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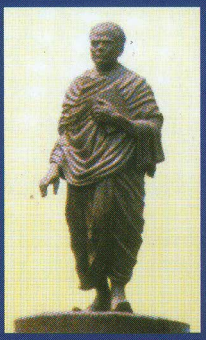

SYLLABUS

M.Sc. Course in Physics

VIDYASAGAR UNIVERSITY
MIDNAPORE - 721102

SYLLABUS
for the
MASTER OF SCIENCE COURSE IN
PHYSICS

COURSE STRUCTURE

Paper	Group	TOPIC	Marks	Number of Classes (hours)
1	A	Classical Mechanics	30	45
1	B	Solid State Physics	45	65
2	A	Quantum Mechanics(I)	50	75
2	B	Molecular Spectroscopy and laser	25	37
3	A	Electrodynamics	35	50
3	B	Plasma Physics	40	60
4	A	Electronics (general)	40	60
4	B	Digital Electronics	35	50
5	A	Numerical analysis and Computer Programming	35	52
5	B	Method of Mathematical phys	40	60
6	-	Electronics Practicai	75	150
7	-	Programming in FORTRAN &C	50	75
8	A	Quantum Mechanics (II)	40	60
8	B	Statistical Mechanics	35	52
9	A	Nuclear Physics	40	60
9	B	Field theory and Particle Physics	35	52
10	A	Photonics	40	60
10	B	Optional	35	52
11	-	Special Paper	75	110
12	-	Special practical	75	150
13	-	Advance Practical	75	150
14	-	Project Work+Seminar	35+15	

Paper 1 : Group - A

Classical Mechanics - 30, No. of Lectures - 45

1. Recapitulation of : D' Alembert's priniciple, Lagrange's equation, velocity dependent potential, sysmmetry (isotropy of space, homogencity of time) and corresponding conservation laws. (9)

2. Central force problems: Kepler's problem, transformation from centre of mass to laboratory system, Rutherford scattering. (6)

3. Rigid body motion: degrees of freedom, Euler's theorem infinitesimal rotation vector, Inertia dynamic, principal axes and priniciple moments of inertia. Euler's equation. Torque free motion of an axially symmetric rigid body, symmetric top. precession and nutation. (8)

4. Small oscillation: The eigenvalue equation, principle axis transformation, Oscillating system, Normal modes, free vibration of a diatomic molecule. (8)

5. Action integral, Hamiltons principle, principle of least action, Routhian Hamiltonian for typical systems: particle in a central force, chared particle in an external EM field, harmonic oscillator. (8)

6. Lagrangian and Hamiltonian formulation for fields. Relativistic field theory. (6)

Paper I : Group - B

Solid State Physics - 45, No. of Lectures - 65

1. Crystal structure: Space lattice, Miller indices of crystal Planes and direction. Simple crystal structures. Symmetry operations; Polycrystalline and amorphous materials. (8)

2. X-ray diffraction & reciprocal lattice: Origin of X-rays, Line & continuum spectrum, X-ray diffraction. Bragg law, Derivation of scattered wave amplitude, Lauc conditions, reciprocal lattice vectors, Brillouin Zone, Atomic form factor, Structure factor and experimental diffraction methods. (10)

3. Lattice Dynamics: Vibrations of monoatomic and diatomic linear lattice Phonons. Its application in specific heat calculations. Anharmonic crystal interactions, thermal expansion, thermal conductivity, Debye Waller effect. (8)

4. Free electron Fermi Gas: Free electron gas in metals, density of orbital, effect of temperature on Fermi Dirac distribution function, Heat capacity of the electron gas, Boltzman transport equation, electrical conductivity and Ohm's law, Hall effect, thermal conductivity of metals, ratio of thermal to electrical conductivity, Field emission. (10)

5. Energy Bands: Origin of the energy gap, Bloch function, Kronig penny model, empty lattice approximation, nearly free electron model, extended, reduced and periodic zone schemes, tight binding approximation. (13)

6. Dielectrics: Polarization mechanisms, Classius-Mossoti relation, qualitative discussion on piezo and pyroelectricity. (5)

7. Magnetism: Diamagnetism, Paramagnetism, qualitative discussion on magnetic order, ferro, antiferro and ferrimagnetism.

8. Superconductivity: Basic phenomenoloy, Meissner effect, type-I and II superconductors, BCS pairing mechanism, Thermodynamics of Superconducting transition, London equation. (5) (6)

Paper II : Group - A

Quantum Mechanics - 50, No. of Lectures - 75

1. Wave particle dualism, Uncertainty principle, Complementarity principle, Wave packets in space and time. (8)

2. Formalism of Quantum Mechanics: Development of the wave equation, the Schrodinger wave equation, Born's statistical interpretation of the wave function, Probability density and Probability current density. Ehrenfest's theorem, stationary states, energy eigenfunctions, one dimensional square well potential, (8)

parity. Completeness and closure property, momentum eigenfunctions. minimum uncertainty product, form of minimum packet.

3. Exactly Soluble problems: (i) Linear harmonic oscillator. Spherically symmetric potential, Solution for radial equation for a Square well potential, the Hydrogne atom. (ii) Scatterin theory (unbound system), one dimensional potential barrier, reflection and transmission coefficients. (16)

4. Matrix formulation of Quantum Mechanics: Hermitian and unitary matrices, transformation and diagonalization of matrices, function of matrices, transformation of the hamiltonian with unitary matrices, equation of motion in Schordinger, Heisenberg and interaction picture, classical Lagrangian and hamiltonion equations of motion, Poisson brackets and commutator brackets. Matrix theory of the harmonic oscillator. (10)

5. Approximation methods for bound states: Stationary pertubation theory, non degenerate and degenerate cases, stark effect, Zeeman effect, Variation method, ground state of Helium atom, WKB approximation, time dependent perturbation, theory of ionization of a Hydrogen atom, Sudden approximation. (15)

6. Symmetry and Conservation laws: Space and time displacement, rotations angular momentum matrices, space inversion parity. (8)

Paper II : Group - B

Molecular Spectroscopy and laser- 25, No. of Lectures - 37

1. Microwave spectroscopy: Classification of molecules, Diatomic molecular rotational spectroscopy, Rotational Constant, Rotational energy levels of rigid and non-rigid diatomic molecules. Maximum intensity line, Rotational spectroscopy of triatomic molecules. Informations on interatomic distance of Diatomic & (10)

Triatomic molecule from microwave spectrscopy. Microwave spectrscopy of polyatomic molecule.

2. Infra-red spectroscopy: Diatomic molecular vibrational spectroscopy, vibrational Energy levels of diatomic molecules having Simple harmonic and anharmonic vibration. Dissociation of energy level, Diatomic molecular vibrational and rotational spectrosecopy. Informations of force.
Constant, anharmonic oscillation constant, rotational constant, vibratinal spectroscopy of Diatomic melceules.

3. Visible and ultraviolet spectrocopy: Molecular electronic spectroscopy, Frank Condon principle, Molecualr electronic vibrational rotational spectroscopy, Born- Oppenheimer approximation, Deslendes table, Fortarat parabolla, bank peak. (10)

4. Laser and laser spectroscopy: Laser resonator, population inversion, active and passive laser resonator, Q-factor, CO2 laser, Rubby laser, Dye (tunable laser), Application of tunable leser in (7)

Paper III : Group - A

Electrodynamics - 35, No. of Lectures - 50

1. Recapitulation of field equations, scalar & vector potentials, Lorentz and Coulomb gague, Conservation laws; Electromagnetic wave in nonconducting and conducting medias, reflection and refraction of EM wave from the interface; wave guides. (10)

2. Field of moving charges and radiations: Retarded potentials, Lienard wichert potentials, Field produced by arbitrarily moving charged particle at low velocity and at high velocity, angular distribution of radiated power. (10)

3. Radiating System: Oscillating electric dipole, radiation from an oscillating dipole, radiation from a liner antenna. (10)

4. Radiation in material media: Cherenkoy effect, Thomoson and Rayleigh Scattering, dispersion and absorption , Kramer (10)

kronig dispersion relation. (10)
spectroscopy, He - Ne laser,

5. Relativistic electrodynamic: Review of special theory of relativity 4 vectors and Tensors, transformation equation for f and J. Transformtion equations for A and f the electromagtnetic field tensor. Transformation equations for field vectors and (10) covariance of Maxwell equations in 4 vector form : Covariance of Maxwell equations in 4-tensor forms Covariance and transformation law of Lorentz foree Selfenergy of electron.

Paper III : Group - B

Plasma Physics - 40, No. of Lectures - 60

1. Introduction: Definition, Electrical neutrality, phase space, Distribution functions, Plasma sheaths and Debye length, (5) Temperature.

2. Creation of an ionized gas (Plasma) : Ionization processes, Collision ionization, photoionization, thermal Ionizaton coefficients, (10) DC breakdown, Steady - State discharges.

3. Fundamental concepts about plasma: Magnetic and Kinetic pressur in partially ionized gas. Mean free path and collision cross section. Effect of magnetic field on mobility of ions and electrons, Diffusion of ions and electrons; Ambipolar diffusion, (14) Electron and ion temperature. Ouasineutrality of plasma; Debye shielding distance.

4. Radiation by the free charges of a plasma: Transport of radiation, Bremsstrahlung, Recombination radiation Cyclotron (8) radiation, Radiation by excited atoms and ions.

5. Plasma oscillation and waves: Theory of simple oscillations Electron oscillations in a plasma, ion oscillations and wave. Single (6) beam in prescribed field.

6. Plasma diagonistic technique Single probe method, double

probe method. Radiofrequency probe method, Microware probe (8) method, Spectroscopic method.

7. Plasma Instabilities: Plasma equilibrium and instbility, Pinch (5) effect, experimental aspects; Toroidal pinch.

8. Man-made applications: Controlled fusion, MHD (4) Generation.

Paper IV : Group - A

Electronics (general) - 40, No. of Lectures - 60

1. (i) Network analysis: Network theorems, equivalent circuits twoport paramenters hybrid paramenters. Topological descirptions of different commonly used networks p to T and T top aversions reduction of a complicated network.

(ii) Filter Circuit: L filter, p filter, image impedance of a retwork, symmetrcal network, characteristic impedience and (10) propagation constant of a network. Methods of development of different filters like high pass, low pass, band pass and band stop filter circuits.

2. Transmission Lines: Line parameters, charcterisitc impedance and propagation constant of a transmission, line, voltage and current equations of transmission line, attenuation (10) constant, phase constant, line of finite lenght behaving as a line, line at radio frequency, distortion less line, cable fault location telephone cable.

3. Radio wave propagation: Ground wave, lonoshperic wave and spacewave and their characteristics, reflection and refraction (6) of radio wave in ionosphere, critical frequency, skip distance, Maximum sable frequency, fading, Secant law, duet propagation.

4. Modulation: Principle of amplitude modulation (AM) and frequency mdulation (FM), principle demodulation, AM spectrum and FM spetrum, channel bard width and signal band width, side band frequency, principle of generation of A.M. wave with (8)

necessary circuits, principle of generation of F.M. wave with necessary circuits Detection of A.M. wave and F.M. wave.

5. Antenna: Dipole antenna, half wave antenna, antenna with two half elements, N elements array, induction field and (6) retardation field.

[illegible]nge equation, pulsed radar transmitter & (4) receiver. Dopplar radar.

7. Amplifiers: Feed back amplifers, effect of feed back, FET and its characteristics, FET amplifiers, gain computations, MOSFET Characteristics and applications. Power Amplifier: (4) Class A, Class B, pushpull tuned amplifers.

8. Operational Amplitiers: Differenial amplifier, OP-AMP architecture, OP-AMP characterisitcs and parameters. OP-AMP (6) in analog computer. OP-AMP as comparator.

9. Transducer & sensors: Photo-transducer themistor photo-clectric transducer photoconductors. photo-transistors. (5)

Paper IV : Group - B

Digital electronics - 35, No. of Lectures - 50

1. Ligic gates (revision) (4)

2. Combinational ligic gates: Karanaugh mapping: Methods of minimization (reduction) of Product of Sum (Pos) and Sum (5) of products (Sop) expressions of 2,3 and 4 variables Boolean expressions, Logical implementations.

3. Multivibrators: Astable and monostable (Principles, Circuis (4) and operation), Timer circuit with 555.

4. Flip-flops: One bit memory cell, S-R flip-flop (clocked) D flip-flop, J-K ordinary flip-flop J-K master slave flip-fop. (8) Operation and functions. T-flip flop.

5. Counter: Synchronous and Asynchronous counter, mdulo (5) Counter, decade counter.

6. Registers: Shift Register, Serial in Serial out, Parllel in (6)

Serialout, Parallel in parallel out registers.

7. Digital displaly: Seven segment display system, Developing (3) of display system for deciaml, octal number system.

8. Digital Communication: Multiplexing and de multiplexin (time deivision, space division and frequency division), pulse (6) Coded Communication system (idea only).

9. Microprocessor organisation and assembly language Programming. Organisation of 8085 A microprocessor Kit, function of RAM, ROM, PROM, EPROM, I/O unit, Port, A to (10) D and D to A Conversion (Ideas only)

Paper V : Group - A

Numerical Analysis & Computer Programming - 35, No. of Lectures - 52

Numerical Analysis: Computer Arithmatic Floating point numbers and their operation calculation of error Iterative methods:- Solution of transcendal equations and polynomial equations. Newton-Raphson method.

Solution of Simultaneous linear equations, Gauss elimination method. Numericla differentiation and intergation: Runge-Kutta method. Simposon rule etc.

Interpolation: polynomial interpolation Newton Lagrange equation. Hermite difference equations.

Matrix inversion, diagonalization, eigenvalue and eigenvector determination.

Least square technique: Problems of linear least squares fit, (30) applications.

General awareness of computer hardware (2)

Operating systems Dos and Windows 95 (8)

Fortran Programming (7)

DBMS (2)

Preliminary of Ms Word. (3)

Paper V : Group - B

Methods of Mathematical Physics - 40, No. of Lectures - 60

1. Vector spaces and matrices: Vector spaces of n dimensions, innerproduet, Sehmidt's orthogonalisation, Schwarz and Bessel inequality. (3)

Hermitian and unitary matrices eigenvectors and elgenvalues, diagonalization, unitary transformation. Cayley Hamilton theorem. (3)

2. Complex variable: Cauchy Reimann conditions, cauchs integral and residue theorem, singularities, poles, branch points contour integration. Taylor & layrebt seres expansion, Principle value of an integral Reimann Surface. (10)

3. Differential equation and special functions: Second order differential equation, solvability regular and irregualr singularities, series solution.

Hermite & Legendre (only revision). Laguerre and Bessel functions polynomials Gamma. Beta and error functions. (12)

4. Partial differential equations Flliptic, parabolic and hyperbolic type equations, Lagranges formular for 2nd order partial differential equation, Dirchlet Neumann and Cauchy Boundary value problem. Greens function with applications. (10)

5. Integral transforms: Fourier series, Fourier transforms, laplace transformation inverse laplace transform. Solution of differential equation using LT and FT dirac delta function and its FT.

6. Group theory: Definitions, rearrangement theorem, subgroups and cosets, conjugate element and factor group, class multiplication group representation-faithful representations: refucible and irreducible representations; the great orthogonality theorem, character of a representation and orthogonality relation for character construction of character table, decomposition of (12)

reducible representations theory in quantum mechanics, basic functions for the irredcible representation, direct product group and their representation, elementary representations of the three-dimensional rotation group.

M.Sc. Practical

Electronics Part-I, Marks - 75, Paper - VI

1. To develop a filter circuit and to find out frequency response characterstics and ripple factor.
2. To prove and verify maximum power transfer theorem.
3. To study transistorised version of VTVM and to find out its characterstics & different paramaters.
4. To study a transformer and to find its various parameters.
5. To construct and design a regulated power supply and to find out its ripple factor and perecentage of regulation.
6. To obtain the frequency response characterstic of a non-inverting operational amplifier and to find out its band width.
7. To obtain the frequency response characterstic of a non-inverting operational amplifier and to find out its band width.
8. To design a J-K master slave flip-flop and to verify its truth table.
9. To design a ripple counter and to develop different modulo counter.
10. Design and developement an astable multivibrator.
11. Monostable multivibrator and timer circuit with IC 555,
12. To design and devlop Wein bridge oscillator.
13. To design and devlop cascaded transistor amplifier and to find out its frequency response characteristic.
14. Band gap measument of a Semiconductor junction.

Computer Practical

Paper - VII, Marks - 50, Classes - 70

Programming in Fortran and Classes.

Fortran

1. Error analysis.
2. Solution of simultaneous linear equations.
3. Solution of eigenvalue problems.
4. Differentiation and integration.
5. Finding inverse of a matrix.

MS. Word Writing an article in MS. Word.

Part III

Paper VIII, Group - A

Quantum Mechanics (II), Marks-40, Classes-60

1. Collision theory: Collision in three dimensions, scattering cross section Scattering by spherically smmetric potential,phase shifts, partial wave analysis. Greens function and propagator, differential equation for the Green's function application to Scattering unitarity of the S matrix. (12)

2. Spin, spin of elementary poarticles spin and statistics. Pauli spin matrices and their commutation and anti-commutation relations. addition of angular momentum. Clebesch Gordon Coefficient, wave function of total angular momentum operator. (8)

3. System of identical particles, permutation symmetry, symmetric and anti-symmetric wave function, Pauli exclusion principle. (4)

4. Semiclassical treatment of radiation with matter, selection rules. (4)

5. Atoms, Molecules: Central field approximation. Hatree and Hartree Fock approximation, Koopman's theorem, Thomas-Fermi statistical model, LS coupling, JJ coupling, Hund's rule spectral term, weak field, strong field, quardartic Zeeman effect. (12)

6. Releativistic wave mechanics: Klein-Gorden equation for a free particle, solution of the KG equation, fine structure, Dirac equation in EM field, Coulomb field. (20)

Paper VIII, Group - B

Statiatical Mechanics, Marks - 35, No. of lectures - 52

Boltzman transport equation, H theorem based on Boltzman's equation, Maxwell Boltzman Distribution function, Statistical approach to H-theorem.

Ensamble concept, Liouville's theorem formalisms for obtaining thermody namic functions for a system in a state of macroscopic equilibrium.

Fluctuation of fundamental thermodynamic quantities, correlation of fluctuations in space and time.

Cluster expansion of the equation of state of real classical gas. Fluctation phenomena in gases: Statistical physics of ideal monatomic and diatomic gases, degenerate ideal quantum gases. conduction of electrons in metals. Landau Diamagenetism. Pauli paramagetism. DeHass-Van-Alphen effect-Relativistic degenerate electron gas. Bose condensation.

Chemical equilibrium in a mixture of ideal gases. Law of mass action. Elements of lattiee statisties, Bragg-William approximation, treatment of issuing lattiee, Ising lattice in one dimenion.

Phase transition and critical exponetns, Direct space renormalization group, Kadanoffs spin decimation triangular lattiee, fixed points and critical exponent extraction.

Elements of liquid state, distribution in function, radial distribution and thermodynamic properties, Born-Green-Yuon theory, superposition approximation, Kirkwood's integral equation. direct correlation function lattice model of liquid state.—

Paper IX, Group - A

Nuclear Physics, Marks-40, Lectures-60

Properties of Nuclei: Double focusing mass Spectrometer, Nuclear Spin, magnetic moment Rabin method; electric quadruple moment; parity; statistics.

Stable nuclides: Regularities, the odd-even classification, stable isotopes, isotones and isobars, mass and energy of nuclides, the mass prarbolas for isobars.

α-decay: Systematic Gamow theory of α-decay.

B-decay: Continuous nature of Spectrum; neutrino detection; Fermi's theory of beta decay; Kurie plot, simple ideas of parity violation in beta - dcay.

Y-decay: The modes of gamma transition, theory of multiple radiations's selection rules, internal conversions; nuclear isomerism; recoil free gamma-ray spectroscopy.

Nuclear reations: Classifications Conservation laws; reaction channels: the mass & energy: compound nucleus model: basic ideas on continuum theory: nuclear resonance.

Nuclear force: The dellteron-Square well potenital: neutron-proton and proton senttering at low energies.

Nuclear models: Elementary ideas of Fermi gas models, liquid drop model, shell model and collective model.

Nuciear fission: Fissile nuclei; Bohr Wheeler theory; Nuclear Chain reaction; multiplication factor, elementary theory of nuclear reactor.

Neutron Fhysics: Thermal neutrons; Velocity selection and time of flight methods elements of neutron optics.

Paper IX, Group - B

Field Theory & Particle Physics, Marks-35, Lectures-52

Classical fieldequations, Lagrangian and Hamiltonian for fields, quantization for fields, KG,

Dirac and electro-magnetic field, interacting fields, Feynman graph technique, mass renormalization, self energy, Normal ordering.

Classification and properties of elementary particles, Gellman-Nishijima model, +Su(3) model, Quark model, charm and other flavours, color, properties of strange paritcles, improper symmetry, parity, charge conjugation, time reversl, CPT theorem, spontaneous symmetry breaking, parity non-conservation, K-meson, complex and tiem reversal invariance, brief idea on Gauge theory. weak and strong interactions, brief discussion on Weinberg-Salem model, quantum chromodynamics, Grand unified theories.

Paper X, Group - A

Photonics, Marks-40, Lectures-60

1. Photonics Information Processing: Optical Logic operations, Optical arithmetic operation
with binary, tristate and modified tristat number.
2. Laser: Laser resonator, Phershold condition, saturation condition.Three level laser and four level laser system, classification of laser, Dye and Tunable laser, Quality factor.
3. Non-liner Optics: Non-linearity of medium, second and higher harmonic generation,
4. Fiber optics: Different types (single and mulit mode of step index and garded index optical fibre. Model propagation of Electro magnetic wave in optical fibre. Numercal aperture of optical fiber. Application of fibre in digital communication. Pulse broadening in optical fibre.
5. Holography: Coherent light and application of coherent light in holography. Recording and reconstruction of wave front.

Paper X, Group - B

Optional (a) Plasma Physics, Marks-35, Lectures-54

1. Production of plasma: Various ionization processes, (8) ionization by ultra high frequncy and microwaves, ionization by

shock waves, ionization by laser.

2. Fundamental concepts about plasma: Mobility of charged particles, effect of magnetic field on the mobilityof ions and electrons. Thermal conductivity, electron and ion temperature, effect of magnetic field on electron temperature. Dielectric constant of plasma, effect of magnetic field, motion of charged particles in electric and magnetic field. (12)

3. Particle description of plasma, motion of charged particles in a electostaic field, motion of charged particle in uniform magnetic field, motion of chargd paritcles in crossed electric and magnetic field. (12)

4. Magneto hydrodynamics: Decay of charge and current in conductors, equation of Magnetohydrodynamics, Immediate consequences of magnetohydrodynamics equations: Conditions for magnetohydrodynamics behavior. (10)

5. Properties of fully lonized plasmas: Collision and relaxation processes, Dynamic of collision between charged patticles, conductivity of fully ionised plasmas, in configuration space. Head conductivity viscosity. (12)

Paper X, Group - B

Optional(b), Semiconductor Physics,

1. Classification of semiconductors-Degenerate and non degenerate, intrinisic and extrinisic; carrier concentration under different conditions, surface states, Alloy semiconductors and their improtance.

2. Boltzaman transport equation applied to semiconductors, electrical conductivity of nondegenerate semiconductor, Hall effect, Magneto resistance, thermoelectric power, Measurement of mobility of a carrier, Quantum Hall effect.

3. p-n junction, Diffusion in p-n junction, Debye length, Derivation of diode equation, junction (capacitance, Abrupt and

Lineraly graded),
Tunnel Diode, Gunn effect Oscillator, Metal semiconductor junction, Transistor, FET, MOSFET, Super lattiec.

4. Optical absorption exciton, photoconductivity, Hall Schokley Ried theory, Solar cell, LED, Semiconductor laser, Photo detector.

Paper XI, Special paper

(a) Solid State Physics, Marks-75, Classes-110

1. Symmetry properties of crystalline solids, Crystalline symmetry operators, Group theoretical matrix element theorem, crystal space group, symomorphic space group, Elastic properties of solids, Thermo=elasticity in anisotriopic solids, second, third and fourth order elastic constants, homogencous Deformation-elastic deformation for anisotropic solids.

2. Electronic energy band theory: Bloch's theorem, equivalent and none equivalent wave vectors, Group of wave vectors, empty lattice band, Fermi surface, LCAO method, cellular, APW, OPW & KKR methods of energy band claculation, effective mass, pseudo potential.

3. Electronic propertics: Boltzman transport equation, relaxaition time, application of Sommerfield theory to metals and semiconductors, thermal scattering: Quantization of orbits in a magnetic field, De-Hassvan-Alphen effect, Magnetic breakdown. Quantum Hall effect.

4. Plasmons, Dispersion relation for electromagnetic wave electrostatic sereening, Polaritions, LST relation, electron-electorn interaction, Fermi liquid, electron phonon interactions, Polarons.

5. Dielectric properties: electronic polarizability, dielectric constant, polarization catastrophe, ferroelectic crystals and ferroelectic domains.

6. Optical processes and excitons, Kramers-Kronig Relation , electronic energy band transition, excitions, electron hole drops,

Raman effect in crystals, electon spectroscopy with X-rays.

7. Magnetism: Quantum theory of dia, paramagnetism, transition and rare-earth elements, Pauli. paramagnetism. Ferromagnetic, anti-ferromagnetic and Ferri-magnetic order, molecular fields, direct and indirect exchange interaction, Heisenberg and Ising model, domain theory, Bloch wall, spin waves, magnons, magnetic resonance, principle and application of NMR, EPR, ESR.

8. Superconductivity: Review of experimental results, Thermodynamics of superconducitivity, London-Pippard theory, penetraion depth, coherence lenght, electrophonon interaction, Copper pair, BCS theory, energy gap, transition temperature, Ginzburg Landau theory, Flux Tunelling and Josephson effects, SQUD, superconductors.

9. Defect Studies: Defect in solids, lattice vacancis, diffusion role of lattice defects in ionic conductivity, color centres, order, disorder transformation, dislocations.

10. Material preparation and charactersitics: Various methods of crystal growth, preparation of thin films experiemental methods for measuring dielectric constant, specific heat.

Paper XI, Special paper

Plasma Physics, Marks-75, Classes-110

1. Plasma Oscillation and waves. Theory of Simple osciallations. Electron oscillations in plasma, electron oscillation when the motion of ions is also taken into consideration, Derivation of plasma oscillations by utilizing Maxwell's equations. Ion oscillations and waves, Experimental verfication oscillations and waves in a magnetic field. Thermal effect on plasma oscillations, Landan damping propagation of electromagnetic waves in plasma containing a magnetic field. Hydromagnetic oscillations in electron beams. (25)

2. Plasma deagnostic techniques: Single probe method, Double probe method, use of probe techniques for measurement of plasma parameters in magnetic field, sources of error in probe measurements. Radio frequency probe method, spectroscopic method. Measurement of electorn and ion density by stark effect, Laser as a tool for plasma diagnostic, X-ray diagnositc of plasma, Magnetic probe method. Mass Spectrographic method. (20)

3. Kinetic theory of plasma: Boltzman transport equation, Screeing and Fokker plank equation for a plasma, Electrostatic instabilities, equilibruim in magnetic field some exact solutions. Approximate procedure for solving transport equation, equilibrium theory perturbation theory stability theory, High current discharges, instabilities in pinched discharge. Kind instability, emission of high energy radiation from high current discharges. X-ray and neutron emission. (30)

4. Research in Controlled fusion: Introduction, Thermonuclear power, Nuclear rate, critieria for aeration system, plasma production, Heating of plasma, plasma confinement. (17)

5. Possible applications of plasma physics: Magntohy drodynamic generator, Faraclay generator, Hall generator, Fuel in Hall generator, use of non-equilibrium ionization, Magnetic field in MHD generator, Generation of microwaves using high density plasma, plasma diode. (20)

Paper XI, Special paper

Applied Electronics, Marks-75, Classes-110

OP-AMP Circuit & applications: Bridge amplifier, instrumentation ampliticrs, logarithmic amplifiers, anti-log amplifer, ana-log multiplier, summing intergarator, chopper modulator, chopper stabilized amplifier, pulse width modularor, voltage regulation, precision current and voltage sources, precision detector, Schmitt

trigger, crystal oscillator, tuned oscillator, voltagae controlled oscillator (VCO), pulse generator, ramp generator, square and triangular wave generator, active filters, first, second and higher order low pass and high pass acitve filters, Butterworth characteristics, bandpass and bandstop active filters. Phase Lock Loop (PLI) & applications: PLL operational characteristics and paramenters, Frequency mulitplication, tracking, FM demodulation. Television: Working priniciple, TV camera, Picture tube, scanning and deflection, synchronizaiton, composite video signal, Transmitting and Receiving systems, colour television.

Detectors: Peak detectors, zero-crossing detectors, phase-sensitive detectors.

Digital Circuits & systems: Display systems, memory organization and addressing, Erasable PROMS. Random-acess memory (RAM), digital magnetic recording.

Digital communication: Pluse coded communication, modulation and demodulation.

Signal processing & date conversion: Signal sampling, aliasing effect, sample and hold systems, anti-aliasing after, analog-multiplexer, Digital image processing (ideas only)

Sucessive approximation A/D converter, Digital data-acquisition system (DAS)

Thyristors: SCR, Triac, Diac, charactersitic parameters, Thyristor rectifier & control circuits.

Microprocessor & Microcomputer: Architecture, organization, microprocessor based control and recording instrumentations in process industry microprocesor based data acquisition (DAS) system Instrumentations: Digital voltmeter, ammeter and ohmmeters. Oscilloscope, Ultrasonic tecniques and instrumentations.

Paper XI, Special paper

(d) Applied Optics and Opto-electronics, Marks-75, Classes-110

1. Laser and its application.

a) Optical amplifiers: Losses inside the resonator cavity, Active reasonator, Quality factor, Cavity damping.

b) Types of Laser: Laser clarification and functional relationship. Solid state laser (Nd: YAG, Ruby) glass lasers, organic dye lasers, Photo dissociation Lasers, Ion and atomic lasers, (Argon ion laser, He-Ne laser), Molecular laser, (The CO2 laser, Excimer lasers), Electro ionization Lasers, Gas dynamic lasers, Chemical lasers, Plasma laser, Semiconductor Lasers, Injection Laser.

c) Methods fo Q-Switching: Q-Switching by electro optical shutters, By mechanical shutters, by aeoustic-optic modulators, by magneto-optic modulators, by passive Q-switching using saturable absorbers.

d) Mode Synchronization: Longitudinal modes in a laser resonator, Mode synchronization and pulse duration, Attainment of mode synchronization.

e) Laser rate equations: Three level laser system and its rate equation, condition of population inversion, Threshold power and efficiencies of three-level system. Four label laser system and its rate equation. Condition of population inversion. Threshold power in four-level laser system. Advantages of Four-level laser system over three-level laser system.

f) Spectral broadening: Natural line width of radiation Lorenz line shape function Emission time, line shape function in for force free oscillaiton of electron and elastically bound electron.

g) Non-linear optics: Non-linearity of optical media, attainment of phase matching condition with index ellipsoid fourth harmonic generation, Different non-linear media, Wave front reversal, Use of non-linear media for wave front reversal in laser resonator cavity.

Self focusing and de-focusing measurement of focal lenght in a self focusing system.

2. Optical fiber: Optical fiber as wave-guide, as sensor, as communication channel. Pulse coded communication. Maxwell's equation in in-homogeneous media. Scalar wave quation and modes in a step index optical fiber, modes in a graded index optical fiber, fundamental mode and its character. TE and TM modes in a fiber like planar wave giide. Relative magnitude of the longitudianal components of the E and H filds, physical understanding of modes in a planar wave guide. Power associated with a mode, radiation modes, quasi modes, bending in optical fiber, Different types of losses in optical fiber, coupler in optical fiber, fiber drawing system. Polarisation and field distribution in single and two-mode wave guide.

3. Holography: Gabore off-axis holography. Concept of complete recording in a Hologram. Interference, its pattern of two waves in holography, Diffraction, Hologram as plane diffraction grating and volume diffraction grating, Hologram formation, wave front reconstruction, Basic hologrphy equations, Fourier transform Holography. Use fuleness of Choerence lenght, Relation between Co-Terence lenght and bandwidth, Lens less Fourier transform hologram. Time average holography and vibration analysis. Applications of holography.

Concept of spatial ffequency, Different types of filter, Principle of phase contrast microscopy.

4. The Electro-Optic Effect:

Optical materials.

Different electro-optic materials. Electro-optic effect in KDP crystals

(Longitudinal modes) Phase modulation. Amplitude modulation.

5. Digital Optics and its application in information processing. Spatial light modulator as optical switches. Optical Opto-electronic half and full adder, Optical / Opto-electronic addition and subtraction scheme carry-brow less paralled arithmetic in optis.Inherent parallelism in Optics, modified urinary number ande Mixed modified signed digit number representation for optical parallel arithmetic progressing. Residue arithmetic in optics. Tractate number system and tractate logician optics. Spatical encoding in optics. Optical shadow casting technique and its limitations.

6. Fourier Optics: Fourier transform. Fourier transform by thin lnses, spatial filtering.

7. Dispresion in fibers, loss in fibers optical amplifiers, Modulator, fiber as well as in LiNb03 wafer. Ion Exchange in glass.

Paper XII, Special Practical

Marks-75, Lectures - 112, Solid state Physics

1. Determination of energy gap in thermistor material
2. Determination of barrier potential and doping profil of transistor junctions.
3. Determination of carrier life time in Photoconductor
4. Measurement of magnetic susceptibility and Bohr magneton number of given sample by Guoy method.
5. Measurement of Susceptibility of given sample by Quincke's method.
6. Determination of Lande g-factor for the given sample using electron spin resnance spectrometer.

7. Determination of ionic conductivity of the given smaple.
8. Absorption/Tansmission spectra of thin films by using UV/ Vis spectrophotometre.
9. Study of Hysterisis loop of magnetic materials by using Hysterisis Tracer.
10. Diclectric measurement of polycrstalline ferroelectric sample.

Paper XII, Special Practical

Marks-75, Lectures-112

(b) Plasma Physics

1. Determination of electron density and electron temperature by single/double Probe method.
2. Determination of electron density frequency and electorn temperature by radio frquency probe method.
3. Determination of breakdown voltage in a gas under low frequency excitation over a wide range of pressure, calculaltion of Vi the ionization potential of gas and mean free path of the electron.
4. Determination of break down potential in a gas under low frequency fields.
5. Determination of break down voltage under radio frequency excitation over a wide range of pressure, calculate the molecular constants of Kihara.
6. Determination of the azmuthal conductivity of an arc plasma for different arc currents by eddy current effect.

Paper XII, Special Practical

Marks-75, Lectures-112

(c) Applied Electronics Design, Construction and Performance testing of the following IC Circuits:

1. Log of the following IC Circuits:
2. Power Amplifier

3. Precision adjustable voltage regulator
4. Active high pass second order Butterworth filter.
5. Digital adder subtractor and comparator.
6. Shift registers and shift counter
7. Pattern waveform genrator for analog multiplexing.
8. Digital mulitplexing.
9. Schmitt trigger generator.
10. DSB-TC and DSB-SC generation using analog multiplier

Paper XII,Special Practical

Marks-75, Lectures-112

(d) Applied optical and opto-electronics

Experments:

1. Time response Characterstic of LDR
2. Measurement of a hole diameter by laser.
3. Optical/ Opto electronic D/A Converter.
4. Holographic recording and reconstruction.
5. Communication by optical fiber, loss measurement.
6. Measurement of numerical aperture of optical fiber.
7. Junction charactersitcs of LED.
8. Experiment with gratify (measurement of wave lenght and number of lines/cm) using laser.
9. Solar cell Chianti charactersitc.

Paper XII, Advance practical

Marks-75, Classes-150

1. Determination of electron temperature by single probe method.
2. Study of the characteristics of a GM tube.
3. Determination of the gamma and beta ray absorption coefficients by using a G.M. counter.
4. To Study experimentally the variation of resistivity of

semiconductor with temperature and hence to find out the band gap energy.

5. Measurement of the Hall coefficient of a given sample and calculation of its concentration.
6. Detrmination of Ultrasonic velocity in some liquids at varying temperature by Ultrasonic interferometer.
7. Obtain the lane photograph of a single crystal and drawing gnononic projectional and indexing the spots.
8. Obtain X-ray Debye-Scherrer photograph and determination of Unit Cell dimensions of a crystal.
9. Determination of Electron/ Ion temperature by Double probe method.
10. To study V-I characteristics of L E D
11. To study characteristics of L D R
12. Programming of Microprocessor 8085.
13. Laser wise Experiment.
14. Determination of Wavelength by Michelson's / Febry Perot Interferometer.
15. To Find e/m of an electron.

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