

Course Structure for V semester UG Programs

Department of Physics

Discipline Specific Core Course: Physics

Sem	Theory/ Practical	Course Title	Teaching/ Practical Instruction hour/week	Total Hours/ Sem	Duration of Exam in hours	Assessment Marks			Credits
						Summative	Formative	Total	
V	Theory	Solid State Physic	4	60	3	80	20	100	4
	Practical	Solid State Physic Practical - V	4	60	3	40	10	50	2
	Theory	Wave and optics	4	60	3	80	20	100	4
	Practical	Wave and optics Practical - V	4	60	3	40	10	50	2
	Elective	Energy Sources	4	60	3	40	10	50	3

SEMESTER-V

Solid state Physics

No. of credits-043, 64 Hours

Unit –1	16 hours
Crystal Structure: Concept of lattice, periodic crystal, unit cell, Bravais lattice, Crystal planes and Miller indices, Interplanar spacing in terms of miller indices. X-ray diffraction, Bragg's law, Bragg's spectrometer (construction and working), powder method, Structure of NaCl and KCl, Crystal binding: Ionic, Covalent, Metallic, Molecular and Hydrogen bonding, X-ray spectra; Moseley's law, Scattering of X-rays- Compton effect, Bragg's law. And Numerical	8hrs
Band Theory of Solids: Classification of solids: Conductors, Semiconductors and Insulators Intrinsic and extrinsic semiconductors. Derivation of expression for Electron density, hole density and Electrical conductivity in intrinsic semiconductors Expression for Fermi level in intrinsic and extrinsic semiconductors. PN junction diode. And Numerical	8hrs
Unit –2	16 hours
Free Electron Theory of Metals: Study of Electrical and thermal properties of metals, expression for electrical and thermal conductivities, Weidman Franz Law, Ohm's law, Drude and Lorentz theory, derivation of electron density of states, Concept of Fermi energy, expression for Fermi energy and Kinetic Energy of Electron (at absolute zero Temperature), Density of States for Free Electrons with derivation, Qualitative discussion of Lattice vibration and concept of Phonon, and Numerical.	

Unit –3	16 hours
<p>Specific heat of solid: Dulong and Petit’s law, Einstein’s theory and Debye’s theory of specific heats(derivation),Hall Effect: Experimental Determination of Hall Co-efficient and its Application, Fermi- Dirac distribution, Numerical</p> <p style="text-align: right;">6hrs</p>	
<p>Magnetic properties of materials: Review of basic Formulae: Magnetic intensity,MagneticInduction,Permeability,MagneticSusceptibility,Dia, Para and Ferro magnetism and its properties, qualitative explanations of Classical (Langvein’s theory) and Quantum theory of Paramagnetism (Currie law Currie- Weiss law), Discussion of B-H Curve, Hysteresis and Energy loss. And Numerical</p> <p style="text-align: right;">10hrs</p>	
Unit –4	16 hours
<p>Super conductivity :Introduction,Elementary ideas of super conductivity and experimental facts-Zero Resistivity and critical Temperature,Meissner effect, BCS theory of Superconductor, Critical magnetic field, persistent current, London’s equations. Type I and Type II super conductors, Applications of semi conductors, and Numericals</p>	

References Books:

Sl No	Title	Name of Author	Publication	year
1	Introduction to Solid State Physics	Charles Kittel	Global Publication	2018
2	Solid State Physics	Giuseppe Grosso and Giuseppe		2000
3	Modern Physics	R.Murigeshan	S,Chand Publication	2010
4	Elementary Solid State Physics	M. Ali Omar	Pearson Education	1975
5	Condensed Matter Physics	Ajay Kumar Saxena.	Laxmi Publications Pvt. Ltd	2000
6	Introduction to Superconductivity	Michael Tinkham	McGraw-Hill	2004
7	Solid State Physics	A J Dekker	MacMillan India Ltd	2000
8	Essential of crystallography	M A Wahab	Narosa Publications	2009

Practical Content

List of Experiments to be performed in the Laboratory (Minimum of 8 Experiments)

Solid State Physics

No. of Credits: 02

1.	To Measurement of Susceptibility of paramagnetic solution
2.	To Measure the Magnetic Susceptibility of Solids
3.	To determine the inter planar Spacing d and structure Factor s using X-ray powder Diffraction film.
4	To the temperature co-efficient of resistance of semiconductor.
5	To Draw the B-H Curve of iron and determine the energy loss from Hysteresis
6	To measure the resistivity of a semiconductor (Ge) Crystal with temperature by Four Probe Method (from Room Temperature to 150°c) and determine its Band Gap.
7	To Determine the energy gap of a semiconductor.
8	Resistivity of a material by four probe method.
9	Determination of Lorentz Number
10	Semiconductor temperature sensor.
11	Temperature coefficient of resistance and energy gap of thermistor.
12	Solar cell characteristics – Open circuit voltage – short circuit current – efficiency.
13	Study of Hall effect in a metal.
14	Analysis of X-ray diffraction pattern obtained by powder method to determine properties of crystals.
15	Determination of Fermi energy of a metal
16	Determination of thermal conductivity of a metal by Forbe's method.
17	Measurement of heat capacity of metals.

Reference Books:

Sl No	Title	Name of Author	Publication	year
1	Experiment in Physics	saraf	Vikas publicatios	1975
2	Advanced Practical Physics	S.P. Singh	Pragati Prakashan	1969
3	Physics Practicals	C L Arora	S.chand	2010
4	Experiments in Modern Physics.	Melissons		1966
5	Physics Lab. Manual	Misra and Misra.	South Asian publishers	2000
6	Practical physics	Gupta and Kumar	Pragatiprakashan	1976

WAVES AND OPTICS

No. of Credits – 04, 64 Hours

Unit-1. Waves and Superposition of Harmonic Waves.	16 Hours
<p>Waves: plane and Spherical waves, Longitudinal and Transverse waves, Characteristics of wave motion ,plane progressive waves, and its equation, wave equation for differential forms, particle and wave velocities, and relation between them, Energy transport of transverse wave, Expression for intensity of progressive wave, and Numerical.</p>	5hrs
<p>superposition of Harmonic Waves: principle of superposition and linearity, superposition of two Collinear Harmonic Oscillator: Oscillation having Equal Frequency, Explanation of Lissajous Figures (amplitude un equal, same phase, phase of $\pi/4$), Composition of the harmonic motion with un equal frequency and different amplitude, Transverse Waves On A String. Travelling And Standing Waves On A String. Normal Modes Of A String. Group Velocity, Phase Velocity, Plane Waves, Spherical Waves, Wave Intensity, and Numerical</p>	6hrs
<p>Sound : Simple Harmonic Motion-Forced Vibrations And Resonance - Intensity And Loudness Of Sound Motion-Decibels - Intensity Levels - Musical notes. Acoustics Of Buildings Reverberation And Time Of Reverberation - Absorption Coefficient - Sabine's Formula - Measurement Of Reverberation Time -Acoustic Aspects Of Buildings. Newton's formula for velocity of sound and laplace Correction. Beats and its application. And Numerical</p>	5hrs

Unit-2. Optics	16 hours
<p>Wave optics: Theories of light, Electromagnetic Nature Of Light. Definition And Properties Of Wave Front. Huygens Principle. Construction Of Wave Front. 4hrs</p> <p>Interference of light: Coherent sources, interference due to Division Of Wave front: Young's Double Slit Experiment, Expression for Fringe Width, Lloyd's single Mirror And Fresnel's Bi- prism. interference due to Division of Amplitude: Interference in Thin Films, interference due to Transmitted light, Wedge-Shaped Films. (Air Wedge), Newton's Rings, Theory of Newton's rings by Reflected and Transmitted light, Michelson interferometer, Measurement of a wavelength and Numericals. 12hrs</p>	
Unit-3. Diffraction and Polarization.	
16 hours	
<p>Diffraction: Idea Of Form Of Fringes, Determination Of Wavelength, Wavelength Difference, Refractive Index And Visibility Of Fringes Diffraction: Fraunhofer Diffraction, Single Slit, Double Slit, Multiple Slits Or Diffraction Grating Fresnel Diffraction: Half-Period Zones. Zone Plate. Fresnel Diffraction Pattern Of A Straight Edge Slit and a Wire Using Half-Period Zone Analysis. And Numerical . 6hrs</p> <p>Polarization of light: Types of polarization, Transverse Nature Of Light Waves. Plane Polarized Light ,Methods of polarization: polarization by Reflection, Refraction, Scattering, absorption, Double refraction in a calcite Crystal, Brewster's law and its application, , Huygens Theory Of Positive And Negative Crystal, Optical Activity: Fresnel Theory of Quarter Wave Plate And Half Wave Plate. Laurent Half Shaded Polari meter. Malus law, Super position of Waves linearly polarized at right angles, production of Elliptical and Circular polarized light, Application of polarized light, and Numerical. 10hrs</p>	

Unit-4 Optical Instruments.**16 hours**

Cardinal points, Equivalent focal length of two Thin convex lenses separated by distance, Tracing of cardinal points, aberrations Spherical and Chromatic aberrations in lenses, Achromatic Combination of lenses, in Contact and separated by a distance, power of lenses, Huygens and Ramsdons eye pieces,

Reference Books:

Sl No	Title	Authour	publication	year
1	optics text book	Brijilal and subramanyam	S.Chand publications	2006
2	College Physics for B.Sc	N.Sundararajan,GeorgeThomas, SayyedAzeez	United Publication	2002
3	Optics	AjoyGhatak	S.Chand publications	2008
4	A text Book of Sound	Brijilal and subramanyam	S.Chand publications	1985
5	Engineering Physics	R K Gour and S L Gupta	Dhanpat Rai & Co. (P) Ltd.	2012

Practical Content

List of Experiments to be performed in the Laboratory (Minimum of 8 Experiments)

Waves and Optics

No. of Credits: 02

1	To investigate the motion of coupled oscillators
2	To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify $\lambda^2 - T$ Law
3	To study Lissajous Figures.
4	To determine the Refractive Index of the Material of a given Prism using Mercury Light
5	To determine Dispersive Power of the Material of a given Prism using Mercury Light
6	To determine the value of Cauchy Constants of a material of a prism
7	To determine the Resolving Power of a Prism.
8	To determine wavelength of sodium light using Fresnel Biprism.
9	To determine wavelength of sodium light using Newton's Rings.
10	To determine the wavelength of Laser light using Diffraction of Single slit
11	To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating.
12	To determine the Resolving Power of a Plane Diffraction Grating.
13	Familiarization with schuster's focusing; determination of angle of prism.
14	Velocity of sound through a wire using Sonometer.
15	Frequency of AC Using Sonometer
16	To Verify the laws of transverse vibration using Melde's apparatus.
17	To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge shaped film.

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2	Advanced Practical Physics	S.P. Singh	Pragati Prakashan	1966
3	Physics Practicals	C L Arora		2010
4	Experiments in Modern Physics.	Melissons.		1966
5	. Physics Lab. Manual	Misra and Misra	South Asian Publisher	2000.
6	Practical physics	Gupta and Kumar	PragatiPrakashan	1976

Elective Paper
Energy Sources
No. Of Credits 03: 48 Hours

Unit –1 Non-Renewable Energy Sources	12 Hour
<p>Introduction: Energy concept-sources in general, its significance & necessity, Classification of energy sources: Primary and Secondary energy, Commercial and Non-commercial energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy, Based on Origin- Examples and limitations. Importance of Non-commercial energy resources</p>	
6hours	
<p>Conventional energy sources: Fossil fuels & Nuclear energy- production & extraction, Usage rate and limitations. Impact on environment and their issues & challenges. Overview of Indian & world energy scenario with latest statistics- consumption &Necessity. Need of eco-friendly & green energy & their related technology.</p>	
6hrs	
Unit –2 : Renewable energy, sources	12 Hours
<p>Introduction: Need of renewable energy, non-conventional energy sources. An Overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy System, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical Conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.</p>	
06 hours	
<p>Solar energy: Solar Energy-Key features, its importance, Merits & demerits of solar energy, Applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell-brief discussion of each. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.</p>	
06 hours	
Unit –3 : Energy harvesting.	12 hours
<p>Wind and Tidal Energy: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies, Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices, Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy.</p>	
10 hours	
<p>Geothermal and hydro energy: Geothermal Resources, Geothermal Technologies Hydropower resources, hydropower technologies, environmental impact of hydro power sources, Carbon captured technologies, cell, batteries, power consumption.</p>	
2 hours	

Unit –4 : Biomass Energy and Fuel Cells	12Hours
<p>Biomass Energy: Introduction Of Biomass energy, Photosynthesis Process, Bio Fuel, Biomass Resources, biomass Conversion Technology-fixed dome, urban waste to energy conversion, biomass gasification Classification of biomass, energy plantations, and wood chemistry, factors influencing biogas yield, and differences between anaerobic and aerobic digestion,</p> <p style="text-align: right;">6hrs</p> <p>Fuel Cells: Overview of Fuel Cells, fuel cell Definition, brief history, classification, how does it work, why do we need fuel cells, Fuel cell basic chemistry and thermodynamics, heat of reaction, theoretical electrical work and potential, theoretical fuel cell efficiency, Hydrogen, Hydrocarbon fuels, effect of impurities such as CO, S and others, liquid hydrogen and compressed hydrogen-metal hydrides, alkaline fuel cell.</p> <p style="text-align: right;">6hrs</p>	

References Books:

Sl No.	Book Title	Author Name	Publication	year
01	Fuelcell Techonology	Hoogers G	CRC Press	2003
02	Fuelcell and their application	Karl Kordesch &Gunter R.Simader	VCH Publisher	2001. 1ed
03	Energy Harvesting Technologies	Shashank Priya and Daniel J. Inman	Springer nature link	2009
04	Renewable Energy and Energy Harvesting	Binapani Satpathy	Kalyani Publishers	2018

