COURSE DETAILS
I SEMESTER (July - December 2011)

PHYSICS

THEORY COURSES

PT – 101 METHODS IN MATHEMATICAL PHYSICS
- Unit – I Tensor Analysis
- Unit – II Elements of Complex Variable
- Unit – III Theory of Fourier and Laplace Transforms
- Unit – IV Special Functions
- Unit – V Partial Differential Equations

PT – 102 CLASSICAL MECHANICS
- Unit – I Lagrangian Mechanics
- Unit – II Variational Principle
- Unit – III Two body central force problem and scattering
- Unit – IV Small oscillations
- Unit – V Transformation and equation of motion

PT – 103 ELECTROMAGNETISM AND LASER OPTICS
- Unit – I Application of Maxwell Equations
- Unit – II Electromagnetic Wave an Isotropic Medium
- Unit - III Electromagnetic Wave Interactions
- Unit - IV Elements of Laser Physics
- Unit -V Nonlinear Optics

PT – 104 SEMICONDUCTOR ELECTRONICS
- Unit - I Biasing Techniques And Linear Amplifier
- Unit - II Power Amplifier And Oscillators
- Unit - III Wave Shaping Circuits
- Unit - IV Basics of Differential and Operational Amplifiers
- Unit - V Application of Operational Amplifier

LABORATORY COURSES

- PL – 105 General Laboratory
- PL – 106 Electronics Laboratory

PT – 101 METHODS IN MATHEMATICAL PHYSICS

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit – I Tensor Analysis

Definition of Tensor and its rank, Transformation laws of covariant, contravariant and mixed tensors, Fundamental Operations with tensors (addition, subtraction and multiplication), Inner and outer product, Contraction of tensors, Associated tensors, Christoffel symbols, covariant differentiation of tensor

Unit – II Elements of Complex Variable

Functions of a complex variable, the derivative and the Cauchy-Riemann differential equations, line integrals of complex functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor's series, Laurent's series, residues; Cauchy's residue theorem, singular points of an analytic function, the point at infinity, evaluation of residues, evaluation of definite integrals, Jordon-Lemma

Unit – III Theory of Fourier and Laplace Transforms

Fourier series analysis, evaluation of constants, Fourier sine, cosine and complex transforms, transforms of derivatives, Convolution theorem, Parseval's relation, Momentum representation: Examples from optics, Electromagnetism and quantum mechanics, Laplace transforms of simple function and derivatives, LT solution of simple differential equations, convolution theorem.

Unit – IV Special Functions

Singularity structure of a general second order homogeneous differential equation : ordinary points, regular and irregular points, indicial equation, The point at infinity, Series expansion method for solving differential equations, series solutions, Generating functions and recurrence relations and orthogonality of Legendre and Hermite polynomials

Unit – V Partial Differential Equations

Laplace equation, 2-D study flow of heat, circular harmonics, conducting cylinder in a uniform field, The potential of a ring, The potential about a spherical surface, the equation of heat, conduction or diffusion, variable linear flow, two-dimensional heat conduction, temperature inside a circular plate.

BOOKS RECOMMENDED

1) Applied Mathematics for Engineers and Physicist: Pipes
2) Mathematical Physics: Harper
3) Advanced Engineering Mathematics: Kreyszig
4) Schaum Series for Transforms, Complex Variables and Tensors
5) Mathematical Methods: Arfken
6) Elements of Complex variables: Churchill

PT – 102 CLASSICAL MECHANICS

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit – I Lagrangian Mechanics

Mechanics of a particle, Mechanics of a system of particles, Constraints, Generalised coordinates, De Alembert's principle and Lagrangian equations, Lagrangian for a charged partcle in an electromagnetic field, application of Lagrangian formulation to (a) single particle in space, (b) Atwood's machine.

Unit – II Variational Principle

Hamilton's principle, some techniques of the calculus of variation, application to (a) geodesics in a plane (b) minimum surface of revolution, Derivation of Lagrange's equation from Hamilton's principle, Conservation laws and corresponding symmetry principles

Unit – III Two body central force problem and scattering

Reduction of two body central force problem to the equivalent one body problem, The equation of motion and the first integrals, Classification of orbits, the virial theorem, the Kepler problem, scattering in a central force field, Rutherford scattering, transformation of the scattering problem to laboratory coordinates.

Unit – IV Small oscillations

Formulation of the problem, the eigen value equation, frequencies of free vibration, free vibration of a linear tri atomic molecule, transition from a discrete to a continuous system, the Lagrangian formulation for continuous system.

Unit – V Transformation and equation of motion

Lagendre transformations and the Hamilton equations of motion, cyclic coordinates and conservation theorem, Hamilton's equation from variational principle, equation of canonical transformation, Poisson brackets: Definition and identity relation, equation of motion and conservation theorem in the Poisson bracket formulation, the Hamilton-Jacobi equation for Hamilton's principal function, the Harmonic oscillator problem as an example of Hamilton-Jacobi method.

BOOKS RECOMMENDED

1. Classical Mechanics: Goldstein.
2. Classical Mechanics: Takwale

PT – 103 ELECTROMAGNETISM AND LASER OPTICS

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit – I Application of Maxwell Equations

Maxwell's equation, Field energy, Poynting theorem, plane wave solution of Maxwell's equations, Reflection and Refraction at a plane boundary of dielectrics, Polarization by reflection and total internal reflection, Waves in a conducting medium, Reflection and refraction by the ionosphere.

Unit – II Electromagnetic Waves in Anisotropic Medium

The dielectric tensor of an anisotropic medium, structure of a monochromatic plane wave in an anisotropic medium: The phase velocity and the ray velocity, Fresnel's formulae for the propagation of E.M. wave in crystals, Geometrical constructions for determining the velocities of propagation and directions of vibrations, optical properties of uniaxial and biaxial crystals: The optical classification of crystals, E.M. wave propagation in uniaxial crystals.

Unit - III Electromagnetic Wave Interactions

E.M. wave propagation in biaxial crystals Refraction in crystals: double refraction, internal and external conical refraction, experimental demonstration of double refraction and conical refraction, Acoustic-optic interaction: Raman-Nath theory of ultrasonic diffraction of E.M. waves, magneto-optic interaction: Faraday effect, Electro-optic interaction: Kerr effect, interaction with matter: (a) normal and anomalous dispersion (b) Rayleigh scattering.

Unit - IV Elements of Laser Physics

The Laser amplifier: Amplifier gain, amplifier phase shift, Amplifier power source: Rate equation, four and three level pumping schemes, Examples of laser amplifiers, Characteristics of the laser output: Power, spectral distribution, Spatial distribution and polarization, Mode selection, Characteristics of common lasers.

Unit -V Nonlinear Optics

Nonlinear optical media, Second order nonlinear optics Second harmonic and rectification, The electro-optics effect, Three-wave mixing, Third order nonlinear optics, Third harmonic generation and self pulse modulation, four wave mixing, optical pulse conjugation.

Books Recommended

1. Introduction of electrodynamics: Griftith
2. Foundation of electromagnetic Theory: Reitz, Millford and Christy.
3. Plasma physics by F.F. Chen
4. Electromagnetic waves and radiation systems: Jordan and ball man
5. Classical electrodynamics: Jackson

PT – 104 SEMICONDUCTOR ELECTRONICS

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit-I Biasing Techniques and Linear Amplifier

Continuity equation and its application to p-n junction under forward and reverse bias, Solution of Continuity equation for reversed and forward biased abrupt p-n junctions, Derivation of Einstein's equation, Load line for a transistor, Location of Q-point for the bipolar transistor, variation of bias current, Fixed and emitter feedback bias, Design idea of emitter feed back bias, Stability index, Stabilization against variation in I_{CO}, V_{BE} and b, The band pass amplifier, High frequency equivalent circuit, RC coupled CE amplifier, its frequency response and gain frequency plot, Gain band product, cascading of amplifiers, common source FET amplifier.

Unit – II Power Amplifier and Oscillators

Operating conditions for power amplifier, power relations, The ideal transformer, voltage limitations of the transformer, non-linear distortion, Idea of intermodulation distortion, The class A power amplifier, The push-pull amplifier, Feedback requirements of oscillations, Basic oscillator analysis, Hartley and Colpitt oscillators, Piezo-electric, frequency control , RC oscillators.

Unit – III Wave Shaping Circuits

Linear wave shaping, High pass RC circuit, High pass RC circuit as a differentiator, Low pass RC circuit, Low pass RC circuit as a integrator, Non-linear wave shaping, Shunt diode clipper and series diode clippers, Double ended p-n junction and Zener diode clipper circuits, Clamping circuits, Zero level and given level clamping, Fundamentals of voltage and current sweep generators, sweep wave forms, Miller integrating sweep circuits, Blocking and Triggered transistor blocking oscillator

Unit – IV Basics of Differential and Operational Amplifiers

Differential amplifier, Differential amplifier circuit configuration, Dual input balanced output differential amplifier, Voltage gain, differential input resistance, inverting and non-inverting inputs, common mode rejection ratio, Operational amplifier, input offset voltage, input offset currents, input bias currents, differential input resistance, input capacitance, offset voltage supply, rejection ratio, Ideal OP Amp, equivalent circuit of an OP Amp, ideal voltage transfer curve, inverting, dual and non-inverting amplifier, measurement of OP Amp parameters, frequency response

Unit – V Application of Operational Amplifier

Use of OP Amp as sign changer, scale changer, phase shifter, voltage to current converter differential dc amplifier, bridge amplifier, ac voltage follower, analog integration and differentiation, electronic analog computation, Non-linear function generator, series and shunt regulator

BOOKS RECOMMENDED

1. Electronics Fundamentals and Application: J.D. Ryder
2. Solid State Electronic Devices: B.G.Streetman
3. Electronic Principals: Malvino
4. Principals of Microwave: Atwarter
5. Electromagnetic Wave and Radiating System: Jorden and Ballmon
6. Electronic Devices and Circuits: Millman and Halkius

COURSE DETAILS
II SEMESTER (January - June 2012)

PHYSICS

THEORY COURSES

PT – 201 CLASSICAL ELECTRODYNAMICS, PLASMA AND ANTENNAE PHYSICS

UNIT - I	Dipole Radiation
UNIT - II	Radiation From A Point Charge
UNIT - III	Plasma Physics
UNIT - IV	Single Particle Theory and Wave Propagation
UNIT - V	Antenna Arrays

PT – 202 NONRELATIVISTIC QUANTUM MECHANICS – I

Unit – I	Fundamentals
Unit - II	Three-dimensional Systems
Unit - III	Matrix Theory
Unit - IV	Approximation Methods
Unit - V	Approximation Methods for Bound States - I

PT – 203 BASIC ELEMENTS OF SOLID STATE PHYSICS

Unit – I	Crystal Structure
Unit – II	Lattice Dynamics and Thermal Properties
Unit – III	Electronic Energy Bands
Unit – IV	Elements of Semiconductor Physics
Unit – V	Optical Properties of Solids

PT – 204 DIGITAL ELECTRONICS, NUMERICAL ANALYSIS AND COMPUTER PROGRAMMING

Unit – I	Binary Logic, Digital Switching Circuits, Counters
Unit – II	Numerical Solutions, Least Square Fits and Error Analysis
Unit – III	Interpolation, Numerical Integration and Solution of Differential Equations
Unit – IV	Computer Programming
Unit–V	Programming in ‘C’

LABORATORY COURSES

PL – 205	General Laboratories
PL – 206	Electronics Laboratory

PT–201 CLASSICAL ELECTRODYNAMICS, PLASMA AND ANTENNAE PHYSICS

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

UNIT - I Dipole Radiation

Maxwell's equations in terms of scalar and vector potential, Gauge transformations: Lorentz gauge and Coulomb gauge, Retarded potentials, Radiation from oscillating electric and magnetic dipoles with simple applications.

UNIT - II Radiation from a Point Charge

Lienard-Wiechart potentials, Fields due to point charge in uniform and accelerated motions, Power radiated by a point charge (in non relativistic limit), Radiation reaction: Abraham Lorentz formula, Physical origin of the radiation reaction.

UNIT - III Plasma Physics

Occurrence of Plasma in nature, Definition of plasma, Concept of temperature, Debay shielding, The Plasma Parameter, Criteria for plasma, plasma diagnostics by Langmuir probe and by microwave techniques, Plasma oscillations, adiabatic invariants, Plasma confinement by magnetic mirrors and by pinch effect condition for reflection by mirrors.

UNIT - IV Single Particle Theory & Wave Propagation

Hydro magnetic description of plasma, Hydro magnetic waves, Magneto sonic and Alfven waves, Motion of charged particle in Electric Magnetic E and B fields, Gravitational field, time varying fields, Phase velocity, Group velocity, Cutoff and resonance for electromagnetic wave propagating parallel and perpendicular to the magnetic field.

UNIT - V Antenna Arrays

Two element array, Horizontal pattern in broadcast array, Linear array, Multiplication of patterns, Binomial arrays, Antenna gain, Effective area, Antenna terminal Impedance, Idea of super directive arrays, Radiation from current sheet.

Books Recommended:

1. Classical Electrodynamics by J.D.Jakson
2. Introduction to plasma physics by F.F.Chen
3. E.M. Waves and Radiating systems by Jorden and Ballman
4. Introduction to Classical Electrodynamics by Griffth

PT – 202 NONRELATIVISTIC QUANTUM MECHANICS – I

Note: This paper has been divided into FIVE units. The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit.

Unit – I Fundamentals

Correspondence principle, Complementarity, Uncertainty, Schrödinger wave equation, Statistical interpretation, Normalisation, Probability current density, Expectation value, Ehrenfest's theorem, Eigenfunctions and eigenvalues, Energy eigenfunctions, Separation of the time dependent wave equation, Stationary states, Significance of the separation constant E, Boundary and continuity conditions, Boundary conditions for infinite potential energy, Dynamical variables as operators, Hermitian operators and their properties, Orthonormality, Free particle solution, One-dimensional step potential (finite and infinite), Particle in a one-dimensional square potential well (finite and infinite), parity, Schmidt orthogonalization, Schwarz inequality, Momentum eigenfunctions, Linear harmonic oscillator parity, zero point energy, Correspondence with classical theory, The rectangular potential barrier.

Unit - II Three-dimensional Systems

Particle in a three-dimensional box, The Dirac delta-function, Orbital angular momentum, Commutation relations, Eigenfunctions and Eigenvalues of L^2 and L_z , Infinitesimal rotations, Central force problem in three dimensions, Separation of the wave equation, Parity, Series solution, generating functions, recurrence relations and orthogonality of Laguerre polynomials, Bessel equation, Series solution, Generating function, Integral order, Recurrence relations, Integral representation, Orthogonality, Neumann functions, Spherical Bessel and Neumann functions (definition only), Bound states in a three-dimensional square potential well, Solution for *1=0*, Interior and exterior solutions for arbitrary *'l'*, The hydrogen atom, Reduced mass, Asymptotic behaviour, Hydrogen atom wave functions, Energy levels, Degeneracy Energy eigenvalues of a three-dimensional harmonic oscillator, Energy eigenvalues of (a) plane rigid rotator (b) 3-D rigid rotator, Partial wave expansion of a free particle wave function.

Unit - III Matrix Theory

Postulates of quantum mechanics, Commuting operators and commutator algebra, Virial theorem, Derivation of uncertainty relation through operators Matrix formulation of quantum theory, Linear vector spaces, Vectors and operators, Matrix representation of vectors and operators, Bra and ket notation, Projection operator Change of basis and unitary transformations, Matrix theory of the linear harmonic oscillator (energy representation), Raising and lowering operators, Matrices for a *x, p* and *H*, Transformation to coordinate representation, Spin: Pauli spin matrices and their algebra, Matrix formulation of angular momentum, Matrices for J^2 and J_Z, Addition of two angular momenta (elementary discussion).

Unit - IV Approximation Methods

The WKB approximation, Classical limit, Approximate solutions, Connection formulae Application to the problem of i) penetration though a potential barrier ii) energy levels in a potential well, Formulation of variational approximation method, Application to helium atom ground state, Linear combination of atomic orbitals, Application to the ground state of .

Unit - V Approximation Methods for Bound States - I

Stationay perturbation theory, Nondegenerate case, Formulation upto second order, Penurbation of a linear harmonic oscillator (i) estimation of correction to second order for perturbation terms 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.

Books Recommended:

1. Quantum Mechanics: L.I. Schiff.
2. Quantum Mechanics: J.T. Powell and Crasemann
3. Quantum Mech. & Field Theory By " Agrawal.
4. Quantum Mechanics A. K. Ghatak & S.Loknathan
5. Intro. to quantum mechanics by *Pauling & Wilson*

PT – 203 CONDENSED MATTER PHYSICS - I

Note: This paper has been divided into FIVE units, The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit,

Unit – I Crystal Structure

A review of concepts of space and crystal lattice, Primitive vectors and cells; Symmetry elements, Miller indices for planes and axes, Space groups and point groups, Bragg's law, Construction of reciprocal lattice, reciprocal lattice vectors, Brillion zones, Reciprocal lattice of SC, BCC and FCC, Structure and atomic factors

Unit – II Lattice Dynamics and Thermal Properties

Vibrations of one dimensional monoatomic and diatomic lattices, Quantization of lattice vibrations, Phonon momentum, Qualitative description of phonons in three dimensional lattice, phonon density of states, Einstein and Debye models of lattice specific heat, Anharmonic effects in crystals: thermal expansion of solids, Equation of states of solids, Phonon-phonon interaction and thermal conductivity

Unit – III Electronic Energy Bands

A brief review of properties of free electron gas, Hall effect and quantised Hall effect, The periodic potentials, Bloch theorem and Born-von Kramer boundary conditions, General remarks about Bloch theorem, Fermi surface, Electron density of states, Kroning-Penny model, Equation for electron wave in a periodic potential: solution of central equation, approximate solution near zone boundary, Construction of Fermi surfaces, The tight binding approximation for bond structure, Effective mass in solids

Unit – IV Elements of Semiconductor Physics

Examples of semiconductors, Typical band structure of a semiconductor, Number of carriers in thermal equilibrium, Intrinsic (non-degenerate) semiconductors, Extrinsic semiconductors, Effect of doping, Impurity levels, Population of impurity levels, Fields and carrier densities in equilibrium, p-n junctions, Elementary picture of rectification by p-n junction.

Unit – V Optical Properties of Solids

Optical reflectance, Kramers-Kroning relations, Electronic intra and inter band transitions, Direct and indirect transitions, Absorption of light in metals and semiconductors, Idea of excitons, Elements of Raman effects in solids, Energy loss by fast moving particle in solids

BOOKS RECOMMENDED

1. Introduction to solid state physics: Kittel
2. Solid State Physics: Ashcroft and Mermin
3. An introduction to x-ray crystallography: woolfson
4. Solid state Physics: Azaroff
5. Intermediate quantum theory of crystalline solids: Aniamalu
6. Solid state Physics: Epifanov

PT-204 DIGITAL ELECTRONICS, NUMERICAL ANALYSIS & COMPUTER PROGRAMMING

Note: This paper has been divided into FIVE units, The paper will be set as per existing examination norms covering uniformly all the units and providing to the examinee sufficient choice in each unit,

Unit – I Binary Logic, Digital Switching Circuits, Counters

Binary number systems and other codes, Binary arithmetic, Boolean theorem, synthesis of Boolean functions, Karnaugh diagram, Half and full adders, demultiplexers, Multiplexers, D/A and A/D converters.

Transistor as a switch, Clock generator, RS flip flop, D flip flop, T flip flop, JK flip flop, Master-Slave flip flop, Shift register, Ripple counter, Decade counter, up-down counter, divide by n counters, Synchronous counters, Applications of counters, Dynamic MOS circuit, two phases of MOS, Idea of MOS shift register and MOSROM

Unit – II Numerical Solutions, Least Square Fits and Error Analysis

Numerical solutions of Transcedental equations: Bisection method, False Position and Newton Raphson method, Numerical solutions of simultaneous linear equations: Gauss Elimination and Gauss Seidle method, Least Square fits: Linear and polynomial regression, Error analysis: Basic concepts of errors and their types with special reference to numerical methods

Unit – III Interpolation, Numerical Integration and Solution of Differential Equations

Forward, Backward and Central differences and their symbolic relation with shift operator, Newton 's forward and backward interpolation, Gauss central difference interpolation formula, Trapezoidal formula and Simpson 1/3 rule, Solution of Differential equation: Picard's method, Eulers and Runga-Kutta methods (second and Fourth order)

Unit – IV Computer Programming

Introduction to modern digital computers, Organization to a digital computer, Computer instruction and programs, Motivation of high level languages, Basic elements of any programming language, Arithmetic expressions, operators, Standard arithmetic functions, Input and output statements, various types of control statements, loops, nesting of loops, concept of main program, subprograms, declarations statements

Unit – V Programming in 'C'

Introduction to programming in C; constants, variables, operators, header files; Statements: Input/output, control, looping.

General examples based on units II and III.

BOOKS RECOMMENDED

1. Digital principals and applications: Malvino & Leach
2. Electronic Devices and Circuits: Millman and Halkius
3. Numerical Analysis: Rajaram
4. Computer programming by S.S. Sastri
5. Programming in C by Balaguruswami
6. Numerical Computational methods by Patil and Verma