.	30
2	To determine the Hall coefficient of a semiconductor sample.	
3	To study V-I characteristics of PN junction diode, and Light emitting diode.	
4	To study the V-I characteristics of a Zener diode and its use as voltage regulator.	
5	Study of V-I & power curves of solar cells, and find maximum power point & efficiency.	
6	To study the characteristics of a Bipolar Junction Transistor in CE configuration.	
7	To study the various biasing configurations of BJT for normal class A operation.	
8	To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.	
9	To study the frequency response of voltage gain of a RC-coupled transistor amplifier.	
10	To design and study a Wien bridge oscillator.	
11	To design a phase shift oscillator of given specifications using BJT.	
12	To study the Colpitt`s oscillator.	

Keywords:	Semiconductor Resistivity, Hall Coefficient, Diode Characteristics, Zener Diode Voltage Regulation, Solar Cell Efficiency, Bipolar Junction Transistor (BJT), BJT Biasing Configurations, Oscillator Design

Signature of Convener & Members (CBoS) :

10/6/24

PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.
5. Practical Physics B.Sc III : R P Goyal, Shivlal Agrawal Publications

Reference Books Recommended-

1. Semiconductor Physics and Devices by Donald A. Neamen
2. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky
3. Microelectronic Circuits by Adel S. Sedra and Kenneth C. Smith
4. Practical Electronics for Inventors by Paul Scherz and Simon Monk

Online Resources (e-books/ learning portals/ other e-resources)

1. Virtual Lab : https://vlab.amrita.edu/?sub=1&brch=282
2. https://vlab.amrita.edu/index.php?sub=1&brch=282&sim=370&cnt=3
3. https://bop-iitk.vlabs.ac.in/exp/energy-band-gap/simulation.html
4. http://vlabs.iitkgp.ac.in/ssd/index.html#
5. http://vlabs.iitkgp.ac.in/psac/newlabs2020/ssds/#
6. https://ae-iitr.vlabs.ac.in/List%20of%20experiments.html
7. https://da-iitb.vlabs.ac.in/List%20of%20experiments.html

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance – **05** Total Marks - **15**	Better marks out of the two Test / Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

10/6/24