MAHATMA GANDHI KASHI VIDYAPITH

VARANASI

BACHELOR OF SCIENCE

IN PHYSICS

Syllabus
(B.Sc. Part I, II and III)
(With Effect from Session 2009-10)

Department of Physics

Faculty of Science and Technology

M.G. Kashi Vidyapith Varanasi-221002

Scheme of Examination

B.Sc.I

S.No.	Name of Paper	Maximum Marks
1.	**Mechanics**	**50**
2.	**Waves and Oscillations**	**50**
3.	**Electricity and Semiconductor Electronics**	**50**
4.	**Practical Examination**	**50**

B.Sc.II

S.No.	Name of Paper	Maximum Marks
1.	**Thermal Physics**	**50**
2.	**Optics**	**50**
3.	**Atomic Physics**	**50**
4.	**Practical Examination**	**50**

B.Sc.III

S.No.	Name of Paper	Maximum Marks
1.	**Quantum Mechanics**	**50**
2.	**Statistical Mechanics and Solid State Physics**	**50**
3.	**Basic Digital Electronics and Photon Devices**	**50**
4.	**Electromagnetic theory, Laser, Holography**	**50**
5.	**Practical Examination**	**100**

Physics
B.Sc. I
Paper I: Mechanics

M.M. 50

Unit I: Vector

Reciprocal system of vectors, vector differentiation: Gradient, divergence and curl; Gauss, Stoke's and Green's Theorems and their applications ,Vector identities.

Unit II: Moment of Inertia

Physical significance, radius of gyration, Theorems of parallel and perpendicular axes; Moment of inertia of rod, ring, disc, rectangular and cylindrical rods, hollow and solid cylinder and sphere, spherical shell, compound pendulum.

Unit III : Motion under a Central Force

Two particle problem, reduced mass, lab and Centre of mass coordinate systems, motion in an inverse square field, Kepler's Laws, Motion of Satellite, Geostationary Satellite.

Mechanics of non rigid Bodies

Strain and stress in an isotropic homogeneous medium, elastic moduli and relation between them, Torsion of cylinders, bending of Beams, Internal energy of strained body.

Unit IV

Fluid Mechanics

Ideal fluid, Equation of continuity, Streamline flow, Rotational and irrotational flows, Euler's equation of motion. Viscous fluids, Poiseulle's equation of flows, Viscosity by cylinder method. Stoke's law, Variation of viscosity with temperature.

Special Theory of Relativity

Inference of Michelson Morley Experiment , Postulates of special relativity, Lorentz transformations, Length contraction, Time dilation, Simultaneity in relativity theory.

Paper II

Waves and Oscillations

M.M. 50

Unit I

Simple Harmonic Motion of Mechanical and Electrical Systems. Lissajous figures. Energy in SHM. Damped Harmonic motion in Mechanical and Electrical systems.

Oscillations of system with two or more degrees of Freedom.

Unit II

Normal Modes; vibration of string and rectangular membrane. Forced oscillation of mechanical and electrical systems. Resonance, sharpness of resonance. Mechanical and electrical Impedances, Elementary theory of filters.

Unit III

Fourier analysis: Analysis of square wave saw tooth wave and rectified sinusoidal wave.

Electromagnetic wave, Maxwell's Equation; Poynting vector, E.M. waves and its propagation in free space.

Unit IV

Ultrasonic: Production of Ultrasonic waves and its applications.

Acoustics of Building: Acoustic condition for a good hall, reverberation time and Sabine formula.

Waves: Stationary waves. Phenomenon of beats and modulation, wave velocity and group velocity in absorptive and dispersive media.

Paper III

Electricity and Semiconductor Electronics

M.M. 50

Unit I

Electronics: Electric field due to a dipole, polar and nonpolar dielectric materials. Polarization and Displacement. Vector, Electric field in Dielectric (Lorentz field), electronic, atomic, ionic and Orietational polarization, Relation between dielectric constant and polarizability.

AC Bridges: Balance and sensitivity conditions for AC Bridges, Andersons, Wien's and Robinson's Bridges.

Unit II

Electrical Circuits: Circuit parameters, Kirchhoff's law for a loop and junction, T and π network, Network's theorem. Norton's Theorem, Thevenin's Theorem , Maximun power transfer Theorem.

Magnetism: Variation of magnetic field on the axis of a circular loop current, Helmholtz Galvanometer; Field on the axis of solenoid and Toroid.

Unit III

Power supply: Rectifier Filtering by RC and LC circuit, Regulation: Voltage regulation using zener diode.

Basic Semiconductor Electronics: Conduction in solid: Conductor, insulator, Semiconductor, intrinsic and extrinsic semiconductor, conductivity and mobility.

Unit IV

PN Junction: Diode Characteristics, Depletion region, break down voltage, forward and reverse biasing. Characteristics of Zener Diode.

Transistor: NPN and PNP transistor action. Its configuration, Hybrid parameter and equivalent circuit, RC coupled Amplifier.

Oscillator: Principles of feedback, Barkhausen criteria for sustained oscillation, Circuit of Hartley and Colpitt's Oscillator.

B.Sc. II

Paper I

Thermal Physics

M.M. 50

Unit I

Thermodynamics

Thermodynamics systems, Macroscopic and Microscopic variables, Thermodynamic Equilibrium, Thermo dynamical state, Zeroth law of thermodynamics and concept of Temperature, First Law of Thermodynamics.

Unit II

Carnot cycle, Carnot Engine and Refrigeration, Reversible and irreversible processes, Carnot's Theorem. Thermodynamical scale of temperature, entropy, calculation of entropy in various processes, Entropy and unavailable energy, Physical significance of entropy, Second law of thermodynamics.

Conditions of natural changes, Thermodynamics potentials and Maxwell's equations, Application of Maxwell's equations, Clausius-Clapeyron's equation, specific heat of saturated vapour, Triple Point , Clausius theorem, Clausius inequality, Joule Thomson effect, Inversion Temperature.

Unit III

Kinetic Theory of Gases: Maxwell-Boltzmann Law of distribution of molecular velocities, Evaluation of R.M.S., average and most probable speeds, Mean free path, Transport phenomenon(Viscosity, thermal conductivity and diffusion).

Conduction of Heat: Fourier equation for one-dimensional flow of heat and its steady-state solution, Periodic flow of heat (only sinusoidal heat current).

Unit IV

Radiation-Radiation as electromagnetic waves, Emissive and absorptive powers, Radiation in a hollow enclosure, Black-body radiation, Kirchhoff's Law, Intensity and energy density, Pressure and energy density, Stefan-Boltzmann law, solar constant and temperature of sun, temperature of non-black bodies, Distribution of energy in the spectrum of black body radiation, Adiabatic expansion of black body radiation, Wien's displacement law, Wein's formula, Rayleigh-Jean's law, Planck's law.

Paper II

Optics

M.M. 50

Unit I

Cardinal Points of coaxial optical systems. Simple problems on combination of thin lenses, Eyepieces, Atlantic points. Chromatic aberration.

Unit II

Conditions for observing interference, Degree of coherence and disability of fringes, Production of interference fringes and determination of wave length, Michelson interferometer and its uses, Colour of thin films, Newton's Rings. Theory of multiple refelections, FP Etalon. Temporal and Spatial Coherence. Stimulated emission, Basic idea of laser emission. Ruby and He-Ne Lasers as examples.

Unit III

Fresnel's theory of diffraction, Half-period elements. Diffraction from circular obstacle and aperture (Elementary theory), Zone Plate, Cornu's Spiral, Fresnel diffraction by straight edge and single slit.

Fraunhofer's diffraction by single slit and double slit, Theory of plane grating, Width of principal maxima. Rayleigh's criterion of resolution, resolving power of prism, grating and FP etalon, Limit of resolution for telescope and grating, concave grating (elementary theory), and its mountings.

Unit IV

Unpolarised, polarized and partially polarized lights. Polarization by reflection and refraction Double refraction by uni-axial crystals, Polaroids, Huygen's theory of double refraction. Half and quarter wave plates. Production of elliptically and circularly polarized light.

Babinet compensator, Analysis of elliptically polarized light by using a Nicol and quarter wave plate, Optical activity. Fresnel's theory of optical rotation, Specific rotation, Biquartz and Laurent's half-shade polarimeters.

Paper III

Atomic Physics

M.M. 50

Unit I

Bohr-Summerfield Model (Historical development). Bohr model and the spectra of hydrogen atoms, Critical resonance and the Ionization potentials. Frank-Hertz experiment. Characteristics and continuous X-rays, Moseley's law, Bragg's law.

Space quantization, vector atom model and quantum Numbers, Magnetic moment of electrons , Larmor Precession, Electron Spin, Stem-Gerlack experiment, Pauli's exclusion principles and electron configuration of atoms, Zeeman effect, Raman effect.

Unit II

Quantum Concepts

Particle nature of radiation, Photoelectric effect and Compton Effect. Wave nature of particles.

de-Brogli Waves, Davisson-Gerner experiment, Wave Packets, Phase velocity and group velocity, Heisenberg's Uncertainty Principle and its applications, one dimensional Schrodinger's Wave Equation and concept of probabilistic amplitude.

Unit III

Nuclear Physics

Natural radioactivity, laws of radioactivity, radioactive disintegration, radioactive series, detection of radiation, GM Counter and Bubble Chamber, Scintillation Counter.

Kinematics of nuclear reactions, artificial nuclear transmutation, discovery of neutron, radioactive tracers, transuranic elements.

Cyclotron-Constitution of nucleus, binding energy, liquid drop model and the semi empirical mass formula, elementary theory of α - decay, β-decay and discovery of neutrino , magic numbers and the shell model.

Unit IV

Classification of Elementary particles, Leptons, mesons and baryons and their quantum numbers, Conservation laws.

Relativity-Relativistic addition of velocities; variation of mass with velocity, Mass energy relation.

Physics

B.Sc. (III)

Paper-I: Quantum Mechanics

Unit I

Need of Quantum Mechanics, Schrodinger Equation and interpretation of wave function. Applications of Schrodinger Equations.

Unit II

Observable and Operators, Hermitian operator, Parity operator, Commutation relations, Eigen values and eigen functions, orthonormality and completeness, Dirac Delta function. Non-commutability, uncertainty, Expectation values, Ehrenfest's Theorem.

Unit III

Separation of variables in Time-Dependent Schrodinger Equation. Density of states, One-dimensional Potential Barrier problems. Tunneling through square well potential. One-dimensional Haromonic Oscillator, Hermite Polynomials, Zero-point energy. Correspondence with classical theory.

Unit IV

Angular Momentum, Commutation Relations, Eigen Values and Eigen functions of ladder operators, spherically symmetric potential, complete solution of the Hydrogen atom problem, Hydrogen spectrum.

Elementary concept of spin, Pauli Matrices and spin wave functions, Total angular momentum.

Time-independent, non-degenerate, first-order Perturbation Theory, Spin-Orbit coupling. Identical Particles. Symmetric and Antisymmetric wave functions, Pauli's Exclusion Principle.

Paper-II: Statistical Mechanics and Solid State Physics

Statistical Mechanics:

Unit I

Microscopic and Macroscopic systems, Phase space representation, Division of phase space into cells, Liouville theorem and its consequences, Statistical ensembles, Equilibrium and fluctuations, Distribution probability, Equilibrium between two macroscopic systems in thermal diffusive and mechanical contacts, Postulates of quantum statistical mechanics, Entropy and probability, entropy of perfect gas using the concept of micro canonical ensemble.

Unit II

Distribution function for two types of quantum statistics (Bose-Einstein and Fermi-Dirac): Simple applications (Black-body radiations).

Unit III

Solid State Physics

Crystalline, amorphous and glassy state of solids. Lattice translation vector, Crystal lattices, Primitive lattice cell, Miller indices, interplanar spacing, Bravais lattices, Crystal structure of s.c., b.c.c, f.c.c., diamond and h.c.p. Reciprocal lattices: s.c., b.c.c., and f.c.c. lattices, Brillouin Diffraction conditions in reciprocal lattice, Bragg's Law.

Unit IV

Free electron theory: Free electron gas in one dimension, Energy levels and density of states, Fermi Energy, Electrical conductivity, Hall Effect.

Band theory of solids: Energy Bands, Kronig-Penny model in one dimension, Energy gap, Number of states in a branch, Distinction between metal, semi-conductor and insulator. Intrinsic semi-conductors, Variation of Fermi level with temperature. Effective mass.

Paper III: Basic Digital Electronics and Photon Devices

Unit –I

Review of characteristics of a semi-conductor diode: cutin voltage, explanation of storage and transition capacitances.

BJ transistor as a switch, Analytic expression using Ebers-Moll mode, saturation properties for normal, inverse and emitter follower modes and their comparisons. Switching speed of a diode, storage and transition time, switching speed of a BJT. Metal-semi-conductor junction, Schottky diode and transistor.

Unit-II

Field effect transistor, principle of operation, a practical FET structure, MOSFET, enhancement and depletion modes, their representations, The MOS switch, Logic Circuits. AND, OR, NOT, NAND and EX-OR operation, Truth tables, their representations, Venn diagrams.

Unit-III

Binary notation, Boolean algebra, Karnaugh mapping. The Resistance transistor logic, RTL ,nor gates, pull up resistors, fanout, I/O characteristics, noise margin, rise time, RTL Ex-OR gate.

Unit-IV

The diode transistor gate, fan out, I/O characteristics. The transistor-transistor logic, comparison between TTL and DTL. The active pull up, I/O characteristics.

Paper IV: Electromagnetic theory, Laser, Holography

Unit I

Electromagnetic Theory: Electrostatics potential due to a charge distribution, Multipoles and their interaction with an electrostatic field, Solution of Laplace Equation by separation of variables in Cartesian, Spherical and Polar Coordinates.

Poynting's Theorem, conservation of energy and momentum for a system of charged particles and electromagnetic field, Maxwell's stress tensor.

Unit II

Plane wave solution of Maxwell's equations in source free space and simple dielectrics, Polarization of electromagnetic waves, plane wave propagation in metal and plasma. Elementary theory of dispersion. Boundary condition at a discontinuity, Fresnel's forumula. Total internal reflection, Metallic reflection and skin depth.

Unit III

Laser and Holography: Stimulated and spontaneous emission, Einstein's coefficients, relative contribution of stimulated and spontaneous emission, population inversion, Laser emission, characteristics of Laser light (including temporal).

Unit IV

Amplification on an inverted medium, threshold condition for lasing. Basic principles of Holography, Recording and Viewing of a hologram.

List for Experiments for B.Sc. I and II

Mechanics

1. Compound Pendulum
2. Rectangular Lamina
3. Maxwell's Needle
4. n by Torsion Table
5. n by Statical Method
6. Y , n, o by Searle's Method
7. Y by bending of beam
8. Moment of Inertia of flywheel
9. Coefficient of Viscosity of water
10. Force per unit extension of Spiral Spring
11. Surface Tension of Water

Thermal Physics

12. Thermal Conductivity of rubber
13. Thermal Conductivity by Lee's Disk Method
14. Verification of Stefan's Law
15. Thermal Conductivity of Cu by Searle's Method
16. Thermocouple

Electricity and Electronics

17. Characteristics of (p-n) Junction Diode
18. Characteristics of Zener Diode
19. Calibration of Energy Meter
20. Characteristics of a Transistor(Common Base)
21. Characteristics of a Transistor(Common Emitter)
22. Current Sensitivity of a Moving Coil Galvanometer
23. Students Potentiometer
24. Post office Box
25. Common Power Supply
26. LCR Circuit
27. RC Time Constant
28. Reduction Factor Of Helmholtz Galvanometer
29. Carey Foster's Bridge
30. Use of CRO for Calibration of an Oscillator

Experiments using Ballistic Galvanometer

31. Self Inductance
32. Mutual Inductance
33. Capacity of a condenser
34. High Resistance by Leakage
35. Earth Inductor
36. Search Coil

AC Bridges

37. Schering Bridge
38. Maxwell's Bridge

Optics Experiments

39. Dispersive Power of the Material of a Prism by Spectrometer
40. Wavelength of Spectral Lines of Hg Source Using Grating
41. Newton's Rings
42. Fresnel's Biprism
43. Polarimeter
44. Brewster's Law
45. Single Slit
46. Nodal Slide
47. Sextant
48. Fresnel Diffraction at a Wire
49. Resolving Power Of a Telescope

Modern Physics

50. Ionization Potential

Waves And Oscillations

51. AC Frequency by Sonometer
52. AC frequency by Experiments of Electrical Vibrator

List for Experiment of B.Sc. III

Electronics

1. Band gap and Bias Stabilization.
2. DTL and TTL (switching and Fan Out).
3. RTL (switching and Fan Out).
4. FET characteristics and FET as an amplifier.
5. Common Emitter Amplifier.

6. Hysterisis loss by CRO.
7. Velocity of Sound using CRO.
8. Verification of Richard Dushman Equation.
9. Inter stage Audio Transformation.

Optics

10. Refractive index of material of Prism and of Water by spectrometer.
11. Babinet's Compensator.
12. Michelson of interferometer.
13. Diffraction of light .
14. Plane Refection Grating using laser.
15. Fraunhoffer diffraction at double slit using laser.
16. Refractive Index gradient using laser.
17. Calibration of constant deviation spectrometer.
18. Photocell and Plank Constant.
19. Cornu's Fringes and Elastic constants.
20. Young's Modulus by Newton's Ring(Searle's Apparatus)

Opto Electronics

21.Photodiode and Photo transistor

Atomic Physics

21. e/m by Magic Eye
22. Magnetic Susceptibility by using Quincke's Tube

Special Recommendation:

In view of the importance of applications of computers in science, it is recommended that in addition to the above experiments, computers may also be used in the analysis of experimental data and in projects.

List for Experiments for B.Sc. I and II

Mechanics

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Modern Physics

69. Ionization Potential

Waves And Oscillations

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