



माँ विन्ध्यवासिनी विश्वविद्यालय , मीरजापुर

Maa Vindhyavasini University, Mirzapur

**Syllabus
for
Two Years M.Sc. (Physics) Programme
2026**



Department of Physics

Maa Vindhyavasini University, Mirzapur (U.P.)

Effective → **SESSION: 2026-2027**

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Dean
Faculty of Science And Technology
Maa Vindhyavasini University, Mirzapur

[Signature]
Convener
Board of Studies
Maa Vindhyavasini University, Mirzapur

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11.09.2026

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11.09.26



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Course Structure of Two Years M.Sc. (Physics) Programme

YEAR	COURSE CODE		PAPER TITLE	CREDIT	EVALUATION Internal+External
1 st Year	Semester-I				
	PHY-101	Core	Mathematical Physics	4	25+75
	PHY-102	Core	Classical Mechanics	4	25+75
	PHY-103	Core	Electromagnetic Theory	4	25+75
	PHY-104	Core	Quantum Mechanics	4	25+75
	PHY-105	Practical	Practical Related to Theory Papers	4	25+75
	Semester-II				
	PHY-201	Core	Advanced Quantum Mechanics	4	25+75
	PHY-202	Core	Condensed Matter Physics	4	25+75
	PHY-203	Core	Atomic and Molecular Physics	4	25+75
2 nd Year	PHY-204	Core	Electrodynamics and Plasma Physics	4	25+75
	PHY-205	Practical	Practical Related to Theory Papers	4	25+75
	Semester-III				
	PHY-301	Core	Lasers and Opto-electronics	4	25+75
	PHY-302	Core	Nuclear Physics	4	25+75
	PHY-303 (S1)	Special	Electronics-I	4	25+75
	PHY-304 (S1)	Special	Electronics-II	4	25+75
	PHY-303 (S2)	Special	Solid State Physics-I: Crystallography and Imperfection In Crystals	4	25+75
	PHY-304 (S2)	Special	Solid State Physics-II: Characterization of Solids	4	25+75
	PHY-305	Practical	Practical Related to Theory Papers	4	25+75
	Semester-IV				
	PHY-401	Core	High Energy Physics	4	25+75
	PHY-402 (S1)	Special	Advanced Electronics-I	4	25+75
	PHY-403 (S1)	Special	Advanced Electronics-II	4	25+75
	PHY-402 (S2)	Special	Solid State Physics-III: Special Solids, Surfaces & Properties	4	25+75
	PHY-403 (S2)	Special	Solid State Physics-IV: Many Particle Systems	4	25+75
	PHY-404	Practical	Practical Related to Theory Papers	4	25+75
	PHY-405	Dissertation	Research Project/Dissertation*	4	00+100

Research Project/Dissertation* should be allotted at end of semester III and will be evaluated by external/ Practical examiner at the end of semester IV.

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M.Sc. (Physics) First Semesters

PHY-101

Mathematical Physics

Unit – I

Special Functions: Second order linear differential equations; Solution by series expansion; Legendre, Bessel, Hermite and Laguerre differential equations, their solutions and properties, Spherical Harmonics.

Unit – II

Fourier Transform: Dirac Delta function, Fourier Transform, Sine and Cosine transform, Linearity, Change of Scale, Translation, Modulation, simple applications. Green Function: Green's function as a technique to solve linear ordinary differential equations, Homogeneous and Inhomogeneous boundary conditions, Solution of Poisson equation using Green's function technique, Symmetry property.

Unit – III

Complex Variables I: General function of complex variable, Analyticity of complex function, Cauchy-Riemann condition,, Conformal Mapping: Some Elementary Transformation (Translation, Rotation, Magnification, Inversion), Cauchy's Integral theorem and formula, Taylor's and Laurent's series, singularity poles.

Unit – IV

Complex Variables II: Residue theorem. Evaluation of definite integrals, around (i) unit circle and (ii) infinite semi-circle; using Jordan's lemma with poles lying on real axis, and of integrals involving multiple valued function-branch point.

References:

1. Mathematical Methods for Physicists by G. Arfken, H. Weber and F.E. Harris (Elsevier)
2. Mathematics for Physicist by P. Dennery and A. Krzywicki (Dover Publication)
3. Special Functions and their Applications by N.N. Lebedev (Dover Publication)
4. Mathematical Methods for Physics and Engineering by K.F. Riley, M.P. Hobson and S.J. Bence (Cambridge University Press)
5. Mathematical Physics by B. S. Rajput (Pragati Prakashan)
6. Complex Variables and Applications by J.W. Brown and R. V. Churchill (McGraw-Hill)

  



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M.Sc. (Physics) First Semesters

PHY-102

Classical Mechanics

Unit – I

Mechanics of a system of particles, Generalized Co-ordinates, D'Alembert's principle. The Lagrangian formulation and equations of motion (with full derivation). The Hamiltonian formulation and equations of motion (with full derivation).

Unit – II

Calculus of variations and its application–Hamilton's principle. The modified Hamilton's principle and principle of least action, the rigid body motion–Euler angles, Motion of symmetrical top.

Unit – III

Canonical transformations, Poisson brackets, Equations of motion and infinitesimal canonical transformations in the Poisson bracket formulation, Liouville's theorem.

Unit – IV

Hamilton – Jacobi equations, Action angle variables, the connection between Hamilton- Jacobi theory and geometrical optics, Theory of small oscillations – Free vibrations of linear tri- atomic molecule.

References:

1. Classical Mechanics by H. Goldstein (Narosa, New Delhi)
2. Classical Mechanics by K.C. Gupta (Wiley Eastern)
3. Classical Mechanics by L.D. Landau (Elsevier)
4. Classical Mechanics by N.C. Rana and P.S. Joag (Tata-McGraw-Hill)



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M.Sc. (Physics) First Semester

PHY-103

Electromagnetic Theory

Unit – I

Maxwell's Equations in vacuum and matter, Maxwell's correction to Ampere's law for non-steady currents and concept of Displacement current, Boundary conditions, Poynting's theorem, Conservation of Energy and momentum for a system of charged particles and electromagnetic field.

Unit – II

Vector and scalar potentials, Maxwell's Equations in terms of Electromagnetic Potentials, Electromagnetic wave equation, Non-uniqueness of Electromagnetic Potentials and Concept of Gauge. Gauge Transformations: Coulomb and Lorentz Gauge; Green's Function for the Wave Equation, Transformation Properties of Electromagnetic Fields and Sources under Rotation, Spatial Reflection and Time-Reversal.

Unit – III

Propagation of Electromagnetic Plane Waves in Vacuum, Non-conducting Medium, Conducting Medium and Plasma; Reflection, Refraction and Polarization of Electromagnetic Waves, Stokes Parameters; Frequency Dispersion Characteristics of Dielectrics and Conductors; Normal and Anomalous Dispersion, Spreading of Pulse in Dispersive Media, Kramer-Kronig Relations.

Unit – IV

Propagation of Electromagnetic Waves in Rectangular Waveguides, TE and TM Modes, Cut off frequency, Energy Flow and Attenuation. Modal Analysis of guided modes in a cylindrical waveguide. Field and Radiation due to an Oscillating Electric Dipole. Magnetic dipole and electric quadrupole fields.

References:

1. Electromagnetic Theory *By* Julius Adams Stratt
2. Electromagnetic Field Theory *by* V.A.Bakshi, A.V.Bakshi
3. Electromagnetic Theory and Electrodynamics *By* Satya Prakash



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M.Sc. (Physics) First Semester

PHY-104

Quantum Mechanics

Unit-I Fundamentals

Uncertainty principle and applications, Schrödinger wave equation, normalization, probability current density, expectation values, Ehrenfest theorem, energy eigen function and eigen values, hermitian operators and their properties, Orthonormality, free particle solution. One dimensional step potential (finite and infinite) particle in one dimensional square potential well (finite and infinite), linear harmonic oscillator, zero point energy, rectangular potential barrier.

Unit-II Three Dimensional System

Particle in three dimensional box, Dirac delta functions, orbital angular momentum, commutation relations, central force problems, solution of Schrödinger equation for spherical symmetric potentials, Hydrogen atom- reduced mass, wave function, energy levels, degeneracy, Energy Eigen function and Eigen values of three dimensional harmonic oscillator, and rigid rotator.

Unit-III Matrix Theory

Matrix, formulation of quantum theory, linear vector space, vector and operators and their matrix representation, bra and ket notations, projection operator, unitary transformation, matrix theory of linear harmonic oscillator, raising and lowering operators eigen values and eigen functions of L^2 and L_x , spin, Pauli spin matrices, and their algebra, matrices for J^2 and J_x , addition of two angular momenta, (elementary discussion).

Unit-IV Approximation Methods

Time independent perturbation theory for non degenerate case, formulation upto second order, perturbation of linear harmonic oscillator- (i) estimation of correction up to second order for perturbation term depending on x and x^2 (ii) first order correction to energy by x^3 and x^4 type terms, Ground state of Helium atom, Stark effect of a plane rigid rotator.

References:

1. Quantum Mechanics: L I Schiff, TMH
2. Quantum Mechanics: S Gasiorowicz, Wiley
3. Quantum Mechanics: J D Powell, Addison Wiley
4. Quantum Mechanics: Mathews and Venkatesan
5. Modern Quantum Mechanics: J J Sakurai.

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M.Sc. (Physics) First Semester

PHY-105

Practical

LIST OF EXPERIMENTS

1. Michelson Interferometer
2. Elastic constant by Newton's Ring
3. Hall Effect .
4. Use of constant deviation spectrograph
5. FET/MOSFET Characteristics
6. Study of phase shift oscillator
7. Study of regulator circuits
8. Study of TTL gates



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M.Sc. (Physics) Second Semester

PHY-201

Advanced Quantum Mechanics

Unit-I

Variational method, Wentzel Kramer Brillouin (WKB) approximation, Time-dependent perturbation theory, Harmonic perturbation, Fermi's golden rule, Adiabatic and sudden approximation.

Unit-II

Collision in 3-D and scattering, Laboratory and CM reference frames, scattering amplitude, differential scattering cross section and total scattering cross section, scattering by spherically symmetric potentials, partial waves and Phase shifts, scattering by perfectly rigid sphere and by square well potential and absorption. Born approximation for scattering. Scattering by coulomb potential.

Unit-III

Identical particles, symmetric and antisymmetric wave functions, Collision of identical particles, Spin angular momentum, Spin function for a many electron system.

Unit-IV

Semi classical theory of radiation, Quantum Theory of radiation, Relativistic theory, The Klein-garden equation, The Dirac equation, covariance of Dirac equation, energy level of hydrogen atoms, hole theory and positrons.

References:

1. L I Schiff, Quantum Mechanics (Mc Graw Hill)
2. S Gasiorowicz, Quantum Physics (Wiley)
3. B Craseman and J D Powell, Quantum Mechanics (Addison Western)
4. A P messiah, Quantum Mechanics
5. J J Sakurai, Modern Quantum Mechanics
6. Mathews and Venktesan, Quantum Mechanics

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M.Sc. (Physics) Second Semester

PHY-202

CONDENSED MATTER PHYSICS

Unit-I Crystal Physics

Crystalline solids, unit cell and direct lattice, Miller indices of planes and axes, two and three dimensional Bravais lattices, closed packed structures, Braggs law, experimental diffraction techniques, construction of reciprocal lattice, reciprocal lattice vector, Brillouin zone and atomic factor.

Unit-II Point Defect and Imperfection

Point defect, line defect and planer stacking fault, the role of dislocation in plastic deformation and crystal growth, the observation of imperfection in crystal, X-ray and electron microscopic techniques.

Unit-III Electronic Energy Bands

Electrons in periodic lattice, Bloch theorem, Band theory, classification of solids, effective mass, tight binding, cellular and pseudo potential method.

Unit-IV Superconductivity

Superconductivity: Critical temperature, persistent current, Meissner effect, type I and type II superconductors, heat capacity, energy gap, isotopic effect, London's equation, coherent length.

References:

1. Verma and Shrivastava: Crystallography for Solid State physics
2. Aschroff and Mermin: Solid State physics
3. Kittel: Solid State physics
4. Chaikin and Lubensky: Principles of Condensed Matter Physics
5. Dekker: Solid State physics

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M.Sc. (Physics) Second Semester

PHY-203

ATOMIC AND MOLECULAR PHYSICS

Unit-I Atomic Physics

Quantum states of one-electron atoms, atomic orbital, hydrogen spectrum, Pauli's principle, spectra of alkali elements, spin orbit interaction and fine structure in alkali spectra- equivalent, non-equivalent electrons.

Unit-II Atomic Spectra

Normal and anomalous Zeeman effect, Paschen Back effect, Stark effect, two electron system, interaction energy in LS and JJ coupling, hyperfine structure (qualitative).

Unit-III Diatomic-Molecular Spectra

Rotational spectra of diatomic molecules as a rigid rotator, Energy levels and spectra of non-rigid rotator, Intensity of spectral lines.

Unit-IV Energy of Molecules

Vibrational energy of diatomic molecules, diatomic molecules as a simple harmonic oscillator, Energy level and spectrum, Morse potential energy curve, Molecules as vibrating rotator, vibrational spectrum of diatomic molecules, PQR branches.

References:

1. Introduction to atomic spectra, H E White (T)
2. Fundamental of molecular spectroscopy, C W Banwell (T)
3. Spectroscopy Vol I II III, Walker and Straughen
4. Introduction to molecular spectroscopy, G M Barrow
5. Spectra of diatomic molecules, Herzberg

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M.Sc. (Physics) Second Semester

PHY-204

Electrodynamics and Plasma Physics

Unit-I Motion of Charged Particles

Motion of charged particles in electromagnetic field: Uniform E and B fields, non- uniform magnetic fields, diffusion across magnetic field, electrostatic and magnetostatic lenses time varying E and B fields, adiabatic invariants: first, second and third adiabatic invariants.

Unit-II Retarded Potentials

Retarded potential and Lienard-Wiechert potential, electric and magnetic fields due to a uniformly moving charge and an accelerated charge, Linear and circular acceleration and angular distribution of power radiated Bremsstrahlung, synchrotron radiation and cherenkov radiation, reaction force of radiation.

Unit – III Plasma State

Elementary concepts of Plasma state of matter : Derivation of moment equations from Boltzmann equation, plasma oscillations, Debye shielding, plasma parameters, magnetoplasma, plasma confinements (Pinch effect, Mirror confinement, Van Allen Belts), Elementary idea of fusion technology.

Unit – IV Hydrodynamics of Plasma:

Hydrodynamical description of plasma, Equation of magneto hydrodynamics, High frequency plasma oscillations, Short wavelength limit and Debye screening distance. Wave Phenomenon in Magneto-Plasma: Electromagnetic waves perpendicular to B_0 , phase velocity, Polarization, Cut-off and resonances, Electromagnetic waves parallel to B_0 , magnetosonic and Alfven waves.

References:

1. Introduction to Electrodynamics by D.J. Griffiths (Prentice - Hall, New Delhi)
2. The Classical theory of Fields by L.D. Landau and E.M. Lifshitz (Elsevier)
3. Classical Electrodynamics by J.D. Jackson (Wiley Eastern)
4. Introduction to Plasma Physics by F.F. Chen (Plenum Press, New York)
5. Plasma Physics by S.N. Sen (Pragati Prakashan)

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M.Sc. (Physics) Second Semester

PHY-205

Practical

List of Experiments

1. Ultrasonic Diffraction
2. Q of coil
3. Richardson Equation
4. Planck's constant
5. Energy band gap of semiconductor
6. Fourier analysis by CRO
7. Experiment on Laser
8. Study of saw tooth wave generation by UJT
9. Study of characteristic of SCR and controlled rectification by SCR



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M.Sc. (Physics) Third Semester

PHY-301

Lasers and Opto-Electronics

Unit-I

Laser theory, Einstein Coefficients, Light Amplification, threshold condition, Laser Rate Equations-two, three and four level systems, Laser power around threshold, optimum output coupling.

Unit-II

Line Broadening Mechanisms – Natural, Collision and Doppler, Optical Resonators – Modes of a rectangular cavity and open planar resonator, Modes of a Confocal resonator system, General Spherical resonator, Higher order modes.

Unit-III

Essential criterion to observe non linear optical effects. First experimental demonstration of non-linear phenomena. Classical theory of non-linear response in one dimension. Generalization to 3 dimensions.

Unit-IV

Non-linear coupling of 3 waves to produce sum and difference frequencies. Manley Rowe relations and their significance. Sum and difference frequency generation when both input frequencies are lasers. Parametric conversion and amplification.

References:

1. Svelto: Lasers
2. Yariv: Optical Electronics
3. Demtroder: Laser Spectroscopy
4. Latekhov: Non linear Spectroscopy
5. Robert Boylested and Louis Nashdsky: Electronic devices and circuit theory, PHI, New Delhi
6. Ramakanth A Gayakwad: OP amps & linear integrated circuits, PHI second addition, 1991
7. Jacob Millman: Microelectronics, Mc-Hill international book co, New Delhi, 1990



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M.Sc. (Physics) Third Semester

PHY-302

Nuclear Physics

Unit – I

Basic facts about nuclei, Mass and binding energy, Semi-empirical mass formula, Nuclear size determination using mu-mesic X-rays and scattering of fast electrons, Nuclear spin and magnetic moment of nuclei, Molecular beam resonance method, Nuclear resonance absorption and induction method, Electric quadrupole moment

Unit – II

Alpha decay, Experimental results on alpha decay-Alpha spectra and Geiger-Nutall relation, Theory of alpha decay. Beta-spectra, Fermi's theory of beta decay, Sergeant's law, Kurie Plot, Allowed and forbidden transitions, Parity violation in beta-decay, Detection of neutrino.

Unit III

Gamma emission, Multipolarity of gamma rays, Selection rules, Theoretical prediction of decay constants, Estimation of Transition probabilities, Internal conversion, Angular correlation, Nuclear isomerism, Mossbauer Effect.

Unit – IV

Nuclear reactions, Conservation laws, The Q-equation and deduction of nuclear energy levels, Compound nucleus, Bohr hypothesis, Resonance phenomena, Breit- Wigner one level formula, Optical model, Simple discussion of direct reactions, Nuclear fission, Bohr-Wheeler theory of nuclear fission, Controlled chain reaction, Nuclear reactors.

References:

1. Ghosal: Atomic and Nuclear physics, vol 2
2. D Griffiths: Introduction to elementary particles, Harper and Row, New York, 1987
3. H A Enge: Introduction to nuclear physics, Addison Wesley, 1975
4. D C Tayal: Nuclear physics
5. M K Pal: Theory of nuclear structure affiliated East- West, Madras, 1982.



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M.Sc. (Physics) Third Semester

PHY-303 (S1)

Electronics-I

(Electronics Devices and Circuits)

Unit-I Linear Wave Shaping

High Pass and Low Pass RC Networks, Response to Sinusoidal, Step, Pulse, Square wave, Exponential and Ramp Inputs. High pass RC circuit as a differentiator, Criterion for good differentiation, Double Differentiation, Low Pass RC circuit as an Integrator. Laplace Transforms and their application to circuit elements.

Unit-II Amplifiers

Difference Amplifiers, Broadband Amplifiers, Methods for achieving Broadbanding, Emitter Follower at High Frequencies, Operational Amplifiers and its Applications, IC 741, Active Filters.

Unit-III Power Supplies

Electronically Regulated Power Supplies, Converters and Inverters, High and Low Voltage Supplies, Switched Mode Power Supply (SMPS).

Unit-IV Integrated Circuit Fabrication Technology

Basic Monolithic Integrated Circuits, Steps involved in the Manufacture of Monolithic ICs: Epitaxy, Masking, Etching, Diffusion, Metallization, Bonding, Assembling, Package types. Introduction to VLSI techniques.

References:

1. Robert Boylested and Louis Nashdsky: Electronic devices and circuit theory, PHI, New Delhi
2. Ramakanth A Gayakwad: OP amps & linear integrated circuits, PHI second addition, 1991
3. Jacob Millman: Microelectronics, Mc-Hill international book co, New Delhi, 1990
4. Alien Chappal: Optoelectronics- theory and practice, Mc-Hill international book co, New York



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M.Sc. (Physics) Third Semesters

PHY-304 (S1)

Electronics-II

(Digital Electronics)

Unit-I Logic Hardware

Transistor as a Switch, Switching times: Definition and Derivation, Storage Time, Delay Time, Turn On Time, Turn Off Time, Charge Control Analysis. Logic Specifications: Fan In, Fan Out, Noise Immunity, Noise Margin, Propagation Delay, Power Dissipation. Logic Families: DTL, DCTL, I²L, ECL, TTL, CMOSL, CML, HTL.

Unit-II Number Systems and Boolean Algebra

Binary, Octal and Hexadecimal Number Systems. Binary Arithmetic. Arithmetic Circuits. Binary Codes: Gray, 8421, 2421, 5211. Boolean Variables and Operations, Simplification of Boolean Expressions. Karnaugh Maps.

Unit-III Multivibrators

Astable, Monostable and Bistable Multivibrators. Schmitt Trigger. 555 Timer. SR, JK, T and D, J Master Slave Flip flops, Race problem and Edge Trigger JK Flip flop, Preset and Clear Functions.

Unit-IV Counters and Registers

Binary Counters: Modulus of Counters: Asynchronous and Synchronous Counter Reset Method, Logic Gating Method. Ring Counter. Shift Registers: SISO, PIPO, SIPO, PISO. Universal Shift Register. Tristate Switches, Tristate Registers.

References:

1. Barrey B Brey: The internal microprocessors 8086/8088, 80186, 80286, 80386, 80486 pentium and Pentium processors architecture, programming interfacing, IVth edn. 1999.
2. Douglas V Hall: Microprocessors and interfacing, programming and hardware, IInd edn. Mc-Graw Hill, 1992.
3. M A Maxidi and J G Mazidi: The 80x86 IBM PC and compatible comp. (Vol. I & II), IInd edn. Prentice-Hall international, 1998.



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M.Sc. (Physics) Third Semester

PHY-303 (S2)

Solid State Physics -I

(Crystallography and Imperfection In Crystals)

Unit-I

Miller indices, Diffraction of X-rays by crystals, Scattered wave amplitude-Fourier Analysis, Reciprocal Lattice Vectors, Diffraction Condition , Laue Equation, Brillouin Interpretation. Principal of powder diffractometer, Interpretation of powder-photographs. Analytical indexing: Ito's method. Application of powder method.

Unit-II

Interpretation of oscillation photograph, X-ray method of orienting crystals about a crystallographic direction. Bernal chart, Indexing of reflection. Fourier representation of electron density, the phase problem, Patterson function.

Unit-III

Mechanism of plastic deformation in solids, stress and strain fields of screw and edge dislocations, elastic energy of dislocation, forces between dislocations, stress needed to operate Frank-Read source. Partial dislocations and stacking faults in close-packed structures.

UNIT-IV

Basic features of Piezo, Pyro and Ferro Electric Material, order-disorder and displacive type ferro electric materials, Occurrence of Ferro electricity due to polarization catastrophe and lattice modes , Devonshire Theory of ferroelectric phase transition.

References:

1. Crystallography for Solid State Physics: Verma and Srivastava
2. X-ray Crystallography: Leonid V. Azaroff.
3. Elementary Dislocation Theory: Weertman and Weertman
4. Crystal Structure Analysis: R. Buerge.
5. Electron Microscopy of Thin Crystals: Peter B. Hirsh



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M.Sc. (Physics) Third Semester

PHY-304 (S2)

Solid State Physics –II

(Characterization of Solids)

Unit-I

Linearised Boltzmann transport Equation , Electrical Conductivity, Relaxation time, Impurity scattering, Ideal resistance, Carrier mobility, General transport coefficient, Thermal Conductivity, Thermoelectric effects, Lattice Conduction. Phonon Drag, Hall effect and Magnetoresistance.

Unit-II

Elementary Concepts of Scanning and Scanning Tunneling Microscopic Techniques (SEM, STM) X-ray Photoelectron Spectroscopy (XPS/ESCA) for chemical analysis. RBS (Rutherford Back Scattering) and SIMS (Secondary Ion Mass Spectroscopy). Defect related electronic states characterization by C-V characteristics of electronic junction devices, Temperature stimulated current and capacitance (TSC/TSCAP), Deep Level Transient Spectroscopy (DLTS), Electronic Beam Induced Current (EBIC) and Light Beam Induced Current (LBIC).

Unit-III

Double Beam IR Spectrometers, Basic Concepts of Raman Spectroscopy in Solids, Sensitive Detectors such as CCD Camera, Concept of Space Group and Point Group, Identification and Analysis of Optic and Acoustic Modes in Solids. Electronic Absorption Study for Band Gap Determination.

Unit-IV

General theory of magnetic resonance and Bloch equation, Electron paramagnetic resonance, Structure of Resonance lines and their uses, Nuclear magnetic resonance: Salient theory and method of observation, structure of resonance lines and their uses.

References:

1. Analytical Techniques for Thin Film-Treatise on Material Science and Technology, Vol. 27: K.N. Tu and R. Rosenberg (ed.).
2. Electron Microprobe Analysis: S.J. B. Reed.
3. Topics in Applied Physics, Vol. 4: R. Gomer (ed.).
4. Principle of Magnetic Resonance : C.P Slicher

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M.Sc. (Physics) Third Semester

PHY-305

Practical

List of Experiments - Electronics group

1. Study of High Pass and Low Pass RC Networks
2. Study of Switch Mode Power Supply (SMPS)
3. Study of RC Coupled Amplifier
4. Negative Feedback Amplifier
5. Study of Multivibrator 4. Study of Oscillators
6. . Amplitude Modulation & Demodulation
7. NAND and NOR gate as universal gate.
8. D/A and A/D Convertor

List of Experiments - Electronics group

1. Hysteresis Curve (a) by Ballistic method (b) by Oscillograph
2. Hall Effect
3. Electro-Luminescence
4. X-ray powder diffraction
5. Laue photograph or rotation photograph
6. Energy band gap by four probe technique
7. Dielectric constant of BaTiO₃ and Curie temperature
8. To study the modulus of rigidity and internal friction in a metal as a function of temperature

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Maa Vindhyavasini University, Mirzapur

M.Sc. (Physics) Fourth Semester

PHY-401

High Energy Physics

Unit-I

Nuclear two-body problem, Simple theory of deuteron, Spin dependence and noncentral feature of nuclear forces, Partial wave analysis, Low energy n-p scattering, Scattering length and effective range theory, Low energy p-p scattering, Charge symmetry and charge independence of nuclear forces, Meson theory of nuclear forces.

Unit-II

Nuclear models, Evidence of shell structure, magic numbers and spin-orbit coupling, extreme single particle model. Predictions of spin, parity and electromagnetic moments, Collective model-Vibrational and rotational spectra.

Unit-III

Classification of elementary particles, Exact conservation laws, Approximate conservation laws: isospin and isospin wave functions for pion-nucleon system, strangeness, parity, time reversal and charge conjugation, CP violation.

Unit-IV

Eight fold way, Quarks, Quark-Quark interaction, SU (3) quark model, Magnetic dipole moment of baryons, Masses of hadrons, Basic ideas about the standard model.

References:

1. Ghosal: Atomic and Nuclear physics, vol 2
2. D Griffiths: Introduction to elementary particles, Harper and Row, New York, 1987
3. H A Enge: Introduction to nuclear physics, Addison Wesley, 1975
4. D C Tayal: Nuclear physics
5. M K Pal: Theory of nuclear structure affiliated East- West, Madras, 1982.



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Maa Vindhyavasini University, Mirzapur

M.Sc. (Physics) Fourth Semester

PHY-402 (S1)

Advanced and Digital Electronics-I

(Analog and Digital Communication)

Unit-I Amplitude Modulator

Amplitude Modulation, Spectrum of the modulated signal, Square law Modulator, Balanced Modulator, DSBSC, SSB and vestigial sideband modulation. Limitations of Amplitude Modulation. AM Receiver.

Unit-II Frequency Modulator

Analysis and frequency Spectrum, Generation and Detection of FM. Comparison of AM and FM. Pre-emphasis and De-emphasis. Reactance Modulator. Capture Effect. Varactor Modulator. Amplitude Limiter. FM Receiver. Foster Seely Discriminator. Ratio Detector.

Unit-III Radar & Television

Radar: Principle of radar, Elements of radar system, Peratind characteristics and maximum range of radar set, Duplexer, Radar beacons. Television: General principle of image transmission scanning sequence and synchronization, Television camera tubes, elements of color television.

Unit-IV Microwave and Digital Communication

Microwave Generator: High frequency generation problems, Klystron amplifier and oscillators, Gunn oscillator and microwave components. Digital Communication: Sampling theorem, Pulse Modulation: Pulse Code, Pulse Amplitude, Pulse Position Pulse Width Modulation. Differential PCM, Delta Modulation. Digital Communication System. Digital Carrier System. Frequency Shift Keying. Phase Shift Keying. Differential Phase Shift Keying. Division Multiplexing.

References:

1. Wayne Tomasi: Advanced electronics communications systems, Phi. Edn.
2. Taub and Schilling: Principles of communication systems, second edition TMH, 1990
3. Simon Haykin: Communication systems, third edition, John Wiley and sons, Inc., 1994



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M.Sc. (Physics) Fourth Semesters

PHY-403 (S1)

Advanced Electronics-II

(Logic Circuits, Memories, Converters, Microprocessors)

Unit-I Combinational Logic Circuits

Pin out Diagrams, Truth Table and Working. Decoders: 1-of-4 IC 74AS139, 1-of-16 IC 74154 BCD to Decimal Decoder IC 7445, BCD to Seven Segment Decoder Driver: IC 7447A, 7448. Encoders: Decimal Priority Encoder IC 74147 Multiplexers, Implementation of Boolean Function using multiplexer, Demultiplexers: Demultiplexeral Decoder.

Unit-II Memories

Memory Devices: Read Only Memories, Masked Memory, ROM, Programmable ROM, EPROM. Random Access Memory: Static and Dynamic, Bipolar Ram Cell, Static RAM cell.

Unit-III A/D and D/A Converters

Binary weighted Resistor D/A Converter, Ladder Network D/A Converter. D/A Converter Specifications: Resolution, Accuracy, Linearity, Settling Time, Temperature Sensitivity. Flash A/D Converter, Ramp A/D Converter, Successive Approximation A/D Converter.

Unit-IV Microprocessors and Displays

LED Displays: Common Anode Display FND 507, FND 567. Common Cathode Display FND 500, FND 560. Flat Panel Displays (LCD, Plasmas etc.) and their addressing techniques. Smart Windows. Intel Microprocessors: Historical Perspective. Architecture of Microprocessor 8085: Addressing modes and Instruction Set of 8085. Programming examples.

References:

1. Barrey B Brey: The internal microprocessors 8086/8088, 80186, 80286, 80386, 80486 pentium and Pentium processors architecture, programming interfacing, IVth edn. 1999.
2. Douglas V Hall: Microprocessors and interfacing, programming and hardware, IInd edn. Mc-Graw Hill, 1992.
3. M A Maxidi and J G Mazidi: The 80x86 IBM PC and compatible comp. (Vol. I & II), IInd edn. Prentice-Hall international, 1998.



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M.Sc. (Physics) Fourth Semester

PHY-402 (S2)

Solid State Physics -III

(Special Solids, Surfaces & Properties)

Unit-I

Structure and symmetries of liquids, liquid crystals and amorphous solids. Liquid Crystals: Definition, Classification, Characteristic features: Thermotropic and Lyotropic Liquid Crystals, FLCs, Basic Principle of LCDs.

Unit-II

Difference of behavior of thin films from bulk. Boltzmann Transport equation for a thin film. Determination of distributing function for thin films and qualitative estimates of electrical conductivity. Scanning tunneling and Atomic Force Microscopy.

Unit-III

Weiss theory of ferromagnetism, Molecular field theory. Heisenberg explanation of internal magnetic field, Landau theory of Domain, Spin-wave theory, Magnon excitation and Bloch $T^{3/2}$ law, Antiferromagnetism, Ferrimagnetism, Neels Two sub-lattice model.

Unit-IV

Polymers: Structure, Properties and Method of Polymerization, Degradation of Polymers, Viscoelectric State, Glass transition temperature. Nano-Materials: Definition, Types and characteristic features, Quantum size effect, density of states, Synthesis and characterization of Nanocomposites.

References:

1. Liquid Crystals: S Chandrashekar
2. An Introduction to Polymer Physics: I. I. Perepechko
3. Physics of Thin Films: K.L. Chopra
4. Nanotechnology: Principle and Practices: S K Kulkarni



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Maa Vindhyavasini University, Mirzapur

M.Sc. (Physics) Fourth Semester

PHY-403 (S2)

Solid State Physics-IV

(Many Particle Systems)

Unit-I

Basic features of Superconductors: Zero resistance, Meissner Effect, Penetration Depth, Critical Field, Heat capacity and Isotopic shift. Soft and Hard superconductors, Thermodynamics of superconducting transitions, London equation, Coherent length, Particle tunneling and Josephson effect.

Unit-II

Interaction of Electron with Acoustic and Optical Phonons, Cooper Pairing due to Phonon, BCS Theory of Superconductivity, Ginzberg-Landau Theory of Superconductivity and Application to type II superconductors, Vortices and Abrikosov Phase. Charge transfer model of Cuprates.

Unit-III

Interactions of Electrons and Phonons with Photons, Elementary ideas on Direct and Indirect Transitions, Polaritons. Electron Localization in Disordered System: Electron Localization, Density of States, Mobility Edge, Anderson Localization, Hopping Conductivity.

Unit-IV

Difficulties in observing resonance fluorescence of nuclear system, Recoil energy, Natural and dipole broadening , Classical and Quantum theories of Mossbauer effect, Experimental method and principle uses of Mossbauer effects.

References:

1. Principle of theory of solid: J M Ziman
2. Theoretical Solid State Physics: W. Jones and N H March
3. Principle of Magnetic Resonance: C.P Slicher
4. Mossbauer Effect and its Application: V. G. Bhinde

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M.Sc. (Physics) Fourth Semester

PHY-404

Practical

List of Experiments - Electronics group

1. Characteristics of Operational Amplifier
2. Operational Amplifier as inverting, non-inverting, D-summing Amplifier
3. Study of time 555
4. Series regulated power Supply
5. Multiplexer & Demultiplexer circuits
6. Study Encoders and decoders and BCD to seven segment.
7. Semiconductor memory using IC 7489 RAM
8. Microprocessor 8085

List of Experiments - Electronics group

1. To measure the Cleavage step height of a crystal by multiple Fizeau Fringes.
2. To determine magnetoresistance of a Bismuth crystal as a function of magnetic field.
3. E. P. R.
4. Synthesis/ Fabrication of Carbon Nanotubes by spray pyrolysis method and its verification through X-ray diffraction.
5. To build crystal structures and to calculate its powder diffraction pattern using material Studio software and to analyze structures and diffraction patterns.



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M.Sc. (Physics) Fourth Semester

PHY-405

Research Project/Dissertation

Students shall develop research skills through focused study of a research topic of choice.

The students shall develop a research project under the mentorship of any faculty of the

Department of Physics or any equivalent faculty or scientist as approved by the Department.

*Research Project/Dissertation should be allotted at end of semester III and will be evaluated by external/
Practical examiner at the end of semester IV.

Ch

Manoj

Dean / Science and Technology
Faculty of Science And Technology
Maa Vindhyavasini University, Mirzapur



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Maa Vindhyavasini University, Mirzapur

Faculty of Science & Technology

Department of Physics

Syllabus Developed by:

S.No.	Name	Designation	Department	University/ College
1	Dr. Chandan Sahu	Asstt Prof	PHYSICS	Govt P.G College, Chunar, MZP
2	Dr. Manoj Kumar Prasad	Asstt Prof	PHYSICS	Govt Degree College, Majhwa, MZP
3	Prof. Deependra Singh	Dean	Science Faculty	Chunar, MZP


Dean / संयोजक
Faculty of Science And Technology
Maa Vindhyavasini University, Mirzapur

 

