List of Revised Courses

Department : *Pure and Applied Physics*

Program Name : *B.Sc. (Physics)*

Academic Year : 2019-20

List of Revised Courses

Sr. No.	Course Code	Name of the Course
01.		**Quantum Mechanics &Applications**
02.		**Solid State Physics**
03.	PS/PHY/DSE-502L	**DSE-2: Nano Materials and Applications**
05.		**Electro-magnetic Theory**
07.		**Electro-magnetic TheoryLab**
08.	PS/PHY/DSE-503L	**DSE-3: Nuclear & Particle Physics**
09.	PS/PHY/DSE-503P	**DSE-3 Lab: : Nuclear & Particle Physics Lab**

Minutes of Meetings (MoM) of Board of Studies (BoS)

Academic Year : 2019-20	
School	: *School of Physical Sciences*
Department	: *Pure and Applied Physics*
Date and Time	: *July 13, 2018 – 11:30 AM; July 18, 2018 – 5:00 PM*
Venue	: *Smart Class Room*

The scheduled meetings of member of Board of Studies (BoS) of Department of Pure and Applied Physics, School of Studies of Physical Sciences, Guru Ghasidas Vishwavidyalaya, Bilaspur, were held to design and discuss the B. Sc. (Physics) First year (V and Vi Semesters), scheme and syllabi.

The following members were present in the meeting:

1. Prof. P K. Bajpai
2. Dr. H. S. Tewari
3. Prof. S. B. Kondawar (External Member)
4. Dr. M. N. Tripathi
5. Dr. P. Thakur
6. Dr. R. K. Pandey
7. Dr. T. G. Reddy
8. Dr. R. P. Prajapati
9. Dr. A. K. Gupta
10. Dr. M. P. Sharma
11. Dr. P. Das
12. Dr. T. Trivedi
13. Dr. S. P. Patel
14. Prof. R. Dhar (External member)

The committee discussed and approved the scheme and syllabi. The following courses were revised in the B. Sc. (Physics) Third year V and VI Semesters):

- Quantum Mechanics & Applications
- Solid State Physics
- DSE-2: Nano Materials and Applications (PS/PHY/DSE-502L)
- Electro-magnetic Theory
- Electro-magnetic Theory Lab
- DSE-3: Nuclear & Particle Physics (PS/PHY/DSE-503L)
- DSE-3 Lab: : Nuclear & Particle Physics Lab (PS/PHY/DSE-503P)

Signature & Seal of HoD

PHYSICS-C XI: QUANTUM MECHANICS AND APPLICATIONS
(Credits: Theory-04) Theory: 60 Lectures

Objective:

To study the basic principle of quantum mechanics. To explain the operator formulation of quantum mechanics. To learn the concept of wave function, Schrodinger equation and their application.

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Linearity and Superposition Principles. Expectation values of position and momentum. Wave Function of a Free Particle. (6 Lectures)

Time independent Schrodinger equation: Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; Fourier transforms and momentum space wavefunction. (10 Lectures)

General discussion of bound states in an arbitrary potential: Continuity of wave function, boundary condition and emergence of discrete energy levels; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method; Hermite polynomials; ground state. (12 Lectures)

Quantum theory of hydrogen-like atoms: Time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator & quantum numbers; Radial wavefunctions from Frobenius method; shapes of the probability densities for ground & first excited states; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells. (10 Lectures)

Atoms in Electric & Magnetic Fields: Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. (8 Lectures)

Atoms in External Magnetic Fields:- Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only). (4 Lectures)

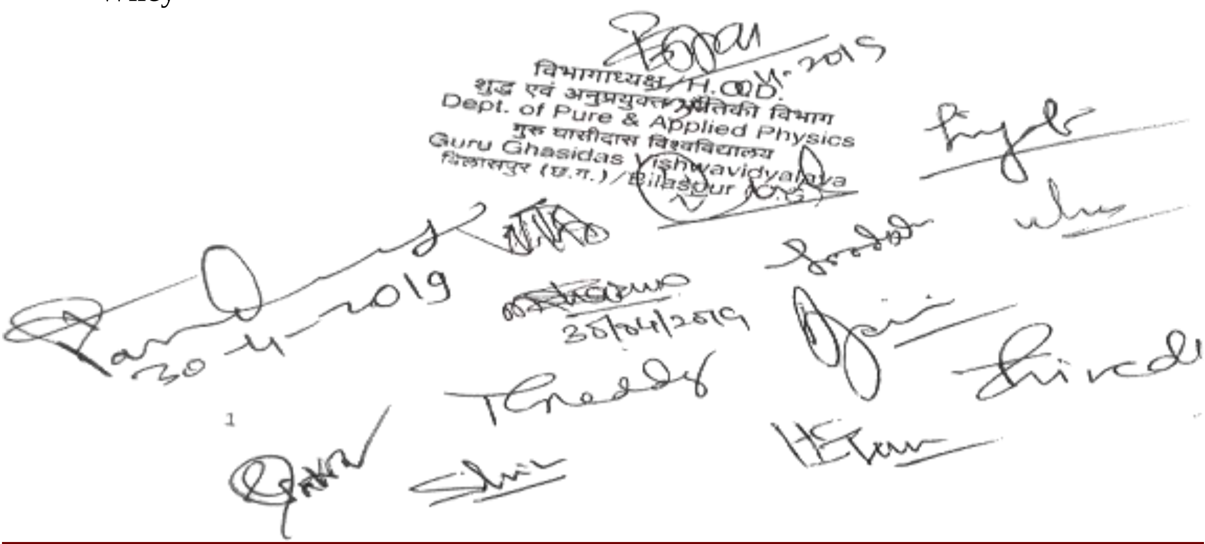
Many electron atoms: Pauli's Exclusion Principle. Symmetric & Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Vector Model. Spin-orbit coupling in atoms L-S and J-J couplings. (10 Lectures)

Outcome:

After the completion of course, the student will be able to: pinpoint the time dependent and independent aspects of Schrodinger wave equation. Understand and explain the difference between classical and quantum mechanics

Reference Books:

- Quantum Mechanics: Theory and Applications, Ajoy Ghatak and S. Lokanathan, Springer
- A Text book of Quantum Mechanics, P. M. Mathews and K. Venkatesan, 2nd Ed., 2010, McGraw Hill
- Quantum Mechanics: Concepts and Applications, 2nd Edition Nouredine Zettili, Wiley



Subject: Solid State Physics | Theory: 60 Lectures

Credits: 04

Objectives:
Understanding the lattice vibrations of a three-dimensional polyatomic vibrating crystal. Introduction to the band structuresfor studying different materials

UNIT - I

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. **(12 Lectures)**

UNIT - II

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law. **(12 Lectures)**

UNIT - III

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials.Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss. **(12 Lectures)**

UNIT - IV

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. **(12 Lectures)**

UNIT - V

Elementary band theory and Superconductivity: Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. **(12 Lectures)**

References :

- Introduction to Solid State Physics, Charles Kittel, 8^{th} Ed., 2004, Wiley India Pvt. Ltd.
- Elements of Solid State Physics, J.P. Srivastava, 2^{nd} Ed., 2006, Prentice-Hall of India
- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
- Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning

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30-4-2019

30/04/2019

Subject: (DSE II) Nano Materials and Applications
Credits: Theory-04 Practicals-02 Theory: 60 Lectures

NANOSCALE SYSTEMS: Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Quantum confinement: Applications of Schrodinger equation- Infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences. (10 Lectures)

SYNTHESIS OF NANOSTRUCTURE MATERIALS: Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD). Sol-Gel. Electro deposition. (8 Lectures)

CHARACTERIZATION: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy. (8 Lectures)

ELECTRON TRANSPORT: Carrier transport in nanostrcutures. Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity. Defects and impurities: Deep level and surface defects. (6 Lectures)

APPLICATIONS: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron transfer devices (no derivation). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. (14 Lectures)

Reference books

- C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
- S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company)
- K.K. Chattopadhyay and A. N. Banerjee, Introduction to Nanoscience and Technology (PHI Learning Private Limited).

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Sub: Electro-magnetic Theory

Subject Code: PS/PHY/C-601L Credit-04 Theory Lectures (60)

UNIT I **(15 Lectures)**

Maxwell Equations: Review of Maxwell's equations. Vector and Scalar Potentials. Maxwells equations in terms of scalar and vector potentials. Concept of Gauge. Gauge Transformations: Lorentz and Coulomb Gauge. Propagation of electromagnetic plane waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density and Momentum Density. Radiation Pressure.

UNIT II **(15 Lectures)**

EM Wave Propagation in Unbounded Media: Transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, skin depth. Propagation of E.M. Waves in Anisotropic Dielectrics. Fresnel's law of normal velocities. Propagation of plane electromagnetic waves in ionized gases.

UNIT III **(15 Lectures)**

EM Wave in Bounded Media: Boundary Conditions at Interface between two Media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Total internal reflection, Metallic reflection (normal Incidence).

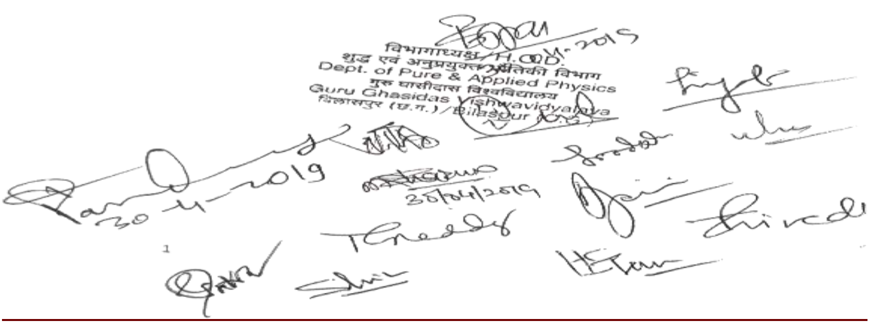
UNIT IV **(15 Lectures)**

Polarization of Electromagnetic Waves: Description of Linear, Circular and Elliptical Polarization. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Optical Rotation. Fresnel's Theory of optical rotation. Specific rotation. Laurent's half-shade polarimeter.

Reference Books:

- Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
- Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
- Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning

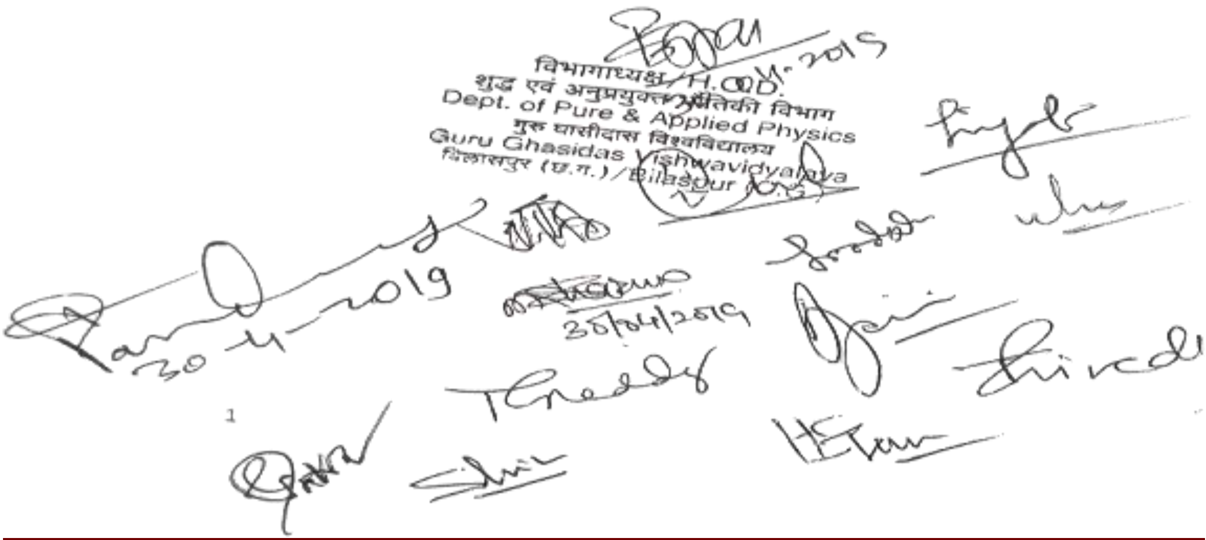
Figure 1



Sub: Electro-magnetic Theory Lab

Subject Code: PS/PHY/C-601P Credit-02

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
4. To study the reflection, refraction of microwaves.
5. To study Polarization and double slit interference in microwaves.
6. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
7. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
8. To verify the Stefan`s law of radiation and to determine Stefan's constant.
9. To determine the Boltzmann constant using V-I characteristics of PN junction diode.



Sub: DSE-3 (Nuclear & Particle Physics)

Subject Code: PS/PHY/DSE-603L **Credit-04** **Theory Lectures (60)**

UNIT I **(13Lectures)**

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments.

UNIT II **(17 Lectures)**

Nuclear Models: Liquid drop model approach, semi empirical mass formula and, significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model, evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field.

Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

UNIT III **(16 Lectures)**

Nuclear Detector and Particle Accelerators

Interaction of charge particle through matter, Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection.

Accelerator facility available in India: Van-de Graaff generator, Pelletron accelerator, Cyclotron

UNIT IV **(14 Lectures)**

Particle physics: Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons

Reference Books:

- Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
- Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
- Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).

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Sub: DSE-3 (Nuclear & Particle Physics Lab)
Subject Code: PS/PHY/DSE-603P Credit-02

1. To study the variation of count rate with applied voltage of Geiger-Müller counter and their by determine its plateau, operating voltage and slope of plateau.
2. Verify the inverse square law for γ-ray using Geiger-Müller counter.
3. To estimate the efficiency of GM detector for beta and gamma source.
4. To determine the different reaction channels for a given reaction using PACE4 softwere and draw the excitation function.
5. To perform energy calibration of NaI detector and determine the energy resolution of known decay transition.
6. To perform spectrum analysis of ^{60}Co and ^{137}Cs with NaI detector using single channel analyzer.
7. To determining the efficiency of a given unknown alpha emitting radio isotope