BUNDELKHAND UNIVERSITY, JHANSI
DEPARTMENT OF PHYSICS

SYLLABUS

M. Sc. (PHYSICS)

Papers Name	Theory	Internal	Total
First Semester			
PHY-101 Mathematical Physics	70	30	100
PHY-102 Classical Mechanics	70	30	100
PHY-103 Quantum Mechanics-I	70	30	100
PHY-104 Electronic Devices	70	30	100
Practical			100
		Total	**500**
Second Semester			
PHY-201 Quantum Mechanics-II	70	30	100
PHY-202 Condensed Matter Physics	70	30	100
PHY-203 Atomic and Molecular Physics	70	30	100
PHY-204 Electrodynamics and Plasma Physics	70	30	100
Practical			100
		Total	**500**
Third Semester			
PHY-301 Computational Methods & Programming	70	30	100
PHY-302 Nuclear and Particle Physics	70	30	100
Special Paper (Any two)			
PHY-303 (S) Electronics-I	70	30	100
PHY-304 (S) Electronics-II	70	30	100
OR			
PHY-305 (S) Condensed Matter Physics-I	70	30	100
PHY-306 (S) Condensed Matter Physics-II	70	30	100
Practical			100
		Total	**500**
Fourth Semester			
PHY-401 Statistical Mechanics	70	30	100
Elective Paper (Any one)			
PHY-402 (A) Advanced Numerical Techniques	70	30	100
OR			
PHY-402 (B) Physics of Laser and Laser Applications	70	30	100
Special Paper (Any two)			
PHY-403 (S) Electronics-III	70	30	100
PHY-404 (S) Electronics-IV	70	30	100
OR			
PHY-405 (S) Condensed Matter Physics-III	70	30	100
PHY-406 (S) Condensed Matter Physics-IV	70	30	100
Dissertation/Practical			100
		Total	**500**
	Grand Total		**2000**

M. Sc. (Physics) First Semester
PHY-101
MATHEMATICAL PHYSICS

Unit-1 Vectors and Matrices

Vector space and matrices, linear dependence and independence, Bases, Dimensionality, Gauss, Stokes and Green Theorem with application, Inner Product, Linear Transformation, Matrices, Inverse, Orthogonal and Unitary matrices, Independent elements of matrix, Eigen values and eigen vectors, Diogalization, complete orthonormal set of functions.

Unit-2 Element of Complex Variables

Function of complex variables, the derivative and Cauchy-Riemann differential equations, line integral of complex functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor's Series, Laurent series, Residues, Cauchy residue theorem, Singular pints of an analytical function, The point at infinity, evaluation of residues, evaluation of definite integrals, Jordan's lemma.

Unit-3 Special Functions Differential Equations

Differential Equations and Special Functions, beta and gamma functions, second ordered linear differential equations, with variable coefficients, solution by series expansion, Legendre, Bessel, Hermite and Laguerre equations, Physical applications, Generating functions, recursion relations.

Unit-4 Laplace Transformation

Integral transform, Laplace Transform, first and second shifting theorems, inverse LT by partial fractions, LT of derivatives, and integral of a function.

Unit-5 Fourier Series and Transform

Fourier series, FS for arbitrary period, half wave expansions, partials sums, Fourier integrals and transform, FT of delta functions.

Text and Reference Book

1. Mathematical methods for Physicist: G. Artken
2. Mathematical Physics: Harper
3. Advanced Engineering Mathematics: Kreyazig
4. Elements of Complex variable: Churchill
5. Mathematical methods for Physicist and Engineers: K F Reilly, M P Hobsen

M. Sc. (Physics) First Semester
PHY-102
CLASSICAL MECHANICS

Unit-1 Preliminaries of classical mechanics

Newtonian mechanics one and many particle systems, Conservation laws, work energy theorem, open system (with variable system) Constraints, their classification, D'Alembert principle, generalized coordinates.

Unit-2 Lagrangian Formulation

Lagrange's equations, gyroscopic forces, dissipative systems, Jacobi integral, gauge invariance, generalized coordinates and momenta, integrals of motion, symmetries of space and time with conservation laws, invariance under Galilean transformation.

Unit-3 Central Forces

Rotating frames, inertial forces, terrestrial and astronomical applications, coriolis forces, Central force, definition and characteristics, two body problems, closure and stability of circular orbits, general analysis of orbits, Kepler laws and equations, Rutherford scattering.

Unit-4 Hamiltonian Formulation

Principle of least action, derivation of equation of motion, variation and end points, Hamilton's principles and characteristics functions, Hamilton-Jacobi equation.

Unit-5 Canonical Transformation

Canonical transformation, generating functions, properties, group properties, examples, infinitesimal generators, Poisson brackets, Poisson theorems, angular momentum, PBs small oscillation, normal modes and coordinate.

Text and Reference Book

1. Classical Mechanics: N C Rana & P S Joag, TMH 1991
2. Classical Mechanics: H Goldstein, Addison Wasley, 1980
3. Mechanics: A Sommerfield, Academic Press, 1952
4. Introduction to Dynamics: I Perceival & D Richards, Cambridge Univ Press, 1982

M. Sc. (Physics) First Semester
PHY-103
QUANTUM MECHANICS-I

Unit-1 Fundamentals

Correspondence principle, complementarily, uncertainty principle and applications, Schrödinger wave equation, normalization, probability current density, expectation values, Ehrenfest theorem, energy eigen function and eigen values, separation of time dependent wave equation, stationary states, boundary and continuity conditions, dynamical variables as operators, hermitian operators and their properties, Orthonormality, free particle solution.

Unit-2 Application to One Dimensional Problems

One dimensional step potential (finite and infinite) particle in one dimensional square potential well (finite and infinite) parity, linear harmonic oscillator, zero point energy, rectangular potential barrier.

Unit-3 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-4 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-5 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.

Text and Reference Book

1. Quantum Mechanics: L I Schiff, TMH
2. Quantum Mechanics: S gasioriwiez, Wiley
3. Quantum Mechanics: J D Powell, Addision Wiley
4. Quantum Mechanics: Mathews and Ventesan
5. Modern Quantum Mechanics: J J sakurai

M. Sc. (Physics) First Semester
PHY-104
ELECTRONIC DEVICES

Unit-1 Transistors

Bipolar junction transistor BJT, Junction field effect transistor JFET, Metal oxide semiconductor field effect transistor MOSFET: Structure, working, derivation of the equation for I-V characteristics under different conditions, high frequency limits.

Unit-2 microwave Devices

Tunnel Diode, Transfer electron devices, Gunn Diode, Avalanche transit time devices, Impact diode and parametric devices.

Unit-3 Photonic Devices

Radiative and non-radiative transitions, Photoconductive devices LDR, diode photo detector, Solar cell, light emitting diode LED, high frequency limit, effect of surface and indirect recombination light confirmation factor, optical gain and threshold current for lasing.

Unit-4 Memory Devices

Static and Dynamic random access memories, SRAM and DRAM, CMOS and NMOS, non volatile NMOS, magnetic, optical and ferro-electric memories, charge coupled devices CCD.

Unit-5 Other Electronic Devices

Electro-optic, Magneto-Optic and Acousto-Optic effects, material properties related to get these effects, Piezo-electric, Electro-strictive and Magneto-strictive effects, sensors and Actuators devices.

Text and Reference Book

1. Semiconductor Devices- Physics and Technology: S M Sze, Willey, 1985
2. Introduction to Semiconductor Devices: M S Tyagi, John Willey & Sons
3. Measurement, Instrumentation and Experimental Design in Physics and Engineering: M Sayer and A Mansingh, PHI
4. Opticl Enginnering: Ajoy Ghatak and K Tyagrajan, Cambridge Univ Press

M. Sc. (Physics) Second Semester
PHY-201
QUANTUM MECHANICS

Unit-1 Approximation Methods-II

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

Unit-2 Scattering

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.

Unit-3 Identical Particles

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

Unit-4 Radiation Theory

Semi classical theory of radiation, Quantum Theory of radiation, Transition probability for absorption and induced emission, electric dipole, forbidden transmissions, selection rules.

Unit-5 Relativistic Theory

Relativistic theory, The Klein-garden equation, The Dirac equation, covariance of Dirac equation, energy levels of hydrogen atoms, hole theory and positrons.

Text and Reference Book

1. L I Schiff, Quantum Mechanics (Mc Graw Hill)
2. S Gasiorowiez, 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

M. Sc. (Physics) Second Semester
PHY-202
CONDENSED MATTER PHYSICS

Unit-1 Crystal Physics

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

Unit-2 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-3 Electronic Energy Bands

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

Unit-4 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.

Unit-5 Magnetic Properties of Solids

Wei's theory of ferromagnetism, Heisenberg model and molecular field theory, spin waves and magnons, Curie-Weiss law for susceptibility, ferri and antiferro magnetic order, Domains and Bloch-wall energy.

Text and Reference Book

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

M. Sc. (Physics) Second Semester
PHY-203
ATOMIC AND MOLECULAR PHYSICS

Unit-1 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-2 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-3 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-4 Energy of Molecules

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

Unit-5 Spectrometers

IR spectrometer (qualitative), UV spectrometer, NQR spectrometer, Stark modulated microwave spectrometer (qualitative).

Text and Reference Book

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

M. Sc. (Physics) Second Semester
PHY-204
ELECTRODYNAMICS AND PLASMA PHYSICS

Unit-1 Review of Electrodynamics

Review of four vectors and Lorentz transformation in four dimensional space, electromagnetic field tensor in four dimensions and Maxwell's equation, dual field tensor, wave equation for vector and scalar potentials.

Unit-2 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 Bremssahlung, synchrotron radiation and cerenkov radiation, reaction force of radiation.

Unit-3 Motion of Charged Particles

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

Unit-4 Basics of Plasma

Elementary concepts: Devation of moment equations from Boltzmann equation, plasma oscillations, Debye shielding, plasma parameters, magnetoplasma, plasma confinement, hydro dynamical description of plasma, fundamental equations, hydromagnetic waves, magnetosonic and Alfven waves.

Unit-5 Wave Propagation

Wave phenomena in magnetoplasma: Polarization, phase velocity, group velocity, cutoffs, resonance for electromagnetic wave propagating parallel and perpendicular to the magnetic field, Appleton-Hanree formula.

Text and Reference Book

1. Panofsky & Phillips: Classical electricity and magnetism
2. Bittencourt: Plasma Physics
3. Chen: Plasma POysics
4. Jackson: Classical electrodynamics

M. Sc. (Physics) Third Semester
PHY-301
COMPUTATIONAL METHODS AND PROGRAMMING

Unit-1 Error Analysis and Roots of Equations

Precision and accuracy, significant figures, floating point arithmetic, round-off and truncation error, False-position method, Newton-Raphson method, multiple roots, Fixed-point iteration method, convergence of solutions.

Unit-2 Linear Algebra Equations

Gauss elimination, Pivoting, Iterative method, eigen value and eigen vectors of matrices, power and Jacobi method.

Unit-3 Interpolation

Finite difference, Lagrange interpolation, interpolation with equally spaced and unevenly spaced points, cubic spline and least square curve fitting.

Unit-4 Numerical Integration and Ordinary Differential Equations

Trapezodial rule, Simpson's rules and Gauss method, Euler's methods, Huen's method, Runga Kutta method, Predictor and corrector method.

Unit-5 Fortran Programming-I

Elementary information about Digital computer principals, Interpreters and operating systems, Fortran programming, Expression, built in functions, executable and non-executable statements, assignment, control and input-output elements, subroutines and functions, operation with files.

Text and Reference Book

1. Sastry: Introductory methods and Numerical analysis
2. Rajaraman: Numerical analysis
3. Rajaraman: Fortran programming
4. Vetterming, Teukolsky, Press and Flannery: Numerical Reeipes

M. Sc. (Physics) Third Semester
PHY-302
NUCLEAR AND PARTICLE PHYSICS

Unit-1 General Properties of Nucleus

The construction of the nucleus and its general properties, proton electron hypothesis, proton neutron hypothesis, nuclear mass, mirror nuclei and isotopic spin, packing fraction and binding energy, nuclear radius and its determination, nuclear force.

Unit-2 Nuclear Decay

α decay-range, α particle spectra, Gamow theory, bete decay- Fermi decay of beta decay, shape of the beta spectrum, total decay rate, angular momentum and parity selection rules, parity voilation, detection and properties of neutrino, application of radiation theory to multipole transitions in nuclei, angular momentum and parity selection rules, internal conversion, nuclear isomerism.

Unit-3 Nuclear Models

Experimental evidences for shell model, spin orbit coupling, magic numbers, angular momenta and parities of nuclear ground states, qualitative discussion and estimates of transition rates, magnetic moments and Schmidt lines, collective model of Bohar and Mottelson.

Unit-4 Nuclear Reactions

Direct and compound reaction mechanism, scattering by a central potential, cross section in terms of partial wave amplitudes, effective range analysis.

Unit-5 Elementary Particle Physics

Types of interaction between elementary particles, Hadrons and leptons- symmetry and conservation laws, elementary ideas of CP and CPT invariance, classification of hadrons quark model SU(2) SU(3) multiplets, Gell-Mann-Okubo mass formula for octet decuplet hadrons.

Text and Reference Book

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. S de Benedeti: Nuclear interaction, John Wiley & Sons, New York, 1955
5. M K Pal: Theory of nuclear structure affiliated East- West, Madras, 1982.

M. Sc. (Physics) Third Semester
PHY-303 (S)
ELECTRONICS-I

Module-1 Operational Amplifier

Differential amplifier, circuit configuration, dual input, balanced output, differential amplifier, inverting and non-inverting inputs, CMRR.

Block diagram of a typical Op-amplifier analysis, inverting and non-inverting amplifier, Op-amplifier with negative feedback, voltage series feedback, integrator and differentiator.

Oscillators principles, Oscillator types- frequency stability response, the phase shift oscillator, wein bridge oscillator, IC tunable oscillator, multivibrators, monostable and astable comparators, square wave and triangular wave generators.

Module-2 Analog and Digital System & Opto-electronics

Analog computation, active filters, comparators, logarithmic and antilogarithmic amplifiers, sample and hold amplifiers, waveform generators, square and triangular wave generators, pulse generators.

ROM and applications, RAM and applications, digital to analog converters, analog to digital converters, successive approximation and dual slope converters, applications of DACs and ADCs.

Photodetectors: Photo detectors with external photo effect, Photo detectors with internal photo effect, photo conductor and photo resistor, junction photo detector, circuits with LED, diode tester, polarity and voltage tester, LED, numeric and alphanumeric display units, semiconductor switches and potential isolation, the phototransistor as a switch in the optocouplers, steady state performance, dynamic performance.

Text and Reference Book

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

M. Sc. (Physics) Third Semester
PHY-304 (S)
ELECTRONICS-II

Module-1 Communication and Digital Electronics

Amplitude modulation- generation of AM wave, demodulation of AM waves DSBSC modulation, generation of DSBSC waves, coherent detection of DSBSC waves, SSB modulation, generation and detection of SSB waves, vestigial sideband modulation, frequency division multiplexing (FDM), Principle of superhetrodyne receiver, square law detector, linear diode detector, frequency modulation & spectrum, reactance tube modulator, FM using verector diode, Armstrong method of FM, frequency stabilization.

Module-2 Digital Communication

Pulse modulation system: Sampling theorem-pass and band-pass signals, PAM, channel BW for a PAM signal, natural sampling, flat top sampling, single recovery through holding, quantization of signal, differential PCM, delta modulation, adaptive delta modulation, CVSD.
Mathematical representation of noise: sources of noise, frequency domain representation of noise, effect of filtering on the probability, density of Gaussian noise, spectral component of noise, effect of a filter on the power spectral density of noise, superposition of noise, mixing involving noise, linear filtering, noise bandwidth.

Text and Reference Book

1. Symen Haykins: Communication System
2. A P Malvino and Donald P Leach: Digital principles and applications, Tata McGraw Hill comp, New Delhi, 1993
3. B P Lathi: Communication System

M. Sc. (Physics) Third Semester
PHY-305 (S)
CONDENSED MATTER PHYSICS-I

Module-1 Crystal Physics and X-Ray Crystallography

External symmetry elements of crystals, concept of point groups, influence of symmetry on physical properties, electrical conductivity, space groups, derivation of equivalent point positions (with examples from triclinic and monoclinic systems), experimental determination of space group, principle of power diffraction method, interpretation of powder photographs, application of powder method.

Module-2 Lattice Dynamics

Inter atomic forces and lattice dynamics of simple metals, ionic and covalent crystals, optical phonons and dielectric constants, inelastic neutrons scattering, mossbauer effect, Debye-Waller factor, Anharmonicity, thermal expansion and thermal conductivity, fermi surface, de Hass van Alfen effect, cyclotron resonance, magneto-resistance, Quantum Hall effect.

Text and Reference Book

1. Azaroff: X-ray crystallography
2. Verma & Shrivastava: Crystallography for solid-state physics
3. Madelung: Introduction to solid-state theory
4. Callaway: Quantum theory of solids state
5. Huang: Theoretical solid-state physics

M. Sc. (Physics) Third Semester
PHY-306 (S)
CONDENSED MATTER PHYSICS-II

Module-1 Electron-Phonon Interaction

Interaction of electron with acoustic and optical phonons, polarons, superconductivity: crystal temperature, persitent current, meissner effect, manifestations of energy gap, cooper pairing due to phonons, BCS theory of superconductivity, Ginzsburg-Landau theory and application to Josephson effect: d c josephson effect, a c josephson effect, macroscopic quantum interference, vortices and type II superconductors, high temperature superconductivity (elementary).

Module-2 Disordered Systems

Point-defects shallow impurity states in semiconductors, localized lattice states in solids, vacancies, interstitials and colour centers in ionic crystals.

Disordered in condence matter, substitutional positional and topographical disorder, short and long range order, atomic correlation function and structural descriptions of glasses and liquids.

Anderson model for random systems and electron localization, mobility edge, qualitative application of the idea to amorphous semiconductors and hopping conduction.

Text and Reference Book

1. Azaroff: X-ray crystallography
2. Verma & Shrivastava: Crystallography for solid-state physics
3. Madelung: Introduction to solid-state theory
4. Callaway: Quantum theory of solids state
5. Huang: Theoretical solid-state physics
6. Kittel: Quantum theory of solids

M. Sc. (Physics) Fourth Semester
PHY-401 Core Paper
STATISTICAL MECHANICS

Unit-1 Basics of Statistical Mechanics

Foundation of statistical mechanics, specification of states of a system, contact between statistics and thermodynamics, classical ideal gas, entropy of mixing and Gibb's paradox, phase space, trajectories and density of states, Liouville's theorem.

Unit-2 Ensemble Theory

Micro-canonical, canonical and grand canonical ensembles, partition functions, calculation of statistical quantities.

Unit-3 Statistics

Density matrix, statistics of ensembles, statistics of indistinguishable particles, Maxwell Boltzmann, Fermi-Dirac and Bose Einstien statistics, properties of ideal Bose and Fermi gases, Bose-Einstein condensation.

Unit-4 Isling Model

Cluster expansion for a classical gas, virial equation of state, isling model, mean field theories of isling model in one, two and three dimensions, exact solution in one dimension.

Unit-5 Fluctuations

Fluctuations in ensemble, correlation of space-time dependent fluctuations, fluctuations and transport phenomenon, Brownian motion, Langevin theory, fluctuation dissipation theorem, Fokker-Plank equation.

Text and Reference Book

1. F Rief: Statistical and Thermal physics
2. K Huang: Statistical mechanics
3. R K Patharia: Statistical mechanics
4. R Kubo: Statistical mechanics
5. Landau and Lifshitz: Statistical mechanics

M. Sc. (Physics) Fourth Semester
PHY-402 (A) Elective Paper
ADVANCED NUMERICAL TECHNIQUES

Solution of system of ODEs, multistep method, stiffness of ODEs, Gear's technique for stiff equations, general method for boundary value problems (shooting and finite difference method).
Solution of PDEs (elliptic, parabolic and hyperbolic) by finite difference technique and their scientific applications, Leibmann itretive method, explicit and implicit methods, Crank-Nicolson method, ADI scheme, elementary idea of finite element method in one dimension.
Random variate, Monte-Carlo evaluation of integrals, method of important sampling, random walk and metropolis method.

Text and Reference Book

1. S C Chapra & R P Canale: Numerical methods for Engineers, IV edition, Tata Mc-Graw Hill.
2. S K Gupta: Numerical methods for Engineers
3. Suresh Chandra: Computer application in physics

M. Sc. (Physics) Fourth Semester
PHY-402 (B) Elective Paper
PHYSICS OF LASER AND LASER APPLICATIONS

Laser Characterization & Laser System: Gaussian beam and its properties, Stable Two Minor optical resonators, Longitudinal and Transverse modes of Laser Cavity, Mode Selection, Gain in regenerative laser cavity, Threshold for 3 and 4 level laser systems, Mode locking Pulse Shortening, Picosecond & femtosecond operation, Spectral Narrowing and Stabilization. Ruby Laser, Nd-YAG Laser, Semi Conductor Lasers, Diode Pumped Solid State Lasers, Nitrogen Laser, Carbon dioxide Laser, Excimer Laser, Dye Laser, High Power Laser system.
Laser Spectroscopy, Techniques and Other Applications: Laser fluorescence, Raman Scattering and their use in Pollution studies, Non linear interaction of light with matter, Laser induced multiphonon processes and their applications, Ultra high resolution spectroscopy with lasers and its applications, propagation of light in a medium with variable refractive index, Optical fibers, Light wave communication, Qualitative treatment of Medical and Engineering applications of lasers.

Text and Reference Book

1. Svelto: Lasers
2. Yariv: Optical Electronics
3. Demtroder: Laser Spectroscopy
4. Latekhov: Non linear Spectroscopy

M. Sc. (Physics) Fourth Semester
PHY-403 (S)
ELECTRONICS-III

Module-1 Microwave Devices

Klystrons, magnetrons and traveling wave tubes, velocity modulation, basic principles two cavity klystrons and reflex klystrons, principles of operation of magnetrons, Helix traveling wave tubes, wave modes, transferred electron devices, gunn effect, principle of operations, read diode, IMPATT and TRAPATT diode.

Advantage and disadvantage of microwave transmission, loss in free space, propagation of microwaves, atmospheric effects on propagation, Fresnel zone problem, ground reflection, fading sources, detectors, components, antennas used in MWC system.

Module-2 Radar Systems & Satellite Communications

Radar block diagram of an operation, radar frequencies, pulse considerations, radar range equation, derivation of radar range equation, minimum detectable signal, receiver noise, signal to noise ratio, integration of radar pulses, radar cross section, pulse repetition frequency, antenna parameters, system losses and propagation losses, radar transmitters, receivers, antenna displays.

Satellite communication: orbital satellites, geostationary satellites, orbital patterns, look angles, orbital spacing, satellite systems, link modules.

Text and Reference Book

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

M. Sc. (Physics) Fourth Semester
PHY-404 (S)
ELECTRONICS-IV

Module-1 Microprocessor and Micro-Computer

Microprocessor & Architecture: Internal microprocessor architecture, real mode and protected modes of memory addressing, memory paging.
Addressing modes: Data addressing modes, program memory addressing modes, stack memory-addressing modes.
Instruction set: Data movement instructions, arithmetic and logic instructions, program control instructions, assembler details.
Programming the microprocessor: Modular programming, using the keyboard and video display, data conversions, disk files, example programs.

Module-2 Memory Interface

Memory devices: Address decoding, 8088 and 80188 (8-bit) memory interface, 8086, 80186, 80286 and 80386 (16-bit) memory interface, 80386DX and 80486 (32-bit) memory interface, dynamic RAM.
Basic I/O interface: Introduction to I/O interface, I/O port address decoding, 8255, 8279, 8254, 16550, ADC and DAC.
Interrupts: Basic interrupts processing, hardware interrupts, expanding the interrupt structure, 8259 A PIC.

Text and Reference Book

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. Prentiee-Hall international, 1998.

M. Sc. (Physics) Fourth Semester
PHY-405 (S)
CONDENSED MATTER PHYSICS-III

Module-1 Optical Properties of Solids

Interaction of electron and phonons with photons, direct and indirect transition, absorption in insulators, polaritions, one phonons absorption, optical properties of metals, skin effect and anomalous skin effect.

Interacting electron gas: concept of many electron system, Thomas Fermi theory, Hartee and Hartee-Fock approximations, correlation energy, Linhard theory and Thomas Fermi theory of screening, plasma oscillations in free electron gas.

Module-2 Electrons in Solid and Surface States

Dielectric function of an electron gas in random phase approximation, limiting cases and Friedel oscillation, strongly interacting Fremi system, elementary introduction to Landau's quasi-particle theory of a Fermi liquid, Strongly correlated electron gas, elementary idea regarding surface states, metallic surfaces and surface reconstruction.

Text and Reference Book

1. Azaroff: X-ray crystallography
2. Verma & Shrivastava: Crystallography for solid-state physics
3. Madelung: Introduction to solid-state theory
4. Callaway: Quantum theory of solids state
5. Huang: Theoretical solid-state physics
6. Kittel: Quantum theory of solids

M. Sc. (Physics) Fourth Semester
PHY-406 (S)
CONDENSED MATTER PHYSICS-IV

Module-1 Imperfection in Crystals

Mechanism in plastic deformation in solids, Stress and strain fields of screw and edge dislocation, elastic energy of dislocations, forces between dislocation, stress needed to operate Frank-Read source, dislocation in fcc, hcp and bcc lattices, partial dislocations and stacking faults in closed-packed structures.

Module-2 Films and Surfaces

Study of surface topography by multiple beam interferometry, condition for accurate determination of step height and film thickness (Fizeau fringes), electrical conductivity of thin films, difference of behavior of thin films from bulk, Boltzmann transport equation for a thin film (for diffused scattering), expression for electrical conductivity for thin film.

Text and Reference Book

1. Azaroff: X-ray crystallography
2. Verma & Shrivastava: Crystallography for solid-state physics
3. Madelung: Introduction to solid-state theory
4. Callaway: Quantum theory of solids state
5. Huang: Theoretical solid-state physics
6. Kittel: Quantum theory of solids