SEMESTER – III

CODE	COURSE TITLE
18PHPC308	CONDENSED MATTER PHYSICS

Category	CIA	ESE	L	T	P	Credit
Core	25	75	71	4	-	4

Preamble

The aim of this course is to introduce the structure of crystal and various magnetic properties. To concentrate on types of Superconductor and its theory. To apply the gained knowledge and skills to carry out advanced tasks projects.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Know the basic idea about Crystal defect	K4
CO2	Analyse the lattice vibration and Thermal Properties	K3
CO3	Gain the knowledge Energy band and Semiconductor crystal	K3
CO4	Know about Dia and Para magnetic material and its application	K2
CO5	Realize the concept of Superconductivity	K2

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	L	S
CO2	M	S	L	S	M
CO3	S	M	L	M	S
CO4	M	S	M	S	M
CO5	S	M	S	M	S

S- Strong; M-Medium; L-Low

Syllabus

Unit -I **(15 Hrs.)**

Crystal Structure and Diffraction:

Crystalline state – Basic definitions and crystal systems-elements of Symmetry – Crystal directions – Miller indices – Simple crystal structures(NaCl, CsCl, Hexagonal closed packed structure, Diamond structure, Cubic ZnS structure) – Bragg's law – The Laue method- Reciprocal lattice- Brillouin zones

Defects and dislocations: Elementary ideas about crystal defects – Schottkey defect – Frenkel defect – Dislocations – Edge and screw dislocation – Grain boundaries – Dislocations in crystal growth.

Unit - II **(15 Hrs.)**

Lattice Vibrations and Thermal Properties:

Vibrations of one dimensional monoatomic linear lattices – Vibrations of one dimensional diatomic linear lattice – Quantization of lattice vibrations – Forbidden frequency band– Phonon momentum – Inelastic scattering of neutrons by phonons – Einstein model of the lattice specific heat of solids – Debye model of lattice heat capacity –Thermal conductivity.

Unit -III **(15 Hrs.)**

Free electron theory, Energy bands and Semiconductor Crystals:

Energy levels and density of orbital – Fermi Dirac distribution – Free electron gas in 3-D Heat Capacity of electron gas – Electrical conductivity and Ohm's law – Motion in magnetic fields – Hall effect – Nearly free electron model – Bloch functions – Kronig – Penny model – Semiconductors – Band gap – Effective mass – Intrinsic carrier concentration.

Unit- IV **(15 Hrs.)**

Dielectrics and Ferroelectrics:

Macroscopic electric field – Local electric field at an atom – Dielectric constant and Polarizability – Clausius Mossotti equation – Ferroelectric crystals – Polarization Catastrophe – Ferroelectric domains. **Diamagnetism and Para magnetism:** Langevin diamagnetic equation – Quantum theory of Para magnetism – Rare earth ions – Hund's rules – Demagnetization of a paramagnetic salt – Paramagnetic susceptibility of conduction electrons.

Unit -V **(15 Hrs.)**

Ferromagnetism and Anti ferromagnetism:

Ferromagnetic order – Curie point and the exchange integral – Temperature dependence of saturation magnetization – Magnons – Thermal excitation – Ferromagnetic order – Anti ferromagnetic order – Anti ferromagnetic magnons – Ferromagnetic domains – Origin of domains – Coercive force and hysteresis. **Superconductivity:** Occurrence of superconductivity – Meissner effect – Thermodynamics of superconductivity transition – London equation – Coherence length – BCS theory – Flux quantization – Type I and Type II superconductors – Josephson superconductor tunneling – DC and AC Josephson effect.

Text Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Gupta and Kumar	Solid State Physics	Pragathi Prakashan, Meerut	2003, 9th Edition
2.	Kittel. C	Introduction to Solid State Physics,	Wiley Eastern, New Delhi,	1977, 5th Edition
3.	Dekkar. A.J	Solid State Physics	Mac. Millan, Madras	2012 , 4th Edition

Reference Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	A.M.Wahab	Solid State Physics	Narosa Publishing House, New Delhi	2007, 2nd Edition
2.	Blackmore.J.S	Solid State Physics	Cambridge University Press, London	1974, 2nd Edition
3.	Gupta.H.C	Solid State Physics	Vikas Publishing House	2001, 2nd Edition
4.	Saxena.B.S	Fundamentals of Solid State Physics	Pragati Prakasham	1982, 6th Edition

Web Resources

1. https://www.chem.uci.edu/~lawm/263%204.pdf
2. https://www.chem.uci.edu/~lawm/263%204.pdf
3. http://hyperphysics.phy-astr.gsu.edu/hbase/Solids/band.html
4. https://today.anl.gov/2015/11/dielectrics-and-ferroelectrics/
5. https://phy.ntnu.edu.tw/~changmc/Teach/SS/SS_note/chap12.pdf

Pedagogy

Lecture, Seminar, Quiz, PPT and Group Discussion

SEMESTER – III

CODE	COURSE TITLE
18PHPC309	ELECTROMAGNETIC FIELDS AND WAVES

Category	CIA	ESE	L	T	P	Credit
Core	25	75	71	4	-	4

Preamble

The aim of this course is to provide the basic skills required to evaluate fields in Electrostatics and Magnetostatics using basic laws. To understand and gain complete knowledge on the fundamentals of Electromagnetism. To impart the concepts of electrodynamics and its applications. To provide an idea on the relativistic nature of electrodynamics.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the solid foundation of the behaviour of static electric fields and to solve Laplace equation	K2
CO2	Acquire Knowledge about the basic laws in static magnetic fields to find the various parameters with the related problems	K3
CO3	Analyze Maxwell's equations in differential and integral forms and attain intense knowledge in the Poynting's theorem for the electromagnetic fields	K4
CO4	Evaluate and solve electromagnetic wave equation in different propagating media and to study reflection/ transmission of plane waves	K5
CO5	Formulate and solve problems in relativistic electrodynamics in four-dimensional space-time	K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S

CO2	S	M	M	M	S
CO3	L	M	S	S	S
CO4	S	S	M	S	M
CO5	S	S	M	M	S

S-Strong; M-Medium; L-Low

Syllabus

Unit- I **(15 Hrs.)**

Electrostatics

Columb's law – surface, line and volume charge distributions - Gauss' Law and its applications; Electrostatic potential - Laplace and Poisson equations – Potential of a localised charged distributions – Laplace equation in one, two and three dimensions – Boundary conditions and Uniqueness theorems.

Unit- II **(15 Hrs.)**

Magnetostatics

Lorentz force law- Biot-Savart law – condition for steady electric current - Ampere's law – Application of Ampere's law – Ampere's circuital Law - Magnetic vector and Scalar potential – Magneto static boundary conditions- comparison of Magnetostatics and Electrostatics

Unit –III **(15 Hrs.)**

Electrodynamics

Electromotive force – ohms law – Faradays law – Induced electric field – Energy in magnetic fields – Maxwell's equation in free space – Magnetic charge - Maxwells equation in matter – Boundary conditions - Conservation laws – Conservation of energy – Poynting's theorem - conservation of momentum .

Unit –IV **(15 Hrs.)**

Electromagnetic waves & interaction with matter

Electromagnetic waves in vacuum – Energy and momentum of EMW – EMW in matter – Propagation in linear media – Reflection and transmission at Normal incidence – Reflection and Transmission at Oblique incidence – Implications: Laws of incidence and reflectance, snell's law, Brewster law – Freshnel's equations.

UNIT V **(15 Hrs.)**

Relativistic electrodynamics: Four vectors – Transformation relation for charge and current densities – for electromagnetic potentials –Covariant from of inhomogeneous wave equations - Field equations in terms of four vectors – Transformation selection for field vector E and B covariant form of Lorenz force law.

Text Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	D.Griffiths	Introduction to Electrodynamics	Percentice Hall of India,New Delhi	2013, 4th Edition
2.	Gupta-Kumarl-Singh	Electrodynamics	Pragati Prakashan, Meerut	1987, 8th Edition
3.	Jackson	Classical electrodynamics	Wiley & sons, New York	2004, 1st Edition

4.	Sathya Prakash	Electromagnetic theory and Electrodynamics,	K.N.Ram Nath & Co, Meerut	2006, 1st Edition
5.	Chopra & Agarwal	Electromagnetic theory	Nath & co, Meerut	2004, 6th Edition

Reference Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Edward C.Jordan-Keith .G.Balmalin	EMW and radiating systems	Percentice Hall of India, New Delhi	2005, 2nd Edition
2.	John.R.Reitz.Frederic J.Milford,Robert W.Christy	Foundation of Electromagnetic theory	Narosa Publishing House	1998, 3 rd Edition
3.	Paul Lorrain and Dale R.Corson	Electromagnetic Fields and Waves	CBS Publishers and Distributors New Delhi.	2003, 2nd Edition

Web Resources

1. https://electronicspani.com/the-equations-of-poisson-and-laplace/
2. https://study.com/academy/lesson/amperes-law-definition-examples.html
3. https://study.com/academy/lesson/amperes-law-definition-examples.html
4. https://www.mtholyoke.edu/courses/tdray/phys310/electromag.pdf
5. https://www.ndeed.org/EducationResources/CommunityCollege/RadiationSafety/theory/interaction.htm

Pedagogy

Lecture, PPT, Seminar, Quiz, and Group Discussion

SEMESTER – III

CODE	COURSE TITLE
18PHPE301	INTRODUCTORY ASTRONOMY, ASTROPHYSICS & COSMOLOGY

Category	CIA	ESE	L	T	P	Credit
Core	25	75	71	4	-	4

Preamble

The aim of this course is to understand astrophysical processes and systems, ranging from our own sun to stars, galaxies and the whole universe. To understand the physical principles that is important in astronomy and astrophysics. To become familiar with the basic ideas of cosmology.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand astrophysics as a way to illustrate our real physical world and discuss the contributions of Ptolemy, Copernicus, Kepler, Tycho, Galileo and Newton to astronomy	K2
CO2	Analyze different types of stars and study the relationship between the stars absolute magnitudes vs effective temperatures using HR diagram	K3
CO3	Show how novas, supernovas, neutron stars, white dwarfs, red giants, and black holes relate to stellar masses and ages.	K3
CO4	Describe the Cosmological Principle, gravitational red shift, Hubble constant and to explain the evidences of Big Bang theory	K2
CO5	Examine the FRW universes to explain Standard Model of modern cosmology and define inflation in the cosmological context	K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	S	M	M	M	S
CO3	L	M	S	S	S
CO4	S	S	M	S	M
CO5	S	S	M	M	S

S-Strong; M-Medium; L-Low

Syllabus

Unit - I **(15 Hrs.)**

History of Astronomy: Introductory History of Astronomy - Ptolemy's Geocentric Universe- Copernicus Heliocentric Universe - Tycho Brahe and Galileo's Observations - Kepler's Laws of Planetary Motion - Newtonian Concept Of Gravity - Highlights of Einstein's Special and General Theory of Relativity - Curved Space Time - Evidence of Curved Space Time - Bending Of Light - Time Dilation.

Unit - II **(15 Hrs.)**

Stars & Galaxies: Stars and Galaxies – Distances - Trigonometric Parallax - Inverse Square Law- Magnitude of Stars - Apparent Magnitude - Absolute Magnitude and Luminosity - Color and Temperature - Composition of Stars - Velocity, Mass and Sizes of Stars - Types of Stars- Temperature Dependence-Spectral Types - Hertzsprung-Russell (HR) Diagram - Spectroscopic Parallax.

Unit - III **(15Hrs.)**

Lives and death of stars: Stellar Evolution - Mass Dependence - Giant Molecular Cloud-Protostar - Main Sequence Star- Sub giant, Red Giant, Supergiant - Core Fusion - Red Giant (Or) Supergiant - Planetary Nebula (Or) Supernova - White Dwarfs - Novae And Supernovae - Neutron Stars – Pulsars -

Black Holes - Detecting Black Holes -The Sun - Its Size and Composition - Sun's Interior Zones - Sun's Surface - Photosphere - Chromosphere - Corona -Sun's Power Source - Fusion Reaction Mechanism.

Unit -IV **(15 Hrs.)**

Cosmology I: Introduction to Cosmology - Basic Observations and implications - Olber's Paradox - Expanding Universe - Gravitational Red shift - Doppler Effect - Hubble's Law and the Age of the Universe - Cosmological Principle - The Perfect Cosmological Principle - Observation and interpretation of Cosmic Microwave background Radiation (CMBR) - Evidence Supporting the General Big Bang Theory - Salient features of Steady State Theory.

Unit - V **(15 Hrs.)**

Cosmology II: Fate of the Universe - Dependence on Mass (Curvature of Space) - Critical density - Open Universe - Closed Universe - Homogenous and Isotropic Freidman – Robertson -Walker Universes - Deriving the Geometry of the Universe from the Background Radiation -Flatness Problem - Horizon Problem - Inflation and its effect on the universe -The Cosmological Constant.

Text Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	S. Kumaravelu	Astronomy	Universities Press	1983 7nd Edition
2.	Sivaram, C. Kenath Arun	Modern Astronomy Startling facts	Wiley	2009, 1st Edition

Reference Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	V.B. Bhatia	Textbook of astronomy and astrophysics	Astrophysics and Cosmology	2001, 1st Edition
2.	Michael Berry	Principles of Cosmology and Gravitation	Cambridge University Press	1978, 1st Edition

Web Resources

1. https://bohr.wlu.ca/as101b/ASTRONotes7.pdf
2. https://nightsky.jpl.nasa.gov/news-display.cfm?News_ID=573
3. https://www.nasa.gov/audience/forstudents/9-12/features/stellar_evol_feat_912.html
4. https://map.gsfc.nasa.gov/universe/
5. http://scihi.org/alexander-friedmann-expanding-universe/

Pedagogy

Lecture, PPT, Seminar, Quiz, and Group Discussion

SEMESTER – IV

CODE	COURSE TITLE
18PHPC410	NUCLEAR AND PARTICLE PHYSICS

Category	CIA	ESE	L	T	P	Credit
Core	25	75	86	4	-	4

Preamble

The aim of this course is to provide basic concepts of nuclear-particle physics. To learn experimental techniques, particle detectors and accelerators. To impart the Capability of elementary problem solving in nuclear and particle physics.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Explain the origin of the various terms in the semi-empirical mass formula and the properties of nuclear ground and excited states based on the shell model	K2
CO2	Demonstrate the radioactive laws to acquire the knowledge of alpha, beta and gamma decays and with models for calculating these decays	K3
CO3	Analyze different type of nuclear reactions by applying conservation laws and understand the theoretical cross section of nuclear reactions	K4
CO4	Explain experimental techniques used in neutron and nuclear detectors and understand the classification of neutrons	K5
CO5	Describe the four fundamental interactions and concepts of elementary particles	K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	S	S	S
CO2	S	S	S	S	S
CO3	S	M	S	S	S
CO4	S	S	S	S	M
CO5	S	S	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

Unit –I (**18 Hrs.)**

Nuclear force and Binding

Properties of Nuclear Force – Ground state properties of Deuteron – Square well solution of Deuteron – Low energy, neutron proton scattering - Limits of energy for the scattering of different partial waves - Binding energy - Weizacker's semi empirical mass formula – Application of semi empirical formula for

alpha decay – mass parabola for stability of nuclei against beta decay - Evidence of shell effects – Single particle energy levels for infinite square well, harmonic oscillator with spin orbit potential – Application of shell model for spin and parity

Unit –II **(18 Hrs.)**

Radioactive disintegration

Properties of radioactive rays – Law of radioactivity – Half life and mean life-Radioactive equilibrium - Radioactive series - Range of alpha particles – Alpha spectrum and Fine structure - Alpha-Particle Disintegration Energy- Gamow's theory of Alpha decay – Energetics of Beta decay - Beta-Ray Spectra-Pauli's neutrino hypothesis – Properties of neutrino - Absorption of Gamma rays – Interaction – Diamond bent crystal spectrometer – selection rule -Internal conversion

Unit –III **(18 Hrs.)**

Nuclear reactions

Types of nuclear reaction – Conservation laws in nuclear reactions – Balance of Mass and Energy in nuclear reactions – The Q equation and its solution – Proton, deuteron, neutron and alpha induced reactions – Cross section of nuclear reactions - Partial wave method for scattering and reaction cross section – Compound nucleus hypothesis – Breit Wigner one level formula

Unit –IV **(18 Hrs.)**

Neutron Physics and detectors

Properties of neutron – Classification of neutrons according to energy – Sources of neutron – Neutron detectors – Neutron multiplication and fission chain reaction – Four factor formula – Reactor materials – Geiger Muller counter –Semi conductor detectors (Diffused junction detector, Surface barrier detector) – Uses of semiconductor detectors – Scintillation detector

Unit- V **(18 Hrs.)**

Elementary Particles

Classification – Fundamental Interaction – Parameters – Symmetry and Conservation laws – C P T theorem – Leptons – Mesons – Baryons – Bosons – SU (3) Symmetry of hadrons – Gell-Mann Okuba mass formula –CP violation in K Meson decay- Quark theory—Overview of cosmic rays .

Text Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	S.N. Ghosal	Nuclear Physics	S. Chand CompanyLtd	2016, 1st Revised Edition
2.	D.C. Tayal,	Nuclear Physics	Himalaya Publishing House Ltd, Mumbai	2004, 1st Revised Edition
3.	M.L. Pandya and R.P.S. Yadav	Elements of Nuclear Physics	Nath & Co, Meerut	1983, 3rd Edition

Reference Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	S.B. Patel	Nuclear Physics an Introduction	New Age international Publishers	2015, 2nd Revised Edition
2.	K.S. Krane	Introductory Nuclear Physics	Wiley India Ltd	1987, 2nd Edition
3.	I. Kaplan	Nuclear Physics	Narosa Publishing House	2002, 2nd Edition

Web Resources

1. http://www.nat.vu.nl/~wimu/EDUC/QB_Lecture_12-2014.pdf
2. https://www.khanacademy.org/science/in-in-class-12th-physics-india/nuclei/in-in-nuclear-physics/a/radioactive-decay-types-article
3. https://www.nuclear-power.net/nuclear-power/nuclear-reactions/
4. http://www0.mi.infn.it/~sleoni/TEACHING/Nuc-Phys-Det/PDF/lesson1-OW.pdf
5. https://www.britannica.com/science/subatomic-particle/Elementary-particles

Pedagogy

Lecture, PPT, Seminar, Quiz, and Group Discussion

SEMESTER – IV

CODE	COURSE TITLE
18PHPC411	MOLECULAR SPECTROSCOPY

Category	CIA	ESE	L	T	P	Credit
Core	25	75	86	4	-	4

Preamble

The aim of this subject it teaches students how to apply quantum mechanics and extract information from many-electrons atoms and molecules and to expose the students to various molecular and atomic spectroscopy techniques available to study the chemical and structural properties of materials

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Know about the rotational spectrum of diatomic and polyatomic molecules by using microwave and Raman spectroscopy	K2
CO2	Acquire the knowledge of Infrared spectroscopy and to study the functional groups of molecules	K4
CO3	Impart the ideas and concepts associated with electronics spectroscopy in atoms	K2
CO4	Gain knowledge the vibrational spectra and their progressions of molecules by electronic spectroscopy	K5
CO5	Introduces the ideas of spin resonance spectroscopy	K3

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5

CO1	S	M	M	S	S
CO2	S	M	M	M	S
CO3	L	M	S	S	S
CO4	S	S	M	S	M
CO5	S	S	M	M	S

S-Strong; M-Medium; L-Low

Syllabus

Unit-I **(18 Hrs.)**

Microwave and Raman Spectroscopy

Rotation of molecules and their spectra – diatomic molecules – intensity of line spectra – the effect of isotropic substitution – non-rigid rotator and their spectra – polyatomic molecules (linear and symmetric top molecules) – Classical theory of Raman effect - pure rotational Raman spectra (linear and symmetric top molecules).

Unit-II **(18 Hrs.)**

Infra-red and Raman Spectroscopy

The energy of diatomic molecules – Simple Harmonic Oscillator –the Anharmonic oscillator – the diatomic vibrating rotator – vibration-rotation spectrum of carbon monoxide – breakdown of Born-Oppenheimer approximation – the vibrations of polyatomic molecules – influence of rotation on the spectra of polyatomic molecules (linear and symmetric top molecules) – Raman activity of vibrations – vibrational Raman spectra – vibrations of Spherical top molecules.

Unit-III **(18 Hrs.)**

Electronic Spectroscopy of Atoms

Electronic wave function and atomic quantum numbers – hydrogen spectrum – orbital, spin and total angular momentum - fine structure of hydrogen atom – many electron spectrum: Lithium atom spectrum, angular momentum of many electrons – term symbols – the spectrum of helium and alkaline earths – equivalent and non equivalent electrons – basics of X-ray photoelectron spectroscopy.

Unit-IV **(18 Hrs.)**

Electronic Spectroscopy of Molecules

Diatomic molecular spectra: Born-Oppenheimer approximation – vibrational spectra and their progressions – Franck-Condon principle – dissociation energy and their products – rotational fine structure of electronic-vibration transition - molecular orbital theory – the spectrum of molecular hydrogen – change of shape on excitation – chemical analysis by electronic spectroscopy – reemission of energy – fundamentals of UV photoelectron spectroscopy.

Unit-V **(18 Hrs.)**

Spin Resonance Spectroscopy

Spin and magnetic field interaction – Larmor precession – relaxation time – spin-spin relaxation - spin–lattice relaxation - NMR chemical shift - coupling constants – coupling between nuclei – chemical analysis by NMR – NMR for nuclei other than hydrogen - ESR spectroscopy - fine structure in ESR.

Text Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1	Aruldhas.G	Molecular structure and spectroscopy	PHI Learning Pvt Ltd	2007, 2nd Edition

2	Gupta., Kumar., Sharma	Spectroscopy	Pragati Prakashan	2016, 1st Edition
3	Gurdeep R.Chatwal	Spectroscopy(Atomic and Molecular)	Himalaya Publishing House	2009, Ist Edition
4	Straughan and S.Walker	Spectroscopy**,** Vol 1, 2, 3	Chapman & Hall	1976, 1st Edition

Reference Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1	Banwell. C.N	Spectroscopy	Tata McGraw Hill	1980, 3rd Edition
2	Barrow. G.M	Introduction to molecular spectroscopy	Tata McGraw Hill	1962, 1st Edition

Web Resources

1. http://www.pci.tu-bs.de/aggericke/PC4e_osv/Molecular-Spectroscopy.pdf
2. https://nptel.ac.in/courses/122101001/downloads/lec-13.pdf
3. https://cefrc.princeton.edu/sites/cefrc/files/Files/2011%20Lecture%20Notes/Alden/Lecture-2-Molecular-Spectroscopy.pdf
4. http://instructor.physics.lsa.umich.edu/adv-labs/Atomic_Molecular_Spectroscopy/atomic_spectroscopy_2005.pdf
5. http://sci.tanta.edu.eg/files/Introduction%20Molecular%20Spectroscopy%20BSc-Lect%20-1.pdf

Pedagogy

- Lecture, PPT, Seminar, Quiz, and Assignment

SEMESTER – IV

CODE	COURSE TITLE
18PHPE402	THERMODYNAMICS AND STATISTICAL MECHANICS

Category	CIA	ESE	L	T	P	Credit
Core	25	75	86	4	-	4

Preamble

To acquire in-depth knowledge about the basic principles of thermodynamics and statistical mechanics and apply them to describe equilibrium thermal properties of bulk matter. To derive the different types of statistical distribution. To analyze the applications of Statistical mechanics in terms of thermodynamics.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the Entropy and Second law of thermodynamics and the concept relating Thermodynamic Equilibrium	K2
CO2	Analyze the basic concepts of Phase space and ensemble and to explore the Density distribution in phase space	K4
CO3	Familiarize the basic difference exists between Microstates and Macro states by adopting the Principle of equi-partition of energy	K2
CO4	Relate the different types of Statistical systems and interpreting with the Thermodynamic parameter and to acquire knowledge on Specific heat of solids	K5
CO5	Explore the relation connecting the energy and pressure of ideal Bose Einstein gas and Fermi-dirac gas and their applications	K6

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	M	M	M	S
CO3	M	M	S	L	S
CO4	S	S	M	S	M
CO5	S	S	M	M	S

S-Strong; M-Medium; L-Low

Syllabus

Unit – I **(18 Hrs.)**

Thermodynamics and Radiation

Second law of thermodynamics- Entropy and Second law of thermodynamics- Entropy and Disorder- Thermodynamic Potential and Reciprocity relation- Thermodynamic Equilibria- Chemical Potential- Blackbody radiation- Planck's Radiation law.

Unit – II **(18 Hrs.)**

Basic Concepts

Phase space- Volume in phase space-Number of phase cells in given energy range of harmonic oscillator- Number of phase cell in the given energy range of 3-dimensional free particle- Concept of ensemble- Micro canonical ensemble-Canonical ensemble- Grand Canonical ensemble- Density distribution in phase space- Liouvilles theorem- Postulate of equal apriori probability- Statistical equilibrium- Thermal equilibrium- Mechanical equilibrium-Particle equilibrium-Connection between Statistical and thermodynamic quantities.

Unit – III **(18Hrs.)**

Classical Distribution Law

Microstates and Macro states-Classical Maxwell-Boltzmann distribution law- Evaluation of constants, α and β- Maxwell's law of Distribution of velocities- Principle of equi-partition of energy- Gibbs paradox- Partition function and its correlation with thermodynamics quantities- Partition functions and its properties- Comparison of ensembles- Equipartition theorem- Applications.

Unit – IV **(18 Hrs.)**

Quantum Statistics

Indistinguishability and quantum statistics- Statistical weight and apriori probability- Identical particle's and symmetry requirements- Bose Einstein's Statistics- Fermi Dirac Statistics- Results of three statistics- Thermodynamic interpretation of parameter's α and β- Blackbody radiation and Planck radiation- Specific heat of solids: Dulong and Pettit's law- Einstein's Theory- Debye theory.

Unit – V **(18 Hrs.)**

Application of Quantum Statistics

Energy and pressure of ideal Bose Einstein gas- Bose Einstein condensation- Liquid helium- Energy and pressure of ideal Fermi Dirac gas- Free electron model and electronic emission- Onsager relations- Fluctuation, Energy, Pressure, Enthalpy- Bragg William Approximation- One dimensional Ising model

Text Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	S.L. Gupta & V. Kumar	Statistical Mechanics	Pragati Prakashan Meerut	2003, 20th Edition
2.	Palash B. Pal	An Introductory Course of Statistical Mechanics	Narosa Publishing House, New Delhi	2013, 3rd Edition
3.	Kamal Singh & S.P. Singh	Elements of Statistical Mechanics	S. Chand & Company, New Delhi.	1999, 3rd Edition

Reference Books

Sl.No.	Author Name	Title of the Book	Publisher	Year and Edition
1.	Kerser Huang	Fundamentals Of Statistical Mechanics	John Wiley & Sons, New York	1986, 1st Edition

2.	Avijit Lahiri	Statistical Mechanics An Elementary Outline	University Press, Hyderabad	2002, 1st Edition

Web Resources

1. https://opentextbc.ca/physicstestbook2/chapter/entropy-and-the-second-law-of-thermodynamics-disorder-and-the-unavailability-of-energy/
2. http://www.physics.udel.edu/~glyde/PHYS813/Lectures/chapter_6.pdf
3. https://www.britannica.com/science/Maxwell-Boltzmann-distribution-law
4. https://ps.uci.edu/~cyu/p115A/LectureNotes/Lecture13/lecture13.pdf
5. https://www.ucl.ac.uk/~ucapahh/teaching/3C25/Lecture14s.pdf

Pedagogy

Lecture, PPT, Seminar, Quiz, and Group Discussion

SEMESTER – IV

CODE	COURSE TITLE
18PHPCP03	CORE PRACTICAL-III ADVANCED EXPERIMENTS

Category	CIA	ESE	L	T	P	Credit
Core	40	60	-	-	120	4

Preamble

The aim of this course is to enhance the student understanding through hands on experience by advanced experiments. To understand the theory by performing experiments and study the inferences based on the results. To develop and improve the practical knowledge to analyze the observations in performing experiments. To motivate advanced level of thinking by execution of practical experiments.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept of optics and to measure various parameters by advanced experiments	K2
CO2	Develop the skill of performing experiments accuratelyand to compare the results with theoretical calculations	K3
CO3	Gain knowledge and to determine the values with advanced experimental methods	K3
CO4	Explore the concepts of solid state physics such as hall effect	K4

	in a practical way	
CO5	Enhance the basic research idea in thin film technology by dip coating method	K6

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	S
CO3	S	M	S	S	S
CO4	M	S	S	S	M
CO5	S	S	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

(Examination at the end of Fourth Semester)

Any Twelve Experiments

1. Arc Spectra
2. Self inductance and Mutual inductance of the coil - Anderson's Bridge
3. Michelson Interferometer – λ, d λ
4. Susceptibility – Guoy's method
5. Susceptibility – Quincke's method
6. Deposition of thin film by Dip coating method
7. Compressibility of a liquid – Ultrasonic method
8. Hall Effect
9. e/m – Magnetron Method
10. B – H curve – Anchor ring method
11. B – H curve – Solenoid, Tracer
12. Wavelength and refractive index of liquid – Diode laser
13. Kelvin's Double Bridge – Determination of very low resistance & Temperature coefficient of resistance
14. Refractive index of liquid- Biprism.
15. Polarizability of liquid-Spectrometer.
16. Thickness of the material using diode laser.
17. Measurement of resistivity and Hall coefficient – Vander Pauw method

SEMESTER - IV

CODE	COURSE TITLE
18PHPCP04	CORE PRACTICAL - IV SPECIAL ELECTRONICS

Category	CIA	ESE	L	T	P	Credit
Core	40	60	-	-	120	4

Preamble

The aim of this course is to impart hands-on experience in constructing the electronic circuits and also to verify the theoretical concepts of solid state devices. To understand the operations of microprocessor. To gain experience in constructing advanced electronic circuits using IC's and diodes. To improve the practical knowledge in digital logic circuits and data converters.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Achieve practical knowledge by designing different counters	K3
CO2	Explain the functions of microprocessor for developing programs to interfacing with circuits	K5
CO3	Develop the link in connecting theory with designing practical circuits	K3
CO4	Analyze and design the applications of digital ICs and diodes	K4
CO5	Improve the creative skills and advanced level of thinking in designing the logic circuits	K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	M	S	S
CO3	S	S	S	S	S
CO4	S	M	S	S	M
CO5	S	S	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

CORE PRACTICAL - IV
SPECIAL ELECTRONICS
(Examination at the end of Fourth Semester)
Any Twelve Experiments

1. OP-Amp : Circuits using diodes – Half wave, full wave, clipper and clamper
2. IC 555 timer application – Monostable and Astable Multivibrator
3. A/D Converters – any one method.
4. D/A Converters – Binary weighted and Ladder methods
5. Modulation Counter
6. 7473 –Up/Down Counter, Shift Register, Ring Counter and Johnson Counter
7. Instrumentation amplifier
8. Tunnel diode – characteristics

Microprocessor 8085 Experiment:

9. Square and Square root of a single byte, two digit BCD number.
10. Code Conversions – (i) Decimal to Hexadecimal (ii) Hexadecimal to Decimal (iii) Hexadecimal to ASCII and (iv) ASCII to Hexadecimal.
11. Largest /Smallest number in an array and Ascending / descending order of N numbers.
12. LED Interfacing.
13. Stepper Motor Interfacing.
14. Traffic control simulation.
15. Hex Key board interfacing.
16. Musical Tone Generator.
17. ADC Interface.
18. DAC Interface.