FACULTY OF SCIENCES

SYLLABUS

FOR

M. Sc. (Hons. School) Physics

(Under Credit Based Continuous Evaluation Grading System)

(Semester: I to IV)

Examinations: 2014-15

GURU NANAK DEV UNIVERSITY
AMRITSAR

**(ii) Subject to change in the syllabi at any time.
Please visit the University website time to time.**

M.Sc. (Hons. School) Physics (Semester System)

Semester I

Course No.	C/E/I	Course Title	Hrs/Week	LTP
PHL-401	C	Analog & Digital Electronics	4	4-0-0
PHL-402	C	Electrodynamics-I	4	4-0-0
PHL-403	C	Condensed Matter Physics-I	4	4-0-0
PHL-404	C	Atomic and Molecular Spectroscopy	4	4-0-0
PHP-421	C	Spectroscopy Lab	6	0-0-3
PHP-422	C	Electronics Lab	6	0-0-3
			Total Credit	**22**

Semester II

Course No.	C/E/I	Course Title	Hrs/Week	LTP
I-1	C		3	3-0-0
PHL-451	C	Quantum Mechanics-II	4	4-0-0
PHL-452	C	Electrodynamics-II	4	4-0-0
PHL-453	C	Condensed Matter Physics-II	4	4-0-0
PHL-454	C	Nuclear Physics	4	4-0-0
PHP-471	C	Condensed Matter Physics Lab	6	0-0-3
PHP-472	C	Nuclear Physics Lab	6	0-0-3
			Total Credit	**22**

M.Sc. (Hons. School) Physics (Semester System)

SEMESTER–III

Course Code: PHB 1

Course No.	**C/E/I**	**Course Title**	**Hrs/Week**	**LTP**
PHL-501	C	Quantum Mechanics-II	4	4-0-0
PHL-502	C	Electrodynamics-II	4	4-0-0
PHL-503	C	Condensed Matter Physics-II	4	4-0-0
PHL-504	C	Nuclear Physics	4	4-0-0
I-1	I		3	3-0-0
PHP-521	C	Nuclear Physics Lab	6	0-0-3
PHP-522	C	Advanced Lab	6	0-0-3
			Total Credit	**25**

SEMESTER–IV

Any of following FOUR Electives

Course No.	**C/E/I**	**Course Title**	**Hrs/Week**	**LTP**
E-1	E		4	4-0-0
E-2	E		4	4-0-0
E-3	E		4	4-0-0
E-4	E		4	4-0-0
I-2	I		3	3-0-0
PHD-571	C	Project	12	0-0-6
			Total Credit	**25**

<u>Elective Courses</u>

PHL-581	Experimental Methods
PHL-583	Reactor Physics
PHL-584	Material Science
PHL-585	Nanotechnology
PHL-586	Communication Electronics
PHL-587	Radiation Physics
PHL-588	Plasma Physics
PHL-589	Quantum Computation
PHL-590	Statistical Mechanics
APL-581	Physics of Low Dimensional Semiconductors
APL-582	Digital Signal Processing
APL-583	Digital Communications
APL-584	Optical Communications

M.Sc. (Hons. School) Physics (Semester–I)

ANALOG AND DIGITAL ELECTRONICS

Course No.	**LTP**
PHL-401	**4 0 0**

Switching Devices: Construction and Working of UJT & SCR and their applications in wave generation and power control.

Microwave Devices: Gunn diode, Gunn effect, two valley model, principle and operation of Reflex Klystron and Magnetron.

Ideal operational Amplifier: Open loop op-amp, inverting amplifier, noninverting amplifier, voltage follower, differential amplifier, difference and common mode gain, common mode rejection ratio.

Operational Amplifier Internal Circuit: Difference amplifier, constant current source, input resistance, active load, level translator, output stage, DC analysis.

Practical Operational Amplifier: Input bias current, input offset current, input offset voltage, total output off set voltage, frequency response. Stability of operational amplifier, frequency compensation and slew rate.

Operational Amplifier as: Summing, scaling and averaging amplifiers, instrumentation amplifier, integrator and differentiator. Comparator; Schmitt trigger, Multivibrators; Monostable & astable, square wave & triangular wave generators.

D/A Converters, Ladder and Weighted resistor type: A/D convertors, counter type, successive approximation and dual slope converters.

Combinational Logic: The transistor as a switch, OR, AND and NOT gates, NOR and NAND gates, Boolean algebra, Demorgan's theorems, Exclusive OR gate, Karnaugh maps, Decoder/Demultiplexer, Data selector/multiplexer, encoder.

Sequential Logic Flip-Flops: The RS Flip-Flop. JK master slave Flip-Flop, T Flip-Flop, D Flip-Flop, Shift registers, synchronous and asynchronous counters, Mod counters.

Reference Books:

1. Semiconductor Devices (Physics and Technology)- SM Sze-Wiley, 1995.
2. Solid State Electronics Devices –BG Streetman and S Banerjee-Prentice Hall, 1999.
3. Microwave Devices and Circuits-Samuel Y Liao-PHI, 1991.
4. OP-Amps and Linear integrated circuits-Ramakanth A. Gayakwad-PHI, 1991.
5. Linear Integrated Circuits-D. Roy Choudhary and Salil Jain-New Age International, 2001.
6. Digital Principles and Applications-AP Malvino and DP Leach-Tata McGraw Hill, 1993.

M.Sc. (Hons. School) Physics (Semester–I)

ELECTRODYNAMICS-I

Course No.	**LTP**
PHL-402	**4 0 0**

Electrostatics: Coulomb's law. Gauss's law, Poisson's equation, Laplace equation. Solution of boundary value problem: Greens function, method of images and calculation of Green's function for the image charge problem in the case of a sphere. Laplace equation, uniqueness theorem. Electrostatics of dielectric media, multipole expansion. Boundary value problems in dielectrics; molecular polarisability Electrostatic energy in dielectric media.

Magnetostatics: Biot and Savart's law. The differential equation of Magnetostatics and Ampere's law , vector potential and magnetic field of a localized current distribution. Magnetic moment, force and torque on a magnetic dipole in an external field. Magnetic materials, Magnetization and microscopic equations.

Time Varying Fields: Time varying fields, Maxwell's equations, conservation laws, Faraday's law of induction, Energy in a magnetic field. Maxwell's displacement current, vector and scalar potential, Gauge transformations; Lorentz gauge, Coulomb Gauge. Poynting theorem, conservation laws for a system of charged particles and electromagnetic field, continuity equation.

Electromagnetic Waves: Plane wave like solutions of the Maxwell equations. Polarization, linear and circular polarization. Superposition of waves in one dimension. Group velocity. Illustration of propagation of a pulse in dispersive medium. Reflection and refraction of electromagnetic waves at a plane surface between dielectrics. Polarization by reflection and total internal reflection. Waves in conductive medium, Simple model for conductivity.

Text and Reference Books:

1. Classical Electrodynamics - J.D. Jackson-John Wiley & Sons Pvt. Ltd., New York, 2004.
2. Introduction to Electrodynamics - D.J. Griffiths-Pearson Education Ltd.,
3. Classical Electromagnetic Radiation -J.B. Marion-Academic Press, New Delhi, 1995.

M.Sc. (Hons. School) Physics (Semester–I)

CONDENSED MATTER PHYSICS-I

Course No. **LTP**
PHL-403 **4 0 0**

Lattice Specific Heat and Elastic Constants: The various theories of lattice specific heat of solids. Einstein model of the Lattice Specific heat. Density of modes of vibration, Debye model of Lattice specific heat, Born cut-off procedure, specific heat of metals, Elastic strain and stress component. Elastic compliance and stiffness constants. Elastic constants of cubic crystals. Elastic waves in cubic crystals.

Dia, Para and Ferromagnetism: Classification of magnetic materials, the origin of permanent magnetic dipoles, diamagnetic susceptibility, classical theory of Para magnetism, Quantum theory of Para magnetism, Quenching of orbital angular momentum, cooling by adiabatic demagnetization. Paramagnetic susceptibility of conduction electrons, Ferromagnetism, the Weiss molecular field, the interaction of the Weiss field, Ferromagnetic domains, Spin Waves, quantization of spin waves, Thermal excitations of magnons.

Antiferro, Ferrimagnetism: The two sub lattice model, exchange interaction, the structure of ferrites, saturation magnetization, Neel's theory of ferrimagnetisms, Curie temperature and susceptibility of ferrimagnets

Superconductivity: Critical field, Meissner effect, Types of superconductors, specific heat, London equation, penetration depth, coherence length flux quantization. BCS Theory, Tunneling phenomena, Josephson effect, Introduction to high temperature superconductors.

Text and Reference Books:

1. An Introduction to Solid State Physics-C. Kittel-Wiley Eastern Ltd., New Delhi, 1979.
2. Solid State Physics-A. J. Dekkar-Mc millian India Ltd., New Delhi, 2004.
3. Principles of Solid State Physics-R. A. Levy-New York Academy, 1968.
4. Elementary Solid State Physics-Omar-Addison Wesly, 1975.
5. Introduction to solid state Physics-Ashcroft and Mermin-New York Holt, 1976.

M.Sc. (Hons. School) Physics (Semester–I)

ATOMIC AND MOLECULAR SPECTROSCOPY

Course No.	**L T P**
PHL-404	**4 0 0**

Spectra of One and Two Valance Electron Systems:
Magnetic dipole moments; Larmor's theorem; Space quantization of orbital, spin and total angular momenta; Vector model for one and two valance electron atoms; Spin-orbit interaction and fine structure of hydrogen, Lamb shift, Spectroscopic terminology; Spectroscopic notations for L-S and J-J couplings; Spectra of alkali and alkaline earth metals; Interaction energy in L-S and J-J coupling for two electron systems; Selection and Intensity rules for doublets and triplets

Breadth of Spectral Line and Effects of External Fields:
The Doppler effect; Natural breadth from classical theory; natural breadth and quantum mechanics; External effects like collision damping, asymmetry and pressure shift and stark broadening; The Zeeman Effect for two electron systems; Intensity rules for the zeeman effect; The calculations of Zeeman patterns; Paschen-Back effect; LS coupling and Paschen –Back effect; Lande's factor in LS coupling; Stark effect

Microwave and Infra-Red Spectroscopy:
Types of molecules, Rotational spectra of diatomic molecules as a rigid and non-rigid rotator, Intensity of rotational lines, Effect of isotopic substitution, Microwave spectrum of polyatomic molecules, Microwave oven, The vibrating diatomic molecule as a simple harmonic and an harmonic oscillator, Diatomic vibrating rotator, The vibration-rotation spectrum of carbon monoxide, The interaction of rotation and vibrations, Outline of technique and instrumentation, Fourier transform spectroscopy.

Raman and Electronic Spectroscopy:
Quantum and classical theories of Raman Effect, Pure rotational Raman spectra for linear and polyatomic molecules, Vibrational Raman spectra, Structure determination from Raman and infra-red spectroscopy, Electronic structure of diatomic molecule, ,Electronic spectra of diatomic molecules, Born Oppenheimer approximation- The Franck Condon principle, Dissociation and pre-dissociation energy, The Fortrat diagram, Example of spectrum of molecular hydrogen.

Text and Reference Books

1. Introduction to Atomic Spectra: H.E. White-Auckland McGraw Hill, 1934.
2. Fundamentals of molecular spectroscopy: C.B. Banwell-Tata McGraw Hill, 1986.
3. Spectroscopy Vol. I, II & III: Walker & Straughen
4. Introduction to Molecular spectroscopy: G.M. Barrow-Tokyo McGraw Hill, 1962.
5. Spectra of diatomic molecules: Herzberg-New York, 1944.
6. Molecular spectroscopy: Jeanne L. McHale.

M.Sc. (Hons. School) Physics (Semester–II)

QUANTUM MECHANICS-II

Course No.	**LTP**
PHL-451	**4 0 0**

Perturbation Theory: First and second order perturbation theory for non-degenerate and degenerate systems. Perturbation of an oscillator and Anharmonic oscillator, the variation method. First order time dependent perturbation theory, constant perturbation, Calculation of transition probability per unit time for harmonic perturbation. The Helium atom problem. Stark effect.

Scattering theory: Born approximation, extend to higher orders. Validity of Born approximation for a square well potential. Optical theorem. Partial wave analysis, unitarity and phase shifts. Determination of phase shift, applications to hard sphere scattering. Low energy scattering in case of bound states. Resonance scattering.

Relativistic Quantum Mechanics: Klein Gordon equation. Dirac Equation, Lorentz covariance of Dirac equation. Positive and negative energy solutions of Dirac equation, positrons. Properties of gamma matrices. Parity operator and its action on states. Magnetic moments and spin orbit energy.

Identical Particles*:* Brief introduction to identical particles in quantum mechanics (based on Feynmann Vol. III) symmetrisation postulates. Application to 2-electron systems. Pauli exclusion principle. Bose Einstein and Fermi Dirac Statistics.

Text and Reference Books:

1. Modern Quantum Mechanics by J. J. Sakurai (Principal text)-Pearson Education Pvt. Ltd., New Delhi, 2002.
2. Quantum Mechanics by L I Schiff-Tokyo Mc Graw Hill, 1968.
3. Feynman lectures in Physics Vol. III-Addison Wesly, 1975.
4. Quantum Mechanics by Powel and Craseman-Narosa Publication, New Delhi, 1961
5. Quantum Mechanics by Merzbacher-John Wiley & Sons, New York, 1970.

M.Sc. (Hons. School) Physics (Semester–II)

ELECTRODYNAMICS – II

Course No.	LTP
PHL-452	**4 0 0**

Wave Guides: Field at the surface of and within a conductor. Cylindrical cavities and wave-guides, modes in a rectangular wave guide, energy flow and attenuation in wave guides. Perturbation of boundary conditions, resonant cavities, power loss in cavity and quality factor.

Relativistic Formulation of Electrodynamics: Structure of space-time, four scalars, four vectors and tensors, relativistic mechanics: proper time and proper velocity, relativistic energy and momentum. Relativistic electrodynamics: Magnetism as a relativistic phenomena and field transformations. Field tensor. Recasting Maxwell equations in the language of special relativity, covariance and manifest covariance, Lagrangian formulation for the covariant Maxwell equations.

Radiating Systems: Fields of radiation of localized oscillating sources, electric dipole fields and radiation, magnetic dipole and electric quadrupole fields, central fed antenna, brief introduction to radiation damping and radiation reaction

Fields of Moving Charges: Lienard Wiechert potential, field of a moving charge. Radiated power from an accelerated charge at low velocities, Larmour's power formula and its relativistic generalization; Angular distribution of radiation emitted by an accelerated charge.

Text and Reference Books:

1. Classical Electrodynamics - J.D. Jackson-John Wiley & Sons Pvt. Ltd., New York, 2004.
2. Introduction to Electrodynamics - D.J. Griffiths-Pearson Education Ltd.,
3. Classical Electromagnetic Radiation -J.B. Marion-Academic Press, New Delhi, 1995.

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M.Sc. (Hons. School) Physics (Semester–II)

CONDENSED MATTER PHYSICS-II

Course No.	**LTP**
PHL-453	**4 0 0**

Defects and Diffusion in Solids:
Point defects: Impurities, Vacancies- Schottky and Frankel vacancies, Color centers and coloration of crystals, F-centres, Line defects (dislocations), Edge and screw dislocations, Berger Vector, Slip, Planar (stacking) Faults, Grain boundaries, Low angle grain boundaries, Frank Reed Mechanism and Dislocation Multiplication, the Hydration energy of ions, Activation energy for formation of defects in ionic crystals, interpretation of diffusion in alkali halides, Ionic conductivity in pure alkali halides.

Conductivity of Metals and Luminescence: Electrical conductivity of metals, Drift velocity and relaxation time, the Boltzmann transport equation. The Sommerfeld theory of conductivity, Mean free path in metals, qualitative discussion of the features of the resistivity, Mathiesson's rule Luminescence, excitation and emission, Decay mechanisms, Thallium activated alkali halides. Sulphide phosphors. Electro Luminescence.

Plasmas, Polaritons and Optical Properties: Dielectric function of the electrons gas, plasma optics, transverse and longitudinal modes in plasma, Electrostatic screening, polaritons and LST relations, Electron- phonon interaction, polarons, Kramer-Kroning relations. Liquid Crystals: Introduction, types, physical properties and applications.

Dielectrics and Ferro Electrics: Macroscopic field, The local field, Lorentz field. The Claussius-Mossotti relations, different contribution to polarization: dipolar, electronic and ionic Polaris abilities, General properties of ferroelectric materials. The dipole theory of ferroelectricity, objection against dipole theory Thermodynamics of ferroelectric transitions.

Text and Reference Books:

1. An Introduction to solid state Physics-C. Kittel-Wiley Eastern Ltd., New Delhi, 1979.
2. Solid State Physics-A. J. Dekkar-Mc millian India Ltd., New Delhi, 2004.
3. Principles of Solid State Physics-R. A. Levy-New York Academy, 1968.
4. Elementary Solid State Physics-Omar-Addison Wesly, 1975.
5. Introduction to Solid state Physics-Ashcroft and Mermin-New York Holt, 1976.

M.Sc. (Hons. School) Physics (Semester–II)

NUCLEAR PHYSICS

Course No.	**L**	**T**	**P**
PHL-454	**4**	**0**	**0**

Nuclear Interactions: Nuclear forces: Two nucleon system, Deutron problem, binding energy, nuclear potential well, pp and pn scattering experiments at low energy, meson theory of nuclear forces, e.g. Bartlett, Heisenberg, Majorans forces and potentials, exchange forces and tensor forces, effective range theory-spin dependence of nuclear forces-Charge independence and charge symmetry of nuclear forces-Isospin formalism Yukawa interaction.

Nuclear Models : Liquid drop model-Bohr-Wheeler theory of fission-Experimental evidence for shell effects-Shell Model-Spin-Orbit coupling-Magic numbers-Applications of Shell model like Angular momenta and parities of nuclear ground states-Quantitative discussion and estimates of transition rates – magnetic moments and Schmidt lines-Collective model-nuclear vibrations spectra and rotational spectra-applications, Nilsson model.

Nuclear Decay : Beta decay-Fermi theory of beta decay-shape of the beta spectrum- Total decay rate, Angular momentum and parity selection rules-Comparative half-lives-Allowed and forbidden transitions-selection rules-parity violation-Two component theory of Neutrino decay-Detection and properties of neutrino-Gamma decay-Multipole transitions in nuclei-Angular momentum and parity selection rules-Internal conversion-Nuclear isomerism.

Nuclear Reactions: Conservation laws, energetics of nuclear reactions, Direct and compound nuclear reaction mechanisms, cross sections in terms of partial wave amplitudes – Compound nucleus – scattering matrix-Reciprocity theorem-Breit Wigner one level formula-Resonance scattering.

Text and Reference Books

1. A. Bohr and B.R.Mottelson : Nuclear Structure, Vol.. 1 (1969) and Vol. 2, Benjamin, Reading, A. 1975
2. Kenneth S. Krane: Introductory Nuclear Physics, Wiley, New York, 1988
3. G.N.Ghoshal: Atomic and Nuclear Physics Vol. 2 , S. Chand and Co.

M.Sc. (Hons. School) Physics (Semester–III)

QUANTUM MECHANICS-II

Course No.	**L**	**T**	**P**
PHL-501	**4**	**0**	**0**

Perturbation Theory: First and second order perturbation theory for non-degenerate and degenerate systems. Perturbation of an oscillator and Anharmonic oscillator, the variation method. First order time dependent perturbation theory, constant perturbation, Calculation of transition probability per unit time for harmonic perturbation. The Helium atom problem. Stark effect.

Scattering Theory: Born approximation, extend to higher orders. Validity of Born approximation for a square well potential. Optical theorem. Partial wave analysis, unitarity and phase shifts. Determination of phase shift, applications to hard sphere scattering. Low energy scattering in case of bound states. Resonance scattering.

Relativistic Quantum Mechanics: Klein Gordon equation. Dirac Equation, Lorentz covariance of Dirac equation. Positive and negative energy solutions of Dirac equation, positrons. Properties of gamma matrices. Parity operator and its action on states. Magnetic moments and spin orbit energy.

Identical Particles*:* Brief introduction to identical particles in quantum mechanics (based on Feynmann Vol. III) symmetrisation postulates. Application to 2-electron systems. Pauli exclusion principle. Bose Einstein and Fermi Dirac Statistics.

Text and Reference Books:

5. Modern Quantum Mechanics by J. J. Sakurai (Principal text)-Pearson Education Pvt. Ltd., New Delhi, 2002.
6. Quantum Mechanics by L .I .Schiff-Tokyo McGraw Hill, 1968.
7. Feynman lectures in Physics Vol. III-Addison Wesly, 1975.
8. Quantum Mechanics by Powel and Craseman-Narosa Publication, New Delhi, 1961
5. Quantum Mechanics by Merzbacher-John Wiley & Sons, New York, 1970.

M.Sc. (Hons. School) Physics (Semester–III)

ELECTRODYNAMICS – II

Course No. **LTP**
PHL-502 **4 0 0**

Wave Guides: Field at the surface of and within a conductor. Cylindrical cavities and wave-guides, modes in a rectangular wave guide, energy flow and attenuation in wave guides. Perturbation of boundary conditions, resonant cavities, power loss in cavity and quality factor.

Relativistic Formulation of Electrodynamics: Structure of space-time, four scalars, four vectors and tensors, relativistic mechanics: proper time and proper velocity, relativistic energy and momentum. Relativistic electrodynamics: Magnetism as a relativistic phenomena and field transformations. Field tensor. Recasting Maxwell equations in the language of special relativity, covariance and manifest covariance, Lagrangian formulation for the covariant Maxwell equations.

Radiating Systems: Fields of radiation of localized oscillating sources, electric dipole fields and radiation, magnetic dipole and electric quadrupole fields, central fed antenna, brief introduction to radiation damping and radiation reaction

Fields of Moving Charges: Lienard Wiechert potential, field of a moving charge. Radiated power from an accelerated charge at low velocities, Larmour's power formula and its relativistic generalization; Angular distribution of radiation emitted by an accelerated charge.

Text and Reference Books:

4. Classical Electrodynamics - J.D. Jackson-John Wiley & Sons Pvt. Ltd., New York, 2004.
5. Introduction to Electrodynamics - D.J. Griffiths-Pearson Education Ltd.,
6. Classical Electromagnetic Radiation -J.B. Marion-Academic Press, New Delhi, 1995.

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M.Sc. (Hons. School) Physics (Semester–III)

CONDENSED MATTER PHYSICS-II

Course No.	**LTP**
PHL-503	**4 0 0**

Defects and Diffusion in Solids:
Point defects: Impurities, Vacancies- Schottky and Frankel vacancies, Color centers and coloration of crystals, F-centres, Line defects (dislocations), Edge and screw dislocations, Berger Vector, Slip, Planar (stacking) Faults, Grain boundaries, Low angle grain boundaries, Frank Reed Mechanism and Dislocation Multiplication, the Hydration energy of ions, Activation energy for formation of defects in ionic crystals, interpretation of diffusion in alkali halides, Ionic conductivity in pure alkali halides.

Conductivity of Metals and Luminescence: Electrical conductivity of metals, Drift velocity and relaxation time, the Boltzmann transport equation. The Sommerfeld theory of conductivity, Mean free path in metals, qualitative discussion of the features of the resistivity, Mathiesson's rule Luminescence, excitation and emission, Decay mechanisms, Thallium activated alkali halides. Sulphide phosphors. Electro Luminescence.

Plasmas, Polaritons and Optical Properties: Dielectric function of the electrons gas, plasma optics, transverse and longitudinal modes in plasma, Electrostatic screening, polaritons and LST relations, Electron- phonon interaction, polarons, Kramer-Kroning relations. Liquid Crystals: Introduction, types, physical properties and applications.

Dielectrics and Ferro Electrics: Macroscopic field, The local field, Lorentz field. The Claussius-Mossotti relations, different contribution to polarization: dipolar, electronic and ionic Polaris abilities, General properties of ferroelectric materials. The dipole theory of ferroelectricity, objection against dipole theory Thermodynamics of ferroelectric transitions.

Text and Reference Books:

6. An Introduction to solid state Physics-C. Kittel-Wiley Eastern Ltd., New Delhi, 1979.
7. Solid State Physics-A. J. Dekkar-Mc millian India Ltd., New Delhi, 2004.
8. Principles of Solid State Physics-R. A. Levy-New York Academy, 1968.
9. Elementary Solid State Physics-Omar-Addison Wesly, 1975.
10. Introduction to Solid state Physics-Ashcroft and Mermin-New York Holt, 1976.

M.Sc. (Hons. School) Physics (Semester–III)

NUCLEAR PHYSICS

Course No.	**LTP**
PHL-504	**4 0 0**

Nuclear Interactions: Nuclear forces: Two nucleon system, Deutron problem, binding energy, nuclear potential well, pp and pn scattering experiments at low energy, meson theory of nuclear forces, e.g. Bartlett, Heisenberg, Majorans forces and potentials, exchange forces and tensor forces, effective range theory-spin dependence of nuclear forces-Charge independence and charge symmetry of nuclear forces-Isospin formalism Yukawa interaction.

Nuclear Models : Liquid drop model-Bohr-Wheeler theory of fission-Experimental evidence for shell effects-Shell Model-Spin-Orbit coupling-Magic numbers-Applications of Shell model like Angular momenta and parities of nuclear ground states-Quantitative discussion and estimates of transition rates – magnetic moments and Schmidt lines-Collective model-nuclear vibrations spectra and rotational spectra-applications, Nilsson model.

Nuclear Decay : Beta decay-Fermi theory of beta decay-shape of the beta spectrum- Total decay rate, Angular momentum and parity selection rules-Comparative half-lives-Allowed and forbidden transitions-selection rules-parity violation-Two component theory of Neutrino decay-Detection and properties of neutrino-Gamma decay-Multipole transitions in nuclei-Angular momentum and parity selection rules-Internal conversion-Nuclear isomerism.

Nuclear Reactions: Conservation laws, energetics of nuclear reactions, Direct and compound nuclear reaction mechanisms, cross sections in terms of partial wave amplitudes – Compound nucleus – scattering matrix-Reciprocity theorem-Breit Wigner one level formula-Resonance scattering.

Text and Reference Books

4. A. Bohr and B.R.Mottelson : Nuclear Structure, Vol.. 1 (1969) and Vol. 2, Benjamin, Reading, A. 1975
5. Kenneth S. Krane: Introductory Nuclear Physics, Wiley, New York, 1988
6. G.N.Ghoshal: Atomic and Nuclear Physics Vol. 2 , S. Chand and Co.

PROJECT

Course No.	**L T P**
PHD-571	**0 0 6**

(Elective Course)
EXPERIMENTAL METHODS

Course No.	**L**	**T**	**P**
PHL-581	**4**	**0**	**0**

Interaction & Detectors: Interaction of heavy charged particles, Interaction of fast electrons interaction of gamma rays, Interaction of Neutrons, Radiation exposure & Dose, Angular distribution, Gamma-Gamma angular distribution, Theory of internal Conversion, charged particles, neutrons etc, GM counter, Scintillation detectors, Solid State detectors.

Counting Statistics & Error Prediction*:* *Error analysis, least square fitting, Chi square test, Normal and Poisson distribution, Statistical errors in nuclear particle counting, propagation of errors, Plotting of graphs.*

Vacuum & Low Temperature Techniques*:* Vacuum techniques, Basic idea of conductance, pumping speed, Pumps: Mechanical pumps, Diffusion pumps, Ionization pumps, turbo molecular pumps, gauges; Penning, Pirani, Hot cathode, Low temperature: Cooling a sample over a range upto 4 K and measurement of temperature.

Transducers and Temperature Measurements: Classification of transducers, Selecting a transducers, qualitative treatment of strain gauge, capacitive transducers, inductive transducers, linear variable differential transformer (LVDT), photoelectric transducers, piezoelectric transducers, temperature measurements (Resistance thermometer, thermocouples, Themisters).

Text and Reference Books:

1. Electronic Devices and Circuits: Jacob Milliman, C. Halkias
2. Vacuum Technology: A. Roth.
3. Techniques for Nuclear and Particle Physics Experiments: W.R. Leo.
4. Radiation Detection and Measurements: Glenn F. Knell.
5. Electronic Instrumentation and Measurements Techniques: William David Cooper.

(Elective Course)

REACTOR PHYSICS

Course No.	**L**	**T**	**P**
PHL-583	**4**	**0**	**0**

Interaction of Neutrons with Matter in Bulk
Thermal neutron diffusion, Transport and diffusion equations, transport mean free path, solution of diffusion equation for a point source in an infinite medium and for an infinite plane source in a finite medium, extrapolation length and diffusion length-the albedo concept.

Moderation of Neutron
Mechanics of elastic scattering, energy distribution of thermal neutrons, average logarithmic energy decrement, slowing down power and moderating ratio of a medium, Slowing down density, slowing down time, Fast neutron diffusion and Fermi age theory, solution of age equation for a point source of fast neutrons in an infinite medium, slowing down length and Fermi age.

Theory of Homogeneous Bare Thermal and Heterogeneous Natural Uranium Reactors
Neutron cycle and mulplication factor, four factor formula, neutron leakage, typical calculations of critical size and composition in simple cases, the critical equation, material and geometrical bucklings, effect of reflector.
Advantages and disadvantages of heterogeneous assemblies, various types of reactors with special reference to Indian reactors and a brief discussion of their design feature.

Power Reactors Problem of Reactor Control
Breeding ratio, breeding gain, doubling time, Fast breeder reactors, dual purpose reactors, concept of fusion reactors, Role of delayed neutrons and reactor period, Inhour formula, excess reactivity, temperature effects, fission product poisoning, use of coolants and control rods.

Reference Books:

1. Glasstone & Edlund : The Elements of Nuclear Reactor Theory-Van Nostrand, 1952.
2. Murray: Introductions of Nuclear Engineering-Prentice Hall, 1961.

(Elective Course)
MATERIAL SCIENCE

Course No.	**L T P**
PHL-584	**4 0 0**

Thin Film Technology: Classification of Thin films configurations; Film deposition method: Physical vapor deposition, Chemical vapor deposition, Spray pyrolysis, Sputtering (RF, DC); Modes of film growth by vapor deposition: from vapor to adatoms, from adatoms to film growth, growth modes based on surface energies; film microstructure: Epitaxial films, polycrystalline films, Origin of films stress: classification, stress in epitaxial films, stress in polycrystalline films, consequence of stress in film; effect of substrate temperature, deposition angle and thickness on thin film formation.

Polymers & Ceramics: Characteristics, Application and Processing of polymers; Polymerization, Polymer types: Stress- Strain behaviour, melting and glass transition, thermosets and thermoplasts; Characteristics, Application and Processing of Ceramics, glasses and refrectories.

Characterization Techniques-I: Electrical, Optical and Mechanical method for determination of thickness of films, Transmission electron microscopy (TEM), Scanning electron microscopy (SEM); Scanning tunneling microscopy (STM); Atomic force microscopy (AFM).

Characterization Techniques-II: X-ray diffraction, data manipulation of diffracted X-rays for structure determination; X-ray fluorescence spectrometry for element detection with concentration; Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS), Secondary ion mass spectroscopy (SIMS)

Text and Reference Books:

1. Thin Film Materials-Stress, defect, formation and surface evolution: L.B. Freund and S. Suresh- Cambridge,
2. Thin Film Phenomena :K.L. Chopra-Mc Graw Hill Book, Comp.,1979.
3. Thin Film fundamentals: A. Goswami-New age International, 2007
4. Material Science and Engg :W.D. Callister-John Wiley, 2001
5. Elements of X-ray Diffraction (3rd edition) : B.D. Cullity, S.R. Stock-Prentice Hall, 2001.
6. X-ray Fluorescence spectroscopy: R. Jenkins-Wiley Interscience, New York, 1999.
7. Methods of Surface Analysis : J.M. Walls- Cambridge University Press, 1989.
8. The principles and Practice of Electron Microscopy: Ian M. Watt-Cambridge University Press, 1997
9. Modern techniques for surface science: D.P. Woodruff and T.A. Delchar- Cambridge University Press, 1994.

(Elective Course)
NANOTECHNOLOGY

Course No.	**L T P**
PHL-585	**4 0 0**

Introduction and Synthesis of Nanomaterials: Basic idea of Nanomaterials and Nanotechnology, Physical Methods: inert gas condensation, arc discharge, Laser ablation, molecular beam epitaxy, electron deposition, ball milling; electron beam lithography; Chemical Methods: sol-gel, micelles and micro emulsions.

Nanoparticles: Introduction to Nanoparticles; Metal Nanoclusters: magic numbers, theoretical modeling of nanoparticles, geometric structure, electronic structure, reactivity, magnetic clusters, bulk to nanotransition; Semiconducting nanoparticles: optical properties, photofragmentation, columbic explosion; Rare gas and molecular clusters.

Quantum Nanostructures: Introduction to quantum wells wires and dots**;** preparation using lithography; Size and dimensionality effects: size effects, conduction electrons and dimensionality, potential wells, partial confinement, properties dependent on density of states, single electron tunneling; Application: Infrared detectors, Quantum dot Lasers.

Carbon Nanostructure: Carbon molecules: nature of carbon bond; new carbon structures; Carbon clusters: small carbon clusters, structure of C_{60}, alkali doped C_{60}; Carbon nanotubes: fabrication, structure, electrical properties, vibrational properties, mechanical properties, Application of carbon nanotubes: field emission and shielding, computers, fuel cells, chemical sensors, catalysis.

Text and Reference Books:

1. Thin Film fundamentals: A. Goswami-New age International, 2007
2. Introduction to Nanotechnology: Charles P. Poole Jr. and Franks J. Qwens,-John Wiley & Sons, 2003.
3. Solid State Physics: J.P. Srivastva-Prentice Hall, 2007.
4. Nanotubes and Nanowires: CNR Rao and A Govindaraj-Royal Society of Chemistry, 2005.

(Elective Course)
COMMUNICATION ELECTRONICS

Course No.	**L T P**
PHL-586	**4 0 0**

Amplitude Modulation: Frequency spectrum of AM wave, representation and power relations in AM wave, evaluation and description of SSB, superstition of unwanted side bands, form of amplitude modulation.

Frequency Modulation: Theory of frequency and phase modulation, mathematical representation, frequency spectrum of FM wave. Generation of frequency modulation.

Pulse modulation: Information theory, pulse modulation: PWM, PPM and PCM, Multiplexing: frequency-division multiplexing. Time division multiplexing, shot, medium and long-hand system.

Microwave Devices: Klystrons, Magnetrons, Velocity modulation, Basic principles of two cavity Klystrons and Reflex Klystrons, principles of operation of magnetrons., Transferred electron devices, Gunn Effect, Principles of operation. Modes of operation, Read diode, IMPATT diode, TRAPATT diode, Tunnel diode and Stimulated emission and associated devices.

Microwave Communications: Advantages and disadvantages 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 MW communication systems.

Radar Systems

Radar block diagram 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. Antennas, Displays.

References Books:

1. Microelectronics:Jacob Millman, Mcgraw-hill International Book Co., New Delhi, 1990.
2. Optoelectronics: Theory and Practice, Edited by Alien Chappal. McGrawHill Book Co., New York.
3. Microwaves :K.L. Gupta-Wiley Eastern Ltd., New Delhi, 1983
4. Advanced Electronics Communications Systems: Wayne Tomasi., Phi. Edn.
5. Electronic Communication Systems :G. Kennedy-Tata McGraw-Hill

(Elective Course)
RADIATION PHYSICS

Course No.	**L T P**
PHL-587	**4 0 0**

Ionizing Radiations and Radiation Quantities:

Types and sources of ionizing radiation, fluence, energy fluence, kerma, exposure rate and its measurement – The free air chamber and air wall chamber. Absorbed dose and its measurement; Bragg Gray Principle, Radiation dose units- rem, rad, Gray and Sievert dose commitment, dose equivalent and quality factor.

Dosimeters:

Pocket dosimeter, films, solid state dosimeters such as TLD, SSNTD, chemical detectors and neutron detectors, simple numerical problems on dose estimation.

Radiation Effects and Protection
Biological effects of radiation at molecular level, acute and delayed effects, stochastic and non-stochastic effects, Relative Biological Effectiveness (RBE), Linear energy transformation (LET), Dose response characteristics. Permissible dose to occupational and non-occupational workers, maximum permissible concentration in air and water, safe handling of radioactive materials. The ALARA, ALI and MIRD concepts, single target, multitarget and multihit theories, Rad waste and its disposal, simple numerical problems.

Radiation Shielding
Thermal and biological shields, shielding requirement for medical, industrial and accelerator facilities, shielding materials, radiation attenuation calculations – The point kernal technique, radiation attenuation from a uniform plane source. The exponential point-Kernal. Radiation attenuation from a line and plane source. Practical applications and some simple numerical problems.

References Books:

1. Nuclear Reactor Engineering -S.Glasstone and A. Seasonke-Van Nostrand Reinhold, 1981.
2. Radiation Theory-Alison. P. Casart
3. Radiation Biology-A.Edward Profio-Prentice Hall, 1968
4. Introduction to Radiological Physics and Radiation Dosimetry -F.H. Attix-Wiley VCH, 1986.

(Elective Course)
PLASMA PHYSICS

Course No.	**L T P**
PHL-588	**4 0 0**

Basics of Plasmas: Occurrence of plasma in nature, definition of plasma, concept of temperature, Debye shielding and plasma parameter. Single particle motions in uniform E and B, nonuniform magnetic field, grad B and curvature drifts, invariance of magnetic moment and magnetic mirror. Simple applications of plasmas.

Plasma Waves: Plasma oscillations, electron plasma waves, ion waves, electrostatic electron and ion oscillations perpendicular to magnetic field, upper hybrid waves, lower hybrid waves, ion cyclotron waves. Light waves in plasma.

Boltzmann and Vlasov Equations: The Fokker Planck equation, integral expression for collision term, zeroth and first order moments, the single equation relaxation model for collision term. Applications of kinetic theory to electron plasma waves, the physics of Landau damping, elementary magnetic and inertial fusion concepts.

Non-Linear Plasma Theories: Non-linear Electrostatic Waves, KdV Equations, Non-linear Schrodinger Equation, Solitons, Shocks, Non-linear Landau Damping.

Non-Linear Effects: Introduction, SHEATHS, ion acoustic shock waves, Ponderomotive force, Parametric Instabilities, The Korteweg-de-Vries Equation.

Reference Books:

1. Introduction to Plasma Physics and Controlled Fusion: F F Chen-Springer, 1984

2. Plasma Physics: R.O. Dendy-Cambridge University Press, 1995.

3. Ideal Magnetohydrodynamics: J P Friedberg-Springer, Edition, 1987.

4. Fundamental of Plasma Physics: S R Seshadri-American Elsevier Pub. Co. 1973.

(Elective Course)
QUANTUM COMPUTATION

Course No.	**L T P**
PHL-589	**4 0 0**

Unit- I

Introduction to Quantum Information, Review of quantum mechanics, Review of linear algebra and quantum mechanics, Stern-Gerlach experiment, Quantum teleporation

Unit -II

Introduction to computer science, Quantum logic gates- one qubit gate and two qubit gate, Quantum circuits, Quantum algorithms, Private and public key cryptography

Unit -III

Quantum fourier transform, Factoring: Shor's algorithm, Quantum parallelism, Deutch's algorithm, Quantum search algorithm (Grover's search), Quantum error correction

Unit -IV

Types of quantum computational schemes: Ions, Neutral atoms, NMR, Quantum dots, Introduction to fault-tolerant quantum computing

References:

1. Quantum Computation and Quantum Information by Michael Nielsen and Isaac L. Chang, Cambridge University Press.
2. Quantum Computing by Mika Hervensalo.
3. Problems & Solutions in Quantum Computing and Quantum Information by Willi-Hans Steeb and Yorick Hardy.

(Elective Course)
STATISTICAL MECHANICS

Course No.	**LTP**
PHL-590	**4 0 0**

Classical Stat. Mech. I : Foundations of statistical mechanics; specification of states in a system, contact between statistics and thermodynamics, the classical ideal state, the entropy of mixing and Gibbs paradox. The phase space of a classical system, Liouville's theorem and its consequences.

Classical Stat. Mech. II : The microcanonical ensemble with examples. The canonical ensemble and its thermodynamics, partition function, classical ideal gas in canonical ensemble theory, energy fluctuations in the canonical ensemble. A system of harmonic oscillators. The statistics of paramagnetism. The grand canononical ensemble, the physical significance of the statistical quantities, examples, fluctuation of energy and density. Cluster expansion of classical gas, the virial equation of state.

Quantum Stat. Mech.I : Quatum states and phase space, the density matrix, statistics of various ensembles. Example of electrons in a magnetic field, a free particle in a box and a linear harmonic oscillator. Significance of Boltzamann formula in classical and quantum statistical mechanics.

Quantum Stat. Mech. II : An ideal gas in quantum mechanical microcanonical ensemble. Statistics of occupation numbers, concepts and thermodynamical behaviour of an ideal gas. Bose Einstein condensation. Discussion of a gas of photons and phonons. Thermodynamical behaviour of an ideal fermi gas, electron gas in metals, Pauli’s paramagnetism, statistical equilibrium of white dwarf stars.

Reference Books:

1. Statistical Mechanics:R.K. Patharia Butterworth-Heineman, 1996
2. Statistical Mechanics: Kerson Huang-Wiley-1963.

(Elective Course)
PHYSICS OF LOW DIMENSIONAL SEMICONDUCTORS

Course No.	**LTP**
APL-581	**4 0 0**

Unit 1

General properties of heterostructures, Growth of heterostuctures: MBE & MOCVD, Band Engineering, Band Diagrams of different heterostructures, Superlattice devices, Doped Heterostuctures: Modulation Doping, band diagram of modulation doped layer, MODFET, electrostatic potential, conduction band and gate bias, threshold voltage, gate-channel capacitance, screening by 2D electron gas, layered structures, band structure modifications by strain, Quantum wires and dots.

Unit –II

Solution of Schrodinger wave equation in one dimensional square wells of finite and infinite. depths, parabolic and triangular wells, Low dimensional systems, sub-bands and their occupation, Two and three dimensional quantum wells: cylindrical, two dimensional parabolic and spherical wells, Quantum wells in heterostructures, Tunneling transport in semiconductors, potential step, square barrier, T -matrices, Tunneling current in one, two and three dimensions, Resonant Tunneling through Quantum Wells, Coulomb Blockade and single electron devices, Tunneling in Heterostructures, Intervalley transfer.

Unit-III

Semiclassical dynamics of electrons in a magnetic field, semiclassical approach to magenetotransport, Quantum mechanical approach to electrons in uniform magnetic fields, Landau levels, Aharonov-Bohm effect, De-Haas effect, Shubnikov-de-Haas Effect, Quantum Hall Effect, Fractional Quantum Hall Effect.

Unit-IV

General Theory of optical properties of Quantum Wells; Kramers-Kronig relations, optical -response functions, sum rules, valence band structure: Kane model, energy bands in a quantum well, interband Transitions in quantum wells, Absorption spectrum, optical gain and lasers, Excitons in two and three dimensions, Excitons in a quantum well.

References Books:

1. Physics of Low Dimensional Semiconductors - John H Davies –- Cambridge University Press -1998.
2. Low Dimensional Semiconductor Heterostructures - Keith Barnham & Dimitri Vvedensley – Cambridge University Press – 2001
3. Physics of Semiconductors and their Heterostructures - Jasprit Singh – Mc Graw Hill -1994.

(Elective Course)
DIGITAL SIGNAL PROCESSING

Course No.	**LTP**
APL-582	**4 0 0**

Unit-I

Signals and systems: Introduction, classification of signals, representation of signals, elementary discrete-time signals, manipulation of signals, classification of systems, static and dynamic systems, linear systems, time invariant systems, causal and non-causal system, stable and unstable systems, Fourier analysis; trigonometric, complex and exponent forms of Fourier series, Parseval identity, power spectrum, Fourier transform and its properties, Fourier transform of power and energy signals, Z-Transform: Introduction, definition, properties, evaluation of inverse z-transform.

Unit-II

DFT and FFT: The DFT, Properties of DFT: Linearity, periodicity, circular shift of a sequence, time reversal of a sequence, circular frequency shift, complex conjugate property, circular convolution, Hilbert transform, FFT: radix-2 FFT, decimation in time (DIT) algorithm, decimation in frequency (DIF) algorithm. Fast convolution: Overlap-add method, Overlap-save method, correlation.

Unit-III

Finite Impulse Response (FIR) filters: Introduction, magnitude and phase response of digital filters, frequency response of linear phase FIR filters, design techniques, design of optimal linear phase transformations.

Unit-IV

Infinite Impulse Response (IIR) filters: Introduction, IIR filters design by derivatives, impulse invariant and bilinear transformation method, frequency transformations. Adaptive filters: Theory, structure and applications (speech analysis and mobile communication)

References Books:

1. Digital Signal Processing - Alan V. Oppenhein and Ronald W. Schaffer – Prentice Hall Inc.- 2002
2. Digital Signal Processing - S Salivahanan, A. Vallavaraj and C Gnanapriya -Tata Mc Graw Hill-2000
3. Digital Signal Processing - S.K. Mitra- Tata Mc Graw Hill-2005
4. Digital Filter Designers Handbook - C.B. Rorabaugh- Mc Graw Hill-1993

(Elective Course)
DIGITAL COMMUNICATIONS

Course No.	**LTP**
APL-583	**4 0 0**

Unit-I

Digital Modulation -Techniques and System: Introduction, comparison of analog and digital signals, advantages and disadvantages of digital communication, elements of digital communication system, pulse code modulation (PCM), quantization noise, companding, signal representation: sampling theorem, PCM bandwidth, PCM system, advantages of PCM over analog modulation, differential PCM, delta modulation (DM), continuously variable slope delta modulator (CVSDM) or adaptive delta modulation.

Unit-II

Digital carrier - modulation techniques and system: Introduction, Amplitude Shift Keying (ASK), ASK spectrum, ASK modulator, Coherent ASK detectors, Noncoherent ASK detector, Frequency Shift Keying (FSK), bandwidth and frequency spectrum of FSK, Non-coherent FSK detector, Coherent FSK detector, FSK detection using PLL, Binary Phase Shift Keying, Binary PSK spectrum, Coherent PSK detection, Quadrature Phase Shift Keying (QPSK), QPSK demodulator, Differential PSK.

Unit-III

Spread-Spectrum Techniques and Communication Systems: Introduction, principles of spread spectrum, direct sequence pseudo noise (DSPM) spreading, Frequency Hop Coding, Time Hop Spreading, spread spectrum modulation systems, generation of pseudo random Sequences, Sequence length, independence of Sequences, number of ones and zeros in maximal Sequence, clustering in a PN Sequence, correlation properties, spread spectrum modulation, Continuous-Phase-Shift-Modulation (CPSM),Code Division Multiple Access (CDMA).

Unit-IV

Cellular and Mobile Communication Systems: Introduction, main methods of radio transmission, GSM standard for cellular phones, GSM architecture, features of GSM, cellular mobile radio systems, inside the cell phone, other services of GSM, future of telecommunication, operation of cellular systems, concept of frequency, reuse channels, frequency reuse schemes, frequency reuse distance, consideration of components of cellular systems, switching equipment data links, security and identification, supervision, power controls, function of the MTSO, cellular analog switching equipments, description of analog switching equipment, modification of analog switching equipment, cell site controllers and hardware, cellular digital switching equipment, general concept, elements of switching, radio.

References Books:

1. Communication Systems - Simon Haykins - 4th edition - John Wiley & Sons - 2001.
2. Digital and Analog Communication System - K Sam Shanmugam - John Wiley & Sons - 1979.
3. Elements of Digital Communication - N Sarkar - Khanna Publishers - 2003.
4. Modern Electronic Communication : Principles and Practice - A. K. Sharma and R. K. Sinha -- Dhanpat Rai Publishing Company - 2001.

(Elective Course)
OPTICAL COMMUNICATIONS

Course No.	**LTP**
APL-584	**4 0 0**

Unit -I

Advantages of Optical Fibre Communication, Ray Theory, Modes in planar guide, Cylindrical fibre, Mode Coupling. Step index fibres: Multimode Step index Fibres, Single Mode Step Index Fibres, Graded index Fibres, Attenuation, Material Absorption Losses, Linear Scattering Losses, Non-Linear Scattering Losses, Fibre Bend Loss, Dispersion, Interamodal, Intermodal Dispersion, Overall fibre dispersion, Multimode, Single mode, Modal Noise, Liquid phase Technique, Vapor phase Deposition Technique, Fibre Cables, Fibre Splices, Fibre Connectors, Fibre attenuation measurements, Dispersion measurements, Fibre refractive index profile, Fibre Numerical Aperture, Fibre diameter, Field Measurements (OTDR).

Unit -II

Lasers, Basic concepts, Emission from semiconductors, Injection laser, Multimode injection laser, Single mode injection laser, Single mode structures, Injection laser characteristics, Non semiconductor lasers, LED, Efficiency, Double heterostructure, Planar, Dome, Burrus type, Lens coupling, Edge emitting, LED characteristics, power, spectrum, Modulation bandwidth, Reliability, Modulation.

Unit -III

Detectors, Device type, Absorption, Quantum efficiency, Responsivity, Longwavelength cut-off, p-n, p-i-n, Avalanche, Silicon reachthrough, Germanium avalanche, Drawbacks of avalanche diodes, Receiver Noise, Thermal, Dark Current, Quantum Noise, p-n and pin diode receiver noise, Receiver capacitance, APD Excess Noise, Receiver Structure, Low impedance front end, Transimpedance front end, FET preamplifiers, GaAs MESFETs, PIN-FET hybrid

Unit –IV

Optical transmitter circuit, Source limitation, LED drive circuits, Laser drive circuits, Optical receiver circuits, Preamplifier, Automatic gain control, equalizaiton, System Design, Component choice, Multiplexing, Digital system, The regenerative repeater, The Optical transmitter, The Optical Receiver, Channel losses, Temporal response, Optical power budgeting, Line coding, Analog Systems, Direct intensity modulation, System Planning, Subcarrier intensity modulation, Subcarrier double sideband modulation, Subcarrier phase modulation, Pulse analog techniques, Coherent Systems, Public Network Applications, Military Applications, Civil and Consumer Applications, Industrial Applications, Computer Applications, Integrated Optics, Integrated Optical devices.

References Books:

1. Optical Fiber Communication - J.M.Senior, Perason Education, 2nd Edition- 1990.
2. Optical Fiber Communication – G.E.Keiser –Tata McGraw Hill , 3rd Edition- 2000.
3. Optical Communication Systems – J. Gowar- Prentice Hall- 1993.
4. An Introduction to Fiber Optics- A. K. Ghatak and K. Thyagarajan- Cambridge University Press-1998.