Faculty of Sciences

Syllabus for

Bachelor of Science (Honours) Physics

(Under Continuous Evaluation System)

(SEMESTER: V-VI)

Session – (2023-24)

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

The Heritage Institution

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

SCHEME AND CURRICULUM OF EXAMINATIONS OF THREE YEAR DEGREE PROGRAMME

Bachelor of Science (Honours) Physics

Session-2023-24

Semester V

Sr. No.	Course Code	Course Type	Course Title	Max Marks Total	Ext L	Ext P	Int	Examination time in Hours)
1	BOPL-5391	C	Condensed Matter Physics – I	75	60	-	15	3
2	BOPL-5392	C	Quantum Mechanics	75	60	-	15	3
3	BOPL-5393	C	Nuclear Physics	75	60	-	15	3
4	BOPL-5394	C	Electronics	75	60	-	15	3
5	BOPP -5395	C	Physics Lab-V	50	-	40	10	3
6	BOPS-5396	C	Seminar and Assignment	50	-	40	10	3
7	*SECJ-5551	AC	Job Readiness Course	25	20	-	5	1
	Total			**400**				

Semester VI

Sr. No.	Course Code	Course Type	Course Title	Max Marks Total	Ext L	Ext P	Int	Examination time in Hours)
1	BOPL-6391	C	Radiation and Particle Physics	75	60	-	15	3
2	BOPL-6392	C	Condensed Matter Physics – II	75	60	-	15	3
3	BOPL-6393	C	Molecular Spectroscopy and Laser	75	60	-	15	3
4	BOPL-6394	C	Digital Electronics and Applications	75	60	-	15	3
5	BOPP -6395	C	Physics Lab-VI	50	-	40	10	3
6	BOPP-6396	C	Physics Lab-VII	50	-	40	10	3
	Total			**400**				

***Marks of these courses will not be included in total marks.**

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-V

(Session-2023-24)

Course code: BOPL- 5391

COURSE TITLE:CONDENSED MATTER PHYSICS – I

COURSE OUTCOMES

After passing this course, students will be able to:

CO 1. Understand basics about crystal structures in solids, various types of crystal structure, unit cells and symmetry operations.

CO 2. Students will also understand the experimental methods to determine crystal structures, reciprocal lattice, Brillouin zones and form factor.

CO 3. Students will understand the concept of free electron model and its applications in explaining concepts of electric conductance.

CO 4. Build concept about Kronig Penny model and its application to band theory to differentiate insulators, semiconductors and conductors, Hall effect

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-V

(Session-2023-24)

Course code: BOPL- 5391

COURSE TITLE:CONDENSED MATTER PHYSICS – I

Maximum Marks: 75 (External 60 + Internal 15) **Examination Time: 3 Hours**

Pass Marks: 35% **Total Teaching hours: 60**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. **Each question carries 12 marks.**

Note: Students can use scientific calculators or logarithmic tables.

UNIT – I

Crystal structure, Symmetry operations for a two dimensional crystal, Two dimensional Bravais lattices, Three dimensional Bravais lattices, Basic primitive cells, Crystal planes and Miller indices, Diamond and NaCl structure.

UNIT – II

Crystal Diffraction: Bragg's law, Experimental methods for crystal structure studies, Laue equations, Reciprocal lattices of SC, BCC and FCC, Brag's law in reciprocal lattice, Brillouin zones and its derivation in two dimensions, atomic from factor and Structure factor.

UNIT – III

Free Electron Theory: Drude-Lorentz theory, the electrical conductivity and Ohm's Law, the thermal conductivity of metals. Wiedemann Frenz law, Sommerfeld model, the Fermi-Dirac distribution, density of electronic states, Fermi energy for one and three dimensions, average kinetic energy

UNIT – IV

Band Theory: Formation of energy bands, Bloch theorem, Kronig - Penney model of an infinite one dimensional crystal, band structures, effective mass, classification of insulators, semiconductors and metals. P and N type of semiconductors, conductivity of semiconductors, mobility, P and N type of semiconductors, conductivity of semiconductors, Fermi levels in P and N type of semiconductors, Hall effect, Hall coefficient.

Books Recommended:

1. Introduction to Solid State Physics by C. Kittel (Wiley Eastern)
2. Elements of Modern Physics by S.H. Patil (TMGH, 1985).
3. Solid State Physics by Puri and Babbar.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-V

(Session-2023-24)

Course code: BOPL- 5392

COURSE TITLE:QUANTUM MECHANICS

COURSE OUTCOMES

After completing this course a student will be able to

CO1: Understand about the need of quantum mechanics and wave nature exhibited by the quantum particle. They will also learn to define a wavefunction of a free particle and under potential

CO2: Understand the concept of operators and expectation values, and their applications in quantum mechanics. They will also be capable of applying the concept of eigenfunctions, eigenvalues.

CO3: Apply Schrodinger's wave equation to solve one dimensional problems in quantum mechanics and to understand the concept of uncertainty in quantum mechanics.

CO4: Apply Schrodinger's wave equation to three dimensional problems and understand the concept of spherically symmetric potentials. They will be able to apply the concept to solve spherical potentials using the spherical coordinates system.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-V

(Session-2023-24)

Course code: BOPL- 5392

COURSE TITLE: QUANTUM MECHANICS

Maximum Marks: 75 (External 60 + Internal 15) **Examination Time: 3 Hours**
Pass Marks: 35% **Total Teaching hours: 60**

Instructions for the Paper Setters: Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carries 12 marks. Students can use scientific calculators or logarithmic tables.

UNIT-I

The Schrodinger Wave equation: Classical versus quantum mechanics, Quantum theory of light: photoelectric effect and Compton scattering, Debroglie wavelength and matter waves: Davisson-Germer experiment, Wave description of particles by wave packet, Group and phase velocities and relation between them, Fundamental postulates of quantum mechanics, Schrodinger Wave equation - one dimensional time dependent Schrodinger equation for free particle and particle under a potential V(x), time independent Schrodinger equation for free particle and particle under a potential V(x), time dependent and time independent 3D Schrodinger wave equation, physical interpretation of wave function, Characteristics to the solution of Schrodinger Wave equation, normalization of wave function, stationary state, conservation of probability, probability current density, conditions of admissibility of the wave function.

UNIT–II

Operator formalism in Quantum mechanics: Operators- operator algebra, linear operators, Laplacian operator, Null operator, identity operator, Hermitian operator, Adjoint or Hermitian conjugate of an operator, Parity operator, operators corresponding to different dynamical variables-Linear Momentum operator, Energy operator, angular momentum operator (in Cartesian and in Spherical polar coordinates), eigenfunctions and eigenvalues, commutators- commutator algebra, commutator for position and momentum, commutator for energy and time, Expectation value of dynamical quantities, Gaussian wave packet, Motion of wave packet or Ehrenfest Theorem, properties of Gaussian wave packet, Schwarz inequality, exact statement and proof of uncertainty principle for wave packets.

UNIT–III

Application of Schrodinger wave equation to 1D problems: Particle in one dimensional box, A single step potential, one dimensional rectangular potential barrier, Quantum mechanical tunnelling effect, Application to barrier penetration α decay, One dimensional square well potential , linear harmonic oscillator- energy of oscillator, classical and quantum mechanical treatment and eigenvalues, significance of zero point energy, uncertainty relation, and wave function, application of linear harmonic oscillator.

UNIT–IV

Application of Schrodinger equation to three dimensional problems: Hydrogen atom - Particle in spherical symmetric potential, solution of R, θ, φ equations, spherical harmonics, wave function of H atom, solution of θ, φ, R equations,, complete wave function, radial probability density, energy values of H atom, degeneracy, polar graphs of probability distribution function, Physical significance of quantum numbers, Free particle in three dimensional rectangular box, wave function and degeneracy, three dimensional harmonic oscillator (Cartesian and spherical polar coordinates) : Isotropic and anisotropic, transition between states the rigid rotator, eigen function and eigen values, rigid rotator in fixed plane.

Books Recommended

1. Quantum mechanics by Powell and Crasemann (Narosa Addison Wesley)

2. Quantum Mechanics by E. Merzbacher (Wiley)
3. Quantum mechanics by Mathews and Venketsan (Tata Mc GrawHill)
4. Perspectives of Quantum Mechanics by S. P Kulia (New Central Book Agency)
5. Quantum Mechanics Concepts and Applications by Nouredine Zettili (JohnWiley and Sons.)
6. Quantum Mechanics by Albert Messiah (Dover Books on Physics)
7. Modern Physics by A. K. Sikri (Pardeep Publications)

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-V

(Session-2023-24)

Course code: BOPL- 5393

COURSE TITLE: NUCLEAR PHYSICS

COURSE OUTCOMES:

After passing this course, students will be able to:

CO 1. Understand basic properties of nucleus and nuclear forces and various hypothesis of nucleus constituents

CO 2. Understand about radioactivity, theories of alpha, beta and gamma decay, neutrino hypothesis.

CO 3. Understand concepts and types about nuclear reactions, reactions cross section, fission and fusion

CO 4. Understand nuclear models (Liquid drop, Fermi gas model and Shell model) and their failures and successes.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-V

(Session-2023-24)

Course code: BOPL- 5393

COURSE TITLE: NUCLEAR PHYSICS

Maximum Marks: 75 (External 60 + Internal 15) **Examination Time: 3 Hours**

Pass Marks: 35% **Total Teaching hours: 60**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. **All questions carry 12 marks.**

Note: Students can use scientific calculators or logarithmic tables.

UNIT–I

Nuclear Properties: Constituents of nucleus, classification of nuclei, Intrinsic properties of nucleus: nuclear charge, size, mass, density, angular momentum, magnetic dipole moment and electric quadruple moment of the nucleus, Wave mechanical properties of nucleus; statistics and parity, mass defect, packing fraction, binding energy and its variation with mass number, properties of nuclear forces, meson theory of nuclear forces. Proton-electron hypothesis, its failure, proton-neutron hypothesis.

UNIT–II

Radioactive Decays: Radioactivity and decay laws, units of radioactivity, radioactive decay series, successive disintegration, radioactive equilibrium, modes of radioactive decay, Alpha decay: barrier penetration as applied to alpha decay, Gamow's theory of alpha decay, its application to Geiger Nuttal law. Beta decays: β-, β+ and electron capture decays, nature of Beta particle spectrum, Neutrino hypothesis, Fermi's theory, angular momentum and parity selection rules, Difference between neutrino and antineutrino, Detection of neutrino, non- conservation of parity in beta decay and its experimental verification. Gamma decay: Gamma emission, internal conversion, internal pair conversion, Auger electron, Radioisotopes and their applications, radioactive dating.

UNIT–III

Nuclear Reactions: Types of nuclear reactions, conservation laws, energetics of nuclear reactions, examples of nuclear reactions, Q-value and its physical significance, threshold energy for exoergic and endoergic reactions, Nuclear fission, neutron reactions, chain reactions, Nuclear reactor, reactor criticality, moderators, Nuclear fusion (Qualitative only), reaction cross section, **microscopic and macroscopic cross-section.**

UNIT–IV

Nuclear Models: Liquid drop model: similarities and differences between nucleus and liquid drop, semi-empirical mass formula, Applications of semiempirical mass formula: stability of nuclei against beta and alpha decay, condition for most stable isobar, stability against spontaneous fission, failure of the liquid drop model. Nuclear stability curve, The Fermi gas model, experimental evidence for nuclear magic numbers, development of Shell Model, energy level scheme, predictions of the Shell model: angular momenta, parity and magnetic moment of nuclear ground states, electric quadrupole moments and nuclear isomerism. Limitations of Shell model.

Books Recommended

1. Basic Ideas and Concepts in Nuclear Physics by K. Hyde
2. Introduction to Nuclear Physics : H.A. Enge
3. Nuclear Physics : I. Kaplan (Addison Wesley)
4. Nuclei and Particles by E. Segre5. Nuclear and Particle Physics: Kulwant S. Thind, Manmohan Singh, Vijay Kumar, Leif Gerward

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-V

(Session-2023-24)

Course code: BOPL- 5394

COURSE TITLE: ELECTRONICS

COURSE OUTCOMES:

Course Outcomes- After completing this course a student will be able to

CO1: understand, concept of voltage and current sources, working of a p-n junction diode, Zener diode, and their use in basic gates, photonic devices, rectification and voltage regulation.

CO2: understand the characteristics, biasing and working of BJT and FETs.

CO3: able to understand h-parameters, amplifiers using BJT & FETs and types of feedback and practical example of negative feedback (emitter follower).

CO4: able to understand LC and RC oscillators and their comparison, operational amplifiers and working of CRO

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-V

(Session-2023-24)

Course code: BOPL- 5394

COURSE TITLE: ELECTRONICS

Maximum Marks: 75 (External 60 + Internal 15) **Examination Time: 3 Hours**

Pass Marks: 35% **Total Teaching hours: 60**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. **All questions carry 12 marks.**

Note: Students can use scientific calculators or logarithmic tables.

UNIT–I

Concepts of current and voltage sources, Intrinsic and Extrinsic semiconductors, Fermi level, Charge carriers in semiconductors, p-n junction, p-n junction fabrication techniques, Depletion region, Biasing of diode, V-I characteristics, Voltage-current equation for p-n junction, Ideal diode, Static and Dynamic resistance of a Junction Diode, Transition and diffusion capacitance, Avalanche breakdown and Zener breakdown, Introduction to Zener diode and voltage regulation, V-I characteristics of Tunnel Diode, Rectification: half wave rectifier, Full wave rectifiers (Centre tapped and bridge rectifiers), Efficiency, Ripple factor, Qualitative ideas of filter circuits (L-filter, Shunt capacitor filter, LC and π filters), Photonic devices (solar cell, photodiode and LED).

UNIT–II

Junction transistor : Transistor fabrication techniques, Structure and working, relation between different currents in transistors, Sign conventions, Amplifying action, Different configurations of a transistor and their comparison, CB and CE characteristics, Accurate expressions for collector current, Transistor load line analysis, Thermal runaway and heat sink, Transistor biasing and stabilization of operating point, Elementary idea about Fixed bias, Base bias with emitter feedback, Collector to base bias. Voltage divider biasing circuit in detail. Structure and characteristics of JFET, Comparison of BJT and FET.

UNIT–III

Transistor as an amplifier, Working of CB and CE amplifier, Coupled Amplifier: RC-coupled amplifier and its frequency response. Concept of hybrid parameters, Amplifier analysis using h- parameters, Equivalent circuits, Determination of current gain, voltage gain, Power gain, Input resistance, output resistance, overall voltage gain, FET amplifier (common source configuration and common drain configuration) and its voltage gain, Feedback in amplifiers, Different types, Voltage gain, Advantage of negative feedback, Emitter follower as negative feedback circuit

UNIT–IV

Barkausen criterion of sustained oscillations, LC oscillator (tuned collector, tuned base Hartley), RC oscillators, phase shift and Weinbridge. Operational Amplifiers (Black Box approach): Characteristics of an Ideal and practical Op-Amp (IC 741), Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground, Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector. Introduction to CRO: Block Diagram of CRO, Electron Gun, Deflection System and Time Base, Deflection Sensitivity, Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current and Frequency

Books Recommended:

1. Electronc Devices and Circuits-J. Milkman and C. C. Halkias(Tata McgrawHill)
2. Basic Electronics and Linear Circuits by N.N. Bhargave, D.C. Kulshreshtha andS.C. Gupta.
3. Foundations of Electronics by D. Chatophadhyay, P.C. Rakshit, B. Saha and N.N.Purkit.
4. Basic Electronics by D.C. Tayal (Himalaya Pub.)
5. Principles of Electronics by V.K. Mehta & Rohit Mehta (S. Chand Publishers)
6. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-V

(Session-2023-24)

Course code: BOPP- 5395

COURSE TITLE: PHYSICS LAB-V

COURSE OUTCOMES :

CO 1. Students will be able to characterize p-n junction, zener diode, and their use as rectifier, filters, clipping element and to find energy gap.

CO 2. Students will be able to use CRO for AC voltage and frequency.

CO 3. Students will be able to characterize Common base and common emitter transistors and their use as amplifiers.

CO 4. Students will be able to use diodes as basic gates.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-V

(Session-2023-24)

Course code: BOPP- 5395

COURSE TITLE: PHYSICS LAB-V

Maximum Marks: 50 (External 40 + Internal 10) **Examination Time: 3 Hours**
Pass Marks: 35% **Total Teaching hours: 90**

General Guidelines for Practical Examination

I. The distribution of marks is as follows:

i) One experiment 20 Marks **ii) Brief Theory 6 Marks**

iii) Viva–Voce 7 Marks **iv) Record (Practical file) 7 Marks**

II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.

III. Number of candidates in a group for practical examination should not exceed 12.

IV. In a single group no experiment be allotted to more than three examinee in any group.

LIST OF EXPERIMENTS-

1. Measurement of reverse saturation current in p-n-junction diode at various temperatures and to find
   the approximate value of energy gap.
2. To measure (a) AC Voltage, and (b) Frequency of a periodic waveforms using CRO
3. Study the variable DC power supply using CRO and obtain the graph between DC voltmeter and CRO measurements.
4. To draw forward and reverse bias characteristics of a p-n junction diode.
5. To study diode as a clipping element.
6. To measure the efficiency and ripple factors for (a) halfwave (b) full wave and (c) bridge rectifier circuits.
7. To study the reduction in the ripple in the rectified output with RC, LC and л filters.
8. To draw the characteristics of a Zener diode.
9. To study the stabilization of output voltage of a power supply with Zener diode.
10. To study characteristics of Common Base transistor. and to find input resistance, output resistance, voltage gain and current gain.
11. To study characteristics of Common Emitter transistor. and to find h-parameters.
12. To draw output and mutual characteristics of an FET (Experiments) and determine its parameters.
13. To study the Hartley oscillator.
14. To study the gain of an amplifier at different frequencies and to find Band width.
15. To study the response of RC circuits to various input voltages (square, sine and triangular).

Books Recommended:

1. Practical Physics by CL Arora S. Chand Publications
2. Practical Physics by S P Singh Pragati Parkashan Meerut.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-V

(Session-2023-24)

Course code: BOPS- 5396

COURSE TITLE: SEMINAR AND ASSIGNMENT

Maximum Marks: 50 (External 40 + Internal 10) **Periods: 6 Periods/week**

Pass Marks: 35%

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-VI

(Session-2023-24)

Course code: BOPL- 6391

COURSE TITLE: RADIATION AND PARTICLE PHYSICS

COURSE OUTCOMES:

After successfully completing this course a student will be able to:

CO1: understand elementary particles, different types of interactions and quark models.

CO2: understand interaction of radiation and charged particles with matter.

CO3: understand theory and working of various particle accelerators, linear and cyclic and phase stability conditions.

CO4: understand theory and working of various types of nuclear detectors like gas filled, semiconductor, solid state track detectors and nucleus emulsions.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-VI

(Session-2023-24)

Course code: BOPL- 6391

COURSE TITLE: RADIATION AND PARTICLE PHYSICS

Maximum Marks: 75 (External 60 + Internal 15) **Examination Time: 3 Hours**

Pass Marks: 35% **Total Teaching hours: 60**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. **Note**: Students can use scientific calculators or logarithmic tables.

UNIT-I

Elementary Particles and their Properties- Historical introduction, particles and antiparticles, classification of particles, Properties of different baryons, Hyperons, Leptons and Mesons like life time, mass, spin parity and conservation law. Observation of Strange particles production and decay, Introduction to quarks and their types, Quark contents of baryons and mesons, Discovery of cosmic rays: hard and soft components, Primary and secondary cosmic Rays, cosmic ray showers, effect of altitude and earth's magnetic field on the cosmic ray trajectories, east-west symmetry.

UNIT-II

Interaction of Radiation and Charged Particles with Matter: Types of interactions, electromagnetic, weak, strong interactions, gravitational interactions, Basic resonance particles. Stopping power of heavy charged particle, derivation of Bethe-Bloch formula, range of particle, Bragg curve, range straggling, Geiger Nuttal's law, Energy loss of electrons and positrons, Positrons annihilation in condensed media, interaction of gamma rays with matter: photoelectric effect, Compton scattering, pair production.

UNIT-III

Accelerators - Accelerators, linear accelerators, Cockcroft-Walton accelerator, Van de Graff accelerator, cyclic accelerators, Cyclotron, Betatron, Synchro-cyclotron, focusing, Phase stability, electron synchrotron, CERN Super Proton Synchrotron (SPS), Larger Hadron collider (LHC), Tevatron.

UNIT-IV

Nuclear Radiation Detection - Gas-filled detectors, Proportional and Geiger-Muller counters, Scintillation detectors, Semiconductor detectors, Cherenkov effect, Electromagnetic and hadronic calorimeter, solid state nuclear track detectors, bubble chambers, spark counter, nuclear emulsions.

Books Recommended:

1. Introduction to Elementary Particles by D. Griffth (Wiley-VCH)
2. Introduction to High Energy Physics by D.H. Perkins (Cambridge University Press)
3. Elementary Particles by I.S. Hughes (Cambridge University Press)

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-VI

(Session-2023-24)

Course code: BOPL- 6392

COURSE TITLE: CONDENSED MATTER PHYSICS – II

COURSE OUTCOMES:

After completing this course student will be able to

CO1: understand the concept of phonons, and role of lattice vibrations in specific heat of solids.

CO2: understand the basic concepts related to superconductivity.

CO3: understand the concept of dielectric polarisation types and frequency dependence.

CO4: understand the basics about nanomaterials and some characterisation techniques.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-VI

(Session-2023-24)

Course code: BOPL- 6392

COURSE TITLE: CONDENSED MATTER PHYSICS – II

Maximum Marks: 75 (External 60 + Internal 15) **Examination Time: 3 Hours**

Pass Marks: 35% **Total Teaching hours: 60**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Note: Students can use scientific calculators or logarithmic tables.

UNIT –I

Lattice vibrations, One Dimensional Monoatomic Lattice, Dispersion relation, phonons, phonon momentum during elastic and inelastic scattering, Inelastic scattering of photons by phonons, Specific heat of solids, Classical Model of specific heat of solids (Dulong and Petit's Law), Einstein and Debye Models of Specific Heat of Solids. T^3 law.

UNIT – II

Superconductivity, Comparison of electrical, magnetic and thermodynamical properties of superconductors and normal conductors. Persistent Currents, Effect of magnetic field on superconductor, Meisner effect, Types of Superconductors, London's equation and penetration depth, Thermodynamics of Superconductors, BCS theory (formation of cooper pairs), ground state and energy gap. High Temperature Superconductors.

UNIT – III

Polar and Non Polar Molecules, Dielectric Polarization, Electric displacement vector and dielectric constant, Local Electric Field, Clausius Mosotti equation, Different contribution to polarization: dipolar, electronic and ionic polarizabilities, frequency dependence Ferroelectric crystals: Classifications and their general properties

UNIT – IV

Basic ideas of materials at nanoscale, Difference from bulk material properties, Nanoparticles, Applications of nanotechnology in various fields. (Qualitative only) Characterization techniques: X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy. Scanning Tunneling Microscopy.

Books Recommended:

1. Introduction to Solid State Physics by C. Kittel (WileyEastern)
2. Elements of Modern Physics by S.H. Patil (TMGH,1985).
3. Solid State Physics by Puri and Babbar.
4. K. P. Jain Physics of Semiconductor Nanostructures. New Delhi: Narosa Publishing House, 1997.
5. Solid State Physics: J.P. Srivastva-Prentice Hall, 2007.
6. Introduction to nanoscience and Nanotechnology: K.K. Chattopadhyay and A.N. Banerjee- PHI Learning Pvt. Ltd. 2009

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-VI

(Session-2023-24)

Course code: BOPL- 6393

COURSE TITLE: MOLECULAR SPECTROSCOPY AND LASER

COURSE OUTCOMES:

After passing this course, students will be able to:

CO 1: understand the basics of microwave and infrared spectroscopy and their applications.

CO 2: understand the Raman and electronic spectroscopy, applications and comparison.

CO3: understand the basics of principle and theory of working of LASERs.

CO 4: understand different types of LASER and basics of Q Switching and holography.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-VI

(Session-2023-24)

Course code: BOPL- 6393

COURSE TITLE: MOLECULAR SPECTROSCOPY AND LASER

Maximum Marks: 75 (External 60 + Internal 15) **Examination Time: 3 Hours**

Pass Marks: 35% **Total Teaching hours: 60**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Note: Students can use scientific calculators or logarithmic tables.

UNIT–I

Microwave and Infra-Red Spectroscopy: Types of molecules, Types of molecular spectra, Born Oppenheimer approximation, rotation of molecules, origin of rotational spectra, rotational spectra of diatomic molecules as a rigid rotator, Thermal distribution of rotational energy levels, Effect of isotopic substitution, diatomic molecule as non-rigid rotator, technique and instrumentation of microwave spectroscopy, The vibrating diatomic molecule: Energy of a diatomic molecule, simple harmonic oscillator, isotopic effect, anharmonic oscillator, Outline of technique and instrumentation, Applications of Infrared spectroscopy.

UNIT–II

Raman and Electronic Spectroscopy: Nature of the Raman spectra, characteristic properties of Raman lines, Experimental arrangement for Raman spectra, Quantum and classical theories of Raman Effect, Pure rotational Raman spectra, Rule of mutual exclusion, applications of Raman and infra-red spectroscopy, Electronic spectra: Salient features of molecular electronic spectra, origin of electronic spectra, Electronic spectra of diatomic molecule, Outline of technique and instrumentation of electronic spectroscopy,

UNIT–III

Laser Fundamentals: Concept of laser, unique properties of lasers, Absorption and spontaneous emission, Einstein coefficients and their relations, light amplification Concept of stimulated emission and population inversion, components of laser and lasing action, three and four level lasing techniques, Principal pumping schemes, Fauchber Ledenberg formula, Threshold and Schawlow Townes condition,

UNIT–IV

Laser Systems: Types of lasers, Ruby and Nd: YAG lasers, He-Ne and CO2 and dye lasers construction and their working, laser beam characteristics. Applications of lasers, Q switching Holography: The underlying principle, applications of Holography

Books Recommended:

1. Fundamentals of Molecular Spectroscopy: C.B. Banwell-Tata McGraw Hill,1986.
2. Spectroscopy Vol. I, II & III: Walker &Straughen
3. Introduction to Molecular Spectroscopy: G.M. Barrow-Tokyo McGraw Hill,1962.
4. Spectra of Diatomic Molecules: Herzberg-New York,1944.
5. Molecular Spectroscopy: Jeanne LMcHale.
6. Atomic and molecular spectra: laser by Rajkumar
7. Laser Fundamentals by W.T. Silfvast (Foundation Books), New Delhi, 1996
8. Laser and Non-Liner Optics by B.B. Laud (New Age Pub.) 2002
9. Laser, Svelto by (Plenum Press) 3rd edition, New York

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-VI

(Session-2023-24)

Course code: BOPL- 6394

COURSE TITLE: DIGITAL ELECTRONICS AND APPLICATIONS

COURSE OUTCOMES:

After passing this course, students will be able to:

CO 1: understand the basics of ICs, binary to digital and digital to binary conversions, different number systems, addition and subtraction in binary systems.

CO 2: understand different gates, Boolean laws, K maps.

CO3: understand the basics of gates as adders, subtractor, comparator, multiplexer, demultiplexer, encoder, decoder and flip-flops.

CO 4: understand IC 555: multivibrators, registers, Counters, Semiconductor Memories.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-VI

(Session-2023-24)

Course code: BOPL- 6394

COURSE TITLE: DIGITAL ELECTRONICS AND APPLICATIONS

Maximum Marks: 75 (External 60 + Internal 15) **Examination Time: 3 Hours**

Pass Marks: 35% **Total Teaching hours: 60**

Instructions for the Paper Setters:

Eight questions of equal marks are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. Each question carry 12 marks.

Note: Students can use scientific calculators or logarithmic tables.

UNIT–I

Integrated Circuits (Qualitative treatment only): Distinction between analog and digital signal, Applications and advantages of digital signals, Advantages and drawbacks of ICs, Classification of ICs, Digital circuit, Binary number system, Decimal to binary conversion, Binary to decimal conversion, Octal number system, Hexa decimal number system, Binary coded decimal code (BCD code), Binary Addition, Binary Subtraction using 2's Complement, A/D Conversion (successive approximation), BCD addition.

UNIT–II

Digital Circuits and Boolean algebra: Definition, symbols and truth table of AND, OR and NOT Gates (realization using Diodes and Transistor); NAND and NOR Gates as Universal Gates; XOR and XNOR Gates and application as Parity Checkers; De Morgan's Theorems; Boolean Laws; Simplification of Logic Circuit using Boolean Algebra; Fundamental Products, Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map (up to 4 variables)

UNIT–III

Arithmetic and Logic circuits: half adder, full adder, half subtractor, full subtractor, comparator, multiplexer, demultiplexer, encoder, decoder, **Flip-flop:** Introduction to sequential circuits; flip flops, RS flip-flop, Clocked RS flip-flop, D flip-flop, Latches, level triggered & edge triggered flip-flops, positive and negative edge triggering, limitations of JK flip-flop, race-around condition. Applications of flip flops.

UNIT–IV

Timers: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator. Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel in-Parallel-out Shift Registers (only up to 4 bits), Counters (4 bits): Ring Counter, Asynchronous counters, Decade Counter. Synchronous Counter. **Semiconductor Memories:** Introduction, Memory organization, Classification and characteristics of memories. Read/write memory, ROM, RAM, EPROM, EEPROM, Basic idea of static dynamic memory,

Books Recommended:

1. A. P. Malvino,and D. P. Leach, Digital Principles and Applications. New Delhi: Tata McGraw Hill, 1986.
2. A. P. Malvino, Digital Computer Electronics. New Delhi: Tata McGraw Hill, 1986.
3. W. H. Gothmann, Digital Electronics. New Delhi: Prentice Hall, 1980.
4. J. Millman,and H. Taub, Pulse, Digital and Switching Waveforms. New Delhi: Tata McGraw Hill, 1992.
5. A. Mottershead, Electronic Devices and Circuits. New Delhi: Prentice Hall, 1977.
6. R. S. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085. New Delhi: Prentice Hall, 2002.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-VI

(Session-2023-24)

Course code: BOPP- 6395

COURSE TITLE: PHYSICS LAB-VI

COURSE OUTCOMES:

After completing this lab student will be able to

CO1: use GM counter as detector

CO2: Characterise Thermistor, diode, LDR and to find magnetic parameters using CRO.

CO3: understand Hall effect and Boltzmann's coefficient, photoelectric effect

CO4: To use OP-Amps as inverting and non inverting amplifiers and its application in zero cross detector and comparator.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-VI

(Session-2023-24)

Course code: BOPP- 6395

COURSE TITLE: PHYSICS LAB-VI

Maximum Marks: 50 (External 40 + Internal 10) **Examination Time: 3 Hours**
Pass Marks: 35% **Total Teaching hours: 90**
General Guidelines for Practical Examination
I. The distribution of marks is as follows:
i) One experiment 20 Marks **ii) Brief Theory 6 Marks**
iii) Viva–Voce 7 Marks **iv) Record (Practical file) 7 Marks**
II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.
III. Number of candidates in a group for practical examination should not exceed 12.
IV. In a single group no experiment be allotted to more than three examinees in any group.

LIST OF EXPERIMENTS-

1. To draw the plateau of a GM counter and find its dead time.
2. Study of counting statistics using background radiation using a GM counter.
3. To study the absorption of beta particles in aluminium using a GM counter and determine the absorption coefficient of beta particles from it.
4. To study the characteristics of a thermistor and find its parameters.
5. To trace the B-H curves for different materials using CRO and find the magnetic parameters from these.
6. To determine the wavelength of laser light using a plane diffraction grating.
7. To determine the Boltzmann constant using V-I characteristics of PN junction diode.
8. To determine the Hall coefficient of a semiconductor sample.
9. To study characteristics of light dependent resistors (LDR).
10. To measure the intensity using LDR in laser diffraction patterns of single and double slit.
11. To study photoelectric current vs intensity of light and cathode voltage using photocell.
12. To study photoelectric current vs wavelength of light using photocell and hence find Plank's constant.
13. To study an inverting and non-inverting amplifier using Op-amp (741) for a given dc voltage.
14. To study the zero-crossing detector and comparator.

Books recommended:

1. Practical Physics by CL Arora S. Chand Publications
2. Practical Physics by S P Singh Pragati Parkashan Meerut.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-VI

(Session-2023-24)

Course code: BOPP- 6396

COURSE TITLE: PHYSICS LAB-VII

COURSE OUTCOMES:

After completing this lab student will be able to

CO1: understand logic gates and their truth tables

CO2: understand 2-bit comparator, adders, subtractors, parity generator and checker.

CO3: understand shift register, flip flops

CO4: understand A/D, D/A converters and counters.

Bachelor of Science (Honours) Physics (Semester System) (12+3 System of Education)

SEMESTER-VI

(Session-2023-24)

Course code: BOPP- 6396

COURSE TITLE: PHYSICS LAB-VII

Maximum Marks: 50 (External 40 + Internal 10) **Examination Time: 3 Hours**
Pass Marks: 35% **Total Teaching hours: 90**

General Guidelines for Practical Examination
I. The distribution of marks is as follows:
i) One experiment 20 Marks **ii) Brief Theory 6 Marks**
iii) Viva–Voce 7 Marks **iv) Record (Practical file) 7 Marks**
II. There will be one session of 3 hours duration. The paper will have one session and will consist of 8 experiments out of which an examinee will mark 6 experiments and one of these is to be allotted by the external examiner.
III. Number of candidates in a group for practical examination should not exceed 12.
IV. In a single group no experiment be allotted to more than three examinees in any group.
LIST OF EXPERIMENTS-
1. Study of logic gates using universal gates.
2. To form a half adder and a full adder using NAND gates and verify their truth tables.
3. To form a 2-bit comparator using NAND gates.
4. To study Half Adder, Full Adder and 4-bit binary Adder.
5. To study Parity generator and checker.
6. To study the truth table of the shift register.
7. To study the truth table of flip flops.
8. To study encoder, decoder circuit.
9. To study D/A and A/D convertors.
10. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates
11. Study of bi-stable, mono-stable and astable multivibrators.
Books Recommended:
1. Digital Electronics Circuit and System by V.K. Puri (TMH, New Delhi).
2. Digital Design by M. Morris Mano (PHI, New Delhi).