J. S. UNIVERSITY
Shikohabad, Firozabad (U.P.)

BACHELOR OF SCIENCE (B.Sc.)
(THREE YEAR DEGREE COURSE)

PROGRAMME BROCHURE
PHYSICS

2018

Program Outcomes (PO's):
The POs of Bachelor in Science (B.Sc.) Programme are:

PO1: To train the Science Graduates so that they become proficient in respective science disciplines and become competent enough for pursuing Post Graduate Programmes in high ranking institutions.

PO2: To cultivate character and ethics, as well as high professionalism in the science graduates during the three years Bachelor of Science Programme so that they can stand to the National Aspirations.

PO3: To inspire Science Graduate to acquire creative and innovative, entrepreneurial and leadership qualities that are global in character.

B.Sc. (PHYSICS)
(Programme code 109)

COURSE STRUCTURE

FIRST-YEAR

PAPER – 101: MECHANICS AND WAVE MOTION	50 MARKS
PAPER – 102: KINETIC THEORY AND THERMODYNAMICS	50 MARKS
PAPER – 103: CIRCUIT FUNDAMENTALS AND BASIC ELECTRONICS	50 MARKS
PAPER – 104: PRACTICAL (Based on Paper 101, 102, 103)	50 MARKS

SECOND YEAR

PAPER – 201: PHYSICAL OPTICS AND LASERS	50 MARKS
PAPER – 202: ELECTROMAGNETICS	50 MARKS
PAPER – 203: ELEMENTS OF QUANTUM MECHANICS, ATOMIC AND MOLECULAR SPECTRA	50 MARKS
PAPER – 204: PRACTICAL (Based on Paper 201, 202, 203)	50 MARKS

THIRD YEAR

PAPER – 301: RELATIVITY AND STATISTICAL PHYSICS	50 MARKS
PAPER – 302: SOLID STATE AND NUCLEAR PHYSICS	50 MARKS
PAPER – 303: SOLID STATE ELECTRONICS	50 MARKS
PAPER – 304: PRACTICAL (Based on Paper 301, 302, 303)	50 MARKS

B.Sc. (PHYSICS)
FIRST-YEAR DETAILED SYALLBUS PAPER – 101
MECHANICS AND WAVE MOTION

UNIT-I

Inertial frame of reference, Newton's laws of motion, Dynamics of the particle in a rectilinear and circular motion, Conservative and Non -conservative forces, Conservation of mechanical energy, linear momentum and angular momentum examples of linear and corsuratmatic, Collision in one and two dimensions, cross-impact parameter, scattering ample and scattering cross-section.

UNIT -II

Definition of a rigid body, Rotational energy and rotational inertia for simple bodies, the combined translational and rotation motion of a rigid body on horizontal and inclined planes, Simple treatment of the motions of a top. Relations between elastic constants, bending of Beam, Cantilever and Torsion of Cylinder.

UNIT - III

Central forces, Two particle central force problem, reduced mass, relative and center of mass motion, Law of gravitation, Kepler's laws of planetary motion and their deductions, motions of planets and satellites, geostationary satellites.

UNIT IV

Simple harmonic motion, differential equation of S. H. M. and its solution, uses of complex notation, damped and forced vibrations, the composition of simple harmonic motion.

Differential equation of wave motion and its solution, plane progressive, harmonic waves in fluid media, the reflection of waves, phase change on reflection, superposition, stationary waves, pressure, and energy distribution, phase and group velocity, and the relation between them.

Text and Reference Books

1. EM Purcell, Ed: "Berkeley Physics Course, Vol. 1, Mechanics" (McGraw-Hill).
2. RP Feymman, RB Lighton and M Sands; "The Feymman Lectures in Physics",Vol. 1 (BI Publications, Bombay, Delhi, Calcutta, Madras).
3. J.C. Upadhyay: 'Mechanics'.
4. D.S, Mathur "Mechanics",

Course Outcomes: After completion of this course students would be able to explain the dynamics of the particle. They would be learned about the conservation laws of physical properties like energy and momentum. Students will be able to know the concept of rigid bodies and their motion in different types of planes. Students would be engaged with the concepts of central forces and their application in different rigid bodies. They could also elaborate on Kepler's laws of planetary motion in planets and satellites. Students will also be able to explain the simple harmonic motion of bodies. They would also be able to solve the differential equation for different types of waves.

B.Sc. (PHYSICS)
FIRST-YEAR DETAILED SYALLBUSPAPER – 102
KINETIC THEORY AND THERMODYNAMICS

UNIT-I

Ideal Gas: Kinetic model, Deduction of Boyle's law, interpretation of temperature, estimation of r.m.s. speed of molecules. Brownian motion, estimation of the Avogadro number. Equipartition of energy, the specific heat of monoatomic gas, extension to di- and polyatomic gases, and Behaviour of gases at low temperatures. Adiabatic expansion of an ideal gas, applications to atmospheric physics.

Real Gas: Vander Waals' gas, equation of state, nature of Vander Waals' forces, comparison with experimental P-V curves. The critical constants, gas and vapour. Joule expansion of an ideal gas, Vander Waals' gas, Joule Thomson effect, Joule coefficient, estimatation of J-T cooling.

UNIT -II

Liquefaction of gases: Boyle's temperature and inversion temperature. Principle of regenerative cooling and of cascade cooling, liquefaction of hydrogen and helium gases. Refrigeration cycles, meaning of efficiency.

Transport phenomena in gases: Molecular collisions, mean free path and collision cross sections. Estimatation of molecular diameter and mean free path. Transport of mass, momentum and energy and inter-relationship, dependence on temperature and pressure.

UNIT - III

The laws of thermodynamics: The Zeroth law, work done by and on the system, internal energy as a state function and other applications, first law of thermodynamics. Reversible and irreversible changes, Carnot cycle and its efficiency, Carnot theorem, Second law of thermodynamics. Its Internal combustion engines. Entropy, principle of increase of entropy and calculations. The thermodynamic scale of temperature; its identity with the perfect gas scale. Impossibility of attaining the absolute zero;

Third law of thermodynamics. Thermodynamic relationships: Thermodynamic variables, Maxwell's general relationships, application to Joule-Thomson cooling and adiabatic cooling in a general system, Vander Waals' gas, Clausius-Clapeyron heat equation. Thermodynamic potentials and equilibrium of thermodynamical systems, relation with thermodynamical variables. Cooling due to adiabatic demagnetization, production and measurement of very low temperatures.

UNIT -IV

Blackbody radiation: Pure temperature dependence, Stefan-Boltzmann law, pressure of radiation, spectral distribution of Black body radiation, Wien's displacement law, Rayleigh-Jean's law, Planck's law of radiations.

Text and Reference Books

1. G.G. Agarwal and H.P. Sinha "Thermal Physics"

2. S.K. Agarwal and B.K. Agarwal "Thermal Physics"

3. Shan & Shrivastava – Heat and Thermodynamics.

4. Brijlal & Shubramaniam – Heat and Thermodynamics.

Course Outcomes: At the end of the course most of the students would be benefitted from the theory of gases (like ideal and real gases) and concept of the Thermodynamics. They will be able to solve the problems based on the behavior of monoatomic, diatomic, and polyatomic gases. Students will also be able to understand the concept of the Liquefaction of gases and Transport phenomena in gases. They will be able to relate mass, momentum, and energy to a gaseous system. Students will also be able to have a great knowledge of the zeroth, first, second, and third laws of thermodynamics, and their physical significance. Most of the students will have gained knowledge of thermodynamic potentials and their physical significance. They would also be able to describe Maxwell's general relationships of thermodynamical energies. Students would be benefitted from the concept of the black body and they would also be able to explain the laws which define the characteristics of a black body.

B.Sc. (PHYSICS)

FIRST-YEAR DETAILED SYALLBUSPAPER – 103

CIRCUIT FUNDAMENTALS AND BASIC ELECTRONICS

UNIT-I

Growth and decay of currents through inductive resistances, charging and discharging in R.C. and R.L.C. circuits, Time constant, Measurement of high resistance. A.C. Bridges, Maxwell's and Schering's Bridges, Wien Bridge. THEVENIN'S, NORTON'S Theorem and Superposition theorems and their applications.

UNIT -II

Semiconductors, intrinsic and extrinsic semiconductors, n-type and p-type semiconductors, P.N. Junction diode forward bias and reverse bias, diode as a rectifier, diode characteristics, LED diodes, zener diode, avalanche and zener breakdown, power supplies, rectifier, bridge rectifier, capacitor input filter, voltageregulated power supply, zener regulator.

UNIT - III

Bipolar transistors, CE, CB, CC Confirmations and Characteristics, DC alpha, DC beta, characteristics of transistor curves in different modes. Transistor biasing circuits: base bias, emitter bias and voltage divider bias, DC load line.

Basic AC equivalent circuits, low frequency model, small signal amplifiers hybrid parameter of a transistor, common emitter amplifier, common collector amplifiers, and common base amplifiers, current and voltage gain, R.C. coupled amplifier, gain, frequency response, equivalent circuit at low, medium and high frequencies, feedback principles.

UNIT-IV

Barkhan Criters for sustained oscillations impedance, transistor as an oscillator, general discussion and theory of Hartley oscillator only.

Elements of transmission and reception, basic principles of amplitude modulation and demodulation. Principle and design of linear multimeters and their applications, cathode ray oscillograph and its simple applications.

Text and Reference Books

1. B.G. Streetman; "Solid State Electronic Devices", IInd Edition (Prentice Hallof India, New Delhi, 1986).
2. W.D. Stanley: "Electronic Devices, Circuits and Applications" (Prentice-Hall).
3. J.D. Ryder, "Electronics Fundamentals and Applications", lI Edition (Prentice-Hall of India, New Delhi, 1986).
4. J Millman and A Grabel, "Microelectronics", International Edition (McGrawHill Book Company, New York, 1988).

Course Outcomes: Upon the completion of this course the students will have the basic concept of electronics and circuit fundamentals. They would be learned about the different types of ac bridges and circuit theorems. Students will be benefitted from the basic knowledge of semiconductors, diodes, and their applications. They will be able to use the diodes in different electronic circuitries. Students will have effective knowledge of the transistors and their applications. They would be able to learn the application of amplifiers in different circuits.

Students will also be able to define the basic principles of multimeters, CRO, and Oscillators.

B.Sc. (PHYSICS)

FIRST-YEAR DETAILED SYALLBUSPAPER – 104

PRACTICALS

Every institution may add experiments of the same standard in the followingsubject.

Mechanics

1. Study of laws of parallel and perpendicular axes for moment of inertia.
2. Study of conservation of momentum in two-dimensional oscillations.
3. To determine the moment of inertia of a flywheel about its own axis of rotation.
4. M.I. of an irregular body by inertia table.

Oscillations

1. Study of a compound pendulum.
2. Study of damping of a bar pendulum under various mechanics.
3. Study of oscillations under a bifilar suspension.
4. Potential energy curves of a 1-Dimensional system and oscillations in it forvarious amplitudes.
5. Study of oscillations of a mass under different combinations of springs.

Properties of Matter

1. Study of bending of a cantilever or a beam.
2. Study of torsion of a wire (static and dynamic methods) and determinationof wire.
3. Determination of Poission's ratio of rubber (in the form of a tube).
4. Study of K (spring constant) by dynamical and statical method.

Heat and Thermodynamics

1. Study of Brownian motion.
2. Study of adiabatic expansion of a gas.
3. Study of conversion of mechanical energy into heat.
4. Heating efficiency of electrical kettle with varying voltages.
5. To determine the mechanical equivalent of heat (J) with help of ammeter and voltmeter by to Joule's calorimeter (electrical method).

Thermodynamics

1. Study of temperature dependence of total radiation (Stefan's Law).
2. Study of temperature dependence of spectral density of radiation (Planci'sLaw).
3. Resistance thermometry.
4. Thermo-emf thermometry
5. Conduction of heat through poor conductors of different geometries.
6. Study of bad conductor by Lee Disc method.
7. To determine mechanical equivalent of heat by Callender and Barne'smethod.

Circuit fundamentals

1. Charging and discharging in R.C. and R.C.L. circuits.
2. High resistance by leakage.
3. A.C. Bridges.
4. Half wave and full wave rectifiers.
5. Characteristics of a transistor in CE, CB and CC configurations
6. Frequency response of R.C. coupled amplifier.
7. P.N. Junction and Zener diode characteristics.
8. LED characteristics.

Waves

1. To study the wave form of an electrically maintained tuning fork (or alternating current source) with the help of cathode ray oscilloscope and to determine the unknown frequency by the analysis of Lissajous figures.
2. Speed of waves on a stretched string.
3. Study of interference with two coherent sources of sound.
4. Studies on torsional waves in a lumped system (frequency of AC mains – Sonometer).

Text and reference books

1. D.P. Khandelwal, "A laboratory manual for undergraduate classes" (VaniPublishing House, New Delhi).
2. S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).
3. Worsop and Flint- Advanced Practical physics for students.

INSTRUCTIONS FOR PRACTICAL MARKS -
TWO PRACTICALS (30 MARKS) + VIVA (10 MARKS) + RECORD (10 MARKS)

Course Outcomes: After completion of this experimental work students would be able to have practical knowledge of mechanics, oscillations, matter properties, Heat and Thermodynamics, waves, and electronic circuitries. They might be capable to find the moment of inertia of any rigid body. Students will be able to extract the oscillation period of different bodies. They would easily find the mechanical properties of matter. Students would be able to apply the thermodynamic processes and fundamentals of electronics in practical life. They would also be capable to define wave properties.

B.Sc. (PHYSICS)

SECOND YEAR DETAILED SYALLBUSPAPER – 201

PHYSICAL OPTICS AND LASERS

UNIT-I

Interference of a light: The principle of superposition of waves, two-slit interference, coherence requirement for the sources, Bi-Prism, Lloyd's Mirror optical path retardations, lateral shift of fringes, Rayleigh refractometer and other applications. Localised fringes; thin films, applications for precision measurements for displacements.

Haidinger fringes: Fringes of equal inclination, Michelson interferometer and its application for precision determination of wavelength, wavelength difference and the width of spectral lines. Intensity distribution in multiple beam interference, Tolansky fringes, Fabry-Perrot interferometer and etalon grating. Twymann Green interferometer and its uses.

UNIT -II

Fresnel diffraction: Fresnel half-period zones, zone plates, straight edge, rectilinear propagation of lights.

Fraunhoffer diffraction: Diffraction at a slit, half-period zones, phasor diagram andintegral calculus methods, the intensity distribution, diffraction at a circular aperture and a circular disc, resolution of images, Rayleigh criterion, resolving power of telescope and microscopes systems.

Diffraction gratings: Diffraction at N parallel slits, intensity distribution, plane diffraction grating, reflection grating and blazed gratings. Concave grating and different mountings. Resolving power of a grating and comparison with resolving powers of prism and of a Fabry-Perot etalon.

UNIT - III

Polarization, Double refraction in uniaxial crystals, Nicol prism, polaroids and retardation plates. Analysis of polarised light. Optical activity and Fresnel's explanation, Half shade and Biquartz polar meters. Matrix representation of plane polarized waves, matrices for polarizers, retardation plates and rotators.

UNIT-IV

Laser system: Purity of a spectral line, coherence length and coherence time, spatial coherence of a source, Einstein's A and B coefficients, spontaneous and induced emissions, conditions for laser action, population inversion.

Application of Lasers: Pulsed lasers and tunable lasers, spatial coherence anddirectionality, estimates of beam intensity; temporal coherence and spectral energy density.

Holograpghy: Basic Principle of Holography, Construction and reconstruction of image on hologram and applications of holography.

Text and Reference Books

1. A K Ghatak, “Physical Optics” (Tata McGrew Hill).

2. D P Khandelwal; “Optics and Atomic Physics” (Himalaya, Publishing House, Bombay, 1988).
3. F Smith and JH Thomson; “Manchester Physics Series: Optics” (EnglishLanguage Book Society and John Wiley, 1977).
4. Born and Wolf; “Optics”

5. KD Moltey; “Optics” (Oxford University Press).

6. Sears; “Optics”.

7. Jonkins and White; “Fundamental of Optics” (McGraw-Hill).

8. Smith and Thomson; “Optics” (John Wiley and Sons).

9. B.K; Mathur; “Optics”.

10. P.K. Srivastava; “Optics” (CBS).

11. B.B. Laud; “Lasers” (New Age).

Course Outcomes: After completion of this course students would be able to differentiate the interference, diffraction, and polarization phenomena. They will feel well-equipped to understand the problems based on light-matter interaction phenomena. They would be at a stage where they could handle interferometers, diffractometers, and polar meters. Students will be able to have a great knowledge of lasers and their applications. They will be able to know the concept of holography.

B.Sc. (PHYSICS)

SECOND YEAR DETAILED SYALLBUSPAPER – 202

ELECTROMAGNETICS

UNIT-I

Electrostatics

Coulomb's law, Electric Field and potentials, Field due to a charged sphere, ring, disc, spherical shell and Derivations of Poisson and Laplace Equations, Gauss Law and its application: The field of a conductor. Electric dipole, Field and potential dueto an electric dipole, Dipole approximation for an arbitrary charge distribution, Electric quadrupole, Field due to a quadrupole, Electrostatic Energy of a uniformly charged sphere, Energy of a condenser, methods of electrical images.

Magnetostatics

Magnetic field, Magnetic Induction and Biot- Savarts Law, Magnetic field due to circular coil, Helmholyz coil and solenoid Lorentz Force, Vector and scalar magneticpotentials, Magnetic Dipole, Magnetomotive force Ampere's circuital theorem andits applications to calculate magnetic field due to wire carrying current and solenoid.

UNIT-Il

Electromagnetic Induction

Faraday's laws of EMT induction and Lenz's Law. Mutual and Self Induction, pecipricity theorem Vector potential in varying Magnetic field, Induction of current in continuous media, Skin effect, Motion of electron in changing magnetic field, Magnetic energy in field, Induced magnetic field (Time varying electric field), Displacement current, Maxwell's equations, Theory and working of moving coil, ballistic galvanometer.

UNIT-III

Dielectrics

Dielectric constant, polarization, Electronic polarization, Atomic or ionic Polarization, Polarization charges, Electrostatic equation with dielectrics, Field, force and energy in Dielectrics.

Magnetic Properties of Matter

Intensity of magnetization and magnetic susceptibility, Properties of dia, Para and ferromagnetic materials, Curie temperature, Hysteresis and its experimental determination.

UNIT -IV

Electromagnetic Waves

The wave equation satisfied by E and B, plane electromagnetic waves in vacuum, Poynting's vector, reflection at a plane boundary of dielectrics, polarization by reflection and total internal reflection, Faraday effect; waves in a conducting medium, reflection and refraction by the ionosphere.

Text and Reference Books

1. Berkeley Physics Course; Electricity and Magnetism, Ed. E.M. Purcell (Mc GrawHill). Halliday and Resnik; “Physics”, Vol 2.
2. D J Griffith; “Introduction to Electrodynamics” (Prentice-Hall of India). Reitzand Milford; “Electricity and Magnetism (Addison-Wesley).
3. A S Mahajan and A A Rangwala; “Electricity and Magnetism” (Tata McGraw-Hill). A M Portis; “Electromagnetic Fields”.
4. Pugh and Pugh; “Principles of Electricity and Magnetism” (Addison-Welsley).
5. Panofsky and Phillips; “Classical Electricity and Magnetism” (India BookHouse). S S Atwood; “Electricity and Magnetism” (Dover).
6. J.D. Jackson’s.

Course Outcomes: At the end of this course students would be able to have deep knowledge of electrostatics and magnetostatics. They would also be able to explain the electrostatics and magnetostatics phenomena. Students would also have deep knowledge of Electromagnetic Induction, Magnetic Properties of Matter, and their features and they would be benefitted from the knowledge of the phenomena due to the interaction of the electromagnetic wave with different media.

B.Sc. (PHYSICS)

SECOND YEAR DETAILED SYALLBUSPAPER – 203

ELEMENTS OF QUANTUM MECHANICS, ATOMIC ANDMOLECULAR SPECTRA

UNIT-I

Matter Waves

Inadequacies of classical mechanics, Photoelectric effect, Compton Effect, wave particle duality, de- Broglie matter waves and their experimental verification, Heisenberg's Uncertainty principle, Complementary principle, Principle of superposition of waves, Motion of wave packets.

UNIT -II

Schrodinger Equation and its Applications

Schrodinger wave equation, Interpretation of wave function, Expectation values of dynamical variables, Ehrenfest theorem, Orthonormal properties of wave functions, One dimensional motion in potential step, Rectangular potential barrier,Square potential well, Particle in a box, normalization, Simple harmonic oscillator.

UNIT - III

Atomic spectra

Spectra of hydrogen and alkali atoms, spectral terms, doublet fine structure, screening constants for alkali spectra for s, p. d, and f states, selection rules. Singlet and triplet fine structure in alkaline earth spectra, L-S and J-J couplings. Continuous X-ray spectrum and its dependence on voltage, Duane and Haunt'slaw. Characteristics X-rays, Moseley's law, doublet structure and screening parameters in X-ray spectra, X-ray absorption spectra.

UNIT -IV

Molecular spectra

Discrete set of electronic energies of molecules, quantisation of vibrational and rotational energies, determination of internuclear distance, pure rotation and rotation- vibration spectra, Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra.

Text and Reference Books

1. H S Mani and G K Mehta; "Introduction to Modern Physics" (Affiliated East-West Press 1989). A Beiser, "Perspectives of Modern Physics".

2. H E White; "Introduction to Atomic Physics".

3. G.M. Barrow; "Introduction to Molecular Physics".

4. R P Feymann, R B Leighton and M Sands; “The Feyrnann Lectures on Physics,Vol. III (B I Publications. Bombay. Delhi, Calcutta, Madras).
5. T A Littlefield and N Thorley; “Atomic and Nuclear Physics” (Engineering Language Book Society).
6. Eisenberg and Resnik; “Quantum Physics of Atoms, ‘Molecules, Solids,Nuclei and Particles” (John Wiley).
7. D P Khandelwal: “Optics and Atomic Physics”, (Himalaya Publishing House, Bombay, 1988).

Course Outcomes: After completion of this course students would be able to differentiate the Classical and Quantum Mechanics. They will feel well-equipped to understand the physics of the microscopic world. They would be at a stage where they could apply different operators on a quantum mechanical system to find out the energy, momentum and angular momentum, etc. Students will be able to have a great knowledge of the Schrodinger Equation and its Applications in different quantum mechanical problems like Rectangular potential barriers, Square potential well, Particle in a box, normalization, and Simple harmonic oscillators. After passing this course most of the students would be benefitted from the knowledge of atomic, and molecular spectra. They will apply the transition rules to the acquired spectra. They would be able to have a keen observation of the Raman scattering and X-ray characteristics and their applications.

B.Sc. (PHYSICS)
SECOND YEAR DETAILED SYALLBUS PAPER – 204 PRACTICALS

Institution may add any experiment of the same standard in the following subject.

Physical optics

1. Study of interference of light (biprism).
2. Study off-P etalon fringes.
3. Study of diffraction at a straight edge or a single slit.
4. Use of diffraction grating and its resolving limit.
5. Resolving limit of a telescope system.
6. Polarization of light by the reflection.
7. Study of optical rotation for any system.
8. To determine the refractive index of liquid by the Newton's ring method.
9. Thickness of a wire by wedge shape air film.
10. To study the polarization of light by reflection and to verify the Brewster'sand Malu's laws.

Electrostatics

1. Characteristics of a ballistic galvanometer.
2. Setting up and using an electroscope or electrometer.

Moving charges and magnetostatics

1. Use of a vibration magnetometer to study a field.
2. Study of field due to a current.
3. Measurement of low resistance by Carey-Foster bridge or otherwise.
4. Measurement of inductance using impedance at different frequencies.
5. Measurement of capacitance using impedance at different frequencies.
6. Study of decay of currents in LR and RC circuits.
7. Electromagnetic damping.
8. ECE of copper by tangent galvanometer.
9. Response curve for LCR circuit and resonance frequency and quality factor.

Varying fields and electromagnetic theory

1. Sensitivity of a cathode-ray oscilloscope.
2. Characteristic of a choke.
3. Measurement of inductance.
4. Study of Lorentz force.
5. Study of discrete and continuous LC transmission lines.

Atomic Physics

1. Study of spectra of hydrogen and deuterium (Rydberg constant and ratio of

masses of electron to proton).
2. Absorption spectrum of iodine vapour.
3. Study of alkali or alkaline earth spectra using a concave grating.
4. Study of Zeeman Effect for determination of Lande g-factor.
5. Molecular Physics
6. Analysis of a given band spectrum.

Lasers

1. Study of laser as a monochromatic coherent source
2. Study of divergence of a laser beam

Text and Reference Books

1. D.P. Khandelwal, "A Laboratory Manual for Undergraduate Classes (Vani Publishing House, New Delhi).
2. S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).
3. Worsnop and Flint- Advanced Practical physics for students.

INSTRUCTIONS FOR PRACTICAL MARKS -

TWO PRACTICALS (30 MARKS) + VIVA (10 MARKS) + RECORD (10 MARKS)

Course Outcomes: After completion of this experimental work students would be able to learn practical knowledge of physical optics and laser, electrostatics and magnetism, and atomic and molecular physics. They might be capable to apply Varying fields and electromagnetic theory in different instrumental working. Students will be able to verify different atomic and molecular phenomena in the physical world.

B.Sc. (PHYSICS)
THIRD YEAR DETAILED SYALLBUSPAPER – 301
RELATIVITY AND STATISTICAL PHYSICS

UNIT-I

Relativity

Reference systems, inertial and non-inertial frames, Galilean invariance and conservation laws, Michelson-Morley experiment; search for ether.

Postulates for the special theory of relativity, Lorentz transformations, length contraction, time dilation, velocity addition theorem, variation of mass with velocity, mass-energy equivalence ($E=mc^2$), particle with a zero rest mass.

UNIT -II

Statistical physics

The statistical basis of thermodynamics: Probability and thermodynamic probability, principle of equal a prior probability, probability distribution and its narrowing with increase in number of particles. The expressions for average properties. Constraints; accessible and inaccessible states, distribution of particles with a given total energy into a discrete set of energy states.

UNIT - III

Some universal laws: The space representation, division of space into energy cells and into phase cells of arbitrary size, applications to one-dimensional harmonic oscillator and free particles. Equilibrium before two systems in thermal contact. Probability and entropy, Boltzmann entropy relation. Statistical interpretation of second law of thermodynamics. Boltzmann canonical distribution law and its applications; rigorous form of equipartition of energy.

UNIT -IV

Maxwellian distribution of speeds in an ideal gas: Distribution of speeds and velocities, experimental verification, distinction between mean, r.m.s. and most probable speeds and their values. Doppler broadening of spectral lines.

Transition to quantum statistics: ‘h’ (Plank’s constant) as a natural constant and’ its implications, cases of particle in a one-dimensional box and one-dimensional harmonic oscillator, Indistinguishability of particles and its consequences, Bose- Einstein, and Fermi-Dirac distributions, photons in black body chamber, free electrons in a metal, Fermi level and Fermi energy.

Text and Reference Books

1. Beiser, “Concepts of Modern Physics” (McGraw-Hill).

2. B B Laud, “Introduction to Statistical Mechanics” (Macmillan 1981).

3. F Reif, “Statistical Physics” (McGraw-Hill 1988).

4. K Haung, “Statistical Physics” (Wiley Eastern, 1988).

Course Outcomes: After completion of this course, Students will acquire knowledge of Relativity and Statistical Physics. They would be able to explain Postulates for the special theory of relativity and their applications. They would be earned knowledge of the statistical basis of thermodynamics and universal laws of Thermodynamics. Students will be able to understand the working of TV and antenna systems. They would be updated with the use of probability distribution functions in a different thermodynamic system. Students will have the potential to write the Maxwell-Boltzman, Fermi-Dirac, and Bose-Einstein Statistics for any system of particles. They would be able to extract the specific heat of the solids using the Einstein and Debye theories.

B.Sc. (PHYSICS)

THIRD YEAR DETAILED SYALLBUSPAPER – 302

SOLID STATE AND NUCLEAR PHYSICS

UNIT-I

Crystal Structure

Lattice translation vectors and lattice, Symmetry operations, Basis and Crystal structure, Primitive Lattice cell, Two-dimensional lattice type, Number of lattices, Point groups and plane groups, three dimensional lattice type, Number of Lattices, Points groups and space groups. Index system for crystal planes Miller indices, Simple crystal structures, NaCI, hcp, diamond, Cubic ZnS; and hexagonal, Occurrence of Non-ideal crystal structures, random stacking of poly-prism, glasses.

Crystal Diffraction and Reciprocal Lattice

Bragg law, Experimental diffraction method, Laue method, rotating crystal method, Powder method, Derivation of scattered ‘wave amplitude, Fourier analysis, Reciprocal lattice vectors, Diffraction conditions, Ewald method, Brillion zones, Reciprocal lattice to sc, bcc and face lattices, Fourier analysis of the basis and atomic form factor.

UNIT -II

Crystal Bindings

Crystal of inert gases, Van der Walls-London interaction, repulsive interaction, Equilibrium lattice constants, cohesive energy, compressibility and bulk modulus, ionic crystal, Madelung energy, evaluation of Madelung constant, Covalent crystals, Hydrogen-bonded crystals, Atomic radii.

Lattice Vibrations Lattice heat capacity, Einstein model, Vibrations of monatomic lattice, derivationof dispersion relation, First brillouin zone, group velocity, continuum limit, Force constants, Lattice with two atoms per primitive cell, derivation of dispersion relation, Acoustic and optical modes, Phonon momentum. Free electron theory, Fermi energy, density of states, Heat capacity of electron gas, Paramagnetic susceptibility of conduction electrons, Hall effect in metals. Origin of band theory, Qualitative idea of Bloch theorem, Kronig-Penney model, Number of orbitals in a band, conductor, Semi-conductor and insulators, Effective mass, Concept of holes.

UNIT - III

Nuclear Physics

General Properties of Nucleus: Brief survey of general Properties of the Nucleus, Mass defect and bindingenergy, charges, size, spin and magnetic moment.

Nuclear Forces: Saturation phenomena and Exchange forces, Deutron ground state properties.

Nuclear Models: Liquid drop model and Bethe Weiszacker mass formula, Single particle shell model (only the level scheme in the context of reproduction of magic numbers).

Natural Radioactivity: Fundamental laws of radioactivity, Soddy-Fajan’s displacement law and law of radioactive disintegration, Basic ideas about α, and β decay.

UNIT-IV

Nuclear Reactions: Nuclear reactions and their conservation laws, Cross section of nuclear reactions, Theory of fission (Qualitative), Nuclear reactors and Nuclear fusion.

Accelerators and detectors: Vande Graff, Cyclotron and Synchrotron, Interaction of charged particlesand gamma rays with matter (qualitative), GM counter, solid state detector, Scintillation counter and neutron detectors.

Elementary Particles: Basic classification based on rest mass, Spin and half life, particle interactions (gravitational, Electromagnetic, week and strong Interactions). Elementary idea about querks.

Text and Reference Books

1. Puri and Babbar, “Solid State Physics” (S. Chand).

2. C. Kittel, “Introduction to Solid State Physics”- Vth Edition (John Wiley & Sons). H.S. Mani and G.K. Mehta, “Introduction to Modern Physics” (Affiliated East-West Press—1989).

3. Beiser, “Perspectives of Modern Physics”.

4. T.A. Littlefield and N. Thoreley, “Atomic and Nuclear Physics” (Engineering

5. Language Book Society). Eisenberg and Resnik, “Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and Particles” (John Wiley).

6. Ghoshal S.N.- Nuclear Physics - S. Chand & Co.

7. Ascroft and Mermin, Solid State Physics.

8. Nuclear Physics by D.C. Tayal.

9. Nuclear Physics by B.N. Shrivastava.

10. Nuclear Physics by Kaplar.

Course Outcomes: At the end of the course most of the students would be benefitted from the theory of Solid State and Nuclear Physics. They would be able to explain crystal structures with their lattice parameters. Students would be able to confirm the Crystal diffraction study of crystal. They would be able to explain how Lattice Vibrates. They would be able to understand the different models for explaining the lattice vibrations of the crystal. Students will be able to solve problems based on nuclear models like a liquid drop model. Students will also be able to differentiate different nuclear decay processes like alpha, beta, and gamma decay. They will have learned the basic concepts, mechanisms, and applications of different particle detectors and accelerators. Students will also be able to identify the different fundamental particles based on their characteristics.

B.Sc. (PHYSICS)

THIRD YEAR DETAILED SYALLBUSPAPER – 303

SOLID STATE ELECTRONICS

UNIT-I

Diffusion of minority carriers in semiconductor, work function in metals and semiconductors Junctions between metal and semiconductors, P.N. Junction diode, Depletion layer, Junction Potential Width of depletion layer, Field and Capacitance of depletion layer, Forward A.C. and D.C. resistance of junction, Reverse Breakdown.

Zener and Avalanche diodes, Tunnel diodes, Point contact diode, their importance at High frequencies, LED photodiodes, Effect of temperature on Junction diode Thermistors.

UNIT -II

Transistor parameters, base width modulation, transit time and life-time of minority carriers, Base- Emitter resistance, Collector conductance, Base spreading resistance, Diffusion capacitance, Reverse feedback ratio, Equivalent circuit for transistors, Basic model, hybrid model and Y parameter equivalent circuit, Input and output impedances.

UNIT III

Current and Voltage gain, Biasing formula for transistors, Base bias, emitter bias and mixed type bias mixed type biasing for small and large signal operation. Transistor circuit application at low frequencies, their AC and DC equivalent for three different modes of operation, Large signal operation of transistors,Transistor Power amplifiers, Class A and B operation, Maximum power output Effect of temperature, heat sinks, thermal resistance Distorsion in amplifiers, cascading of stages, Frequency response, Negative and positive feedback in transistor amplifiers.

UNIT -IV

Field effect transistors and their characteristics, biasing of FET, use in preamplifiers, MOSFET and their simple uses.

Power Supplies:

Electronically regulated low and high voltage power supplies, Inverters for batteryoperated equipments.

Miscellaneous:

Basic linear integrated circuits, phototransistors, Silicon Controlled rectifiers,Unijunction transistor and their simple uses.

Text and Reference Books

1. B G Streetman; “Solid State Electronic Devices”, UK Edition (Prentice-Hall ofIndia. New Delhi, 1986).

2. W D Stanley; “Electronic Devices, Circuits and Applications” (Prentice-Hall,New Jersey, USA. 1988).

3. J D Ryder; “Electronics Fundamentals and Applications” 2nd Edition(Prentice-Hall of India. New Delhi, 1986).

4. I Miliman and A Grabel; “Microelectronics”, International. Edition (McGraw-Hill Book Company, New York, 1988).

Course Outcomes: On the completion of this course the students will have a good knowledge of semiconductors, diode, transistors, and their applications. They would be learned about the different electronic circuitries like amplifiers. Students will also be able to design digital electronic circuitries using logic gates. They will have learned about the application of diode in power supply and Controlled rectifiers.

B.Sc. (PHYSICS)

THIRD YEAR DETAILED SYALLBUSPAPER – 304 PRACTICAL

Institution may add any experiment of the same standard in the following subject.

Statistical Physics

1. Data from n-option systems of several relative weightages to be examinedand interpreted.
2. Plotting F-D distribution in the neighbourhood of Fermi energy for different temperature values.
3. Solar wind as a thermal expansion of solar corona at one million Kelvin.
4. Study of dilute gas for experimental verification of Maxwell-Boltzmanstatistics.
5. Number of microscopic states of perfect gas (Gibbs-paradox).

Solid State Physics

1. Goniometric study of crystal faces.
2. Determination of dielectric constant.
3. Hysteresis curve of transformer core.
4. Hall-probe method for measurement of magnetic field

Solid State Devices

1. Specific resistance and energy gap of a semiconductor
2. Characteristics of a transistor
3. Characteristics of a tunnel diode

Electronics

1. Study of voltage regulation system
2. Study of, a regulated power supply
3. Study of Lissajuous figures using a CR0
4. Study of VTVM

5. Study of RC and TC coupled amplifiers
6. Study of AF and RF oscillators

Nuclear Physics

1. Study of absorption of alpha and beta rays.
2. Study of statistics in radioactive measurement.

Text and Reference Books

1. B.G. Strechman, "Solid State Electronic Devices". II Edition (Prentice-Hall ofIndia, New Delhi, 1986).
2. W.D. Stanley, "Electronic Devices, Circuits and Applications" (Prentice-Hall,New Jersey, USA, 1988).
3. D.P. Khandelwal, "A Laboratory Manual for Undergraduate Classes (Vani Publishiing House, New Delhi). S.P. Singh, "Advanced Practical Physics" (Pragati Prakashan, Meerut).

INSTRUCTIONS FOR PRACTICAL MARKS -

TWO PRACTICALS (30 MARKS) + VIVA (10 MARKS) + RECORD (10 MARKS)

Course Outcomes: Over the study of this course, students will have effective knowledge to handle the instrumental setup of solid state and electronic. They would be able to explain how diodes and transistors take place in solid-state devices. They would be earned knowledge of the working principles of CRO, Oscillators, and Coupled amplifiers. Students will be able to understand the alpha and beta particles absorption by different materials. They would be updated with the static in radioactive measurements.