UNIVERSITY OF ALLAHABAD
SYLLABUS: M.Sc. PHYSICS

SEMESTER – I

PAPER I-MATHEMATICAL PHYSICS

PHY501

Unit I Complex Analysis: Analytic functions, Cauchy-Riemann equations, Cauchy's theorem, Cauchy's Integral formula, Laurent series, Poles, Residue theorem, Evaluation of integrals.

Unit II Linear Differential Equations: Second order linear differential equations; Regular, regular singular and singular points; series expansion method.

Unit III Special Functions: Bessel, Legendre, Hermite and Laguerre differential equations with properties of their solutions.

Unit IV Integral transforms: Laplace transform, Fourier theorem, Fourier transforms.

Unit V Dirac delta function and Green's function: Green's function for Laplace operator, Solution of Poisson's equation, Inhomogeneous Wave equation and applications.

Recommended Books:

1. Complex Variables by Murray R. Spiegel
2. Introduction to Green's Functions in Physics by K.A.I.L. Wijewardena Gamalath
3. Mathematical Physics by B. S. Rajput
4. Mathematical Physics by H K Das
5. Mathematical Method for Physicists: A Comprehensive Guide by G.B. Arfken, H.J. Weber and F.E. Harris

SEMESTER – I

PAPER II-CLASSICAL MECHANICS

PHY502

Unit I Variational Principles and Langrange's Equations: Hamilton's principle, Calculus of variations, Langrange's equations, Conservation Theorems and symmetry properties.

Unit II Hamiltonian formalism: Legendre transformations and the Hamiltonian Equations of Motion, Cyclic coordinates.

Unit III Canonical Transformations: Canonical transformations, Poisson Bracket

Unit IV Hamilton – Jacoby Theory: Hamiltonian Jacoby equations; Hamiltonian Jacoby theory, geometrical optics and wave mechanics

Unit V Small oscillations and normal modes: Small oscillations about a stable equilibrium, Normal modes and their frequencies, Langrangian and Hamiltonian formalism of Classical Fields.

Recommended Books:

1. Introduction to Classical Mechanics by David Morin
2. Classical Mechanics by Herbert Goldestine
3. Classical Mechanics by J. C. Upadhyaya

SEMESTER – I

PAPER III-ELECTROMAGNETIC THEORY

PHY503

Unit I Guided electromagnetic waves: Transmission Lines and Wave Guides, Modes in a rectangular wave guide, Cavity resonators.

Unit II Tensor analysis: General coordinate transformation; contravariant, covariant and mixed tensors; metric tensor; raising and lowering of indices; contraction of indices.

Unit III Minkowsky space and Lorentz transformations: Geometry of space-time in Special Relativity; Minkowsky metric; Light cone and principle of causality; Invariance of Minkowsky metric under Lorentz transformations;Lorentz group; Proper, improper and orthochronous transformations; Pseudo-tensors.

Unit IV Covariant formulation of electromagnetism: Charge-current density four-vector; Scalar and Vector potentials; Gauge invariance; Electromagnetic potential four-vector; Electromagnetic field tensor; Lorentz transformation of electric and magnetic fields; Invariants of the electromagnetic field

Unit V Electromagnetic field of a charge moving with constant velocity, Covariant form of Lorentz force law; Dynamics of charged particles in static and uniform electric fields.

Recommended Books:

1. Vector Analysis by Murrey Speigal, Mc Graw Hill.
2. General theory of Relativity by S.P Puri , Pearson Education limited
3. Special theory of Relativity by Dr Anil Kumar, Dr Anjani Kumar Singh, Dr Sindhu Singh, Book clinic
4. Co-variant Transformation of Electromagnetic by Saty Prakash

SEMESTER – I

PAPER IV-QUANTUM MECHANICS –I

PHY504

Unit I Dirac's Bra & Ket Notations, Hilbert Space, Vector Representations of States, Projection Operators, Observables as Operators, Orthonomality and Completeness of States, Relation between Ket and Wave-functions, Wave-functions in Coordinate and Momentum Representations

Unit II Matrix Theory of Harmonic Oscillator, Uncertainty Relations, Schrödinger, Heisenberg and Dirac Representations.

Unit III Orbital Angular Momentum, Angular Momentum Algebra, Spin, Addition of Angular Momenta

Unit IV Clebsch-Gordon Coefficients, Explicit Addition of Angular Momentum 1/2 with Angular Momenta 1/2 and 1, Spherical Harmonics in Central Field Problems, Spin-Orbit Coupling, Fine-Structure.

Unit V Non-Covariant Derivation of Lagrangian Equations for fields, Canonically Conjugate Momentum Density for Schrodinger Field, Quantum Conditions based on Commutation Relations and Second Quantization, Annihilation and Creation Operators, Second Quantization based on Anti-Commutation Relations, Simple Problems on Algebra of Annihilation and Creation Operators.

Recommended Books:

1. Quantum Mechanics: Theory and Applications by Ajoy Ghatak and S. Lokanathan
2. Quantum Mechanics: Concepts and Applications by Nouredine Zettili
3. Principles of quantum mechanics by R. Shankar
4. Berkeley Physics Course volume 4 (Quantum Mechanics
5. The Feynman Lectures on Physics (Volume III)
6. Quantum Mechanics by B K Agarwal and Hari Prakash
7. Quantum Mechanics by R K Srivastava
8. Quantum Mechanics by L D Landau and E M Lifshitz
9. Quantum Theory by D Bohm
10. Principles of Quantum Mechanic by P A M Dirac
11. Advanced Quantum Mechanics by J J Sakurai
12. Quantum Mechanics by S L Kakani and H M Chandaliya

SEMESTER – II

PAPER I-QUANTUM MECHANICS –II

PHY505

Unit I Time-Independent Perturbation Theory and Applications, Variational Method, WKB Method,

Unit II Time-Dependent Perturbation Theory, Constant and Harmonic Perturbation, Transition probabilities, Fermi's Golden Rule, Semi-Classical Theory of Radiation, Einstein A and B Coefficients, Selection Rules, Scattering,

Unit III Method of Partial Waves, Phase-Shifts, Born Approximation, Simple Applications.

Unit IV Klein Gordon Equation and Free Particle, Solution, Dirac Equation, Dirac Matrices, Covariance of Dirac Equation & Bilinear Covariants,

Unit V Solution for a Free Particle, Negative Energy states and Hole Theory, Spin, Position Operator.

Recommended Books:

1. Quantum Mechanics and Field Theory by B.K. Agarwal
2. Quantum Mechanics: B K Agarwal and Hari Prakash
3. Relativistic Quantum Mechanics: J D Bjorken and S D Drell
4. An Introduction to Relativistic Quantum Field Theory: Silvan S Schweber
5. Quantum Mechanics: R K Srivastava
6. Quantum Mechanics: L D Landau and E M Lifshitz
7. Quantum Theory: D Bohm
8. Intermediate Quantum Mechanics: H A Bethe
9. Principles of Quantum Mechanics: P A M Dirac
10. Advanced Quantum Mechanics: J J Sakurai
11. Quantum Mechanics concept and Application: N Zettili

SEMESTER – II

PAPER II-STATISTICAL MECHANICS

PHY506

Unit I A review of Gibbs ensembles, Partition function for Perfect Gas and ensemble of Harmonic Oscillators, Partition Function for Gases containing Monoatomic, Diatomic and Polyatomic Molecules. Grand partition function,

Unit II Grand potential, FD and BE distribution in Grand Canonical ensemble Degenerate Bose Gas, Momentum Condensation, Liquid He II, Two fluid theory, Superfluidity.

Unit III Degenerate FD Gas, Conduction Electrons in a Metal, Fluctuations, One dimensional Random walk, Gaussian Distribution, Fluctuation in energy in canonical ensemble and concentration in Grand Canonical ensemble.

Unit IV Random processes, Markoff process, Langevin Equation, Correlation functions, Fluctuations Dissipation Theorem, Weiner-Khintchine theorem, Nyquist theorem,

Unit V Conditional probability, Fokker Plank Equation, Brownian motion.

Recommended Books:

1. Statistical Mechanics by R K Pathria
2. Statistical Mechanics by K Huang
3. Statistical Physics by F Reif
4. Statistical Physics by C Kittel

SEMESTER – II

PAPER III-SOLID STATE ELECTRONICS

PHY507

Unit I P-N Junction Diode: Rectifier with LC Filter, Electronic regulator. Bipolar Junction Transistors: h-parameters, inter conversion in different configurations, low frequency transistor amplifier, thermal stability and bias stabilization.

Unit II Field Effect Transistors: Small signal model and dynamic parameters, CS and CD amplifiers. Multistage Amplifiers: BJT at high frequencies, frequency response of gain and phase shift, frequency response of RC coupled amplifier.

Unit III Feedback Amplifiers and Oscillators: Different negative feedback amplifiers, stability and Nychist criteria , sinusoidal oscillators , phase shift and Wien's bridge oscillators, Crystal oscillator, astable multivibrator.

Unit IV Power and Radio Frequency Amplifier: Large signal amplifier and distortions, push-pull amplifier, single and double tuned amplifiers.

Unit V Modulation: Frequency and phase modulation, frequency modulation Demodulation: Frequency changing and tracking; AGC, AFC, FM detection, amplitude limiter, phase discriminator, ratio detector.

Recommended Books:

1. Electronic Devices and Circuit by Robert L. Boylestad and Louis Nashelsky
2. Electronic Devices and Circuits by David A. Bell
3. Millman's Electronic Devices and Circuits by Jacob Millman
4. Electronic Devices by Thomas L. Floyd
5. Solid State Electronic Devices By Ben G. Streetman
6. Electronic Devices and Circuits: An Introduction by Allen Mottershead
7. Electronic Materials and Semiconductor Devices by Dilip Kumar Roy
8. Electronic Devices & Circuits by Muhammad H. Rashid

SEMESTER – II

PAPER IV-ATOMIC & MOLECULAR PHYSICS

PHY508

Unit I Quantum states of an electron in an atom, Spectrum of Hydrogen and Helium atom, fine structure Spectra of Alkali atoms; energy level diagrams, Sharp, Principal, Diffuse and fundamental series.

Unit II Width of spectral lines, X-ray spectroscopy, Spectroscopic terms; LS & JJ couplings, Hyperfine structure

Unit III Zeeman, Paschen Back & Stark effect, Electron spin resonance, Nuclear magnetic resonance, chemical shift

Unit IV Spectra of Diatomic Molecules Rotational Spectra (rigid rotator and non rigid rotator model) Vibrational Spectra (harmonic and enharmonic model) Molecular Symmetric Top, Vibrating rotator Isotopic shift

Unit V Raman Spectra (Quantum mechanical and classical approach) Electronic Spectra-vibrational structure of band system, fine structure of the band systems. Intensity distribution in band systems: Frank Condon principle

Recommended Books:

1. Introduction to Atomic Spectra by H.E. White
2. Atomic Physics by C.J. Foot
3. Spectra of Atoms and Molecules P.F. Bernath
4. Atomic Spectra and Atomic Structure by G. Hertzberg
5. Physics of Atoms and Molecule by B. H. Bransden and C. K. Joachain
6. Atoms, Molecules and Photons: An Introduction to Atomic, Molecular and Quantum Physics by W. Demtroder
7. Molecular Spectra and Molecular Structure-I (Spectra of Diatomic Molecule) by G. Hertzberg
8. Fundamentals of Molecular Spectroscopy by C.N. Banwell
9. The Raman Effect by D.A. Long
10. Modern Spectroscopy by J. M. Hollas

SEMESTER-I AND SEMESTER-II
LABORATORY COURSE CODE

GENERAL LAB	**PHY531**
ELECTRONICS LAB	**PHY532**

SEMESTER – III

PAPER - I CONDENSED MATTER PHYSICS

PHY601

Unit I Electron band theory: one electron band theories. Plane wave like and localized wave functions. Nearly free electron approximation. Elementary discussion of orthogonalized Plane Wave (OPW) and Pseudo potential methods, Variation of Fermi energy in extrinsic semiconductors, de-Hass-van Alphen effect experiment to investigate Fermi surface.

Unit II Superconductivity: Meissner effect, isotope effect, type I and II superconductors. Cooper pairs. Elementary ideas of BCS theory, Approximate estimate of transition temperature, superconducting energy gap , Measurement of energy gap by infrared absorption and electron tunneling methods, Elementary ideas about Josephoson effect and high Tc superconductors.

Unit III Ionic lattice in presence of infrared field, dielectric constant, L.S.T. relation, LO and TO modes, Ordered phases of matter, translational and orientational order, Quasicrystals, conducting polymers.

Unit IV Lattice defects: Frenkel and Schottky defects, colour centres, number of defects (vacancies) in equilibrium, Dislocations, edge and screw Burgers vector.

Unit V Diamagnetism, Langevin diamagnetic equation, Quantum theory of paramagnetism rare earth ions and iron group ions. Ferromagnetism, Curie temperature, Heisenberg model, Temperature dependence of saturated magnetization.

Recommended Books:

1. Introduction to solid state physics by Charles kittel
2. The Oxford solid state basics by Steven H. Simon
3. Solid state physics by R.L. Singhal
4. Solid state physics by M. ali Omar
5. Electron Energy Bands in Solids by Joseph Callaway
6. Quantum theory of solids by Joseph callaway
7. Principles of theory of solids by J M Ziman
8. Solid state theory by Walter A. Harrison
9. Quantum Theory of Magnetism: Magnetic Properties of Materials by Robert M. White
10. Band Theory and Electronic Properties of Solids by John Singleton
11. Magnetism in Condensed Matter by Stephen Blundell
12. Theory Of Superconductivity by J. Robert Schrieffer
13. Introduction to Superconductivity By Michael Tinkham

SEMESTER – III

PAPER - II NUCLEAR PHYSICS

PHY602

Unit I Deuteron, n-n scattering, n-p scattering, p-p scattering, charge symmetry of nuclear forces.

Unit II Shell Model, Extreme Single particle picture and angular momentum, magnetic moment, quadrupole moment of nuclei, Nuclear Isomerism, Collective model (qualitative discussion)

Unit III Compound Nucleus, Breit Wigner Formula, Direct Interaction, Heavy Ion Reactions, Relativistic Kinematics

Unit IV Fundamental types of Interactions, General Classifications of Elementary Particles, Isospin, Strangeness ,Conservation Laws , Symmetries (C, CP, CPT), SU(3) and quark model

Unit V Alpha, beta and gamma decay

Recommended Books:

1. Nuclear Physics by D.C. Dayal
2. Nuclear Physics by Satya Prakash
3. Nuclear Physics by S.N. Ghoshal
4. Element of Nuclear Physics by RPS Yadav and M.L. Pandey

SEMESTER III: SPECIAL PAPERS

SEMESTER III: SPECIAL PAPERS

ELECTRONICS

PAPER – III: ANALOG AND DIGITAL ELECTRONICS

PHY653

Unit I Wide band amplifier: Review of BJT at high frequencies. Hybrid pi-equivalent model, Junction capacitance, Base spreading resistance, Laplace Transform. RC Amplifier (CE BJT case only), transient response using Laplace Transforms. Effect of an emitter bypass capacitor on low frequency response. High and low frequency compensations.

Unit II Operational Amplifier: Ideal op-amp. Emitter coupled differential amplifier. CMRR, Effect of constant current source IC op-amp (emitter follower, level translation and out put device). Off – set error voltage and current and there balancing circuits. Temperature drifts, measurement of op-amp parameters.

Unit III Linear Analog System: Basic op-amp Applications: Inverter, Scale changer, phase shifter, adder, voltage to current converter, current to voltage converter, d.c. voltage follower, differential dc and bridge amplifier, a.c voltage follower, analog integration and differentiation, analog compensation, solution of simultaneous and differential equations upto second order, amplitude and time scaling. Active filter, Butterworth filter, active resonant band pass filter.

Unit IV Non-linear Analog System: Comparators, sample and hold circuits, AC/DC converters and detectors, log and antilog amplifiers, log multiplier, wave form generator, regenerative comparator.

Unit V Digital Electronics (TTL Based): Review upto combination logic, Flip Flop: DSR, JK, Master slave, Registers and counters: Shift Register, ripple counter, up down ashynchronous and synchronous counters, ring counter and sequence generators.

Recommended Books:

1. Op-amps and Linear Integrated Circuits by R A Gayakwad
2. Op-amps for Everyone by Ron Mancini
3. Op-amp applications handbook by Walter G Jung

SEMESTER III: SPECIAL PAPERS

PAPER – IV: MICROWAVES

PHY654

Unit I Cylindrical W/G, two conductor system and TEM mode, discontinuity reflection coefficient and SWR, Scattering coefficients of multiple junction, directional coupler, hybrid T, cylindrical cavity resonator ; S.O. of a cavity resonator, wave meter, attenuator, slotted line, magnetic properties of Ferrites, Faraday rotation, Gyrator and Isolator, Microwave Integrated circuits.

Unit II Vacuum Tube Microwave Generators: Velocity modulation and density modulation, small signal theory of bunching, two cavity klystron amplifier and multiplier, two cavity klystron Oscillator, Reflex klystron: Theory of bunching, optimum power, effect of repeller voltage, electronic admittance, efficiency, electronic tuning.

Unit III Magnetron: Travelling wave magnetron, modes of oscillations, output power.

Unit IV Travelling wave tube: Description, dynamic of electron beam, coupling of beam and slow wave structure, waves in periodic structure, TWT amplifier and BWO, Generation of mm waves.

Unit V Microwave Measurements: Power, frequency, VSWR, Impedance, dielectric permittivity, Network Analyzer and scattering coefficients.

Recommended Books:

1. Microwave Engineering: David M. Pozer
2. Microwave devices and circuits: Samuel Liao
3. Microwave Engineering: M Kulkarni
4. Handbooks of Electronics: Gupta and Kumar

SEMESTER III: SPECIAL PAPERS

NON-LINEAR OPTICS

PAPER – III: COHERENCE THEORY AND ELEMENTARY NONLINEAR OPTICS

PHY657

Unit I Representation of Polychromatic Field by Analytic Signal. Mutual and Self Coherence Functions. Degree of Coherence, Relationship of Spectral-Profile with Correlation Functions.

Unit II Van Cittert Zernicke Theorem, Degree of Coherence of Thermal Circular Thermal Source,

Unit III Free Electron in Plane Electromagnetic Wave, Drift Acceleration of Electron, Second Harmonic Generation in Scattering of Plane Electromagnetic Wave (elementary discussion)

Unit IV Nonlinear Polarization, Classical Model of an Anharmonic Oscillator, Susceptibilities and Miller's Rule. Elementary discussion of Self-Focussing and Self-Steepening.

Unit V Simple explanation of Kerr Effect, Elementary Discussion of Harmonic Generation in Dielectric and Phase Matching.

Recommended Books:

1. Optical Coherence and Quantum Optics by L. Mandel and E. Wolf
2. Nonlinear Optics by Robert W. Boyd.
3. Lasers and Non-Linear Optics by B.B. Laud.

SEMESTER III: SPECIAL PAPERS

NON-LINEAR OPTICS

PAPER – IV: QUANTUM STATES OF RADIATION

PHY658

Unit I Coherent States of Radiation and their Properties, Coherent State as wave packet, Expansion of States and Operators in Terms of Coherent States.

Unit II Density Operator of Radiation, Sudarshan-Glauber Representation, Density Operators of Coherent and Chaotic Radiation, Coherence and Characteristics Functions.

Unit III Polarization and Stokes Parameters, Annihilation and Creation Operators for Modes with General Polarization, Unpolarized Light.

Unit IV Photoelectron Counting Distribution, Hanbury Brown and Twiss Experiment, Bunching and Antibunching, Example of pure Fock State for Antibunching of Photons,

Unit V Schwartz Inequalities and Quantum Behaviour of Optical Fields, Squeezed States of Radiation (Elementary Discussion)

Recommended Books:

1. Quantum Optics: M. O. Scully and M. S. Zubairy
2. Optical Coherence and Quantum Optics: L. Mandel and E. Wolf
3. Introduction to Modern Quantum Optics: J S Peng and G X Li
4. Quantum Optics: D F Walls and G J Milburn
5. Principle of Optics: M Born and E Wolf
6. Quantum Optics: M. Fox
7. Introductory Quantum Optics: C C Gerry
8. Quantum Optics: G S Agarwal
9. Mathematical Methods of Quantum Optics: R R Puri
10. Concepts of Quantum Optics: P L Knight and L Allen
11. Quantum Theory of Light: R Loudan

SEMESTER – IV

PAPER – I: EXPERIMENTAL TECHNIQUES & CONTROL SYSTEMS

PHY603

Unit I Data Interpretation and Analysis: precision and accuracy, error analysis, propagation of errors, least squares fitting, linear and non-linear curve fitting, chi-square test.

Unit II Optoelectronic Devices and Detectors: Solar cells, Photo-detector, Transducers (Temperature, Pressure, Vacuum pumps and Gauges)

Unit III Measurement and Control systems: Signal conditioning and recovery impedance matching. Ideal operational amplifier, characteristics and applications; Inverting and non-inverting amplifier, integrator, differentiator, adder and comparator.

Unit IV Analogue v/s digital data: Statement of sampling theorem, A/D converters (Flash converters, single slope, double slope and successive approximation converter), D/A converter(R-2R ladder type and weighted resistor type converter), Digit filter (tapped delay line filter)

Unit V Fourier Transforms and lock-in detector, Box car averaging. Microprocessor and microcontroller basics, Instruction set related MOV, MVI and I/O commands. Addressing I/O devices (Memory mapped & I/O mapped I/O)

Recommended Books:

1. Instrumentation, Measurement and analysis by B C Nakra, KK Choudhary, Mc Graw Hill education.
2. An introduction to error analysis by John R Taylor, University science book
3. Higher engineering mathematics by B S Grewal, Khanna Publisher.
4. Op-amps and Linear Integrated Circuits by R A Gayakwad
5. Microprocessor Architecture, Programming, and Applications with the 8085 by Ramesh S. Gaonkar

SEMESTER – IV: ELECTIVE PAPER

ELECTIVE – I
PAPER - II PROGRAMMING FOR NUMERICAL METHODS

PHY663

Unit I C++ keywords: various data types, implicit conversions, for loop, while and do-while loop, break and continue statements, switch statement, if else, conditional operator, functions with default arguments, function overloading.
Unit II ++ and – operators, Arrays, Structures, Pointers, Compound assignment.
Unit III Basic concept of OOP: definition of class and object, declaration of classes and objects, simple applications.
Unit IV Programming in C++ for the following: Newton Raphson method, Iterative method, Integration by Trapezoidal and Simpson 1/3 rule, Interpolation, Matrix manipulations.
Unit V Programming in C++ for Euler's method, Runge Kutta (second order and fourth order) method, phase space trajectory, equilibrium points, stability analysis.

SEMESTER – IV: ELECTIVE PAPER

ELECTIVE – II
PAPER - II ELECTROYNAMICS AND SECOND QUANTIZATION

PHY664

Unit I Radiation from a Moving Charge: Solution of Inhomogeneous Wave equation, Greens Functions, Lienard Wiechert Potentials and Field from a moving charge, Larmor's formula and its Relativistic Generalization

Unit II Angular Distribution of Radiation from an Accelerated Charge, Electromagnetic Field and Radiation from an Oscillating Localized Source.

Unit III Radiation Reaction and Self-Force: Radiation Reaction Force from Conservation of Energy, Line Width and Level Shift of an Oscillator.

Unit IV Covariant Lagrangian Formalism, Noether's Theorem, Energy-Momentum, Angular Momentum and Spin Tensors, Current Density Four Vector.

Unit V Second Quantization of Scalar field and of Electromagnetic Field in Radiation Gauge and of Dirac Field, Spin of Photons, Simple Problems on Algebra of Annihilation and Creation Operators.

Recommended Books:

1. Classical Electrodynamics by John David Jackson
2. Classical Electrodynamics by Julian Schwinger
3. Quantum mechanics by L I Schiff

SEMESTER – IV: ELECTIVE PAPER

ELECTIVE - III
PAPER - II GROUP THEORY

PHY665

Unit I Group theory and its application: Abstract definitions: Group, Multiplication Table, Sub-groups, Isomorphism and homomorphism, complexes, Cosets and classes, Indirect-group, Direct product of groups.

Unit II Theory of Representation :Linear vector space, basis, matrix representation of operators, unitary space, Unitary matrices, representation of group, characters, reducible and irreducible representations, Invariant subspaces, Schur's Lemmas

Unit III Orthogonality theorem for irreducible representation and characters Regular representation, occurrence of, an irreducible representation in a reducible representation.

Unit IV Theorem for possible number of irreducible representations of a group. Direct product of representations. Relationship to Quantum mechanics: Symmetry transformations, degeneracy and invariant subspaces, projection operators, transformation of functions.

Unit V Applications to molecular and crystal symmetry, Fundamental point group operations and nomenclature, construction of thirty-two point groups and character tables for their irreducible representations.

SEMESTER – IV: SPECIAL PAPERS

ELECTRONICS

PAPER – III: MICROPROCESSOR

PHY668

Unit I Microprocessor: Microprocessor 8085, Instruction set, Simple programs,

Unit II Memory organization and mapping, I/O devices Chip select and interfacing in I/O mapped and memory mapped I/O schemes.

Unit III Hardware description of 8085.

Unit IV PIA 8255 Handshaking via interrupt and polling, CMOS devices as RAM and ROM. Memory refresh.

Unit V A to D and D to A converter, IC ADC0809 and DAC08, Pin Out their interfacing with 8085.

Recommended Books:

1. Microprocessor Architecture, Programming, and Applications with the 8085 by Ramesh S. Gaonkar
2. 8085 Microprocessor & Its Application by Nagoorkani

SEMESTER – IV: SPECIAL PAPERS

PAPER – IV: ELECTRONICS: SEMICONDUCTOR DEVICES

PHY669

Unit I Semiconductor Physics: Carrier concentration in intrinsic and extrinsic semiconductors, recombination process, current density and continuity equations, decay of photo excited carrirs, steady state injunction, transient and steady state diffusion.

Unit II P-n junction diode : Junction and diffusion capacitance, diode equation, break downs, temperature dependence of voltage and current. Varactor diode and parametric conversion and amplification,

Unit III Tunnel diode, V-I characteristics, tunnel diode as an amplifier and as an oscillator.

Unit IV Gunn diode, modes of operation, power and frequency performance. Impact: Static and dynamic characteristic, small signal analysis and negative conductance, power and frequency performance, device design and performance. Schottky effect and Schottky diode.

Unit V BJT :Current voltage relations in active, cut off and saturation regions, microwave transistor, cut off frequency, device geometry and performance.

Recommended Books:

1. Semiconductor Physics and Devices (Basic Principles) by Donald A Neamen
2. Semiconductor Devices: Basic Principles by Jasprit Singh
3. A Handbook of Electronics by Gupta and Kumar

SEMESTER – IV: SPECIAL PAPERS

NON-LINEAR OPTICS

PAPER – III: RESONANT INTERACTION OF ATOMS WITH RADIATION – I

PHY674

Unit I Homogeneous and Inhomogeneous Broadenings, Semi-classical Theory of Interactions of Two-Level Atoms with Radiation, Rotating Wave Approximation and Description by a Pseudo-spin Vector.

Unit II Optical Bloch Equations, Comparison of Classical and Semi-classical Descriptions, Elementary Ideas about Area of Pulses and Rabi solution of Optical Bloch Equations. Phenomenological Introduction of Decay Constants.

Unit III Solution of Optical Bloch Equations and Elementary Applications, Elementary Ideas about Optical Nutation and Adiabatic Following.

Unit IV Coupled Maxwell and Optical Bloch Equations, The Factorization Assumption, Elementary ideas about Self-Induced Transparency

Unit V Elementary ideas about Mc Call Hahn Area Theorem and, Photon Echo and its Direction

Recommended Books:

1. Resonant Interaction of atom with radiation -l by. L Allen and J H Eberl

SEMESTER – IV: SPECIAL PAPERS

PAPER – IV: RESONANT INTERACTION OF ATOMS WITH RADIATION– II

PHYS675

Unit I Two-Level Model of Atoms, Atomic Spin Operators and States and their properties, Rotations in Atomic Spin Space and Elementary Ideas about Berry's Phase.

Unit II Dicke's Collective Atom Operators and States, Degeneracy of Dicke States of an Assembly of Atoms, Holstein-Primakoff and Two-Boson Modes Representations of Dicke Operators and States.

Unit III Elementary Ideas about Entanglement of Two Two-Level Systems and their Use in Quantum Teleportation.

Unit IV Schrodinger, Heisenberg and Interaction Pictures. Hamiltonian for Interaction of an Atom with Radiation. Relative Contributions of $\mathbf{p.A}$ and $\mathbf{A}^2$ terms, Dipole Approximatiion, Rotating Wave Approximation.

Unit V Weisskopf-Wigner Approximation, Welton's Treatment of Lamb Shift, Superradiance.

Recommended Books:

1. Optical Resonance and Two Level Atom: L Allen and J H Eberly
2. Element of Quantum Optics: P Meystre
3. Quantum Optics: M. O. Scully and M. S. Zubairy
4. Optical Coherence and Quantum Optics: L. Mandel and E. Wolf
5. Introduction to Modern Quantum Optics: J S Peng and G X Li
6. Quantum Optics: D F Walls and G J Milburn
7. Introductory Quantum Optics: C C Gerry
8. Quantum Optics: G S Agarwal
9. Mathematical Methods of Quantum Optics: R R Puri
10. Concepts of Quantum Optics: P L Knight and L Allen

SEMESTER III AND IV
LABORATORY COURSE CODE

ELECTRONICS LAB	**PHY632**
NON-LINEAR OPTICS LAB	**PHY634**