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

PART-A: INTRODUCTION				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**PHSE- 09 T**		
2	**Course Title**	**Solid State Physics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	By course end, students will master: ➢ Energy band concept in solids, including energy gap analysis. ➢ Bloch function, Kronig-Penny model application for electron description. ➢ Hall effect in semiconductors, Fermi-Dirac distribution temperature impact, and free electron gas behavior in 3D. ➢ Zone schemes exploration, Fermi surface construction, and understanding of nearly free electrons, holes, and open orbits.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: CONTENT OF THE COURSE

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

Unit	Topics (Course contents)	No. of Period
I	**Electrical Properties of solid** Free electron model; Solution of one-dimensional Schrodinger equation in a constant potential; density of states; Fermi energy; Energy bands and origin of energy gap and its magnitude, Bloch function, Kronig-Penny model, Wave equation of electron in periodic potential, crystal moment of an electron, Hall effect **Magnetic properties of solids** Dia, para and ferromagnetism; Langevin's theory of dia and paramagnetism, Curie-Weiss law	11
II	Effect of temperature on F-D distribution, free electron gas in three dimensions. Different zone schemes, reduced and periodic zones, construction of Fermi surfaces, nearly free electrons, electron, hole, open orbits, Calculation of energy bands, Tight binding, Wigner-Seitz, cohesive energy, pseudo potential methods. Experimental methods in Fermi surface studies, quantization of orbits in a magnetic field, de Haas van Alphen Effect, External orbits, Fermi surface of copper	11
III	Lattice dynamics in monoatomic and diatomic lattice: two atoms per primitive basis, optical and acoustic modes, quantization of elastic waves, phonon momentum, inelastic neutron scattering by phonons, Anharmonic crystal interactions-thermal expansion, thermal conductivity, thermal resistivity of phonon gas, umklapp processes, imperfections	11
IV	**Superconductivity** Experimental survey: occurrence of superconductivity, Destruction of superconductivity by magnetic field, Meissner effect, heat capacity, energy gap, MW, and IR properties, isotope effect. Theoretical survey: thermodynamics of superconducting transition, London equation, Coherence length, Cooper pairing due to phonons, BCS theory of superconductivity, BCS ground state, flux quantization of superconducting ring, duration of persistent currents, Type II superconductors, Vortex states, estimation of Hc1 and Hc2, single particle and Josephson superconductor tunneling, DC/AC Josephson effect, Macroscopic quantum interference. High-temperature superconductors, critical fields and currents	12
Keywords	*Free electron model, Kronig Penny Model, Hall effect, Zone schemes, fermi surfaces, optical and acoustic modes, Superconductivity, BCS theory*	

Signature of Convener & Members (CBoS) :

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Solid State Physics by Neil W. Ashcroft and N. David Mermin
2. Introduction to Solid State Physic by Charles Kittel
3. Solid State Physics by J. S. Blakemore
4. Quantum Theory of Solids by Charles Kittel
5. Introduction to Superconductivity by Michael Tinkham

Reference Books Recommended–

1. Principles of the Theory of Solids by J. M. Ziman
2. Electronic Properties of Materials by Rolf E. Hummel
3. Solid State Physics: An Introduction by Philip Hofmann
4. Lattice Dynamics by A. A. Maradudin
5. Superconductivity, Second Edition by J. B. Ketterson and S. N. Song
6. Fundamentals of Superconductivity by John Robert Schrieffer
7. The Physics of Solids by Richard Turton
8. Solid State Physics: Structure and Properties of Materials by M. A. Wahab

Online Resources–

e-Resources / e-books and e-learning portals

1. Condensed Matter Physics https://archive.nptel.ac.in/courses/115/106/115106061/
2. Advanced Condensed Matter Physicshttps://archive.nptel.ac.in/courses/115/103/115103102/
3. Introduction to condensed matter physics https://homepages.iitb.ac.in/~kdasgupta/pdf/PH409[Aug2013].pdf
4. Introduction to solid state physics https://archive.nptel.ac.in/courses/115/104/115104109/

PART -D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment(CIA):	**30 Marks**
EndSemester Exam(ESE):	**70 Marks**

Continuous Internal Assessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): Assignment / Seminar - Total Marks -	**20 +20** **10** **30**	Better marks out of the two Test / Quiz **+** obtained marks 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 =20Marks** Section B: Descriptive answer type qts.,**1 out of 2** from each unit-**4x10=40 Marks**		

Name and Signature of Convener & Members of CBoS:

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

PART-A: INTRODUCTION			
Program: Bachelor in Science *(Honors/ Honors with Research)*		**Semester - VIII**	Session: 2024-2025
1	**Course Code**	**PHSC-09 P**	
2	**Course Title**	**Solid State Physics**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	**As per Program**	
5	**Course Learning. Outcomes(CLO)**	After the completion of the course, the Students are expected to : ➢ 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 ➢ Various electronics experiments and some advanced experiments in Physics	
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***
7	**Total Marks**	**Max. Marks:50**	**Min Passing Marks:20**

PART -B: CONTENT OF THE COURSE		
Total No. of learning-Training/performancePeriods:30 Periods (30 Hours)		
Module	**Topics(Course Contents)** **At least 10 of the following or related Experiments**	**No. of Period**
Lab./ Experiment Contents of Course	1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method) 2. To measure the Magnetic susceptibility of Solids 3. To determine the Coupling Coefficient of a Piezoelectric crystal 4. To measure the Dielectric Constant of a dielectric Materials with frequency 5. To study the PE Hysteresis loop of a Ferroelectric Crystal 6. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis 7. Determination of ionization potential of Lithium/Mercury 8. To study I-V characteristics of photovoltaic solar cell and its efficiency 9. Study of optoelectronic devices and verification of inverse square law 10. Determination of 'h' Planck's constant by Photoelectric effect 11. Determination of 'e/m' by Thomson method 12. Determination of Ionization Potential using Thyratron valve 13. Study of absorption coefficient of KMnO4	**30**
Keywords	*Magnetic susceptibility, Dielectric constant, PE hysteresis loop, BH curve, Resistivity, Hall coefficient, Ionization potential, Planck's constant*	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books:

1. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.
3. Practical Physics B.Sc III : R P Goyal, Shivlal Agrawal Publications
4. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd.,
5. London, 1962.
6. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015.
7. Indu Prakash: Practical Physics
8. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014

Reference Books:

1. Experimental Methods for Engineers by J.P. Holman
2. Semiconductor Physics and Devices by Donald A. Neamen
3. Optoelectronics and Photonics: Principles and Practices by Safa O. Kasap
4. Piezoelectricity: Evolution and Future of a Technology by Walter Heywang, Karl Lubitz, and Wolfram Wersing

Online Resources–
e-Resources / e-books and e-learning portals

1. Link for e-Books for Physics: Physics Practical:
   https://www.iiserkol.ac.in/~ph324/experiment_list.html
2. Virtual Lab :https://vlab.amrita.edu/?sub=1&brch=282
3. https://vlab.amrita.edu/index.php?sub=1&brch=282&sim=370&cnt=3
4. https://bop-iitk.vlabs.ac.in/exp/energy-band-gap/simulation.html
5. http://vlabs.iitkgp.ac.in/ssd/index.html#
6. http://vlabs.iitkgp.ac.in/psac/newlabs2020/ssds/#
7. https://ae-iitr.vlabs.ac.in/List%20of%20experiments.html
8. https://da-iitb.vlabs.ac.in/List%20of%20experiments.html
9. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=74

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

Name and Signature of Convener & Members of CBoS:

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