



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited A++ Grade by NAAC | 12B Status by UGC | Approved by AICTE

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School of Science and Humanities

Department of Physics

1.1.3 Courses having focus on Employability / Entrepreneurship / Skill Development

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SPHA1401	OPTICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To learn the fundamental principles of optics.
- To learn the mathematical techniques employed in optics.
- To use these principles and techniques to solve problems in optics

Unit I - Geometrical Optics**9 Hrs**

Thin lens equation - compound thin lenses - Thick lens formula - Power of a thick lens – Lens combination - Refracting surfaces- Spherical aperture and stops - Single lens magnifier – Single lens camera – Two lens optical systems –The Microscope – The Telescope – Telephoto Lens.

Unit II Lens Aberrations**9 Hrs**

Spherical aberration and lenses - Methods of minimizing spherical aberration - Condition for minimum spherical aberration in the case of two lenses separated by a distance - Chromatic aberration in lenses - Condition for achromatism of two thin lenses (in contact and out of contact) - coma - astigmatism - Curvature of the field - Huygen's and Ramsden's eye pieces.

Unit III - Light waves**9 Hrs**

Maxwell's equation – The wave equation-plane wave solution- spherical and cylindrical wave solutions – Homogeneous and Inhomogeneous waves – energy density and Poynting vector - Dispersion produced by a thin prism - Angular dispersion - Dispersive power - Cauchy's formula.

Unit IV – Interference**9 Hrs**

Colours of thin films - Air wedge - Determination of diameter of a thin wire by air wedge - Test for optical flatness - Haidinger's fringes - Michelson's Interferometer - Theory - Applications - thickness of thin transparent material and resolution of spectral lines - Brewster's fringes - Refractive index of gases - Jamin's & Rayleigh's Interferometers - Stationary waves in light - Colour photography (principle only), Holography (principle only).

Unit V - Polarization and Diffraction**9 Hrs**

Double refraction - Nicol prism - polarizer and analyzer - Huygen's explanation of double refraction in uniaxial crystals - Dichroism - Polaroids and their uses - Double image polarizing prisms - Fresnel diffraction - Diffraction at Circular aperture, Opaque circular disc, Straight edge and Narrow wire - Fraunhofer diffraction - single slit - Double slit - Plane diffraction grating - theory and experiment to determine wave length.

Max. 45 Hours**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - Understand the physical significance of Maxwell's equations and hence estimate the speed of light.
- CO2 - To understand the various types of optical aberration.
- CO3 - To know about the basics of electromagnetic waves and their characteristics.
- CO4 - To know the principle of air wedge and Jamin's & Rayleigh's interferometers.
- CO5 - To understand the basics of polarization and applications of polarization.
- CO6 - To understand the basics of diffraction and applications of diffraction.

TEXT / REFERENCE BOOKS

1. Optics by Subramaniam, N.BrijLal, S.Chand & Co. Pvt. Ltd., New Delhi.

2. Optics by Khanna D.R. & Gulati H.R., R.Chand & Co. Pvt. Ltd., New Delhi.
3. Optics by K.K.Sharma, Elsevier, New Delhi, 2006.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 mark each - No choice.**30 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks.**70 Marks**

SPHA1504	FUNDAMENTALS OF AGRICULTURAL PHYSICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- The objective of this discipline is to educate students on
- Understanding of climate and weather elements, principles and processes, and their impact on agricultural activities.
- Agricultural Physics deals with the application of physical principles and processes in agriculture.

Unit I: Basic concepts of physics

Importance of physics related to agriculture- physical laws – Brownian movement – Tyndall effect – Raman Effect – Spectroscopy – Adhesion and Cohesion properties – relevant to agriculture

Unit II: Soil physics

soil moisture movement – physical classification of soil moisture – soil air movement – thermal diffusion in soils – thermal properties of soils – heat capacity – heat conductivity – specific heat. (6 Lectures)

Unit III: Nanophysics

Nano particles – physical properties of nanoparticles – Moore's law – semi conductors – diode – biosensors – quantum dots – working principles of Transmission Electron microscope – Scanning Electron Microscope – Scanning Tunneling Microscope – their applications (7 Lectures)

Unit IV: Soil

plant - water continuum – capillary movement of water in soil and plant – tortuosity of water in soils – Hysteresis effect – osmosis – diffusion. (6 Lectures)

Unit V: Physical constraints in agriculture

soil constraints – impermeability of soil – compaction methods – physical constants of soils – Soil physics as a factor in soil management.

Max. 45 Hours

Course outcomes:

- On completion of the course, student will be able to
- CO1: Agrophysics is a science that studies physical processes
 - CO2: To know the properties affecting plant production.
 - CO3: The knowledge of physical phenomena in agricultural environment
 - CO4: It creates increasing efficiency of use of water and chemicals in agriculture and
 - CO5: Understanding the decreasing biomass losses during harvest, transport, storage, and processing.
 - CO5 They understand about the soil characteristics before starts cultivating,
 - CO6: To understand about the constraints of soil in agriculture

TEXT / REFERENCE BOOKS

1. William Lambe, T. and Robert V. Whitman. 1979. Soil Mechanics. Wiley Eastern Ltd. New Delhi.
2. Helmut Kohnke, 1979. Soil Physics. Tata McGraw-Hill Publishing Company Ltd. New Delhi.
3. Biswas, T.D. and Mukherjee, S.K. 1997. Text book of soil science. Tata McGraw-Hill Publishing Company Ltd. New Delhi.

Employability

4. Chinnamuthu, C.R., B.Chandrasekaran and C.Ramasamy, 2007. Nanotechnology Applications in Agriculture. TNAU Offset & Printing Press, Directorate of Open and Distance Learning, TNAU, Coimbatore.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 6 Questions of 5 mark each - No choice.

30 Marks

PART B: 2 Questions from

each unit of internal choice, each carrying 14 marks. **70 Mark**

SPHA2502	INFORMATION SYSTEM AND COMMUNICATION TECHNOLOGY LAB	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To understand the basics of computer system, internet communications, know about the Microsoft excel, power point designing.
- To understand about the zoom meeting and its operating system and google meet.

1. Identify various input/output devices, connections and peripherals of computer system.
2. Create , edit and save the document
3. Use the numbering, bullets, page formatting
4. Create, open and edit worksheets
5. Practice to draw flow chart, bar chart, line graph, editing in graph.
6. Using Origin , draw a graph and editing
7. Apply animation effects to the text and slides
8. Types of Directories
9. Surfing the NET work for information
10. Introduction to Microsoft Excel
11. Introduction to Microsoft Power point
12. Introduction to IoT
13. Operating zoom meet, Google meet.

Employability

SPHA1603	SOLID STATE PHYSICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To understand the importance of the crystalline order in solids
- To acquire basic concept of crystalline lattices and the techniques.
- To understand the importance of the dynamics of electrons in the conductance properties of materials

Unit 1. Crystal Structure:

9

Hrs

Introduction – Types of solids – amorphous and crystalline solid - space lattice – The basis and the crystal structure unit cell – primitive lattice cell – Lattice parameter - Symmetry considerations – point groups - Bravais lattices in two dimensions–seven crystal systems – co-ordination number for SC, BCC and FCC - Miller indices– features of miller indices - Bragg's law – Rotating crystal method–Powder method–Neutron diffraction.

Unit 2. Magnetic and Dielectric materials:

9

Hrs

Magnetic materials: Magnetic moment – dia and paramagnetism – Ferromagnetism – Domain theory of ferromagnetism – Antiferromagnetic – Ferrites -; applications – floppy and magnetic disc devices, magnetic bubble memory. **Dielectric materials:** Electronic, ionic, oriental and space charge polarization – Internal field – Determination of Clausius – Mosotti relation – dielectric loss – dielectric breakdown.

Unit 3. Superconductivity:

9

Hrs

Introduction – properties of superconductors – High and low temperatures superconductors - BCS theory - Meissner effect – Levitation – Josephson's effect -SQUID -Type I and Type II superconductivity.

Unit 4 - Semiconducting materials:

9

Hrs

Semiconductors - expressions for the carrier concentration in intrinsic and extrinsic semiconductors – calculation of density of holes and electrons – Fermi level and its variation with temperature – Determination of band gap energy – Hall effect – Determination of Hall coefficient.

Unit 5. Optical properties of solids:

9

Hrs

Introduction- Ionic conduction – Optical absorption in metals, Insulators and semiconductors – colour Centres – Excitons – Luminescence – **Maser and Laser – applications of lasers.**

Max. 45 Hrs**Course outcomes:**

- On completion of the course, student will be able to
- CO1: Have a basic knowledge of crystal systems and spatial symmetries
- CO2: Be able to account for how crystalline materials are studied using diffraction, including concepts like form factor, structure factor, and scattering amplitude.
- CO3: Know the principles of structure determination by diffraction.
- CO4: Understand the concept of reciprocal space and be able to use it as a tool
- CO5: Know the significance of Brillouin zones
- CO6: To know the optical properties of solids.

TEXT / REFERENCE BOOKS

1. Modern Physics by R.MurugesanS.KiruthigaSivaprasad. S.Chand Publishers (2012).
2. Modern Physics by Sehgal Chopra SehgalS.Chand Publishers

3. Modern Physics by J.B. Rajam (1967).
4. Solid state physics by Gupta Kumar. Vikas Publishing Pvt., Ltd., (2001).
5. Solid State Physics – R- L Singhal. Wiley Eastern Ltd.
6. An Introduction to Solid State Physics (5th edition), Kittel. C
7. Solid State Physics, Dekker A.N. MacMillan
8. Fundamentals of Electricity and Magnetism, Mandiratta, Sawhey

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 mark each - No choice.

20

Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks.

80

Marks

SPHA3001	Renewable Energy and Energy Harvesting	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To obtain an overview of various renewable energy sources
- Study the exists and gives insight to the actual status of various renewable energy sources.
- Knowledge about Bio energy ocean energy.

UNIT 1 INTRODUCTION TO ENERGY**9Hrs.**

Definition and units of energy, power, Forms of energy, Conservation of energy, second law of thermodynamics, Energy flow diagram to the earth. Origin and time scale of fossil fuels, Conventional energy sources, Role of energy in economic development and social transformation.

UNIT 2 SOLAR ENERGY FUNDAMENTALS**9Hrs.**

Solar constant – Solar radiation at the earth's surface – Solar radiation Geometry – Solar Radiation measurements – Estimation of average solar radiation – Solar radiation on tilted surface. Physical principles of the conversion of solar radiation into heat – Flat plate collectors – Transmissivity of the cover system – Energy balance equation and collector efficiency – Concentrating collector – Focusing type – Advantages and disadvantages of concentrating collectors over flat-plate collectors.

UNIT 3 SOLAR ENERGY APPLICATIONS**9Hrs.**

Solar photovoltaic – Solar distillation – Solar pumping – Solar furnace – Solar cooking – Solar energy storage systems – Solar pond (quantitative study only). Wind Energy: Basic principles of wind energy conversion – Basic components of wind energy conversion system – Classification of wind energy conversion systems – Wind energy collectors – Performance of wind machines.

UNIT 4 BIO ENERGY**9Hrs.**

Biomass conversion techniques – Biogas generation – Factors affecting bio digestion – Classification of biogas plants – Types of biogas plants – Materials used for biogas generation. Geothermal Energy: Nature of Geothermal fields – Geothermal sources – Vapour dominated systems – Liquid dominated systems – Magma resources – Geothermal exploration – Geothermal energy in India.

UNIT 5 OCEAN ENERGY CONVERSION**9Hrs**

Ocean Energy: Introduction, Principle of ocean thermal energy conversion (OTEC), Tidal power generation, Tidal energy technologies, Energy from waves, Wave energy conversion, Wave energy technologies, advantages and disadvantages.

Max. 45**Hrs****Course Outcomes:**

At the course end, the students will be able to

CO1: Understand the importance of renewable energy sources

CO2: Acquire the knowledge of solar energy

CO3: Learn the solar energy application in different form like solar voltaic, solar furnace, solar energy storage system etc.

CO4: Illustrate the biomass conversion technique and geothermal energy

CO5: Understand the concept of ocean thermal energy and hydrogen energy

CO6: Knowledge about the natural resources.

T EXT / REFERENCEBOOKS

1. G.D.Rai, Non-conventional Sources of energy, Fourth edition, Khanna Publishers, New Delhi, 2000.
2. S Rao and Dr.B.B.Parulekar, Energy Technology: Nonconventional, Renewable and Conventional, Third edition, Khanna Publishers, New Delhi, 1999.
3. S P Sukhatme, Solar Energy: Principles of thermal collection and storage, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.1996. M V R KoteswaraRao, Energy Resources: Conventional and non-conventional BS Publications, 2nd Edn, 2006.
4. B.H. Khan, Non conventional energy Resources, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd. 2009.
5. John Twindell and Tony Weir, Renewable energy Resources, 2nd Edn, Taylor and Francis, 2006. 3.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks: 100 Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 mark each - No choice.**20****Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks.**80****Marks**

SPHA3002	Oscillations and Waves	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To know the different modes of vibrations in the string and find out how different harmonics can be produced.
- To describe reflection, refraction, transmission of sound wave and attenuation of sound waves.
- To study the application of oscillation and waves through the vibration of rods, bells, air columns and tuning fork

Unit-1: Vibrations and Sound Waves:**9 Hrs**

Vibration of Strings: Equation of motion of a vibrating string, velocity of waves along a string, frequency and period of vibration of a string, harmonics and overtones. Propagation and velocity of sound wave in solid. Stationary Waves: Reflection of waves in strings from free and fixed ends, stationary waves, nodes and antinodes, pressure and density changes at nodes and anti-nodes, distribution of energy in a stationary wave.

Unit-2: Reflection, Refraction Diffraction and attenuation of Sound Waves**9****Hrs**

Reflection of sound waves, Huygen's Principle, Refraction of sound waves, Huygen's Principle, Diffraction of sound waves, Attenuation of Sound Waves: Causes of dissipation of sound energy, effect of viscosity, attenuation constant, effect of heat conduction, absorption of high frequency waves in gases, sound absorption in narrow tubes and cavities, transmission of power by plane waves, radiation resistance.

Unit-3: Oscillations and Waves: Applications**9****Hrs**

Vibration of Rods and Surfaces Longitudinal vibrations of rods, velocity of a longitudinal wave in a rod, stationary longitudinal waves in rods, transverse vibration of rods, tuning fork, vibration of plates, Chladni's figures, vibration of bells, vibration of stretched membranes and diaphragms, (non-mathematical treatment). Vibration of Air Column. Flue pipes and reed pipes, vibrations of air columns in closed and open organ pipe, overtones, resonance in air columns, end corrections, effect of temperature on pitch.

Unit-4: Acoustics**9****Hrs**

Musical Sounds: Noise and musical sounds, loudness, intensity level, decibel and phon, intensity of a sound, pitch, quality of sound. **Musical Scales and Consonance.** **Architectural Acoustics:** reverberation, absorption coefficient, Sabine's law, good acoustical designs of rooms, noise, measurement, noise reduction and sound insulation. **Technical Applications of Acoustical Principles:** Sound ranging, geophone, hydrophone, echo sounding, seismograph.

Unit-5: Ultrasonics**9 Hrs**

Ultrasonic waves - Different modes - Characteristic properties - Behaviour - Focusing - Stationary waves and resonance - Attenuation - Diffraction - Sources of ultrasound. Magnetostriction method - Piezoelectric method - Low frequency / high Intensity applications - high frequency - low intensity applications - clinical applications of different scans.

Max. 45 Hrs**Course Outcomes:**

At the course end, the students will be able to

CO1: Visualize the vibrations of strings and propagation interference of sound waves.

CO2: Find the behavior of sound waves at interfaces of Reflection, Refraction of diffraction,

Transmission and their attenuation.

CO3: Understand the different application of oscillation and waves.

CO4: Analyze the properties of musical sound and apply into architecture.

CO5: Clarify the ultrasonic characterization, production

CO6: The application at high & low intensity towards clinical application.

TEXT / REFERENCE BOOKS

1. A Text Book of Sound, D. R. Khanna and R. S. Bedi, (Atma Ram & Sons) New Delhi 1985
2. Vibrations, Waves and Acoustics, D. Chattopadhyay and P. C. Rakshit, (New Central BookAgency)
3. A Text Book of Sound, M. Ghosh, (S. Chand & Company)
4. Text book of sound by M N Srinivasan – Himalaya Publications (1991)
5. Science and technology of Ultrasonics by Bladevraj, Narosa (2004)
6. Text book of sound by BrijLal&Subramaniam, N Vikas Publishing House, New Delhi, 1982
7. Fundamentals of Acoustic, Lawrence Kinsler and Austin Frey, (Wiley Eastern)
8. Introduction to Mechanics, Mahendra K. Verma, (Universities Press)
9. Waves & Oscillations ,Subrahmanyam N &BrijLal, Vikas Publishing House Pvt. Ltd., New Delhi, 1994

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100 Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 mark each - No choice.

20

Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks.

80

Marks

SPHA3004	APPLIED DYNAMICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES:

- Introduce students to the concepts of dynamics.
- The students are expected to develop working skills in the dynamic analysis of both particles and rigid bodies.
- Master the basics of dynamics, including free body diagrams and kinematics.

Unit-I. Fundamentals of Dynamics:**9 Hrs**

Reference frames. Inertial frames; Galilean transformations; Galilean invariance. Review of Newton's Laws of Motion. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. Momentum of variable-mass system: motion of rocket.

Unit-II Rotational Dynamics:**9 Hrs**

Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

Unit-III Introduction to Dynamical systems:**9 Hrs**

Definition of a continuous first order dynamical system. The idea of phase space, flows and trajectories. Simple mechanical systems as first order dynamical systems : the free particle, particle under uniform gravity, simple and damped harmonic oscillator. Sketching flows and trajectories in phase space; sketching variables as functions of time, relating the equations and pictures to the underlying physical intuition.

Unit-IV Elementary Fluid Dynamics:**9 Hrs**

Importance of fluids: Fluids in the pure sciences, fluids in technology. Study of fluids: Theoretical approach, experimental fluid dynamics, computational fluid dynamics. Basic physics of fluids: Basic physics of fluids: The continuum hypothesis concept of fluid element or fluid parcel; Definition of a fluid- shear stress; Fluid properties- viscosity, thermal conductivity, mass diffusivity, other fluid properties and equation of state;

Unit-V Applications of Fluid Dynamics:**9 Hrs**

Flow phenomena- flow dimensionality, steady and unsteady flows, uniform & non-uniform flows, viscous & inviscid flows, incompressible & compressible flows, laminar and turbulent flows, rotational and irrotational flows, separated & unseparated flows. Flow visualization - streamlines, pathlines, Streaklines. Applications: Find the coupling coefficient of coupled pendulums and To determine the coupling coefficient of coupled oscillators.

Max. 45 Hrs

Course Outcomes:

At the course end, the students will be able to

- CO1: Understand the basic and descriptive fluid dynamics..
- CO2: Design the relativistic rotational dynamics..
- CO3: Understand the different application dynamical applications.
- CO4: Analyze the elementary fluid dynamics.
- CO5: Clarify the application of fluid dynamics
- CO6: The application at applied dynamics in various aspects.

TEXT / REFERENCE BOOKS

1. Nonlinear Dynamics and Chaos, S.H. Strogatz, Levant Books, Kolkata, 2007 48
2. Understanding Nonlinear Dynamics, Daniel Kaplan and Leon Glass, Springer.
3. An Introduction to Fluid Dynamics, G.K.Batchelor, Cambridge Univ. Press, 2002
4. Fluid Mechanics, 2nd Edition, L. D. Landau and E. M. Lifshitz, Pergamon Press, Oxford, 1987. 5.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100
Hrs.

Exam Duration: 3

PART A: 10 Questions of 2 mark each - No choice.	20
Marks	
PART B: 2 Questions from each unit of internal choice, each carrying 16 marks.	80
Marks	

SPHA3005	MEDICAL PHYSICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Course Objectives:

- Understand the basic principles of biophysics
- Understand the fundamentals of medical instrumentation
- Describe the applications of lasers in medicine.

UNIT I INTERACTION OF RADIATION WITH MATTER**9Hrs**

Interaction of electromagnetic radiation with matter, Thomson scattering, Rayleigh scattering, Compton scattering, Photoelectric absorption, Pair production – Interaction of light (electrons and positrons) and heavy charged particles with matter–specific ionization – Cerenkov radiation-mass-energy-attenuation and absorption coefficient - Interaction of neutron with matter.

UNIT II LASER – TISSUE INTERACTION AND MEDICAL LASER**9Hrs**

Laser tissue interaction - photophysical process - photobiological process - absorption by biological systems - different types of interactions - thermal - photochemical (one photon and multiphoton) - electro mechanical photo ablative process. Laser systems for biophotonics- CO₂ Laser- Nd-YAG Laser - Ar Ion Laser - Excimer laser-Diode lasers- Ti :Sapphire Laser- Beam Characteristics and Radiometry - Nano Imaging and PDT

UNIT III DOSIMETRIC QUANTITIES AND UNITS**9Hrs**

Introduction -exposure-Roentgen - photon fluence and energy fluence -KERMA-Kerma and absorbed dose
-CEMA -Absorbed dose - Radiation Dose Equivalent - stopping power - relationship between the dosimetric quantities - stopping power ratio. Principles of Radiation detection – properties of dosimeters - Theory of gas filled detectors - film dosimetry- Luminescence dosimetry - Gel dosimetry.

UNIT IV GENERATION AND DETECTION OF ULTRASOUND**9Hrs**

Propagation of ultrasound in biological materials - Piezoelectric effect - intensity changes by reflection, scattering, refraction, absorption and attenuation – impedance – transducer probes - Principles of Echo ranging - A-scan - detection, smoothing and filtering - time gain compensation - application of A, B, and M mode scan

UNIT V TYPES OF DOSIMETERS**9Hrs**

Thermoluminescence Dosimeters – Optically Stimulated Luminescence (OSL) Dosimeters – Principles and materials used – OSL measuring technology - Compound semiconductor dosimeters – GaAs detectors – HgI₂ detectors - CdTe dosimeters - Role of impurities: Zn-doped CdTe detectors –Neutron detectors. Radiation dosimeters – pMOS and direct ion storage (DIS) dosimeters - In-vivo dosimetry – Materials and methods

Course Outcomes:

At the course end, the students will be able to

CO1: Understand Dosimetry and standardization in clinical medical physics.

CO2: Analyse Radiation detectors and instrumentations,

CO3: Handling the Ion chambers, radiation chemistry and chemical dosimetry, various dosimeters,

CO4: Knowledge about Personnel monitoring instruments

CO5: Know about the different type of Dosemetries

CO6: Identity the radiations and application in various aspects.

TEXT / REFERENCE BOOKS

1. Frank Herbert Attix, Introduction to Radiological Physics and Radiation Dosimetry, Wiley-VCH Verlag, 2007.
2. Donald T. Graham, Paul J. Cloke, Principles of Radiological Physics, Churchill Livingstone, 2003.
3. Markolf H. Neimz, Laser-Tissue Interactions, Springer Verlag, Germany, 1996.
4. W. R. Hendee, Medical Radiation Physics, Year Book Medical Publishers Inc., London, 2003.
5. Charles Kittel., "Introduction to Solid State Physics", John Wiley, 8th edition, 2013
6. S.W.S. McKeever, "Thermoluminescence Dosimetry Materials: Properties and Uses", Ramtrans Publishing (December 1995).

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100
Hrs.

Exam Duration: 3

PART A: 10 Questions of 2 mark each - No choice.

20

Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks.

80

Marks

SPHA5103	MATERIALS SCIENCE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To acquire enveloping knowledge of physics, chemistry, metallurgy and mathematics
- To know wider field of materials science this is an interdisciplinary subject.
- Also to motivate the students to pursue research in the field of materials science.

UNIT 1 CHARACTERISATION OF MATERIALS**9 Hrs.**

Introduction, **Structural characterization** - X-ray diffraction, Laue's method, Bragg's law, Determination of crystal structure by Bragg's Spectrometer and powder X-ray diffractometer (Debye Scherrer camera) with principle, construction and working. **Microstructural characterization** – electromagnetic lens system, Determination of surface morphology by Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM) with principle, construction, working. **Microhardness testing** – Determination of microhardness by Vickers hardness test and Knoop hardness test with principle construction, working, formula. **Nanohardness test** – Determination of nanohardness by AFM.

UNIT 2 METALS ALLOYS**9 Hrs**

Introduction, Classification of metal alloys-Ferrous and Non Ferrous Alloys, **Ferrous Alloys**-classification, composition, properties and applications; **Synthesization of alloy steels** – construction and working of Electric Furnace process (Heroult furnace); **Phase diagram**–definition and its significance; micro structure-definition, types of micro structures–ferrite, cementite, pearlite, austenite, martensite with diagrams; Iron-Carbon Alloy Phase diagram – graphical description and explanation with all the necessary parameters. **Non-Ferrous Alloys** - Aluminum, Copper, Titanium, Magnesium alloys - composition, properties and applications. **Shape Memory Alloys** – Shape memory effect- mechanism and transformation temperature types of SMA - one way and two way shape memory effect; characteristics of SMA- hysteresis, pseudo-elasticity, super elasticity; characterization of shape memory alloys – explanation with reference to Differential Scanning Calorimetry, resistivity, transformation temperature, tensile test; Advantages and disadvantages of SMA, General applications.

UNIT 3 CERAMICS, COMPOSITES AND POLYMERS**9 Hrs.**

Ceramics: Structural features – Types of ceramics, Production techniques - Mechanical properties - Industrial ceramics like tungsten carbide, silica-alumina, zirconia, silicon carbide and sialons. **Composites:** Definition of composites - Continuous and Discontinuous fiber composites-Polymer and matrix-based composites - Examples of commercial composites. Structural features of polymer materials - Mechanisms of polymerisation and types of polymers- Thermoplastics - rubbers and elastomers - mechanical, physical and chemical properties - Cellular plastics - Liquid crystal polymers .

UNIT 4 ELECTRONIC MATERIALS**9 Hrs.**

Introduction Purification of electronic materials - Crystal growth and doping techniques (an overview) - Epitaxial growth - Impurity diffusion
- Ion implantation - Junction formation - Metallisation - **Lithography (an overview) - Contact formation.**

UNIT 5 NANO MATERIALS**9 Hrs.**

Introduction, Top down and bottom up approach, synthesis and properties, Nanomagnetic-OMR, GMR, TMR, Nano semiconductors-quantum cascade laser, quantum dot-optical

memory, Blockade device, quantum well.

Max. 45Hrs

Course Outcomes:

At the course end, the students will be able to

- CO1: Characterize the materials by AFM, TEM, SEM, XRD etc.
- CO2: Describe the nature and types of alloys and understand its applications
- CO3: Develop the system by using ceramics, composites and polymers
- CO4: Understand the modern society
- CO4: Understand the Crystal growth and Lithography techniques
- CO5: Apply Nano materials in appropriate application.

TEXT / REFERENCEBOOKS

1. J.C. Anderson, K.D. Leaver, R. D. Rawlings and J.M. Alexander, Materials Science, 4th Edition, Chapman-Hall, London, 1990.
2. V. Raghavan, Materials Science and Engineering, 3rd Ed. Prentice-Hall India, New Delhi, 1993.
3. C. M. Srivastava and C. Srinivasan, Science of Engineering Materials, Wiley-Eastern Ltd., New Delhi, 1987.
4. G. K. Narula, K. S. Narula and V. K. Gupta, Materials Science, Tata McGraw-Hill, 1988.
5. Z. D. Jaberezki, The Nature and Properties of Engineering Materials, Wiley Eastern.
6. R. K. Gupta Editor, Physics of Particles, Nuclei and Materials - Recent Trends New Horizons of Physics Series, Narosa, New Delhi, 2002.
7. M.A. Wahab, Solid State Physics, Structure and properties of materials, second edition, Narosa publishing house, 2005

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100
Hrs.

Exam Duration: 3

PART A: 10 Questions of 2 mark each - No choice.	20
Marks	
PART B: 2 Questions from each unit of internal choice, each carrying 16 marks.	80
Marks	

SPHA5305	INTRODUCTION TO RESEARCH METHODOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

Course Objectives:

- To understand the research techniques involved in a successful research.
- To develop the required skills about data analysis and application of software's
- Introducing Research survey to the new researchers.

UNIT 1 Introduction of Research Methodology:**9 Hrs.**

Design, Process and Methodology - Concept of research and its applications: characteristics features, objectives, scope, reliability and validity of research, Scientific process: Steps involved in research process, a brief history of scientific process - defining problem, preparing research design analysis and interpretation of data, Basic Principles of Experimental Techniques. Importance and relevance of ethics and values in science and technology, Primary and secondary sources of literature survey. Advantage of working in a research group.

UNIT 2 Data Analysis, Statistical Modeling and Error Evaluation:**9 Hrs.**

Introduction – Accuracy and Precision, Standard deviation, Relative standard deviation, Methods of reporting analytical data, Statistical evaluation of data-indeterminate errors. Correlation and regression, spectral analysis. Error analysis: Absolute and relative errors. Type of errors in experimental data. Determinate (systematic), indeterminate (random) and gross sources of error and their effects upon the analytical results. Statistical description of data - Mean, variance, skewness, median, mode – Distributions: Binomial, Poisson and Gaussian distributions – Student's t-test, F-test, Least-squares, Chi-square test – Linear and rank correlations.

UNIT 3 Presentation of Research Findings**9 Hrs.**

Methods of presentation - Oral, Communication to conferences, journals in a prescribed template – graphical abstract – ORIGIN software – case studies, contents of power point presentation. Motive, aim, objective, methodology, novelty, originality, usefulness to the society, Paper Writing and preparation of Dissertation: Basic concepts of paper writing - Steps of paper writing, Precautions in preparing the research Dissertation – Concepts of bibliography and annexure, Discussion of results, drawing conclusions, Giving suggestion and recommendation of concerned persons.

UNIT 4 Quality of Research**9 Hrs.**

Web of Science, Scopus, UGC, ICI Indexed Journals. Blind reviewed journals, Importance of peer reviewed journals, Plagiarism, Clarivate analytics, Indexing – i – index, h-index, citation index, Collaborative research work, Intellectual property rights – Patents – types-process-filing, publishing, registered patents, product, and commercialization. Improving the research career – INSPIRE Fellowships, CSIR NET Exam, GATE, JEST, etc – Funding opportunities – JRF, SRF in various government funded research agencies, Online courses – MOOC, NPTEL. Attributes of the research scholar – Keen observation, Passion for Knowledge, Spirit of enquiry, Insight etc, Possible approaches to be followed by research scholar.

UNIT 5 Introduction to Word processing package**9 Hrs.**

Creating and Editing a word document, creating a research paper, creating a cover letter and a resume, Creating a document with a title page, table, chart and watermark, Creating a webpage using word, Mail Merge, creating a professional newsletter. MS-office – Excel, PPT, Word etc.

Course outcome: At the end of the course, the students will be able to
CO1: Understand the structure of the individual research topic
CO2: Enhance their analytical mind.
CO3: Bring out the hidden skills
CO4: Make them aware of updation in their research area.
CO5: Identify the future research problems
CO6: Improve their ability as a researcher in a new field.

END SEMESTER EXAMQUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3

Hrs.

PART A: 5 Questions of 6 mark each - No choice.

30 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks.

70 Marks

SPHA1302	BASIC INSTRUMENTATION SKILLS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To make the student familiar with measurement techniques of force, torque and speed
- To make the student familiar with measurement techniques of acceleration, Vibration and density
- To make the student familiar with pressure measurement techniques

UNIT-1 INDUSTRIAL MEASUREMENTS**9 Hrs**

Measurement of straightness, flatness, roundness and roughness. Force Measurement - Load cell, different types of load cells - elastic load cell-strain gauge load cell. Torque measurement-Using strain gauge and magneto elastic principle, Speed Measurement - Revolution counter-capacitive tacho-drag up type tacho, D.C and A.C tacho generators - stroboscopic methods. Acceleration Measurement- Elementary accelerometer, Seismic accelerometer, Practical accelerometers.

UNIT- 2 TEMPERATURE MEASUREMENT & APPLICATION**9 Hrs**

Definition & Standards, Temperature scales, Calibration of thermometers, Bimetallic thermometer, filled-in Thermometers, Vapour pressure thermometers, Resistance thermometers, Thermistors- color code testing and installation procedure, Thermostat, Thermocouples - types and ranges, characteristics, laws of thermocouples, cold junction compensation, IC temperature sensors AD 590, Pyrometers - radiation and optical pyrometers.

UNIT- 3 PRESSURE MEASUREMENT**9 Hrs**

Manometers - different types of manometers, Elastic pressure transducers, Dead weight Tester, Electrical types, Vacuum gauges - McLeod gauge, Knudsen gauge, Thermocouple gauge, Ionization gauge, Differential pressure Transmitter - electrical & pneumatic types, Complete air supply system for pneumatic control equipment and the different components and their function.

UNIT- 4 MEASUREMENTS OF FLOW & LEVEL**9 Hrs**

Orifice, Venturi, Pitot tube, flow nozzle rotameter, Doherty tube, Positive displacement meter, Turbine flow meter, Electromagnetic flow meter, Ultrasonic flow meter, Open channel flow measurement, Solid flow measurement. Level: Sight glass, float gauge, displacer, torque tube, bubble tube, diaphragm box, Differential Pressure methods, electrical methods- resistance type, capacitance type, ultrasonic level gauging.

UNIT- 5 MEASUREMENT OF DENSITY, VISCOSITY, HUMIDITY**9 Hrs**

Hydrometer - continuous weight measurement, liquid densitometer - float principle, air pressure balanced method, using gamma rays - gas density measurements – gas specific gravity measurements - Viscosity terms, saybolt viscometer, rotometer type viscometer, Industrial consistency meters. Humidity terms - dry & wet bulb psychrometers - hot wire electrode type hygrometer, electrolytic hygrometer, Dew point hygrometer.

Max. 45 Hours**COURSE OUTCOMES:**

By the end of this course students will be able to

- CO1: Applying the concept of measurement, error calculation while performing experiments practically
- CO2: Acquire a detailed knowledge of industrial measurement
- CO3: An exposure to various available techniques of temperature and pressure measurement
- CO4: A detailed knowledge of fluid property measurement will be obtained
- CO5: An idea of newly evolving digital measurement techniques is gained.

TEXT / REFERENCE BOOKS

Skill Development

1. Patranabis D., "Principles of Industrial Instrumentation", Tata McGraw Hill, II Edition, New Delhi, Reprint 2009.

2. Singh. S.K., "Industrial Instrumentation & Control " 3rd Edition, Tata McGraw Hill, Reprint 2009.
3. Krishnaswamy. K & Vijayachitra. S, "Industrial Instrumentation" New age International, Reprint 2008.
4. Ernest O. Doebelin, Dhanish. N. Manik, "Measurement Systems Application & Design", TMH, 5th Edition, 2004.
5. Jain R.K, "Mechanical & Industrial Measurements", Khanna Publishers, 11th Edition, 2004.

END SEMESTER EXAM QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 10 Questions of 2 mark each - No choice.**30 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 16 marks.**70 Marks**

SPHA1402	Electrical circuits and Network Skills	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- The aim of this course is to enable the students to design and trouble shoots the electrical circuits.
- Handling the networks and appliances through hands-on mode.
- Knowledge of Usual electrical Circuits

UNIT-1 Basic Electricity Principles:**9 Hrs**

Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter. Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

Unit-II Electrical Drawing and Symbols:**9 Hrs**

Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers.

Unit-III Solid-State Devices:**9 Hrs**

Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC Sources.

Unit-IV Electrical Protection:**9 Hrs**

Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device)

Unit-V Electrical Wiring:**9 Hrs**

Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation.

Max. 45 Hrs**COURSE OUTCOMES**

On completion of the course, student will be able to

- CO1 - To Understand the basic electric circuits
- CO2 - To Knowledge of simple electrical circuits.
- CO3 - To know the basic electronic components making use of materials.
- CO4 - Understanding the electrical safety.
- CO5 - Handling the electrical circuits
- CO6 - To understand the basics of electrical and wiring.

TEXT / REFERENCE BOOKS

1. A text book in Electrical Technology - B L Theraja - S Chand & Co.
2. A text book of Electrical Technology - A K Theraja
3. Performance and design of AC machines - M G Say ELBS Edn

END SEMESTER EXAMQUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration: 3 Hrs.****PART A:** 6 Questions of 5 mark each - No choice.**30 Marks****PART B:** 2 Questions from each unit of internal choice, each carrying 14 marks.**70 Mark**

SPHA1502	ELECTRICITY AND MAGNETISM	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To understand the basic concepts in static electric field and such as Coulomb's law and electric potential.
- To derive equations for current charges and its applications.
- To know about the basic concepts of magnetism and basic laws.

UNIT I Electrostatics**9 Hrs**

Coulomb's Law – Gauss's Law and its applications (Electric Field due to a uniformly charged sphere, hollow cylinder & solid cylinder)– Electric Potential – Potential at a point due to a uniformly charged conducting sphere – Principle of a capacitor– Capacity of a spherical and cylindrical capacitors – Energy stored in a charged capacitor–Loss of energy on sharing of charges between two capacitors.

UNIT II Current Electricity**9 Hrs**

Ampere's circuital law and its applications -Field along the axis of a circular coil and Solenoid– Theory of Ballistic Galvanometer –Figure of merit– Damping Correction– Kirchhoff's Laws of Electricity – Wheatstone's Bridge–Carey Foster's Bridge–Potentiometer– Calibration of Ammeter – Calibration of Voltmeter (Low range and High range) – Comparison of Resistances.

UNIT III Electromagnetic Induction**9 Hrs**

Laws of electromagnetic induction– Self and mutual induction– Self-inductance of a solenoid– Mutual inductance of a pair of solenoids–Coefficient of coupling–Experimental determination of self (Rayleigh's method) and mutual inductance–Growth and decay of current in a circuit containing L and R– Growth and decay of charge in a circuit containing C and R– Measurement of High resistance by leakage.

UNIT IV AC Circuits**9 Hrs**

Alternating EMF applied to series circuits containing LC, LR and CR– Alternating EMF applied to circuits containing L, C and R–Series and Parallel resonance circuits– Sharpness of resonance–Q factor– Comparison between Series and Parallel resonant circuits –Power in AC circuits (R, L-R, L-C-R only) – Power factor–Wattless current – Choke Coil – Transformer – Uses of Transformers – Skin Effect.

UNIT V Magnetism**9 Hrs**

Intensity of Magnetization– Magnetic Susceptibility– Magnetic Permeability –Types of magnetic materials– Properties of para, dia and ferromagnetic materials–Langevin's theory of dia and para magnetism– Weiss's theory of ferromagnetism –B-H curve–Energy loss due to magnetic hysteresis – Ballistic Galvanometer method for plotting B-H curve - Magnetic properties of iron and steel.

Max. 45 Hrs**COURSE OUTCOMES**

- On completion of the course, student will be able to
- CO1: Use of Coulomb's law and Gauss' law for the electrostatic force
- CO2: Relationship between electrostatic field and electrostatic potential
- CO3: Use of the Lorentz force law for the magnetic force
- CO4: Use of Ampere's law to calculate magnetic fields
- CO5: Knowledge of electricity and magnetism
- CO6: To explain natural physical processes and related technological advances.

TEXT / REFERENCE BOOKS

1. BrijLal and N. Subrahmanyam, *A Text Book of Electricity and Magnetism*, RatanPrakasanMandir

- Educational & University Publishers, New Delhi, 2000.
2. R. Murugesan, *Electricity and Magnetism*, S. Chand & Company Pvt. Ltd., New Delhi – 2015
 3. D. L. Sehgal, K. L. Chopra and N. K. Sehgal, *Electricity and Magnetism*, S. Chand & Sons. New Delhi. 1996

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 6 Questions of 5 mark each - No choice.

30 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 14 marks.

70 Mark

SPHA6201	ADVANCED PHYSICS LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

ADVANCED PHYSICS LABORATORY

Objective:

- To introduce the basic concepts of various advanced experimental techniques used in research through hands on experience.

List of Experiments

1. UV-Vis Spectrophotometer – Determination of absorption coefficient and band gap
2. Fluorescence spectrometer – Emission spectra of a fluorophore
3. FTIR Spectrometer – Determination of vibration levels in a compound
4. Thin Film Deposition and Measurement of Electrical Conductivity – Four Probe Method
5. Impedance Spectroscopy – measurement of impedance of capacitor
6. Band structure study of Si at ambient and under pressure
7. Bridgmann technique – method of growing single crystal
8. Thermo gravimetric analysis and Differential Scanning calorimeter
9. Measurement of thickness of thin film
10. Experiment with microwaves – measurement of dielectric constant of solid
11. Non-Destructive Testing
12. IR Pyrometer

Course Outcomes:

By the end of this course students will be able to

CO1: Calculated the absorption coefficient and band gap by spectrophotometer

CO2: Determine the vibrational levels in a compound by FTIR spectrometer

CO3: Measurement of electrical conductivity of a thin film by four probe method

CO4: Identifying structural problems by NDT method

CO5: The student will be able to understand the fundamental physics behind modern scientific equipment

CO6: TO know the research through hands on experience.

TEXT / REFERENCEBOOKS

1. L.A. Leventhal, Micro Computer Experimentation with the Intel SDK-85 (1980).
2. Learning MATLAB – The MathWorks, Inc (1999).
3. Kenneth L. Ashley, Analog Electronics with LabVIEW, Pearson Education (2003).

SPHA5301	CONDENSED MATTER PHYSICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To provide depth of knowledge and to improve the understanding capability about crystal structure.
- It is intended to describe the bonding nature, optical and dielectric properties of solids.
- Also to motivate the students to pursue research in the field of condensed matter physics.

UNIT 1 CRYSTAL BINDING**9 Hrs.**

Force between atoms-cohesive energy-calculation of cohesive energy bonding in solids-ionic, covalent, metallic, and molecular –hydrogen bonded crystals-binding energy of ionic crystals-Madelung constant- Lattice Energy - Born Mayer potential –Thermo chemical Born-Haber cycle. Crystal Defects: Point, line, surface and volume defects.

UNIT 2 LATTICE DYNAMICS**9 Hrs.**

Direct and Reciprocal lattice.Vibration modes of mono and diatomic lattices- upper and lower branches, Born-von Karman cyclic condition, quantization of lattice vibration-phonon momentum.Lattice vibrations and specific heats for three dimensional lattices, Inelastic scattering of neutrons by phonons-neutron diffraction, Density of Phonon modes in 1D and 3D, Lattice heat capacity, Thermal resistivity, Normal and Umklapp process.

UNIT 3 BAND THEORY OF SOLIDS**9 Hrs.**

Origin of energy bands – periodic potential in 1D - Bloch's theorem, Kronig-Penney 1D model-Limitation - construction of Brillouin zones-extended, reduced and periodic zone schemes-effective mass of an electron-nearly free electron model, Distinction between conductors, semiconductors and insulators, E-k curve, Born cyclic condition and number of electrons per band

UNIT4 ATOMIC MOLECULAR STRUCTURE**9 Hrs.**

Central field approximation-Thomas Fermi model and its application-Hartree and HartreeFock equations hydrogen molecules-Heitler London model-LCAO –Hybridization.

UNIT 5 FERMI SURFACE**9 Hrs.**

Fermi surface and Brillouin zones-Harrison's method of constructing Fermi surface in 2D Electron, hole and open orbits- characteristics of Fermi surface-effects of electric field on the Fermi surface-effect of magnetic field on the Fermi surface- quantisation of electron orbits-experimental study of Fermi surface (dHVA method)

Max. 45Hrs**Course Outcomes:**

By the end of this course students will be able to

CO1: Understand the basic physics behind the various crystal structure.

CO2: Understand the concept of phonons

CO3: Understand the basic concepts to classify the solids based on the electron transport properties.

CO4: Understand in depth concept of atomic structure

CO5: Understand the importance and Fermi surface and classify it.

CO6: Understand the concept of all fluid dynamics.

TEXT /REFERENCEBOOKS

1. C.Kittel, Introduction to solid state Physics 7 thEdn, Wiley Eastern, 1996.
2. A.K.Chandra, Quantum Chemistry, Prentice Hall, 1990.
3. R.E.Hummel, Electronic properties of materials, 2nd Edn, A Narosa, 1993.
4. S.Raimes, The wave mechanics of electrons in metals, 3rd Ed, Amsterdam: North Holland Pub.co, 1967.
5. Michael P. Marder, Condensed Matter Physics, Wiley, 2010.
6. C.P.Smyth, Dielectric behavior and structure, McGraw Hill, New York, 1965

7. M.A.Wahab, Solid State Physics, Structure and properties of materials, second edition, Narosa publishing house,

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration:3 Hrs.

PART A: 10 Questions of 2 mark each - No choice.

20 Marks

PART B: 2 Questions from each unit of internal choice, each carrying 16 marks.

80 Marks