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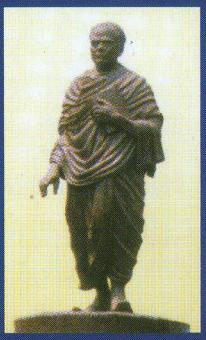

SYLLABUS

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)