Department of Physics, Kazi Nazrul University

Semester-I

Sr. No.	Name of the Subject	Code	No. of classes	Marks	Teaching Scheme			credit
					L	T	P	
1	Classical Mechanics and special theory of relativity.	PH 101	42	50	4	0	0	4
2	Quantum Mechanics 1	PH 102	42	50	4	0	0	4
3	Mathematical methods of physics (From othrer Dept)	Other Dept	42	50	4	0	0	4
4	Electrodynamics and plasma physics	PH 103	42	50	4	0	0	4
5	Physics Lab- I +	PH 104	84	80	0	0	6	4
	Seminar by students		28	20	0	0	2	
	Total Credits = 20							

Semester-II

Sr. No.	Name of the Subject	Code	No. of classes	Marks	Teaching Scheme			credit
					L	T	P	
1	Thermal and Statistical Physics	PH 201	42	50	4	0	0	4
2	Computer programming and computational physics	Other Dept	42	50	4	0	0	4
3	Condensed matter physics	PH 202	42	50	4	0	0	4
4	Nuclear and introduction to particle physics	PH 203	42	50	4	0	0	4
5	Physics Lab -II Seminar	PH 204	84	80	0	0	6	4
				20	0	0	4	
	Total Credits = 20							

Semester-III

Sr. No.	Name of the Subject	Code	No. of classes	Marks	Teaching Scheme			credit
					L	T	P	
1	Quantum Mechanics 2	PH 301	42	50	4	0	0	4
2	Atomic and Molecular Spectroscopy	PH 302	42	50	4	0	0	4
3	Electronics (analog and digital)	PH 303	42	50	4	0	0	4
4	Advanced Optics and Optoelectronics	PH 304	42	50	4	0	0	4
5	Physics Lab –III +	PH 305	84	80	0	0	6	4
	Seminar			20	0	0	2	
	Total Credits =							20

Semester-IV

Sr. No.	Name of the Subject	Code	No. of classes	Marks	Teaching Scheme			credit
					L	T	P	
1	Elective-I	PH 401	42	50	4	0	0	4
2	Elective-II	PH 402	42	50	4	0	0	4
3	Elective-III	PH 403	42	50	4	0	0	4
4	Physics Lab	PH 404	42	50	0	0	6	4
5	Project	PH 405	42	60	0	0	6	4
	Grand Viva			40	0	0	2	
	Total Credits = 20							

List of Elective

1. Optoelectronics and Laser
2. Magnetism, magnetic materials and spintronics application
3. Experimental Techniques in Nuclear and Particle Physics.
4. Nonlinear optics and optical switching

KAZI NAZRUL UNIVERSITY, ASANSOL
MSc Physics Curriculum

SEMESTER-I

PH 101: CLASSICAL MECHANICS AND SPECIAL THEORY OF RELATIVITY

Review of Lagrangian and Hamiltonian formalisms in different systems. Legendre transforms. Hamilton's canonical equations and their applications. Lagrangian and Hamiltonian for relativistic particles. Principle of least action. (6 lectures)

Canonical transformations and some applications. Infinitesimal Canonical transformation. Integral invariant of Poincare. Lagrange and Poisson brackets and their applications. Conservation theorems and angular momentum relation in Poisson brackets. Liouville's theorem. (7 lectures)

Hamilton-Jacobi equation for Hamilton's principle and characteristis function and their application. Separation of variables. Action and angle variable and their applications. Passage from classical to quantum mechanics. (6 lectures)

Rigid body motion. Heavy symmetrical top with one point fixed on the axis. Fast and sleeping top. (3 lectures)

Deformable bodies. Strain and stress tensor. Energy of elastic deformation. (2 lectures)

Flows on the line and circle: introduction; fixed points and stability; linear stability analysis; classification of linear systems; potentials; physical examples including uniform and nonuniform oscillator; overdamped pendulum. Flows in two-dimension: phase plane; phase portraits; index theory; fixed points and linearization; limit cycles; Poincare-Benedixon theorem; weakly nonlinear oscillators. Bifurcations: saddle-node bifurcation; transcritical bifurcation; pitchfork bifurcation; Hopf bifurcations; Poincare maps. Chaos and fractals: various routes; Lorenz equations: simple properties; strange attractor; Liapunov exponent; applications of chaos; Cantor set; dimension of self-similar structures, fractals; One-dimensional maps: fixed points; logistic map; numerics and analysis; computer based problems. [10 lectures]

Review of special theory of relativity: Poincare and Minkowski's 4-dimensional formulation, geometrical representation of Lorentz transformations in Minkowski's space and length contraction, time dilation and causality, time-like and space-like vectors, Newton second law of motion expressed in terms of 4-vectors. Idea of Euclidean and non-Euclidean space, basic tensor analysis, meaning of parallel transport and covariant derivatives, Geodesics and autoparal lelcurves. (8 lectures)

Books Recommended:

1. Classical mechanics-Goldstein
2. Mechanics- Landau and Liftshitz.

3. Classical Mechanics- Rana and Jog
4. Strogatz, Nonlinear Dynamics and Chaos
5. R. Resnick – Introduction to Special Theory of Relativity.
6. S. Banerji and A. Banerjee – The Special Theory of Relativity (Prentice Hall of India, 2002)
7. Stephen Wiggins, "Introduction to Applied Nonlinear Dynamical Systems and Chaos", Springer-Verlag, Second Edition.
8. Dominic Jordan, Peter Smith, "Nonlinear Ordinary Differential Equations: An Introduction for Scientists and Engineers" (Oxford Texts in Applied and Engineering Mathematics)

PH 102: QUANTUM MECHANICS-I (40 marks) 42 Hrs

Review of Basic Quantum Mechanics (4 lectures)
Particle in one-dimensional potential well (finite and infinite depth) and its energy states; Linear harmonic oscillator; Solutions of different one-dimensional barriers (finite and infinite width) and penetration problems. Motion of a charged particle in a spherically symmetric potential; Solution of Hydrogen atom problem. Spin and Angular Momentum. (9 lectures)

Linear vector space – State space, Dirac notation and Representation of State Spaces, Concept of Kets, Bras and Operators, Expectation Values, Superposition Principle, Orthogonality, Completeness, Expansion of State Vector, Non commutating Observables, Uncertainty Relations, Commutation and Compatibility, Change of basis, Unitary operators. State function and its interpretation, Expectation Values, Expansion of a State Function and superposition of states. Matrix Representation of State Vectors and operators, Continuous Basis. Relation between a State Vector and its Wave function. Solution of the Linear Harmonic Oscillator using Operator Method, Coherent States. (13 lecturers)
Equation of Motion: Heisenberg, Schrodinger and Interaction pictures. (2 lectures)
Approximation methods - Time-independent perturbation theory for non-degenerate and degenerate states. Applications: Anharmonic oscillator, Helium atom, Stark effect in hydrogen atom, Variational methods. WKB method; Connection formulae. Time-dependent perturbation theory; Harmonic perturbation; Fermi's golden rule. Sudden approximation. Examples and problems. (14 lectures)

Books Recommended:
1) 'Quantum Physics' by Robert Eisberg and Robert Resnick (John Wiley and sons).

2) 'Introduction to Quantum Mechanics', D, J. Griffiths.

3) 'Quantum Mechanics: Concepts and Applications", N. Zettili.

4) Quantum Mechanics, B. H. Bransden and C. J. Joachain

5) 'Quantum Mechanics' by L. I. Schiff (McGraw-Hill Book, New York).

6) ‘Quantum Mechanics’ by C. Cohen-Tannoudji.

PH 103 : Electrodynamics and Plasma Physics Marks 50 (Class 42)

Inhomogeneous wave equation: it’s solution. Lineard-Wiechert potentials.Field of a uniformly moving charge.Fields of an accelerated charge.Radiation from a charge at low velocity.Radiation from a charge at linear motion and circular motion or orbit.Bremsstrahlung- Cerenkov radiation.Relativistic electrodynamics.Covariant form of EM equations.Transformation law for the EM field.Lienardgeneralisation of Larmor formula; a uniformly moving charge from Coulomb field.

Classical theory of electron: Radiation reaction from energy conversation: Lorentz theory. Self force.

Scattering: free and bound electron. Dispersion and absorption: Lorentz electro magnetic theory. Thomson and Rayleigh Scattering, Nonlinear scattering, Kramers-Kronig relation.

Magnetohydrodynamic (MHD) equations, magnetic, viscosity, pressure, Reynold number, etc.MHD waves. Alfven waves and velocity, Hartmann flow and Hartmann number.

Orbit theory of drift motions in a plasma. Pinch effect.Instability in pinched plasma column.Plasma oscillations, short wavelength of plasma oscillation and Debye screening length.

Propagation of EM waves through plasma. Effect of external magnetic field on wave propagations: ordinary and extraordinary rays.

Antenna theory : Oscillating dipole antenna , Linear antenna (half wave and full wave) , antenna array.

Books Recommended:

1. Marion- Classical Electrodynamics
2. Jackson- Classical Electrodynamics
3. Panofsky & Phillips- Classical Electrodynamics
4. Chen- Plasma Physics
5. Griffith-Electrodynamics
6. Electromagnetics – Sadiku

7. Modern Electrodynamics : Andrew Zangwill

XXXXX: MATHEMATICAL METHODS OF PHYSICS (50 marks) 42 Hrs

Functions of a complex variable. Brief review of the topics included in the honours syllabus: analytic functions, Cauchy-Riemann equations, integration in the Complex plane, Cauichy’s theorem, Cauchy’s integral formula. Liouville’s theorem. Moretra’s theorem.

Proof of Taylor and Laurent expansions. Singular Points and their classification. Branch Point and branch Cut. Riemann sheets. Residue theorem. Application of residue theorem to the evaluation of definite integrals and the summation of infinite series. (11 lectures)

Linear vector spaces, subspaces, Bases and dimension, Linear independence and orthogonality of vectors, Gram-Schmidt orthogonalisation procedure. Linear operators. Matrix representation. The algebra of matrices. Special matrices. Rank of a matrix. Elementary transformations. Elementary matrices. Equivalent matrices. Solution of linear equations. Linear transformations. Change of Basis. Eigenvalues and eigenvectors of matrices. The Cayley-Hamilton theorem. Diagonalisation of matrices. Bilinear and Quadratic forms. Principal axis transformation. (9 L)

Fourier and Laplace transforms. Inverse transforms. Convolution theorem. Solution of ordinary and partial differential equations by transform methods.

(7 lectures)

Green's functions for ordinary and partial differential equations of mathematical physics.

(3 lectures)

Group theory: Definition. Group postulates. Finite and infinite groups, order of a group, subgroup; rearrangement theorem, multiplication table. Cosets, Lagrange's theorem. Order of an element.. Conjugate elements and classes. Invariant subgroups, factor groups. Generators. Isomorphism and homomorphism. Cyclic and other distinct groups. Permutation and alternating groups. Cayley's theorem.
(5 lectures)

Representation theory: Definition of representation. Faithful and unfaithful representations. Invariant subspaces and reducible representations. Reducible and irreducible representations. Schur's lemmas, great orthogonality theorem and its geometrical interpretation. Character. First and second orthogonality theorems of characters and its geometrical interpretation. Regular representation, celebrated theorem and its implication. Projection operators; determination of basis functions. Construction of character tables of simple groups.
(5 lectures)

Application in Physics: Group of Schrodinger equation. Reduction due to symmetry. Perturbation and level splitting. Selection rules.
(2 lectures)

Books Recommended:

1. M. R. Spiegel (Schaum's outline series) – Theory and Problems of Complex Variables.
2. G. Arfken (Academic Press) – Mathematical Methods for Physicists.
3. P. Dennery and A. Krzywicki (Harper and Row) – Mathematics for Physicists.
4. Mary L. Boas; *Mathematical* Methods in the Physical Sciences.
5. W. Joshi (Wiley Esstern) – Matrices and Tensors
6. M. Hammermesh. 'Group Theory'. Addison-Wesley
7. M. Tinkham. 'Group Theory and Quantum Mechanics;. McGraw-Hill.
8. A. W. Joshi. 'Group Theory'. Wiley Eastern Ltd..
9. F. A. Cotton. 'Chemical Application to Group Theory'. Wiley Eastern Limited.
10. N. Deo : Group Theory (Tata McGraw Hill)
11. Advanced mathematical methods for scientists and engineers; Carl M. *Bender*., Steven A.*Orszag*.

Semester-II

PH 201 : Thermal and statistical physics. Marks 50 (classes 42)

Scope and aim of Statistical Mechanics: Phase Space, Phase Points, Ensemble. Density of Phase Point and Liouville's Equation, Stationary ensembles: Micro - Canonical, Canonical and Grand Canonical. Partition functions. Equilibrium Properties of Ideal System: Ideal gas, Harmonic Oscillators, Rigid rotators. Bose – Einstein and Fermi – Direct distribution functions, general equations of states for ideal quantum systems, Properties of ideal Bose - gas, Bose – Einstein condensation.

Density Matrix: Statistical and Quantum mechanics approaches, Properties of mixed and Pure states, density matrix for stationary ensembles, Application of a free particle in a box, an electron in a magnetic field, Density matrix for a beam of spin ½ Particles, construction of density matrix for different spin states and calculation of the polarization vector.

Statistical mechanics of interacting systems: Cluster expansion for a classical gas, Virialexpension of equation of state, Evaluation of the Virial coefficients.

Spin-systems and exchange interaction:

Basic idea of spin-exchange between two electrons (Heitler-London), Ferro- and Antiferro-magnetic exchange, Ising model, solution in one dimension - absence of phase transition at finite temperature.

Phase transitions: General remarks, Examples of phase transition, critical opalescence. Basic ideas of critical phenomena, critical indices, introduction to the order parameter and Ginzburg-Landau theory.

Suggested Readings:

1. R. K. Pathria, *Statistical Mechanics*
2. *K. Huang, Statistical Mechanics*
3. L. D. Landau, and E. M. Lifshitz,*Statistical Physics (Pt.-I)*
4. R. P. Feynaman, *Statistical Mechanics, A set of lectures*
5. S. K. Ma, *Statistical Physics*
6. A. Ishihara, *Statistical Physics*
7. Concepts inThermal Physics**,** Stephen J. Blundell and Katherine M. Blundell

PH 202 : Condensed Matter Physics Marks 50 (class 42)

PH 503 Condensed Matter Physics Structure of solids, lattice translation vectors, unit cell, fundamental types of lattices (2 & 3 dimensions), simple crystal structures, diffraction, Bragg's law, Fourier analysis, reciprocal lattice vectors, structure factor, methods for structure determination, Brillouin zone. Crystal binding-ionic, covalent ,metallicand weak-bonding, cohesive energy. Vibration of lattice, normal modes, spring-mass coupled system, mono and di-atomic chains, periodic lattices, phonons, force constant from experiments, quantization of elastic waves, heat capacity, Debye T3 -law, Einstein model for phonons, heat capacity, thermal expansion, thermal resistivity. Free electron theory of metals, Fermi-Dirac distribution, Free electrons, boundary conditions, Density of levels in 1, 2 & 3 dimensions, Fermi momentum and Fermi energy, Connection between electron density and Fermi energy. Specific heat of metals, semiclassical theory of transport, Drude theory and Hall effect. From atoms to molecules, molecular orbitals, LCAO, band theory, periodic potential, Bloch's theorem, tight binding approximation, Brillouin zones (first and second) for square, triangular, cubic lattices, Energy bands in reduced zone scheme, energy bands and Fermi surfaces in a few metals as example.

Properties of Superconductor, Occurrence of Superconductivity, Superconducting Elements, Zero Resistance, Meissner Effect, AC Resistance, Entropy, Specific Heat. Type-I and Type-II Superconductors, London's Theory, Thermodynamics of Superconductor, BCS Theory, Cooper pair.

BooksRecommended :

1. Ashcroft &Mermin, Solid State Physics;
2. C. Kittel, Introduction to Solid State Physics;
3. Marder, Condensed Matter Physics.
4.Quantum Transport : From atoms to Transistors, SupriyoDatta.
5.Elementary Solid State Physics, M. Ali Omar, Pearson

PH 203: Nuclear and Introduction to Particle Physics Marks 50 (Class 42)

Nuclear Physics: General properties of nucleus: radius, mass, binding energy, angular momentum, parity, electromagnetic moments, excited states. Nuclear models: Liquid-Drop model, Bethe-Weizsäcker mass formula, binding energy curves; Shell model, magic numbers, ground state spin, collective model; Meson-Exchange theory of nuclear force. Nuclear Reactions: Radioactive decay, half-life, radioactive series, compound nucleus; Fission and Fusion within Liquid-Drop model. Alpha, Beta and Gamma decay: Gamow theory, Fermi theory, Kurie plot and neutrinos; Nuclear reactors;

Particle Physics: Fundamental interactions: Strong, weak, electromagnetic and gravity. Particle Zoo: Leptons, Hadrons. Organizing principle: Baryon and Lepton Numbers, Strangeness, Isospin, The Eightfold Way. Quarks: Color charge and strong interactions, confinement, Gell-Mann – Okubo mass relation, magnetics moments of Hadrons. Field Bosons: charge carrier. The Standard Model: party non-conservation of weak interaction, Wu's experiment, elementary idea about electroweak unification, Higgs boson and origin of mass.

Books Recommended :

1. An Introduction to Nuclear Physics, W L Cottingham and D A Greenwood

2. Introductory Nuclear Physics, K S Krane

3. Nuclear and Particle Physics: An Introduction, **Brian R Martin**

4. Introductory Nuclear Physics, **Samuel S. M. Wong**
5. Nuclear Physics, S N Ghosal

6. Introduction To High Energy Physics, **Donald H Perkins.**

7. Introduction to Elementary Particles, **David J Griffiths**

8. Modern Elementary Particle Physics, **Gordon L Kane**

XXXXX Computer Programming and Computational Physics (50 marks) 42 Hrs

Elements of Programming Language:
Algorithms and flowchart; Structure of a high level language program; Features of C language; constants and variables; expressions; Input and output statements; conditional statements and loop statements; arrays; functions; character strings; structures; pointer data type; list and trees. Ideas of Symbolic manipulations. Basic introduction to MATLAB and MATHEMATICA (14 lectures)

Representation of integers and real numbers; Accuracy, range, overflow and underflow of number representation; error propagation and instability. Solution of polynomial equations- bisection, Newton-Raphson algorithm. Zeroes and extremes of multivariate functions. Solution of system of simultaneous equations- Gauss elimination, Gauss-Seidel, LU decomposition algorithms. Interpolation- Newton interpolation formula. Numerical integration – trapezoidal formula, Simpson's formula, Romberg formula. Numerical solution of differential equations- Euler, Runge-Kutta formula. Numerical solution of differential equations. Monte Carlo technique of numerical integration.
(14 lectures)

Solution to Physical Problems: examples of ODE and PDE, damped harmonic oscillator. Eigenvalue problems, Application to 1D Quantum mechanical problems, Shooting methods to solve time-independent Schrodinger wave equation for particle in a box., Maxwell's Equation (boundary value problems), logistic map.
(14 lectures)

Books Recommended:
1. Tanenbaum, Operating system. Prentice Hall.
2. Gottfried, Programming with C. Schaum series.
3. Balaguruswamy, ANSI C. TMH.
4. Sastry, Introductory Methods of Numerical Analysis. PHI

5. Kyayszig, Advance Engineering Mathematics. John Willey, 9^{th}
6. Programming in C
7. An Introduction to Computational Physics, Tao Pang

Semester – III

PH 301 Quantum Mechanics 2

1. WKB Approximation (3)
Quantisation rule, tunnelling through a barrier, qualitative discussion of α-decay.
2 SchrÖdinger equation in two dimensions. Two dimension harmonic oscillator: degeneracy of energy eigen values. Electrons in a 2-D plane subject to strong perpendicular magnetic field, Landau levels and degeneracy. Integer Quantum Hall Effect. (4)
4. Symmetries in quantum mechanics (3)
Conservation laws and degeneracy associated with symmetries; Continuous symmetries — space and time translations, rotations. Discrete symmetries, parity and time reversal.
5. Identical Particles (2)
Meaning of identity and consequences; Symmetric and antisymmetric wavefunctions; Slater determinant; Symmetric and antisymmetric spin wavefunctions of two identical particles.
3. Applications of QM:
A few simple potential problems: density of states; quantum wells (square, triangular, arbitrary); confined levels in semiconductor transistors; Kronig-Penney model and idea of bands. (4)
Applications of tunneling: square barrier(review); Ohmic contacts; field emission devices; STM; Josephson junctions; multiple barriers and resonant tunneling diode; quasi-bound states and transmission resonance widths. (4)
Hydrogen and one-electron atoms (review); doping in semiconductors, excitons in semiconductors; quasi-bound states in spherically symmetric potentials and radioactivity. (3)
Applications of time-independent perturbation theory: exciton in quantum wells, resonant coupling in double wells. (3)
Application of time-dependent perturbation theory: harmonic perturbations, transition probability for continuous spectra, higher orders, electron-photon interaction, electron-phoon interaction. (4)
Scattering: Integral equation; optical theorem, Born approximation, partial wave analysis, applications--screened Coulomb potential scattering, alloy scattering, interface roughness scattering, carrier-carrier scattering. (5)
4. Relativistic Quantum Mechanics (7)
Klein-Gordon equation, Feynman-St¨uckelberg interpretation of negative energy states and concept of antiparticles; Dirac equation, covariant form, adjoint equation; Plane wave solution. Non-relativistic reduction; Helicity and chirality; Klein paradox; Properties of matrices; Charge conjugation; Normalisation and completeness of spinors.
Suggested Books:
1. J J Sakurai, Modern Quantum Mechanics
2. E. Merzbacher, Quantum Mechanics

3. D. J. Griffiths, Introduction to Quantum Mechanics
1. Quantum Mechanics: fundamentals and applications in technology by Jasprit Singh (Wiley)
2. Applied QM by Levi (Cambridge University Press)
3. Applied Quantum Mechanics by W.A Harrision (World Scientific)
4. Quantum Mechanics with Applications to Nanotechnology and Information Science: by Band,YehudaB.,Avishai,Yshai.

PH 302: Atomic and Molecular Spectroscopy

1. One Electron Atom (3)
Introduction: Quantum States; Atomic orbital; Parity of the wave function; Angular and radial distribution functions.

2. Interaction of radiation with matter (7)
Time dependent perturbation: Sinusoidal or constant perturbation; Application of the general equations; Sinusoidal perturbation which couples two discrete states — the resonance phenomenon. Interaction of an atom with electromagnetic wave: The interaction Hamiltonian — Selection rules; Nonresonant excitation — Comparison with the elastically bound electron model; Resonant excitation — Induced absorption and emission.

3. Fine and Hyperfine structure (8)
Fine structure of spectral lines; Selection rules; Lamb shift. Effect of external magnetic field - Strong, moderate and weak field.

4. **Molecular Electronic States** (5)
Concept of molecular potential, Separation of electronic and nuclear wavefunctions, Born-Oppenheimer approximation, Electronic states of diatomic molecules, Electronic angular momenta, Approximation methods for the calculation of electronic Wave function, The LCAO approach, States for hydrogen molecular ion, Coulomb, Exchange and Overlap integral, Symmetries of electronic wave functions.

5. **Rotation and Vibration of Molecules** (5)
Solution of nuclear equation; Molecular rotation: Non-rigid rotator, Centrifugal distortion, Symmetric top molecules, Molecular vibrations: Harmonic oscillator and the anharmonic oscillator approximation, Morse potential.

6. Spectra of Diatomic Molecules (5)
Transition matrix elements, Vibration-rotation spectra: Pure vibrational transitions, Pure rotational transitions, Vibration-rotation transitions, Electronic transitions: Structure, Franck-Condon principle, Rotational structure of electronic transitions, Fortrat diagram, Dissociation energy of molecules.

PH 303 Electronics (Analog and Digital)

1. Semiconductor Device:
   Bipolar Device- Junction diode, Junction capacitance, Bipolar junction transistor, Hetero junction devices, Unipolar devices-Metal-Semiconductor contacts, JFET, MOSFET.
   12 L
2. Active Circuits:
   Amplifiers- Discrete component Transistor, Amplifier design technique, Video amplifiers, RF amplifiers, Power amplifier design consideration. Oscillators-Feed back principle, OP-Amp based R-C phase shift, Wien bridge oscillators, OP-Amp circuits – Active filters, Butter worth filter. 10 L

3. Passive Networks and Transmission line:
   Prototype LC frequency selective networks, HF transmission lines, Primary and secondary line constants, input impedance, VSWR, Distortion of e.m. wave in practical lines, Fault location in practical line.
   5 L
4. Digital Electronic Circuits:
   Logic Circuits- Classification, Logic simplification, SOP and POS design of Combinational circuits. Sequential circuit-Flip-Flap, counters and Registers. Arithmetic circuit-RCA, CLA, BCD adders multipliers. 7L
5. Communication:
   Classification of modulation- AM,FM,and PM and comperative merits in thecontext of transmission bandwidth, Power utilization. AM and FM modulators and demodulators. Effect of noise on communication system-characteristicsof additive noise, Performanceof AM, FM receives in the face of noise. 8L

Text Books:

1. S.M Sze,Physics of Semiconducter Device.
2. J. Millman & Grable, Microelectronics
3. J.D. Ryder, Network lines & Fields.
4. Malvino and Leach, Digital Principles & Applications
5. R.P. Jain , Digital Electronoics
6. Fraser, Telecommunications
7. R. Roody & J. Coolen, Electronic lominilation
8. Jain, Linear Integral Circuit

Reference Books:

1. J. D. Ryder, Electronic fundamental and applications
2. S. Soclof, Applications of analog integral circuit
3. Streetman, Banerjee - Solid state electronic devices.

PH 304 Advanced Optics and Optoelectronics

1. Basic principles of Laser :

Properties of Laser Radiation, Basic components of Laser. Classification of lasers. Spontaneous and simulated emission. **[2]**

Einstein's coefficient and their relations, conditions of population inversion **[2]**

Absorption and amplifications of light in a medium, population inversion and threshold condition for a laser, gain coefficient. **[4]**

Laser Rate Equation, 2- level laser, 3-level and 4-level lasers. **[3]**

Line broadening mechanism- (Spontaneous transition, collision broadening and Doppler broadening) **[3]**

2. Modulation Techniques :

Propagation of EM waves in anisotropic dielectric medium, dielectric Tensor, Index ellipsoid. **[2]**

Electro-optic effect, electro-optic phase retardation, electro-optic amplitude modulation, phase-modulation of light. **[4]**

Acousto-optic effect (introduction), Application of EO effect. **[2]**

3. Photonic devices : Light Emitting Diode (LED), quantum efficiencies (internal and external), responsivities, Characteristics and applications of various kinds of LEDs, dome type LED , homojunction LED, heterojunction LED, guided wave LED, edge-emitting LED, quantum casecaded LED, quantum dot LED, operational circuit and modulation of LEDs. Different type ofs of coupling procedure of LED with optical fiber. Coupling coefficient and coupling loss. **[5]**

Photo diode, quantum efficiencies (internal and external), responsivities, Characteristics and applications of various kinds of photodetectors, P-I-N photodiode, Avalanche photodiode, Metal –Semiconductor-Metal (M-S-M) photodiode, quantum well photodetector, multiquantum well photodetector, infrared photodetector etc. Photomutlipliers tubes, Charged coupled devices (CCD), solar cell **[6]**

4. Fiber Optics: Rectangular and cylindrical wave guides, propagation of radiation in dielectric waveguide. **[4]**

Step index and graded index fiber, modes in fiber, dispersion in multimode & single mode fiber, attenuation mechanisms in fibers, signal distortion, mode coupling, power launching and coupling, fiber parameter specifications. **[3]**

Holography: Importance of Coherence, Principles of holography and characteristics, classification of hologram and application, non-destruction texting. **[3]**

Text Books:

1. S.M. Sze, Physics of semiconductor devices.
2. O. Svelto, Principles of lasers..

3. Franz and Jain, Optical communication system

Reference Books:

1. P. Bhattacharya, Semiconductor opto-electronic devices.
2. W. Koechner Solid State Laser Engineering.
3. J.M Senior, Optical fiber communications principles and practice
4. S.O. Kasap, Optoelectronics and photonics principles and practices
5. Martin A Green Solar Cells: Operating Principles, Technology, and System Applications.