



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

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SCHOOL OF SCIENCE AND HUMANITIES

DEPARTMENT OF PHYSICS

BOARD OF STUDIES

Minutes of Meeting

Date: 07-06-2022

Venue: Board Room, IRC

DEPARTMENT OF PHYSICS

Minutes of the BOS Meeting -2022 combined Board of Studies for PG & UG Programme held on 7th June 2022 at time 11.00 am at Senate room, International Research Centre, Sathyabama Institute of Science and Technology, Chennai.

Members Present

1. **Dr. Y. Ashok Kumar Reddy**, Assistant Professor of Physics, Advanced Energy Materials & Sensors (AEMS) Laboratory, Indian Institute of Information Technology Design & Manufacturing (IIITDM), Kancheepuram, Melakottaiyur, Chennai - 600127, Tamil Nadu, India.
2. **Dr. Ch. Kishan Singh**, Scientific Officer-E, Surface and Sensors Studies Division, Materials Science Group, Indira Gandhi Centre for Atomic Research, Kalpakkam – 603102, Tamil Nadu, India.
3. **Dr. S. Ravichandran**, Professor and Head, Sathyabama Institute of Science and Technology
4. **Dr. Helen Merina Albert**, Professor of Physics, Sathyabama Institute of Science and Technology
5. **Dr. C. Ramesh Kumar**, Associate Professor, Sathyabama Institute of Science and Technology.

Absent: **Dr. D. J. Sharmila**, M.Sc., M.Phil., Ph.D. Assistant Professor,
Department of Physics,
LOYOLA COLLEGE (Autonomous), Chennai.



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Board of studies meeting of Department of Physics was held on 7th June at 11 AM to 2.00 PM at Board Room of IRC. Dr. Rekha Chakravathy Dean S&H, addressed the BOS members. Dr. S. Ravichandran Head/Department of Physics introduced the programmes and courses offered by the Department of Physics and he projected the syllabus of I B.E./B.Tech, B. Sc (Physics) and M. Sc (Physics) on the LCD screen for discussion. The external members had gone through the syllabus and their suggestions are listed below:

Agenda of Meeting:

1. Revised the syllabus for theory and lab for B. Sc (PHYSICS) and M. Sc (PHYSICS), 2022.

M.Sc. – Physics:

- a. Mathematical Physics
- b. Materials Science
- c. Condensed Matter Physics
- d. Spectroscopy

B.Sc. – Physics:

- e. Properties of Matter
 - f. Thermal and Statistical Physics
 - g. Basic Instrumentation Skills
 - h. Quantum Mechanics
 - i. Electricity and Magnetism
 - j. Atomic Physics
2. Discussing the revision of physics syllabus for both theory and Laboratory
 3. Discuss the improvisation of Internship and project review for PG (M.Sc-Physics) students.
 4. Discuss the improvisation of Internship and project review for UG (B.Sc-Physics) students.

EXTERNAL MEMBERS	SIGNATURE	INTERNAL MEMBERS	SIGNATURE
Dr. Y. Ashok Kumar Reddy		Dr.S.Ravichandran	
Dr. Ch. Kishan Singh		Dr. Helen Merina Albert	
Dr. D. J. Sharmila		Dr. C. RAMESHKUMAR	



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SPHA5101	MATHEMATICAL PHYSICS	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To provide the students with an overview of statistical thought
- To learn about respective models and methods
- To provide some of the basic computation skills.
- To learn about vector in details
- To get idea about complex numbers

UNIT 1 VECTOR CALCULUS

12 Hrs

Vector Integration – Simple problems on line, surface and volume Integrals, Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem -Helmholtz theorem ($F(r)$ from curl and divergence of F), Maxwell's equations, Dirac delta function, charge densities for simple geometries- **multiple integration, line integrals, and vector fields**. Application of vectors, hydrodynamics, electromagnetic field.

UNIT 2 MATRICES AND TENSOR ANALYSIS

12 Hrs

Characteristic equation and diagonal form – Cayley-Hamilton theorem – Diagonalization of Matrices by Oorthogonal Transformation – Reduction of Quadratic form to Canonical form - Functions of matrices– Application in solving linear differential equation-Introduction to Tensor Analysis, **Addition and Subtraction of Tensors- Summation convention-Contraction-Direct Product- Levi-Civita Symbol.**

UNIT 3 INTEGRAL TRANSFORMS AND DIFFERENTIAL EQUATIONS

12 Hrs

Laplace transform – Transforms of standard functions – properties – Solution to Ordinary Differential Equations using Laplace Transforms - The infinite Fourier transform – Sine and Cosine transform – Properties – Inversion theorem – Convolution theorem – Finite Fourier sine and cosine transform – Solution to Partial Differential Equations using Fourier Transforms. Introduction to Orthogonal Curvilinear Coordinates **Differential vector operators: Derivations of gradient**, divergence, curl in Cartesian, spherical and cylindrical coordinate systems.

UNIT 4 POWER SERIES SOLUTION TO DIFFERENTIAL EQUATIONS

12 Hrs

Bessel differential equation: Solution – Recurrence formula for $J_n(x)$ – Generating function for $J_n(x)$ - Legendre's differential equation: Solution – **Orthogonal properties of Legendre's polynomials** – Recurrence formula – Rodrigue's formula – Generating function for $P_n(x)$ - Hermite differential equation: Solution – Hermite's polynomials-generating function – Orthogonal properties and different forms for the Hermite polynomials – Recurrence formula.

UNIT 5 COMPLEX VARIABLES

12 Hrs

Analytic function – Necessary and sufficient condition for $f(z)$ to be analytic – Harmonic function – Complex integration – Cauchy integral theorem – Extension to multiply connected region – Cauchy integral formula – Cauchy integral formula for the derivative of an analytic function – **Convergence of a series of complex terms – Taylor's theorem** –Laurent's theorem – Singular points – Residue – Method of finding Residues – Residue theorem – Evaluation of definite integral by contour Integration – **Complex Valued functions- contours - contour integral** Integration round the unit circle of the type $f(\cos T, \sin T)dT$ - Evaluation of $f(x) dx$.

Max. 60 Hours

Course Outcomes:

After successfully completed course, students will be able to

- CO1: Use vector calculus to find flow of energy
- CO2: Solve ordinary and partial differential equations of second order that are common in the physical sciences;
- CO3: Use matrix to know moment of inertia and use tensor to describe the linear relationship of vector and scalar.
- CO4: Use the orthogonal polynomials and other special functions and use Fourier series and integral transformation;
- CO5: Use the calculus of variations and use complex analysis in solving physical problems

TEXT / REFERENCE BOOKS

1. SatyaPrakash, Mathematical Physics, 6th revised edition, Sultan Chand & sons, Reprint, 2014.
2. B.D. Gupta, Mathematical Physics, 3rd Revised Edition, Vikas Publishing House, 2004.
3. L.A. Pipes and L.R. Harvill, Applied Mathematics for Engineers and Physicists, McGraw-Hill, New Delhi, 1970.

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

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SPHA5103	MATERIALS SCIENCE	L	T	P	Credits	Total Marks
		3	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.
- To acquire knowledge in materials properties and applications
- Also to motivate the students to pursue research in the field of materials science.

UNIT 1 CHARACTERISATION OF MATERIALS

12 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

12 Hrs

Introduction, Classification of metal alloys-Ferrous and Non Ferrous Alloys, Ferrous Alloys-classification, composition, properties and applications; Synthesisization 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

12 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 - Mechanism s of polymerization and types of polymers - Thermoplastics - rubbers and elastomers - mechanical, physical and chemical properties - Cellular plastics - Liquid crystal polymers.

UNIT 4 ELECTRONIC MATERIALS

12 Hrs

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

UNIT 5 NANO MATERIALS

12 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 60 Hrs

Course Outcomes:

Having successfully completed this course, 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 to the modern society

CO4: Understand the Crystal growth and Lithography techniques

CO5: Apply Nano materials in appropriate application.

TEXT / REFERENCE BOOKS

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 EXAMQUESTION PAPER PATTERN

Max. Marks: 80

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

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SPHA5301	CONDENSED MATTER PHYSICS	L	T	P	Credits	Total Marks
		3	1	0	4	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

12 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- Derivation

UNIT 2 LATTICE DYNAMICS

12 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 one dimensional lattice and 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

12 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

12 Hrs

Central field approximation-Thomas Fermi model and its application- Kohn Sham approximation Hartree and Hartree Fock equations hydrogen molecules-Heiyrt London model-LCAO –Hybridization.

UNIT 5 FERMI SURFACE

12 Hrs

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

Max. 60 Hours

Outcomes:

After the end of this course, the 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.

TEXT /REFERENCEBOOKS

1. C. Kittel, Introduction to solid state Physics 7th Edition, Wiley Eastern, 1996.
2. A. K. Chandra, Quantum Chemistry, Prentice Hall, 1990.
3. R. E. Hummel, Electronic properties of materials, 2nd Edition, 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: 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

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SPHA5303	SPECTROSCOPY	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To understand the basic principles of molecular spectroscopy
- To learn about the quantization of molecular energy
- Have idea about transitions between molecular energy levels
- To know details when matter interacts with radiation.

UNIT 1 MICROWAVE SPECTROSCOPY

12 Hrs

Rotation of molecules-Rotational Spectra-Rigid and non-rigid diatomic rotator-Intensity of spectral lines-Isotopic Substitution-Polyatomic molecules (Linear and symmetric top)-Hyperfine structure and Quadrupole effects-Inversion spectrum of ammonia-Chemical analysis by microwave spectroscopy-Techniques and instrumentation.

UNIT 2 VIBRATIONAL SPECTROSCOPY

12 Hrs

Vibration of molecules - Diatomic vibrating rotator- vibrational spectrum interactions of rotation and vibrations. Rotational Energy of spherical, Prolate and Oblate Symmetric Rotors, Rotational Raman and IR Spectra of Linear molecules and Determination of their Geometry. Rotation Vibration Band of a Diatomic Molecule, Parallel and Perpendicular type Bands in Linear and symmetric Rotor Molecules. Qualitative description of Type A, B and C bands in Asymmetric Rotor Molecules. existence of overtones and hot bands, vibration-rotation spectrum, rigid rotor-anharmonic oscillator model, energy expressions, selection rules, P, Q, R, branches, Born-Oppenheimer approximation and its breakdown, Polyatomic molecules and normal modes of vibration, applications of vibrational spectroscopy.

UNIT 3 ELECTRONIC SPECTROSCOPY

12 Hrs

Electronic spectra-Frank-Condon Principle-Dissociation energy and dissociation products-Fortrat diagram- predissociation-shapes of some molecular orbits-Chemical analysis by electronic spectroscopy-Techniques and instrumentation-Mass spectroscopy-ESR spectroscopy-Introduction-techniques and instrumentation-Double resonance.

UNIT 4 NUCLEAR SPECTROSCOPY

12 Hrs

Nuclear magnetic resonance spectroscopy-Introduction-Interaction of spin and magnetic field-population of energy levels-Larmor Precession-Relaxation Times-Chemical shift and its measurement-Coupling constant-coupling between several nuclei-quadrupole effects-¹³C NMR spectroscopy, Mossbauer spectroscopy: Principle- instrumentation-Effect of electric and magnetic fields.

UNIT 5 RAMAN SPECTROSCOPY

12 Hrs

Classical and quantum mechanical picture of Raman effect-Polarizability-Pure rotational Raman

spectrum-Vibrational Raman Spectrum- structural determination from IR and Raman spectroscopy techniques. Stokes and anti-stokes- Raman lines. Selection Rules. Spectral structures. Nuclear spin and its effect on Raman spectra. Vibrational spectra of poly atomic molecules. Normal modes. Selection rules for Raman **and infrared spectra. Complementarity of Raman and infrared spectra.**

Max. 60 Hour

Course Outcomes:

After the end of this course, the students will be able to

CO1: Know the various spectroscopic techniques used in the characterization of materials

CO2: Acquire the ability to operate the FTIR spectrometer

CO3: Plot and interpret the UV-Visible and FTIR spectra of the sample

CO4: Predict the NMR and ESR spectra of the sample

CO5: Understand the basic knowledge of group theory

TEXT / REFERENCEBOOKS

1. Colin Banwell and Mc Cash, Fundamentals of molecular spectroscopy, 5th Edition, TMH publishers,2013.
2. J. Michael Hollas, Modern spectroscopy, 4th Edition, Wiley India Pvt. Ltd.2010.
3. S.L.Gupta,V.KumarandR.C.Sharma,Elementsofspectroscopy,22ndEdition, Pragathi Prakasam publishers, Meerut, India, 2010.
4. Gary M. Lampman, Donald L. Pavia, George S. Krizand James R. Vyan,4th Edition, Cengage learning India Pvt. Ltd.
5. B. K. Sharma, Instrumental methods of chemical analysis, 24th edition, Goel publishing house, Meerut,2005.
6. J. Mohan, Organic spectroscopy principle and application,2nd edition, New Age International(P) Ltd, NewDelhi,2001.
7. D. N. Sathyanarayana, Vibrational Spectroscopy: Theory and applications, New Age International(P) Ltd, NewDelhi,1996.
8. SatyaPrakash, Mathematical Physics, 6th revised edn, Sultan Chand & sons, Reprint,2014.
9. B.D. Gupta, Mathematical Physics, 3rd Revised Edition, Vikas Publishing House,2004.

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

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SPHA1103	PROPERTIES OF MATTER	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES:

- To explain the laws of orbit and the gravitational phenomenon surrounding us. It gives a brief idea of the physical Parameters and their relevance in our day-to-day life.
- To give details about physical properties of materials and inculcates interest to observe facts experimentally.
- To impart basic understanding of the various physical techniques theoretically. It caters the needs for engineering applications.
- To deal with general phenomena in Physics and creates a platform for in depth understanding in low temperature Physics.
- To impart a thorough knowledge about liquid motion and various relevant theoretical facts.

UNIT 1: GRAVITATION

9 Hrs

Kepler's Laws- Newton's law of gravitation, Determination of gravitational constant-Boyle's method, Poynting's method-Gravitational field, Intensity of the field, Gravitational potential due to a spherical sphere, Escape velocity.

UNIT 2: ELASTICITY

9 Hrs

Hooke's law – Stress – Strain Diagram – Elastic Moduli – Work done in deforming a body – Relation between elastic constants – Poisson's Ratio – Expression for Poisson's ratio in terms of elastic constants – Twisting couple on a wire – Rigidity modulus by static torsion – Work done in twisting a wire – Torsional pendulum – Determination of rigidity modulus of a wire.

UNIT 3: BENDING OF BEAMS

9 Hrs

Expression for bending moment – Cantilever – Expression for depression – Experiment to find Young's Modulus – Cantilever oscillation – Expression for period – Uniform bending – Expression for elevation – Experiment to find Young's modulus using microscope – Non-Uniform bending – Expression for depression – Experiment to find Young's modulus using mirror and telescope.

UNIT 4: SURFACE TENSION

9 Hrs

Definition and dimensions of surface tension – Examples – Excess of pressure over curved surfaces – Variation of surface tension with temperature – Jaeger's Experiment. **Physics of Low Pressure Production and measurement of low pressure – Gaede's molecular pump – Mercury diffusion pump – Knudsen's absolute gauge – Detection of leakage – McLeod gauge. Capillary rise – experimental determination of surface tension by capillary rise – angle of contact of mercury – Quinck's method.**

UNIT 5: VISCOSITY

9 Hrs

Streamlined motion – Turbulent motion – Coefficient of viscosity and its dimension – Rate of flow of liquid in a capillary tube – Poiseuille's formula – Experiment to determine the coefficient of viscosity of liquid – Variation of viscosity of liquid with temperature.

Max. 45 Hours

COURSE OUTCOMES

By the end of this course students will be able to

CO1: Acquire in depth knowledge about our Universe and its awesome creation.

It paves way to solve complex problems more confidently.

CO2: Apply the Concepts to several relevant fields like Material Science, Civil and Mechanical streams.

CO3: Develop the theoretical and practical skills towards industrial applications

CO4: Choose the optional subjects of interest for further study and research.

CO5: Relate the advanced topics easily later for higher studies.

TEXT / REFERENCE BOOKS

1. Properties of matter – Brijlal and Subramanian, S. Chand Co., Ltd (2001).
2. Properties of matter and acoustics –R. Murugesan, Kiruthiga Sivaprasad, S. Chand Co., Ltd (2013).
3. Elements of Properties of matter – D.S. Mathur S. Chand, Ltd (1968).
4. Properties of matter – Subramanian Iyer and Jeyaraman.

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 16marks.

80 Marks



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SPHA1301	THERMAL AND STATISTICAL PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To learn how to apply thermodynamic principles in order to interpret thermodynamic systems.
- To become familiar with the use of simple statistical mechanical models
- To predict Thermodynamic properties.

UNIT 1: THERMOMETRY AND CALORIMETRY

9 Hrs

Introduction - Principle of thermometry- types of thermometers – scales of temperature (Celsius, Kelvin, Fahrenheit and Rankine) – Mercury thermometer- Platinum resistance thermometer - Callender & Griffith's bridge - Thermistor - Specific heat capacity - Specific heat capacity of solids & Specific heat capacity of liquid by method of mixtures - Specific heat of capacity of gases - C_p and C_v by Regnault's Method.- Any application of Thermistor

UNIT 2: THERMODYNAMICS-I

9 Hrs

Thermodynamic system, Thermodynamic variables, Thermodynamic state, equation of state, Thermodynamic equilibrium, Zeroth law of thermodynamics, Internal energy, First law of thermodynamics, Conversion of heat into work, Various thermodynamic processes (Isothermal, Adiabatic, Isobaric, Isochoric), Reversible and irreversible processes, Work done in Isothermal and adiabatic processes, Application of first law (Isothermal, Adiabatic, Isobaric, Isochoric), Relation between C_p and C_v .

UNIT 3: THERMODYNAMICS-II

9 Hrs

Second law of thermodynamics (Explanation and different statements), Carnot's ideal heat engine, Carnot cycle (working and efficiency), Carnot's theorem, Entropy (concept and significance), Entropy changes in reversible and irreversible processes, Entropy –Temperature diagram, Third law of thermodynamics, Heat Engines in practice-a) Otto Engine b) Diesel Engine.

UNIT 4: CONDUCTION AND RADIATION

9 Hrs

Introduction -Definition of thermal conductivity - thermal conductivity of bad conductor - Lee's disc method - Radiation

- Black body radiation - Wien's law, Rayleigh-Jean's law and Planck's law - Stefan's law –Experimental verification of Stefan's law- solar constant –Temperature of the sun by Angstrom's pyrheliometer- Design a of solar panel.

UNIT 5: STATISTICAL PHYSICS

9 Hrs

Macro and Microstate-Phase space -Ensemble- Maxwell-Boltzmann, Bose-Einstein and Fermi Dirac Statistics – Comparison of Maxwell-Boltzmann Bose-Einstein and Fermi-Dirac gases -Degenerate gases.

Max. 45 Hours

COURSE OUTCOMES

CO1: Apply the concept to determine temperature and specific heat capacity of the substance experimentally.

CO2: Explain working methods and applications of liquid and solid cryogens.
CO3: Solve problems requiring the formulations of solid conduction and fluid convection.
CO4: Distinguish work, energy, heat capacity, specific heat, latent heat, and enthalpy.
CO5: Describe the thermodynamical identity to derive the Maxwell- Boltzmann, Bose-Einstein and Fermi Dirac Statistics.

TEXT / REFERENCE BOOKS

1. Heat and Thermodynamics - J. B. Rajam & C. L. Arora
2. Thermodynamics and statistical Physics - Sharma & Sarkar
3. Statistical Mechanics – Sathya Prakash & C. Agarwal
4. Fundamentals of Physics, 6th Edition, by D. Halliday, R. Resnick and J. Walker, Wiley, NY, 2001.
5. Thermal Physics, A.B. Gupta and H. Roy, Books and Allied (P) Ltd., (2002.)

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 16marks.

80 Marks

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SPHA1302	BASIC INSTRUMENTATION SKILLS	L	T	P	Credits	Total Marks
		3	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
- To make the student familiar with temperature measurement techniques

UNIT 1: INDUSTRIAL MEASUREMENTS

9 Hrs

Measurement of straightness, flatness, roundness and roughness, **Transducers - Need, Classification - Active and Passive, Analog and digital**, 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

Pressure and its units, Types - Absolute, Gauge, Atmospheric, Vacuum, 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: MEASUREMENT OF FLOW & LEVEL

9 Hrs

Flow and its units, Types - Laminar, Turbulent, Reynolds number Orifice, Venturi, Pitot tube, flow nozzle rotameter, Dahl 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 r tube, diaphragm box**, Differential Pressure methods, electrical methods- resistance type, capacitance type, ultrasonic level gauging.

UNIT 5: MEASUREMENT OF DENSITY, VISCOSITY, HUMIDITY

9 Hrs

Density terms, 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:

CO1: Measurement of straightness, flatness, roundness and roughness.

CO2: Define the temperature scales and explain the calibration of thermometers.

CO3: Explain the function of Thermocouple gauge, Ionization gauge.

CO4: Know about the air supply system for pneumatic control equipment.

CO5: Describe the Laminar, Turbulent flow of liquid.

CO6: Explain the Viscosity terms, say bolt viscometer, rotameter type viscometer

TEXT / REFERENCE BOOKS

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.

20 Marks

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

80 Marks

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SPHA1501	QUANTUM MECHANICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To enable the students to understand the basic concepts of quantum mechanics.
- To introduce the key elements of quantum mechanics, including the statistical interpretation of wave functions, the role of operators and their connection with observables, and uncertainty.
- To reinforce concepts through relatively simple problems with analytic solutions

UNIT 1: INTRODUCTION TO QUANTUM MECHANICS

9 Hrs

Postulates of quantum mechanics - Properties of Wave Function. Interpretation of Wave Function- Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Position, momentum and Energy operators; Commutator of position and momentum operators; Expectation values. Uncertainty principle.

UNIT 2: SCHRODINGER WAVE EQUATION

9 Hrs

Time independent Schrodinger equation –derivation- General solution of the time dependent Schrodinger equation; Classical Plane Wave Equation Eigenvalues and Eigenfunctions; Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wave function as a linear combination of energy eigenfunctions; probability current densities.

UNIT 3: GENERAL DISCUSSION OF BOUND STATES IN AN ARBITRARY POTENTIAL

9 Hrs

Continuity of wave function, boundary condition and emergence of discrete energy levels; application to one- dimensional problem- Wave Function of a Free Particle in one dimension - particle in a box- square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigen functions; ground state, zero-point energy and uncertainty principle.

UNIT 4: QUANTUM THEORY OF HYDROGEN-LIKE ATOMS

9 Hrs

Time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; Transitions Between Energy Levels solution, solution of radial wave equation- Radial wave functions; shapes of the probability densities for ground and first excited states; angular momentum operator & quantum numbers.

UNIT 5: ATOMS IN ELECTRIC & MAGNETIC FIELDS

9 Hrs

Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

Max. 45 Hours

COURSE OUTCOMES

Upon successful completion of this course students will be able

CO1: To understand the idea of wave function, normalization and uncertainty.

CO2: To derive Schrodinger wave equation.

CO3: To apply Schrodinger equation to one-dimensional problem, Free Particle in one dimension, particle in a box and square well potential;

CO4: To derive Time independent Schrodinger equation in spherical polar coordinates, radial wave equation.

CO5: To understand the basics of Atoms in Electric & Magnetic Fields, Zeeman effect.

TEXT / REFERENCE BOOKS

1. A Text book of Quantum Mechanics, P.M. Mathews and K. Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edition, 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rd Edition 2010, Tata McGraw Hill.
4. Quantum Mechanics, G. Aruldas, 2nd Edition 2002, PHI Learning of India.
5. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
6. Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edition, 1993, Springer
7. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press
8. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.

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 16marks.

80 Marks

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SPHA1502	ELECTRICITY AND MAGNETISM	L	T	P	Credits	Total Marks
		3	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.
- To learn the properties of various circuits are going to be analyzed.
- To evaluate magnetic concepts and magnetic circuits

UNIT 1: ELECTROSTATICS

9 Hrs

Electric charge - Electric field - Dipole 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 2: 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 3: ELECTROMAGNETIC INDUCTION

9 Hrs

Laws of electromagnetic induction– Motional emf, 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 4: 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 5: MAGNETISM

9 Hrs

Intensity of Magnetization– Magnetic field from a magnetized object, 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 Hours

COURSE OUTCOMES

By the end of this course students will be able to understand the

- 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 to explain natural physical processes and related technological advances.

TEXT / REFERENCE BOOKS

1. Brij Lal and N. Subrahmanyam, *A Text Book of Electricity and Magnetism*, Ratan Prakashan Mandir 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: 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

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SPHA1601	ATOMIC PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand the basics of atomic physics terminology, atomic physics, the scientific study of the structure of the atom, its energy states and its interactions with other particles and with electric and magnetic fields.
- Atomic physics has proved to be a spectacularly successful application of quantum mechanics, which is one of the cornerstones of modern physics.

UNIT 1: CONCEPT OF THE ATOM

9 Hrs

Brief introduction to history of atom - Rutherford's model and Niels Bohr's model of an atom - Sommerfeld's extension of atomic structure - Electronic configuration and quantum numbers; Cathode Rays; Measurement of the Elementary Charge e - JJ Thomson and Millikan's experiments to find charge of an electron; Free Electrons; **Generation of Free Ions**; The Mass of the Isotopes.

UNIT 2: QUANTUM CONCEPTS ON ATOM

9 Hrs

Blackbody Radiation; Planck's Radiation Law; Wien's Law; Stefan-Boltzmann's Radiation Law Photoelectric Effect; Compton Effect; Properties of Photons; Wave and Particle Aspects of Light; De Broglie Wavelength; Heisenberg's Uncertainty Principle **and applications**, Atomic Spectra; Bohr's Atomic Model. **Excitation and ionization potential - Frank and Hertz's experiment.**

UNIT 3: ATOM WITH ONE ELECTRON - HYDROGEN ATOM

9 Hrs

Electron Spin - Normal and anomalous Zeeman Effect; The Stern-Gerlach Experiment; fine structure - Lamb Shift; Hyperfine Structure- Magnetic Dipole-Dipole Interaction; Zeeman Effect of Hyperfine Structure.

UNIT 4: ATOMS WITH MORE THAN ONE ELECTRON

9 Hrs

The Helium Atom - Consideration of the Electron Spin - The Pauli Principle - Energy Levels of the Helium Atom - Helium Spectrum; Building-up Principle of the Electron Shell for Larger Atoms; Alkali Atoms - Electron Configuration - LS Coupling - jj Coupling - the Designation of States.

UNIT 5: EMISSION AND ABSORPTION OF ELECTROMAGNETIC RADIATION

9 Hrs

Transition Probabilities; Induced and Spontaneous Transitions, Einstein Coefficients; Transition Probabilities for Absorption and Induced Emission; Selection Rules - Magnetic Quantum Number - Spin Quantum Number - Lifetime; Characteristic X-Ray - Scattering and Absorption of X-Rays - X-ray Fluorescence - Measurements of X-Ray Wavelengths - Continuous Absorption and Emission Spectra - Photoionization - Recombination Radiation.

COURSE OUTCOMES

Upon successful completion of this course, students should be able to:

CO1: Understand the quantum numbers, including their physical significance, and quantum mechanical states of the hydrogen atom.

CO2: Understand time independent perturbation theory including its derivation and be able to apply it to simple systems, including the Stark-Effect and Zeeman Effect.

CO3: Know about the origins of fine structure in atomic spectra and understand the exchange degeneracy and how this affects the excited states of helium.

CO4: Understand the Periodic table from the viewpoint of the electronic structure and understand and be able to apply to simple cases time dependent perturbation theory.

CO5: Understand the derivation of and be able to apply the selection rules for the interaction of electric dipole radiation and atoms.

TEXT / REFERENCE BOOKS

1. Laser Principles and Applications – A. K. Ghatak and K. Thyagarajan (Tata – McGraw Hill).
2. Optics and Atomic Physics – B. P. Khandelwal (Sibal Agarwala).
3. Physics of Atoms and Molecules – B. H. Bransden and C. J. Joachain (Pearson Education)
4. Atomic and Nuclear Physics – S. K. Sharma (Pearson Education).

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 16marks.

80 Marks

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SCHOOL OF SCIENCE AND HUMANITIES

DEPARTMENT OF PHYSICS

BOARD OF STUDIES

Minutes of Meeting

Date: 12-12-2022

Venue: Board Room, IRC

DEPARTMENT OF PHYSICS

Minutes of the BOS Meeting -2022 combined Board of Studies for PG & UG Programme held on 12th December, 2022 at time 10.00 am at Board room, International Research Centre, Sathyabama Institute of Science and Technology, Chennai.

Members Present

6. **Dr. Y. Ashok Kumar Reddy**, Assistant Professor of Physics, Advanced Energy Materials & Sensors (AEMS) Laboratory, Indian Institute of Information Technology Design & Manufacturing (IIITDM), Kancheepuram, Melakottaiyur, Chennai - 600127, Tamil Nadu, India.
7. **Dr. Ch. Kishan Singh**, Scientific Officer-E, Surface and Sensors Studies Division, Materials Science Group, Indira Gandhi Centre for Atomic Research, Kalpakkam – 603102, Tamil Nadu, India.
8. **Dr. S. Ravichandran**, Professor and Head, Sathyabama Institute of Science and Technology
9. **Dr. Helen Merina Albert**, Professor of Physics, Sathyabama Institute of Science and Technology
10. **Dr. C. Ramesh Kumar**, Associate Professor, Sathyabama Institute of Science and Technology.

Absent: **Dr. D. J. Sharmila**, M.Sc., M.Phil., Ph.D. Assistant Professor,
Department of Physics,
Loyola College (Autonomous), Chennai.



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Board of studies meeting of Department of Physics was held on 12th December at 10 AM to 2.00 PM at Board Room of IRC. Dr. Rekha Chakravathy Dean S&H, addressed the BOS members. Dr. S. Ravichandran Head/Department of Physics introduced the programmes and courses offered by the Department of Physics and he projected the syllabus of B.E./B.Tech., B.Sc (Physics) and M. Sc (Physics) on the LCD screen for discussion. The external members had gone through the syllabus and their suggestions are listed below:

Agenda of Meeting:

5. Revised the syllabus for theory and lab for B. Sc (PHYSICS) and M. Sc (PHYSICS), 2022.

M.Sc. – Physics:

- Electromagnetic Theory
- Thermodynamics and Statistical Mechanics
- Numerical Methods and Computer Programming

B.Sc. – Physics:

- Mechanics
 - Optics
 - Electric Circuits and Networks Skills
 - Mathematical Physics
 - Nuclear and Particle Physics
 - Solid State Physics
6. Discussing the revision of physics syllabus for both theory and Laboratory
7. Discuss the improvisation of Internship and project review for PG (M.Sc-Physics) students.
8. Discuss the improvisation of Internship and project review for UG (B.Sc-Physics) students.

EXTERNAL MEMBERS	SIGNATURE	INTERNAL MEMBERS	SIGNATURE
Dr. Y. Ashok Kumar Reddy		Dr.S.Ravichandran	
Dr. Ch. Kishan Singh		Dr. Helen Merina Albert	
Dr. D. J. Sharmila		Dr. C. RAMESHKUMAR	



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SPHA5201	ELECTROMAGNETIC THEORY	L	T	P	Credits	Total Marks
		3	0	0		

COURSE OBJECTIVE

- To understand the static electric and magnetic fields
- To relate them using Maxwell's equations.
- Also to study propagation of electromagnetic wave
- To learn about its interaction with matter.

UNIT 1 ELECTROSTATICS AND MAGNETOSTATICS

12 Hrs

Dielectric and its Polarization – External Field of a Dielectric Medium – Electric Field Inside a Dielectric – Dielectric Constant and Displacement Vector – Relation Between **D**, **P** and **E**-Polarization of Non-Polar Molecules (Clausius-Mossotti Relation) – Polarization of Polar Molecules – **Electrostatics of capacitance: Molecular model of dielectrics**: Electrostatic Energy. Magnetostatics: Ampere's Circuital Law – Magnetic Scalar Potential – Magnetic Vector Potential – Magnetisation and Magnetisation Current – **Magnetic Intensity – Magnetic Susceptibility and Permeability.**

UNIT 2 FIELD EQUATION AND CONSERVATION LAWS

12 Hrs

Equation of Continuity – Displacement Current – Maxwell's Equations – Derivations and Physical Significance – Energy in electromagnetic fields (Poynting's theorem) – Poynting Vector – **Electromagnetic Potentials A and B** - Maxwell's Equations in terms of Electromagnetic Potentials – Concept of Gauge – **gauge transformation** Lorentz Gauge: **quantum electrodynamics** – Coulomb Gauge.

UNIT 3 PROPAGATION OF PLANE ELECTRO MAGNETIC WAVES

12 Hrs

Electromagnetic Waves in Free Space – Propagation of Electromagnetic Waves in Isotropic Dielectrics – Anisotropic Dielectric – In Conducting Media – In Ionized Gases. Interaction of EMW with Matter on Macroscopic Scale: Boundary Condition of inter faces – Reflection and Refraction – **Fresnell's Formula - Brewster's Law and Polarization of EMW** – Total Internal Reflection and Critical Angle – Reflection from a Metallic Surface – Wave Guides– Rectangular Wave Guide- **magnetic field in the waveguide-speed and cutoff frequency of the guided waves.**

UNIT 4 INTERACTION OF EMW WITH MATTER ON MICROSCOPIC SCALE

12 Hrs

Scattering and Scattering Parameters – Scattering by a Free Electron (Thomson Scattering) – Scattering by a Bound Electron (Rayleigh Scattering) – State of Polarization and Scattered Radiation – Coherence and Incoherence in scattered Light – Dispersion Normal and Anomalous – **Dispersion in Gases (Lorentz Theory)** – Dispersion in Liquids and Solids.

UNIT 5 RELATIVISTIC ELECTRODYNAMICS

12 Hrs

Four Vectors and Tensors – Transformation Equations for Charge and Current Densities – For the Electromagnetic Potentials – The Electromagnetic Field Tensor – Transformation Equations for Electric and Magnetic field Vectors – Covariance of Maxwell Equations in four Vector form – **In four Tensor form** – Covariance and Transformation Law of Lorentz Force.

Max 60 Hrs

Course Outcomes:

Having successfully completed this course, students will be able to

CO1: Apply the basic concepts in Mathematics, Science and Engineering

CO2: Derive Maxwell's equation and to apply many value added problems. and transfer these equations in Gauge factors.

CO3: Interact electromagnetic waves with matter in macroscopic scale - EM waves changes with respect to medium.

CO4: Identify the Interaction of EM waves with matter in microscopic view given more values than previous.

CO5: Transfer EM waves in four vector form gives difference transformation of wave properties

TEXT / REFERENCEBOOKS

1. S.L .Gupta Kumar, V. Kumar and S.P. Singh, Electrodynamics, Pragathi Prakasham.
2. K. K. Chopra and G. C. Agrawal, K. Nath, Electro Magnetic Theory.
3. Paul Lorrain R. Corson, and Dale, Electromagnetic field and waves, 2nd Edition, CBS Publishers.
4. David J. Griffiths, Introduction to electrodynamics, Prentice Hall of India.

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

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SPHA5202	THERMODYNAMICS AND STATISTICAL MECHANICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To study the thermal properties of materials by different methods.
- To explain of the properties of macroscopic system.
- Providing definitions of thermodynamic quantities
- Derivations of the laws of thermodynamics from the laws of quantum mechanics.

UNIT 1 REVIEW OF THE LAWS OF THERMODYNAMICS AND THEIR CONSEQUENCES 12Hrs

Energy and first law of thermodynamics – Heat content and Heat capacity – Specific heat – Entropy and its significance - second law of thermodynamics – thermodynamic potential and the reciprocity relations – Maxwell's relations – Deductions – properties of thermodynamics relations – Gibbs-Helmholtz relation – Thermodynamic equilibrium – Nernst Heat theorem of third law - consequences of third law – phase-Gibb's phase rule – chemical potential. molar Gibbs free energy" and "partial molar Gibbs free energy"

UNIT 2 KINETIC THEORY

12 Hrs

Equilibrium state of dilute gas; Binary collisions – Boltzmann transport equation and its validity Boltzmann's H-theorem and its analysis – Maxwell – Boltzmann distribution – Method of most probable distribution. Transport phenomena: Mean free path – Conservation laws – Zero and first order approximations – Viscous hydrodynamics – Navier – Stokes equation – Examples in hydrodynamics- Introduction to Ideal and Real Fluid Flows

UNIT 3 CLASSICAL STATISTICAL MECHANICS

12 Hrs

Macro and micro states – Statistical equilibrium – Phase space and ensembles – Micro canonical ensemble – Liouville's theorem – Maxwell – Boltzmann distribution law – Distribution of energy and velocity – principles of equipartition of energy – Energy fluctuations – Partition function – Free energy – Relation between partition function and thermodynamic quantities – Boltzmann's entropy relation – Grand canonical ensemble – Basic concepts of distribution laws – Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics-derivation from micro canonical ensembles-grand canonical ensembles

UNIT 4 QUANTUM STATISTICAL MECHANICS

12 Hrs

Black body and Planck's radiation – Phonons – Partition Function for a harmonic oscillator – Specific heat of solids – Einstein's theory – Debye's theory – Specific heat of diatomic molecules – Ideal Bose gas – Energy, pressure and thermal properties – Bose – Einstein condensation – Liquid helium – Fermi – Dirac gas – Properties – Degeneracy– Electron gas – Free electron model and thermionic emission

– Pauli paramagnetism – Pauli Paramagnetism of the Electron Gas chemical potential : Pauli Paramagnetism: Quantum mechanical ensemble theory – Density matrix and Partition function.

UNIT 5 ADVANCED TOPICS IN STATISTICAL MECHANICS

12 Hrs

Critical phenomena and phase transition – Weiss molecular field theory – Ferromagnetic transition – Analogy between phase transitions – Critical indices – Ising and Heisenberg models – Elements of nonequilibrium phenomena – Fluctuations – Weiner- Khinchine theorem – Thermodynamics of irreversible processes – Onsager’s reciprocity relations.

Max. 60 Hours

Course Outcomes:

Having successfully completed this course, students will be able to

CO1: Explain statistical physics and thermodynamics as logical consequences of the postulates of statistical mechanics

CO2: Apply the principles and techniques of statistical mechanics to selected problems and to a range of situations.

CO3: Use tools and methodologies to physics to test and communicate ideas and explanations.

CO4: Able to understand statistical mechanics of bosons and fermions (quantum fluids)

CO5: Able to understand the classical limit and strongly degenerate quantum systems including Fermi Gases and Bose-Einstein condensates

TEXT / REFERENCEBOOKS

1. F. Reif, Statistical and Thermal physics, McGraw Hill, International Edition, Singapore, 1979.
2. B.R. Agarwal and N. Eisnor, Statistiactal Mechanics, 2nd ed, Wiley Eastern Limited, New Delhi.
3. R. Huang, Statistical Mechanics, Wiley Eastern Ltd., New Delhi, 1983.
4. F. Mandl, Statistical physics, John Wiley, London, 1971.
5. C. Kittel, W. H. Freeman, Thermal Physics, 2nd ed. 1980.
6. F.W.Sears and G.L.Salinger, Thermodynamics, kinetic theory and statistical thermodynamics, 3rd edition, Narosa publishing house, 1998.

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

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SPHA5203	NUMERICAL METHODS AND COMPUTER PROGRAMMING	L	T	P	Credits	Total Marks
		3	1	0		

COURSE OBJECTIVE

- To provide the understanding of numerically obtained roots of nonlinear equations
- To learn about system of linear equations.
- Also to apply programming practices into mathematical computing
- To solve mathematical problems effectively.

UNIT 1 SYSTEM OF EQUATIONS

12 Hrs

Solution of algebraic and transcendental equations - Roots of equations - Methods of bisection and false position - Newton-Raphson method - solution of simultaneous linear algebraic equations - Gauss elimination - Gauss Jordan methods - matrix inversion and LU decomposition methods - Gauss-Seidel iterative method - Eigen values of matrices - Power method **and Jacobi's method.**

UNIT 2 INTERPOLATION, CURVE FITTING AND STATISTICS

12 Hrs

Newton's forward and backward interpolation formulae - Lagrange's method - Lagrange's inverse interpolation - curve fitting - principle of least squares - correlation and regression analysis - sampling distributions - small and large samples - tests of hypothesis - Student's distribution - Chi square distribution.

UNIT 3 NUMERICAL DIFFERENTIATION AND INTEGRATION

12 Hrs

Newton's forward and backward difference formulae - numerical integration - Trapezoidal rule and Simpson's rule - **Gaussian quadrature rule** - numerical solution of ordinary differential equations - Taylor series - Euler's method, improved and modified methods - Runge-Kutta methods - Milne's predictor-corrector method.

UNIT 4 C PROGRAMMING

12 Hrs

Basic structure of a C program, executing C program, keyword and identifiers, variables. Introduction to operator, expressions, input, output statements, control statements, functions, arrays, categories of functions, programs for the following computational methods: (a) Zeros of polynomials by the bisection method, (b) Zeros of polynomials / non-linear equations by the Newton-Raphson method, (c) **Lagrange Interpolation**, (d) Trapezoidal and Simpson's Rules, (e) Solution of first order differential equations by Euler's method.

UNIT 5 INTRODUCTION TO LABVIEW and MATLAB

12 Hrs

Introduction to LABVIEW tools palette, controls & functions palette, data types, conversion – front panel, block diagram construction, parallel data flow, create indicators/controls/constants math operations, booleans, arrays, case structures, sequences – for loops, while loops – I/O reading and writing to files, paths, graphing, timed loops, signal generation/processing, waveform types, connecting to hardware, DAQ, serial, GPIB, TCP/IP and USB interface **Max. 60 Hours**

Course Outcomes:

Having successfully completed this course, students will be able to

CO1: Understand the numerically obtained roots of nonlinear equations and system of linear equations

CO2: Apply the programming concept in physics related mathematical problems

CO3: Apply the object-oriented concept in real time mathematical problems.

CO4: Apply C- programming concept in physics related mathematical problems

CO5: Apply LabVIEW and MATLAB tools to understand the basic concept in physics by programming in a real way.

TEXT / REFERENCE BOOKS

1. M.K. Venkatraman, Numerical Methods in Science and Engineering, National Publishing company, Madras, 1996.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, New Delhi, 1992.
3. Kernighan and Ritchie, The C Programming language, Prentice Hall of India, 1999.
4. B.S. Gottfried, Programming with C, Tata Mc Graw Hill, 2000.
5. V. Rajaraman, Computer Programming in FORTRAN, Prentice Hall of India, New Delhi, 1994.
6. P. Dey and M. Ghosh, Computer fundamentals and Programming in C, 2nd edition, Oxford University Press, 2006.

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

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SPHA1201	MECHANICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To study the rotational and vibrational motion of rigid body.
- To determine the Centre of gravity, Centre of pressure, Centre of mass.
- To acquire the details of the Relative motion.
- To introduce the concept of special relativity and its applications.
- To study detailed description of the Simple Harmonic Oscillation.

UNIT 1: DYNAMICS

9 Hrs

Rigid body - moment of inertia - radius of gyration - moment of inertia of a solid cylinder, hollow sphere with external and internal radii. Compound pendulum - theory - equivalent simple pendulum - reversibility of centers of suspension and oscillation - **determination of g and k - Kater's pendulum**

UNIT 2: STATICS AND HYDROSTATICS

9 Hrs

Centre of gravity - Centre of gravity of a solid and hollow tetrahedron, solid and hollow hemisphere, solid cone Centre of pressure - Centre of pressure of a vertical rectangular lamina Laws of floatation - meta centre - meta centric height of a ship - atmospheric pressure and its variation with altitude.

UNIT 3: FRAME OF REFERENCE

9 Hrs

Laws of Mechanics, Inertial frames of reference and three type of co-ordinate system (qualitative), Galilean transformations, conservation of momentum. Non-Inertial Systems: Non-inertial frames and fictitious forces - Rotating frames of reference Centrifugal force - Coriolis force and its applications.

UNIT 4: SPECIAL THEORY OF RELATIVITY

9 Hrs

Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity – Consequences of special relativity- Time Dilation – Length Contraction - Relativistic Doppler effect – Lorentz Transformation – Lorentz Velocity Transformation - Relativistic Kinematics - Transformation of Energy and Momentum – **Relativistic addition of velocities – Variation of mass with velocity – massless particle – mass energy equivalence.**

UNIT 5: OSCILLATIONS

9 Hrs

SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

Max. 45 Hours

COURSE OUTCOMES

By the end of this course students will be able to

CO1: Study about the Relative motion, Inertial and non-inertial reference frames.

CO2: Calculate Centre of mass and inertia tensor of mechanical systems.

CO3: Students can learn about the Newton's laws of motion and conservation principles.

CO4: Establish the knowledge about Michelson-Morley experiments with interferometer, Lorentz Transformation

CO5: Understand the concept of oscillations, constant relative motion of different bodies.

TEXT / REFERENCE BOOKS

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol. I, R.P. Feynman, R.B. Leighton, M. Sands, 2008, Pearson
6. Education Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
8. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010,
9. Cengage Learning Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
10. Mechanics -J.C. Slater and N. H. Frank (McGraw-Hill)

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 16marks.

80 Marks

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SPHA1401	OPTICS	L	T	P	Credits	Total Marks
		3	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
- To be able to identify and illustrate physical concepts and terminology used in optics.
- To be able to make approximate judgements about optical and other wave phenomena when necessary.

UNIT 1: 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 and its types – The Telescope – Telephoto Lens.

UNIT 2: LENS ABBERATION

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 and applications.

UNIT 3: 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 4: 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) and applications.

UNIT 5: 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.

COURSE OUTCOMES

Students should gain fundamental knowledge of optics. This implies that the student will be able to:

CO1: Understand the physical significance of Maxwell's equations and hence estimate the speed of light.

CO2: Explain the basics and applications of LASER.

CO3: Explain the propagation mechanism of light through optical fiber.

CO4: Derive the relation between Numerical Aperture and Refractive indices.

CO5: Classify the types of optical fibers and attenuation mechanisms.

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.
4. Optics by Eugene Hecht, Tata McGraw Hill, New Delhi, 2011.

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 16marks.

80 Marks



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SPHA1402	ELECTRIC CIRCUITS AND NETWORKS SKILLS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To enable the students to design and trouble shoots the electrical circuits
- To develop the students to trouble shoots the electrical circuits
- To learn about networks and appliances through hands-on mode.

UNIT 1: BASIC ELECTRICITY PRINCIPLES

9 hrs

Voltage, Current, Resistance, and Power. Ohm's law, Kirchhoff's laws. 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 2: 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 3: SOLID-STATE DEVICES

9 hrs

Evolution of Semiconductors, Carrier Transport, PN Junction. Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC Sources.

UNIT 4: ELECTRICAL PROTECTION

9 hrs

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

UNIT 5: ELECTRICAL WIRING

9 hrs

Different types of conductors and cables. Basics of wiring-Star and delta connection. Types of wiring - Two-way switch wiring, go down wiring, master switch wiring, room wiring and three phase wiring. Voltage drops and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation.

COURSE OUTCOMES

This implies that the student will be able to:

CO1: Understand the physical significance of different electric components

CO2: Explain the basics and applications of those

CO3: Explain the operation details

CO4: Hands on experience in 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 Edition

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 16marks.

80 Marks



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SPHA1503	MATHEMATICAL PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To demonstrate how to differentiate a function of two variables.
- To describe smooth distribution of energy
- To understand the properties of a particle in universe.
- To introduce Fourier series and its applications to the solution of partial differential equation.
- To describe differential equation through Frobenius Method and Integrals using Beta and Gamma functions.

UNIT 1: CALCULUS: APPROXIMATION

9 Hrs

Taylor and binomial series (statements only). First order differential equations, exact differential equations, homogeneous, linear differential equations and integrating factor. Second order differential equations: Homogeneous equations with constant coefficients, Wronskian and general solution, method of finding complementary functions and particular integrals. Some examples

UNIT 2: VECTOR ALGEBRA

9 Hrs

Properties of vectors, Scalar product and vector product, scalar triple product and their interpretation in terms of area and volume respectively, scalar and vector fields.

UNIT 3: VECTOR CALCULUS

9 Hrs

Vector Differentiation: Directional derivatives and normal derivative, gradient of a scalar field and its geometrical interpretation, divergence and curl of a vector field, del and Laplacian operators, vector identities

UNIT 4: VECTOR INTEGRATION

9 Hrs

Integration of vectors, notion of line, surface and volume elements, line, surface and volume integrals of vector fields, flux of a vector field, Gauss' divergence theorem, Green's and Stokes theorems and their verification (no rigorous proofs). Numerical Problems

UNIT 5: ORTHOGONAL CURVILINEAR COORDINATES

9 Hrs

Orthogonal curvilinear coordinates, derivation of gradient, divergence, curl and Laplacian in Cartesian, spherical and cylindrical coordinate systems. Expressions of unit vectors in the three systems.

Max. 45 Hours

COURSE OUTCOMES

Upon successful completion of this course, students should be able to:

CO1: Know how to recognize and differentiate a function of two variables

CO2: Know distribution energy of the particles or materials.

CO3: Know the properties of a particle in universe using Orthogonal Curvilinear Coordinates

CO4: Know Fourier series representation of function of one variable to find solution of wave, diffusion and Laplace equations

CO5: Know how to handle differentiation using Frobenius Method and Integrals using Beta and Gamma functions.

TEXT / REFERENCE BOOKS

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edition., Elsevier.
2. Fourier analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
6. Essential Mathematical Methods, K.F. Riley and M.P. Hobson, 2011, Cambridge University Press
7. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Books.
8. Mathematical Method for Physical Sciences -- M. L. Boas (Wiley India) 2006.

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 16marks.

80 Marks

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SPHA1602	NUCLEAR AND PARTICLE PHYSICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To provide an in-depth Knowledge of Nucleus, Nuclear radiations detectors, Radioactivity and Elementary particle towards their higher education.
- Introduce students to the fundamental principles and concepts governing nuclear and particle physics and have a working knowledge of their application to real-life problems
- To provide students with opportunities to develop basic knowledge and understanding of scientific phenomena, facts, laws, definitions, concepts, theories, scientific vocabulary, terminology, conventions, scientific quantities and their determination.

UNIT 1: PROPERTIES OF NUCLEI

9 Hrs

Introduction, Classification of Nuclei, Properties of Nuclei - Nuclear size, charge, , **determination of nuclear radius-mirror nucleus method-mass defect – nuclear spin** mass, density, spin, magnetic dipole moment, electric quadrupole moment, binding energy, packing fraction, Nuclear Stability. Nuclear models - Liquid Drop Model (Weizacker Semi Empirical mass formula), Shell Model and magic numbers.

UNIT 2: DETECTORS OF NUCLEAR RADIATIONS

9 Hrs

Introduction, **Ionisation chamber-G.M.Counter-quenching and resolving time-scintillation counter** Interaction between energetic particles and matter, Ionization Chamber, Solid-State Detectors, Proportional Counter, Geiger-Muller Counter, Photo Multiplier Tube, Scintillation Counter.

UNIT 3: PARTICLE ACCELERATORS

9 Hrs

Introduction, Van de Graaff Generator, Linear Accelerator, Cyclotron, Synchrocyclotron, Betatron, Electron Synchrotron, Proton Synchrotron (Bevatron).

UNIT 4: RADIOACTIVITY

9 Hrs

Introduction, Natural radioactivity **law of disintegration-half life and mean life period** **Alpha Particle** – Properties, e/m ratio, charge, range, Geiger-Nuttall law. Measurement of Range of Alpha particle by Bragg - Kleeman method, Geiger - Nuttall method. **Beta Particle** – Properties, e/m ratio, Pauli's Neutrino Hypothesis, Neutrino theory of Beta decay, Detection of Neutrino. **Gamma Particle**– Origin, determination of wavelength by Du Mond Curved Crystal Spectrometer, Nuclear Isomerism, Internal Conversion, Mossbauer effect with experiment.

UNIT 5: ELEMENTARY PARTICLES

9 Hrs

Introduction, Classification of elementary particles (Baryon and Leptons), Particles and Anti-Particles, Antimatter, Fundamental Interactions, Elementary Particle Quantum numbers – Baryon, Leptons, strangeness, **Hypercharge and Isospin**. Conservation Laws – Parity, Charge Conjugation Symmetry and Time Reversal Symmetry. Basic ideas about Quark, Quark Model, Types of Quarks.

Max. 45 Hours

COURSE OUTCOMES

Upon successful completion of this course students will be able to

CO1: Understand the fundamental principles and concepts governing classical nuclear and particle physics.

CO2: Demonstrate knowledge and understanding of detectors of Nuclear Radiations. Ionization chamber, solid state detectors.

CO3: Demonstrate knowledge and understanding of Particle accelerators. Van de Graaff generator, Linear accelerator, Cyclotron.

CO4: Acquire relevant information of Radioactivity. Properties, e/m ratio, charge and range of Alpha, Beta and Gamma particles.

CO5: Acquire relevant information of Elementary Particles. Classification, fundamental interactions, quantum numbers. Basic ideas about Quarks.

TEXT / REFERENCE BOOKS

1. Atomic and Nuclear Physics by N. Subrahmanyam and Brijlal, S Chand & Co., New Delhi (1996).
2. Modern physics by R Murugesan S Chand & Co.
3. Nuclear Physics by Irving Kaplan, Narosa Publishing house, New Delhi.
4. Nuclear Physics by R. C. Sharma, K. Nath & Co., Meerut (2000)

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 1 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

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SPHA1603	SOLID STATE PHYSICS	L	T	P	Credits	Total Marks
		3	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
- To understand the importance of the quantum behavior of electrons in metals
- To understand the origin of the energy bands in solids and basic notions on their calculation

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 - Sodium chloride structure, Zinc Blende structure, Diamond structure, 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: Origin of magnetic moment – Bohr magneton 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, orientational and space charge polarization – Internal field – Determination of Clausius – Mosotti relation – dielectric loss – dielectric breakdown.

UNIT 3: SUPERCONDUCTIVITY

9 Hrs

Introduction – properties of superconductors – Domain theory – Hysteresis – soft and hard magnetic materials 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 Centers– Excitons – Luminescence – Maser and Laser – applications of lasers.

Max. 45 Hours

COURSE OUTCOMES

Students should gain basic knowledge of solid-state physics. This implies that the student will:

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

TEXT / REFERENCE BOOKS

1. Modern Physics by R. Murugesan S. Kiruthiga Sivaprasad. S. Chand Publishers (2012).
2. Modern Physics by Sehgal Chopra Sehgal S. 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: 1 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

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