POST GRADUATE PROGRAMME

1. At each of the Previous and Final Year Examination in a subject, a candidate must obtain for a pass (i) at least 36% marks of the aggregate marks in all the papers prescribed at the examination, and (ii) atleast 36% marks in practical, wherever prescribed, at the examination; provided that if a candidate fails to secure 25% marks in each individual paper of theory at any of the examination and also in the Dissertation; wherever prescribed, he/she shall be deemed to have failed at the examination, notwithstanding his/her having obtained the minimum percentage of marks required in the aggregate for the examination. Division will be awarded at the end of the Final Examination of the combined marks obtained at the Previous and the Final Examinations taken together as noted below. No Division will be awarded at the Previous Examination.

First Division	: 60 Percent	of the total aggregate marks of Previous and Final year taken together
Second Division	: 48 Percent	
Third Division	: 36 Percent	

Note : The candidate is required to pass separately in theory and practicals.

2. Dissertation may be offered by regular students only in lieu of one paper of Final Year Examination as prescribed in the syllabus of the subject concerned. Only such candidates will be permitted to offer dissertation who have secured atleast 50% marks in the aggregate at the previous examination.

Note: Dissertation shall be type-written and shall be submitted in triplicate, so as to reach the Controller of Examinations atleast two weeks before the commencement of Examination.

3. There shall be atleast eight theory in Post-Graduate Examination, 4 in Previous and 4 in Final year examinations of 100 marks each unless and otherwise prescribed. The non-credit papers wherever prescribed will remain as such. The marks of these non-credit papers will not be counted for division but passing in the same is compulsory.

4. Each theory paper will be of three hours duration.

5. Wherever practicals are prescribed the scheme will be included in the syllabus.

6. A candidate who has completed a regular course of study for one academic year and Passed M.A. / M.Sc./ M.Com. Previous Examination of the university shall be admitted to the Final Year

Examination for the degree of Master of Arts / Master Of Science / Master of Commerce provided that he / she has passed in atleast 50% of the papers at the previous examination by obtaining atleast 36% marks in each such paper.

(a) For reckoning 50% of the papers at the previous examination, practical will be included and one practical will be counted as one paper.

(b) Where the number of papers prescribed at the previous examination is an odd number it shall be increased by one for the purpose of reckoning 50% of the paper.

(c) Where a candidate fails for want of securing minimum aggregate marks but secured 36% marks in atleast 50% of the papers, he/she will be exempted from re-appearing in those papers in which he/she has secured 36% marks.

(d) Where the candidate secures requisite minimum percentage in the aggregate of all the papers but fails for want of the requisite minimum percentage of marks prescribed for each individuals paper he/she shall be exempted from re-appearing in such paper (s) in which he / she has secured atleast 25% marks.

7. A candidate who has declared fail at the Final Year Examination for the degree of Master of Science / Arts, Commerce shall be exempted

from re-appearing in a subsequent year in the following papers :

(a) Where a candidate fails for want of securing the minimum percentage in the aggregate marks, he/she shall be exempted from re-appearing in such paper (s) Practical (s). Dissertation in which he/she has secured atleast 36% marks; provided he/she is passing in atleast 55% of the papers. (Here passing in each paper requires 36% marks).

(b) Where a candidate secures the minimum requisite including dissertation wherever prescribed but fails for want of minimum percentage of marks prescribed for in each individual paper / dissertation, he / she shall be exempted from reappearing in such paper (s) dissertation in which he/she has secured atleast 25% marks provided he/she is passing in atleast 50% of the paper (here passing in each paper requires 25% marks)

MASTER OF SCIENCE (M.Sc.) IN PHYSICS 2004-2006

COURSE CURRICULAM

Paper code	Paper	Nomenclature	Lectures	Duration of Exam	Max. Marks	Min. Marks
M.Sc. (Previous)						
4161	I	Mathematical Physics and Computational Physics	120 hrs	3hrs	100	25
4162	II	Classical Mechanics, Electrodynamics and Plasma Physics	120 hrs	3 hrs	100	25
4163	III	Quantum Mechanics	120 hrs	3 hrs	100	25
4164	IV	Electronics	120 hrs	3 hrs	100	25
4165	V	Practical: General Physics	150 hrs	6 hrs	75	27
4166	VI	Practical: Electronics	150 hrs	6 hrs	75	27
4167	VII	Project & Viva Voce & Internal Assessment	Xxx	Xxx	50	18
M.Sc.(Final)						
5161	I	Atomic, Molecular and Statistical Physics	120 hrs	3hrs	100	25
5162	II	Solid State Physics	120 hrs	3 hrs	100	25
5163	III	Nuclear and Particle Physics	120 hrs	3 hrs	100	25

Special Paper (Any one of the following papers)

5164A	IVA	Condensed Matter Physics	120 hrs	3 hrs	100	25
5164B	IVB	Non-Linear Dynamics and Chaos	120 hrs	3 hrs	100	25
5164C	IVC	Communication Electronics and Atmospheric Science	120 hrs	3 hrs	100	25
5164D	IVD	Informatics and Computer Visualization	120 hrs	3 hrs	100	25
5164E	IVE	Advanced Digital Electronics	120 hrs	3 hrs	100	25
5164F	IVF	X-ray and Nuclear Spectroscopy	120 hrs	3 hrs	100	25
5164G	IVG	Advanced Solid State Physics	120 hrs	3 hrs	100	25
5164H	IVH	Quantum Field Theory	120 hrs	3 hrs	100	25
5164 I	IVI	Astronomy and Astrophysics	120 hrs	3 hrs	100	25
5165	V	Practical: Nuclear Physics	150 hrs	6 hrs	75	27

Practical : Based on Special Paper opted by the student (One of the following)

5166A	VIA	Practical: Based on Special Paper IVA	150 hrs	6 hrs	75	27
5166B	VIB	Practical: Based on Special Paper IVB	150 hrs	6 hrs	75	27
5166C	VIC	Practical: Based on Special Paper IVC	150 hrs	6 hrs	75	27

5166D	VID	Practical: Based on Special Paper IVD	150 hrs	6 hrs	75	27
5166E	VIE	Practical: Based on Special Paper IVE	150 hrs	6 hrs	75	27
5166F	VIF	Practical: Based on Special Paper IVF	150 hrs	6 hrs	75	27
5166G	VIG	Practical: Based on Special Paper IVG	150 hrs	6 hrs	75	27
5166H	VIH	Practical: Based on Special Paper IVH	150 hrs	6 hrs	75	27
5166I	VII	Practical: Based on Special Paper IVI	150 hrs	6 hrs	75	27
5167	VII	Internal Assessment, Viva Voce & Project			50	18

In order to pass, candidates are required to obtain 36% of theory aggregate and 36% of practical aggregate separately. In each theory paper, candidates are required to obtain a minimum of 25 marks.

Note:

Internal Assessment : 25 marks

Viva and Project : 25 marks

Internal Assessment marks will be awarded by a committee appointed by the Head, Department of Physics. The committee will award internal marks based on the performance of the students in the following:

(a) There will be two internal examinations on each theory and practical papers which will be conducted by the department, one during

November/December and the other in February/ March.

(b) Each candidate is required to give at least one seminar which will be assessed by teachers

(c) Two internal viva voce examinations are also to be conducted. Assessment will be made by a committee appointed by the Head of Department. The viva voce examination will be conducted to test the candidate's understanding of all the papers offered in M.Sc(previous) /M.Sc.(Final)

(d) Candidates who fail to appear in at least half of the internal theory examinations and viva examinations will be awarded zero marks.

Viva Voce and Project:

(a) The External Viva-Voce Examination will be conducted by one of the practical examiners. Each candidate is required to present his project work and viva voce examination will be conducted to test the candidate's understanding in practicals & project.

(b) Each candidate is required to select a project under a supervising teacher at the beginning of the course. The candidate is required to prepare a detailed project report and submit the same to the external examiner

(c) If a candidate fails to submit the project or fails to attend the external viva or both, he will be awarded zero marks.

Each theory paper in the annual examination shall have three sections.

Section-A shall contain one compulsory question of 10 marks having 10 parts. Two parts shall be set from each unit. The candidate is required to answer each part in about 20 words.

Section-B shall contain five compulsory questions of 10 marks each with internal choice (i.e. one out of two parts). One question with internal choice will be set from each unit. The answer may be given in approximately 250 words.

Section-C shall contain four descriptive questions covering all units and candidate has to answer any two questions of 20 marks each. The answer may be given in approximately 500 words. There can be two parts of the question.

In total the candidate has to answer eight questions in each theory paper.

M.Sc. (Previous) PHYSICS, 2004-2005

PAPER-I
MATHEMATICAL PHYSICS AND COMPUTATIONAL PHYSICS

UNIT – I

Vectors:

Orthogonal, curvilinear coordinates and expressions of gradient, divergence and curl in them. Gauss's, Stoke's and Green's theorems. Applications to hydro-dynamics, heat flow in solids, gravitational potential. Maxwell's equation and wave equation.

Tensors:

Coordinate transformations, scalars, contravariant vectors, covariant vectors. Addition, multiplication and contracton of tensors. Associated tensors, differen-tiation of tensors. Intrinsic and covariant derivatives of tensors. Tensors of higher order, applications to dynamics of a particle.

Matrices:

Special matrices including orthogonal Hermitian and unitary matrices. Number of independent parameters of special matrices. Inverse, linear transformation of matrices, partitioning and rank. Linear equations (simple cases), eigen values and eigen vectors, diago-nalization.

UNIT –II

Second Order Differential Equations:

Partial differential equations of theoretical physics, separation of variables, singular points, series solutions – Frobenius method, Wronskian, Non-homogeneous equations, Greens function. Orthogonal functions, self-adjoint differential equations, boundary conditions, Hermitian operators, Schmidt Orthogonalization, orthogonal polynomials, completeness of eigenfunctions.

Fourier and Laplace Transforms:

Differentiation and integration of Fourier series, Orthogonal functions, Fourier transform, Analysis of the vibrations of a string. Laplace transforms, inverse transform, partial fraction expansion, Laplace transform derivatives, substitution properties of Laplace transform, application to damped oscillator. RLC analog. Convolution or Faltung theorem.

UNIT – III

Special Functions:

Bessel functions of the first kind, orthogonality, Neuman function, Hankel function. Asymptotic expansions. Spherical Bessel functions. Legendre functions-generating function, recurrence relations, properties, orthogonality, Rodrigues formula, Associative Legendre functions, spherical harmonics, Hermite functions. Laguerre functions.

UNIT –IV

Complex Variables:

Functions of complex variable, Cauchy Rieman conditions, Cauchy's Integral theorem, Cauchy integral formula, Laurent expansion. Analytical functions and conformal mapping. Schwartz-Christofel transformation.

Calculus of residues – Singularities, residue theorem, Jordan’s lemma, singularities on contours of integration, evaluation of definite integrals.

Analytical continuation, Strilings formula

Group Theory:

Elementary properties and definition, representation of groups, orthogonality relation for irreducible representation, reduction of representations, cyclic group, unitary group, three dimensional rotation group, two dimensional rotation group, permutation group.

UNIT – V

Note: Students are required to use computers to write and test computer program developed for the numerical methods using Fortran 98 in the practical Lab.

Numerical Methods Iterative methods to find roots-Newton Raphson, bisection, Gauss-Seidel method for solution of simultaneous equations, Matrix inversion, Eigen values and Eigen vectors of matrices, Integration by Simpson's rules and Quadrature method, Solution of differential equations by Runge-Kutta method. Least squares method-linear and polynomial regression. Monte-Carlo evaluation of Integrals

Recommended Books:

Mathematical methods for Physicists – G. Arfken

Applied Mathematics for Physicists and Engineers – L. A. Pipes

Matrices and Tensors in Physics – A.W. Joshi

Computer Oriented Numerical methods–V. Rajaraman

Fortran Programming: V. Rajaraman

Numerical Mathematical methods – Dafilovich

Advanced Engineering Mathematics – E.Kreyszig

Methods of Mathematical Physics – Dettman

PAPER-II
CLASSICAL MECHANICS, ELECTRODYNAMICS AND PLASMA PHYSICS

UNIT – I

Preliminaries: Newtonian mechanics of one and many particle systems; conservation laws, work-energy theorem; open systems (with variable mass).

Constraints; their classification; D'Alembert's principle, generalized coordinates.

Lagrange's equations; gyroscopic forces; dissipative systems; Jacobi integral; gauge invariance; generalized coordinates and momenta; integrals of motion; symmetries of space and time with conservation laws; invariance under Galilean transformations.

Rotating frames; inertial forces, terrestrial and astronomical applications of Coriolis force.

UNIT – II

Central force; definition and characteristics; Two-body problem, closure and stability of circular orbits, general analysis of orbits, artificial satellites, Rutherford scattering.

Principle of least action; derivation of equations of motion; variation and end points. Hamilton's canonical equations. Hamilton's principle and characteristic functions, Hamilton-Jacobi equation.

Canonical transformation: generating functions, properties: group property; examples: infinitesimal generators, Poisson bracket, Poisson theorems, angular momentum PBs. Small oscillations: normal modes and coordinates.

UNIT – III

Review of four – vector and Lorentz transformation in four-dimensional space. Electromagnetic Field tensor in four dimensions and Maxwell's equations. Dual field tensor, wave equation for vector and scalar potential and solution.

UNIT – IV

Retarded potential and Lienard-Wiechert potential, electric and magnetic fields due to a uniformly moving charge and an accelerated charge, linear and circular acceleration and angular distribution of power radiated, Bremsstrahlung, synchrotron radiation, reaction force of radiation.

UNIT – V

Motion of charged particles in electromagnetic field: nonuniform fields, diffusion across magnetic fields, time varying **E** and **B** fields, Adiabatic invariants: First, second and third adiabatic invariants.

Elementary concepts: Derivation of moment equations from Boltzmann equation, Plasma oscillations, Debye shielding, Plasma parameters, Magnetoplasma, Plasma confinement.

Hydrodynamical description of plasma: Fundamental equations, hydromagnetic waves, magnetosonic and Alfven waves.

Text and Reference Books:

1. Classical Mechanics, N.C. Rana and P.S. Joag (Tata McGraw-Hill, 1991)
2. Classical Mechanics, H. Goldstein (Addison Wesley, 1980)
3. Mechanics, A.Sommerfeld (Academic Press, 1952)
4. Introduction to dynamics, I. Percival and D. Richards (Cambridge Univ. Press, 1982)
5. Panofsky and Phillips: Classical Electricity and Magnetism
6. Chen: Plasma Physics
7. Bittencourt: Plasma Physics
8. Jackson: Classical Electrodyamics

PAPER–III
QUANTUM MECHANICS

UNIT – I

Towards Quantum Mechanics: Inadequacy of classical mechanics; Black body radiation and Planck's hypothesis, The photoelectric effect, Compton effect, The Frank-Hertz experiment, Hamilton's principle.

Schrödinger equation: The Schrödinger equation, Normalisation, and probability interpretation of ψ, Equation of continuity, Expectation values, Ehrenfest theorem, Admissible wave functions.

General Formalism of wave mechanics: Vectors; examples of linear vector spaces, norm of a vector, orthonormality and linear independence, Basis and dimensions, Completeness (Closure property), Hilbert space, subspaces. Operators; Equality, product, sum, power, function, inverse of operators, eigenvalues and eigenvectors of an operator. Positive definite and continuous and bounded operators, Hermitian operators, Unitary operators, Projection operators, Completeness of eigenfunctions, Bra and Ket notation for vectors, Dirac Delta function, Representation theory, Matrix elements of change of basis, Unitary transformation. Coordinate and momentum representation.

Uncertainty and the Commutation relations: Uncertainty relation of **x** and **p**, states with minimum uncertainty product, Commutators, simultaneous eigenfunctions.

UNIT – II

One dimensional problems (stationary states): A particle in a square well potential and square potential barrier, Simple harmonic oscillator by Schrödinger equation and by operator method, properties of harmonic oscillator wavefunctions and creation and annihilation operators.

The equations of motion: Schrodinger picture, Heisenberg picture, Solution of Schrodinger equation for spherically symmetric potential; spherical harmonics, Hydrogen atom.

Theory of Angular momentum: The definition, angular momentum of a system of particles, Matrix representation, Pauli spin matrices, the spin eigen vector, orbital angular momentum, addition theorem, addition of angular momenta; Clebsch-Gordan coefficients, the selection rules, properties of CG coefficients (without proof): symmetry, orthogonality, and recursion relations.

UNIT – III

Theory of scattering: The scattering experiment, relationship of the scattering cross-section to the wavefunction, the scattering amplitude, method of partial waves, expansion of a plane wave in terms of partial waves, scattering by a central potential V(**r**), zero energy scattering, the scattering length, scattering by a square well potential, effective range, resonance scattering (No derivation). The Born approximation, the integral equation for scattering, Criterion for the validity of the Born approximation, scattering of electrons by atoms.

Identical particles: The identity of particles, the indistinguishability principle, symmetry of wave functions, spin and statistics, the Pauli exclusion principle, illustrative example: the Helium atom, scattering of identical particles, case of spin half and spin zero particles.

UNIT – IV

Approximation methods: Approximation methods for time independent problems, The WKB approximation; Principle of the method, The WKB wavefunction, Criterion for the validity of the approximation, Connection formulae, Applications to one dimensional bound system, Penetration of a potential barrier. The Variational method; bound state (Ritz method), Applications to linear harmonic oscillator, Helium atom.

Time independent perturbation theory: Non-degenerate case; applications to Anharmonic oscillator (x^4) and linear harmonic oscillator, degenerate case; applications to linear Stark effect and the Zeeman effect in the Hydrogen atom.

UNIT –V

Methods for time dependent problems: Time dependent perturbation theory, constant perturbation, Transition to continuum, Fermi's golden rule,

scattering cross section in the Born approximation, Harmonic perturbation, radiative transitions in atoms, dipole transitions, selection rules.

Relativistic wave equations: Introduction, The Klein-Gordan equation, The first order wave equations, The Dirac equation, Properties of Dirac matrices, The free Dirac particles, equation of continuity,, non-relativistic limit, spin-orbit coupling, Hole theory.

Text and reference books:

1. Quantum Mechanics, V.K. Thankappan, (New Age International).
2. A textbook of Quantum Mechanics, P.M. Mathews and K. Venkatesan. (Tata McGraw-Hill).
3. Quantum Mechanics, J.L. Powell and B. Crasemann, (Addison-Wesley).
4. Quantum Mechanics, L.I. Schiff (McGraw-Hill).

PAPER–IV
ELECTRONICS

Note :

M.K.S.A. system of units are to be used. At least 50% of the question from each unit will be problem based on theory covered in each unit. Problems will be of the level given in Appendix C of the text book "Integrated Electronics" by Millman & Halkias.

UNIT – I

Low Frequency Amplifiers:

Transistor Hybrid model, h-parameters, Analysis of transistor amplifier circuit using h parameters, Emitter follower, comparison of amplifier configuration, cascading amplifiers, simplified model of common emitter, common collector configuration, CE amplifier with emitter resistance, high input impedance transistor circuit (Darlington Pair)

High Frequency and Multistage Amplifiers:

Hybrid - common emitter transistor model, hybrid – pi conductance and capacitance, validity and variation of hybrid – pi model, short circuit current gain, current gain with resistive load, single stage CE amplifier response, the gain-Bandwidth product, emitter follower at high frequencies. Classification of amplifiers, distortion in amplifiers, Noise, frequency response, Bode plots, step response, band pass of cascade stages, Multistage CE amplifier.

UNIT – II

Feed back amplifiers and oscillators:

General characteristics of negative feed back amplifier, input and output resistances, method of analysis, voltage series, current series, voltage shunt feed back, voltage series feed back pair, effect of feedback on amplifier band width, double and three pole transfer function with feed back.Stability – Nyquist criterion, gain and phase margin, compensation by modification of beta network, sinusoidal oscillators, resonant circuit oscillator, general theory of oscillator, crystal oscillator.

UNIT – III

Linear integrated circuits: Operational amplifier, differential amplifier, emitter coupled differential amplifier, transfer characteristics, offset voltage, frequency response, dominant pole compensation, pole-zero compensation, basic applications, differential DC amplifier, analog integration and differentiation, analog computation, active filters, non-linear analog system – comparator, sample and hold circuits, logarithmic amplifier, wave form generators, Schmitt trigger.

UNIT –IV

Power circuits and Systems:

Class A large-signal amplifiers, second harmonic distortion, Higher order harmonic generations, the transformer coupled audio amplifiers, efficiency, push-pull amplifiers, Class B amplifiers, Class AB operations, Regulated power supplies, design of Series voltage regulated power supplies, monolithic regulators, the four layer diode, p-n-p-n characteristics, Bilateral Diode switch, the silicon controlled rectifiers, Gate ON and OFF times, characteristic of SCR, SCS, the triac or Bilateral triode switch, power control – SCR control, Full-wave rectified operation control circuit, AC control, Construction, Characteristics and simple applications of UJT, photodiodes, solar cells and LCD.

UNIT – V

Digital system building blocks:

NAND and NOR gates as universal gates, standard gate assemblies, K-maps and simplification of Boolean functions, Arithmetic circuit: adders, subtractor, comparators, decoders, Multiplexers, encoder and demultiplexers, ROM and application, sequential digital systems: SR Latch, flip-flops: Flip-Flop as a basic memory element, RS and JK flip-flops, Triggering of flip-flops, masterslave JK flip-flop, shift registers, Counters: Asynchronous and synchronous binary and BCD counters. A/D and D/A conversions: Basic principles and simple applications.

RECOMMENDED BOOK:

1. Integrated Electronics by Millman and Halkias (McGraw Hill).

2. Digital Logic and computer Design: M. M. Mano (Prentice Hall of India).

3. Electronic Devices and Circuit theory by R. Boylestead and L. Nashelsky, (Prentice Hall of India).

4. Electronic fundamentals and applications by John D. Ryder (Prentice Hall of India).

5. Electronic Devices and Circuits by Y.N. Bapat (Tata MacGraw Hill Publisher Limited).

6. OP-Amp and Linear Integrated Circuits by Ramakant A. Gayakwad (Prentice Hall of India).

PAPER-V
PRACTICAL-I : GENERAL PHYSICS

Max. Marks : 75

NOTE :

1. Students are required to complete at least ten experiments
2. Error analysis and estimation will be an integral part of all experiments.
3 Students are required to go through workshop practice.

Students are required to give at least one seminar on experiments allotted to them by the teacher.

Marking Scheme

Section-A : 60 Marks Section-B : 15 Marks

LIST OF EXPERIMENTS

1. Measurement of arc spectra by constant deviation spectrometer.
2. Determination of elastic constants of glass by method of Cornu's fringes.
3. Determination of coefficient of thermal conductivity of metal by Angstrom's method.
4. Study of Hall effect: Determination of Hall coefficient of given semiconductor: Identification of type of semiconductor and estimation of charge carrier concentration.

5. Determination of λ, $d\lambda$, and thickness using Michelsons nterferometer.
6. Determination of wavelength of light emitted by He-Ne laser and to verify the law governing Interference from a Young's double slit experiment.
7. (a) Measurement of wavelength of He-Ne laser light using single slit. (b) Measurements of thickness of thin wire with laser. (c) Determination of intensity ratio of diffraction pattern.
8. Study of Faraday effects using He-Ne laser.
9. Investigation of Faraday's effect and to determine Verdt's constant.
10. To plot the polar curve of a filament lamp and to determine its mean spherical intensity.
11. To study the dissociation limit of Iodine.
12. Study of Zeeman effect : Determination of e/m of electron by normal Zeeman effects using Febry Perot Etalon.
13. To investigate creep in metals.
14. To analyze principal stresses in a loaded Araldite specimen using the photo elastic technique.
15. Young's modulus of a metal beam using strain gauge.
16. Thermal conductivity of a liquid using radial heat flow.

17. To calibrate a Chromel-Alumel thermocouple by means of a cooling method (Differential Thermal Analysis).

18. To investigate the variation of capacitance and power factor with temperature change in ferro-electrics.

19. To study phase transition in Monel metal.

20. Hysteresis in Gadolinium Iron Garnet using an optical microscope.

21. Susceptibility measurement of paramagnetic anisotropic crystal.

22. To verify Gaede's equation.

23. B-H curve of the specimen in the form of Rowland ring.

24. Hysteresis in a ferroelectric sample.

25. Jamin's nterferometer's method for determination of refractive index of air using He-Ne Laser.

26. Measurements of resistivity of semiconductor by four-probe method at different temperatures and determination of band gap.

27. Quinke's method for the susceptibility of a liquid.

28. Beam characteristics of a He-Ne laser beam.

29. Refractive index of film emulsion using diffracto-interference profile.

30. Verification of Fresnel's laws of reflection and refraction.

31. Cornu's method for the Poisson's ratio using the He-Ne laser.

32. Determination of Ionization of potential of Lithium.

33. Determination of dissociation Energy of Iodine (I) Molecule by photography the absorption bands of I in the visible region.

34. To study the fluorescence spectrum of DCM dye and to determine the quantum yields of fluore-scence maxima and full width at half maxima for this dye using monochromator.

Section-B

Workshop Practice

Students are required to undergo workshop practice for a period of 4 hrs/Week

1. Getting acquainted with a mechanical Workshop

2. Machine Drawing

3. Operation of Lathe, Drilling, cutting machines etc. for mechanical fabrication work

4. Glass Blowing methods

PAPER-VI
PRACTICAL-II : ELECTRONICS & COMPUTATIONAL METHODS

NOTE :

1. Students are required to complete at least 12 experiments
2. During the examination, the students are required to submit the experiments designed and fabricated by them
3. Students are required to give at least one seminar on experiments allotted to them by the teacher.

Marking Scheme

Section-A : 60 Marks　　　　Section-B : 15 Marks

LIST OF EXPERIMENTS

(All experiments are to be designed and fabricated by the students)

1. Measurement of operational amplifier parameters.
2. Study of difference and Lograthmic amplifier.
3. Study of active filter circuits
4. Study of active integrator and differentiator circuits
5. Study of wave form generators: (a) Square wave generator (astable multivibrator), (b) Pulse generator (monostable multivibrator) and triangular wave generator.

6. Study of Oscillators using op-amp
7. Study of Schmitt trigger circuit
8. Design of a two stage common emitter Transistor amplifier and study of bias stability.
9. Study of the dependence of feedback ratio on gain, bandwidth, impedance of a voltage series/shunt and current series/shunt feedback amplifier
10. FET and MOSFET characterization and application as an amplifier.
11. Study of FET as VVR and AGC devices
12. Study of basic logic Gates, TTL, NAND and NOR
13. Study of RS, JK, Master-Slave flip flops and shift register
14. Study of four bit adder, decoder, multiplexer and demultiplexer
15. (a) Study of characteristics and applications of silicon controlled rectifier

    (b) Study of characteristics and applications.of Uni-Junction Transistor : Relaxation oscillator and triggering of SCR circuits
16. Study of Push – Pull amplifiers
17. Design of a Regulated power supply: (a) Study of series voltage regulated power supply and (b) study of IC regulated power supply

18. Frequency, voltage and temperature measurements.

19. Introduction to SPICE : Spice the gate way to electronic circuit simulations.

20. Simulation and study of electronics problems.

Section-B

COMPUTATIONAL LAB

Minimum 4 hrs/week

Students are required to use computers to write and test computer program developed for the numerical methods Unit IV of Paper-I using Fortran 98 in the practical Lab.

PAPER-I
ATOMIC AND MOLECULAR PHYSICS AND STATISTICAL MECHANICS

UNIT-I

Quantum states of one electron atoms-Atomic orbitals-Hydrogen spectrum-Pauli's principle-Spectra of alkali elements, Spin orbit interaction and fine structure in alkali spectra. Equivalent and non-equivalent electrons, Normal and anomalous Zeeman effect. Paschen Back effect, Stark effect, Two electron systems, Interaction energy in LS and JJ coupling, Hyperfine structure (qualitative). Line broadening mechanisms.

UNIT-II

Types of molecules, Diatomic linear Symmetrical top, asymmetric top and spherical top molecules, Rotational spectra of diatomic molecules as a rigid rotor, Energy levels and spectra of non rigid rotor, Intensity of rotational lines, Stark modulated microwave spectrometer (Qualitative).

UNIT-III

Vibrational energy of diatomic molecule, Diatomic molecule as a simple harmonic oscillator,Energy levels and spectrum, Morse potential energy curve, Molecules as vibrational rotator, vibrational spectrum of diatomic molecule, PQR branches IR spectrometer (Qualitative)

UNIT-IV

Foundations of statistical mechanics: Specification of states of a system, contact between statistics and thermodynamics, classical ideal gas, entropy of mixing and Gibbs paradox, Microcanonical ensemble, phase space, trajectories and density of states, Liouville's theorem, canonical and grand canonical ensembles, partition function, calculation of statistical quantities, Energy and density fluctuations.

Density matrix, statistics of ensembles, statistics of indistinguishable particles, Maxwells Boltzman, Fermi-Dirac and Bose-Einstein statistics, properties of ideal Bose and Fermi gases, Bose-Einstein condensation.

UNIT-V

Cluster expansion for a classical gas, viral equation of state,Ising model, mean field theories of the Ising model in three, two and one dimesions . Exact solutions in one dimension. Landau theory of phase transition,Critical Indices, scale transformation and dimensional analysis. Correlation of space–time dependent fluctuations, fluctuations and transport phenomena, Brownian motion, Langevin theory, fluctuation dissipation theorem, The Fokker-Planck equation.

Reference Books

Introduction to Atomic Spectra- H.E. White (T)

Fundamentals of Molecular Spectroscopy-CB Banwell (T)

Spectroscopy Vol, I,II,III-Walker & Straughen

Introduction to Molecular Sepctroscopy: G M Barrow

Spectra of diatomic Molecules : Herzberg

Molecular Spectroscopy- J eanne L Mc Hale

Molecular Spectroscopy-J M Brown

Spectra of Atoms and Molecules-P F Bemath

Modern Spectroscopy : J M Holias

Statistical and Thermal Physics F Reif

Statistical Mechanics K Huang

Statistical Mechanics R K Panthria

Statistical Mechanics R Kubo

Statistical Mechanics Landau and Lifshitz

PAPER-II
SOLID STATE PHYSICS

UNIT-I

Crystal Structure :

Crystal classes and systems, periodic array of atoms, fundamental types of lattices, 2d and 3d lattices, Index system for crystal planes, simple crystal structures, direct imaging of atomic structure, nonideal crystal structures, elementary ideas of point defects: line defects, planar faults, surface and volume defects, lattice vacancies, interstitials, colour centers, F-centers and dislocations.

Reciprocal lattice :

Reciprocal lattice, diffraction of waves by crystals, X-ray and neutron diffraction, scattered wave amplitude, structure factor, Brillouin Zones, Fourier Analysis of the basis, Quasi crystals.

UNIT-II

Phonons I : Crystal Vibrations :

Lattice vibrations, phonons, vibrations of crystals with monoatomic basis, two atoms per primitive basis, quantization of elastic waves, phonon momentum, Inelastic scattering by phonons.

Phonons II : Thermal Properties :

Specific heat of solids, phonon Heat Capacity, Anharmonic crystal interactions, Thermal Conductivity.

UNIT-III

Free Electron Fermi Gas :

Free electron theory- Fermi statistics, Energy levels in one dimension, effect of temperature on the Fermi-Dirac Distribution, Free electron gas in three dimensions, Heat Capacity of the Electron gas, Electrical Conductivity and Ohm's Law, Motion in magnetic fields, Thermal conductivity of metals, Nano structures.

Energy Bands :

Nearly Free Electron model, Bloch functions, Kroning-Penney model, wave equation of electron in a periodic potential, Number of orbitals in a band, energy bands in metals, insulators and semiconductors, tight binding approximations.

Fermi Surfaces and Metals :

Reduced Zone Scheme, periodic Zone scheme, construction of Fermi surfaces, Electron orbits, hole orbits, open orbits, Experimental methods in Fermi surface studies.

UNIT-IV

Superconductivity :

Experimental Survey, Theoretical survey, High Temperature Superconductors.

Diamagnetism and Paramagnetism:

Langevin Diamagnetism equation,quantum theory of diamagnetism of mononuclear systems, Paramagnetism, quantum theory of paramagnetism, Hund's rules, Cooling by isontropic demagnetization, paramagnetic susceptibility of conduction electrons

UNIT-V

Ferromagnetism and Antiferromagnetism

Ferromagnetic order, magnons, Neutron magnetic scattering, ferromagnetic order, Antiferromagnetic order, Ferromagnetic domains, signle domain particle, magnetic bubble domains

Magnetic resonance :

Nuclear magnetic resonance, Line width, hyperfine splitting, Nuclear quadrupole resonace, ferromagnetic resonance, Antiferromagnetic resonance, Electron paramagnetic resonance, Principle of maser action.

Recommended Book :

1. Introduction to Solid State Physics by Charles Kittel Seventh Edition
2. Solid State Physics by A.J. Dekker

PAPER-III
NUCLEAR and PARTICLE PHYSICS

UNIT – I

Nucleon – nucleon interaction: Exchange forces and tensor forces. Meson theory of nuclear forces. Nucleon – nucleon scattering: Effective range theory. Spin dependence of nuclear forces. Charge independence and charge symmetry of nuclear forces. Isospin formalism. Yukawa interaction. P-p scattering and its comparison with the results of n-p scattering, properties of deuteron (radius, magnetic moment and spin), theory of ground state of deuteron (assuming central potential).

Magnetic moment of nuclei (Schmidt model of measuring the spin and magnetic moment of nuclei). Quadrupole moment of the nucleus. Electric multipole moments of nucleus. Excited state of nuclei (spin and parity of excited nucleus).

UNIT – II

Direct and compound nuclear reaction mechanisms (Q values). Cross sections in terms of partial wave amplitudes. Compound nucleus. Scattering matrix. Reciprocity theorem. Breit-Wigner one level formula. Resonance scattering.

Liquid drop model. Bohr-Wheeler theory of fission. Experimental evidence for shell effects. Shell model. Spin-orbit coupling. Magic numbers. Angular momenta and parities of nuclear ground states. Qualitative discussion and estimates of transition rates. Collective model of Bohr and Mottelson.

Beta decay: Fermi theory of beta decay. Shape of the beta spectrum. Fermi-Kurie plot and its application. Total decay rate. Angular momentum and parity selection rules.

Comparative half lives. Allowed and forbidden transitions. Selection rules. Parity violation. CPT theorems.

Gamma decay: Multipole transitions in nuclei. Angular momentum and parity selection rules. Internal conversion. Nuclear isomerism.

UNIT – III

Interaction of charged particle with matter. Classical theory for calculating dE/dX for heavy, non-relativistic, charged particle. Causes for difference between the energy loss by heavy charged particles and electrons, relative energy loss by ionization and radiation by electron (no derivation). Difference between the absorption curves of electrons and heavy charged particles. Straggling of particles and protons (less than the binding energy of electrons).

Interaction of gamma ray with matter (photo electric effect, Compton effect and pair production) through varying cross section and atomic number (no derivation).

UNIT – IV

Working and construction of Ionization chamber, Proportional counter, Geiger-Muller counter (dead time of G.M. counter and its determination by two source method). Scintillation counter (inorganic, organic: Production of pulse at anode of phototube, energy resolution, discussion of a typical NaI(Tl) energy spectrum), Solid state detectors (diffused junction and surface barrier detector,. Resoultion and discussion of a typical Ge(Li), Si(Li) energy spectrum).

UNIT – V

Types of interaction between elementary particles. Hadrons and leptons. Symmetry and conservation laws. Elementary ideas of CP and CPT invariance. Classification of hadrons. Srong and weak interaction symmetries: uses of symmetry. Space time and internal symmetries. Lie groups generators and Lie algebra. Casimir operators. SU(2) irreducible representation. Weight diagram. Diagonal generators SU(3) generators. U and V spin. Raising and lowering operators. Root diagram. Weight diagram. Multiplets of SU (n). Baryons and meson multiplets. Symmetry breaking. Quark model. Gell-Mann-Okubo mass formula for octet and decuplet hadrons. Charm, bottom and top quarks.

Perturbative QCD:

1. Colour gauge invariance and QCD Lagrangian. Deep inelastic scattering. The GLAP equations,

and alternative approach to the GLAP equations. Common parametrizations of the distribution functions. Structure functions. The spin-dependent structure functions and the MIT bag model.

2. The Drell-Yan process. Small-x physics and the Gribov-Levin-Ryskin equation.

Non Perturbative QCD:

QCD sum rules. The ground state of QCD. Equation of state of a quark. Gluon plasma. Hadronization phase transition.

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. Ghoshal, Atomic and Nuclear Physics, Vol. 2.
4. H.A. Enge, Introduction to Nuclear Physics, Addison-Wesley, 1975
5. M.K. Pal, Theory of Nuclear Structure, Affiliated East-West, Madras, 1982.
6. Y.R. Waghmare, Introductory Nuclear Physics, Oxford – IBH , Bombay, 1981.

7. R.D. Evans, Atomic Nucleus, McGraw Hill, New York, 1955.
8. I. Kaplan, Nuclear Physics, 2nd Ed., Narosa, Madras, 1989.
9. Jagdish Varma, Nuclear Physics Experiments, New Age International 2001
10. B.L. Cohen, Concepts of Nuclear Physics, TMGH, Bombay, 1971.
11. R.R. Roy and B.P. Nigam, Nuclear Physics, Wiley-Eastern Ltd., 1983.
12. I.S. Huges, Elementary particle Physics, Penguin.
13. M. Leon, an introduction to particle physics, Academic Press, New York, 1973.
14. W. Greiner and A Schafer, Quantum Chromodynamics, Springer, Berlin, 1993.
15. F.J. Yndurain, Quantum Chromodynamics: An introduction to the theory of quarks and gluons, Sringer-Verlag, New York, 1983

PAPER–IV A
CONDENSED MATTER PHYSICS

UNIT-I

Crystal Physics and X-ray Crystallography :

External symmetry elements of crystals, sets and groups,symmetry of crystal, symmetry invariance and conservation laws, the crystallographic restriction on symmetry axes, rotation,reflection,inversion and translation, concept of point groups, influence of symmetry on physical properties. Electrical conductivity, Space groups, Bravais lattices, Crystallographic directions and planes, seven crystal systems.

Basic theory of X-ray diffraction method, principle of powder diffraction method, interpolation of powder photographs, Indexing of Debye Scherer patterns from powder samples. Detrmination of lattice parameters using least squares refinement techniques, Oscillation of Buergurs precission methods, Detrmination of relative structure amplitudes from measured intensities, Lorentz and Polarization factors, Fourier representation of electron density, Determination of particle size, increase in the width of XRD peaks of nanoparticles.

UNIT-II

Energy band structure calculation: Nearly free electron model, tight binding method, Cellular methods, Orthogonalization plane wave methods, Green function method.

Electrons in solids and Surface States: Interacting electron gas:Hartree-Fock approximations, correlation energy, Screening, Plasma oscillations, Dielectric function of an electron gas in random phase approximation. Limiting cases and Friedel oscillation, strongly interacting Fermi system, Elementary introduction to Landau's quasi particle theory of a Fermi liquid. Strongly correlated electron gas.

UNIT-III

Superconductivity: BCS theory of superconductivity, manifestation of energy gap, Cooper pairs due to phonons, BCS theory of superconductivity, Ginzburg-Landau theory and application to Josephson effect , dc and ac Josephson effect, macroscopic quantum interfrence. High temperature superconductivity, general features of high Tc superconductors. Type I and Type II superconductors, Organic superconductivity, Low dimensional materials-Characteristics and transport properties.

Films and Surfaces: Study of surface topography by multiple beam interferometry, conditions for accurate determination of step height and film thickness (Fizeau fringes), Electrical conductivity of thin films, differences of behaviour of thin film from bulk, Boltzman transport equation for a thin film (for diffused scattering).

UNIT-IV

Phase diagrams and Crystal Growth: Phase diagrams, chemical potential for different phase composition, limitation of phase rules, solid solutions, Hume Rothary rule, cooling curves. Thermodynamic potentials and fundamental equations, Nucleation, kinds of nucleation, classical theory of nucleation, Gibbs Thomson equation, Kinetic theory of nucleation, Becker and Doring concept of nucleation rate, Energy of formation of a nucleus, nucleation from melt, Statistical theory of nucleation, nucleation rate, Zeldovich-Frenkel approach, free energy of formation for binding system, Hetrogenous nucleation. Crystal growth: Classification of methods of crystal growth, principles and methodology, crystal growth from solution, flux growth, crystal growth in gels, melt growth and vapour growth

Advanced materials: Elementary ideas about classification and characterization and preparation techniques of advanced materials: metals, ceramics, polymers, composites, alloys, ferrofluids, nanomaterials, semiconductors, biomaterials, low dimensional materials, liquid crystals, quasi crystals, hydrogen storage materials and glasses.

UNIT-V

Magnetic materials: Classification of magnetic ordering, Weiss molecular field theory of ferromagnetism, Domain theory, ferromagnetic domains and concept of Bloch wall, Bloch Wall energy, Heisenberg model,quantum mechanical exchange interactions in magnetism, spin waves and magnons, Kondo effect, Spin glass, RKKY Interactions. Introdu-

ction to hard and soft magnetic materials, elementary idea of ferrites, application of ferrites in electronic and magnetic bubbles, Brief introduction to permanent magnetic materials, Breif introduction to disordered magnetic materials and amorphous materials.

Neutron Diffraction and Mossbauer effect: Scattering of neutrons from single nuclei, Neutron nucleus scattering from periodic lattice, magnetic scattering of neutron from crystal, scattering lengths and structure factors. Determination of crystal structures and magnetic structures. Brief introduction to Mossbauer effect, Conditions for observing Mossbauer Effect Mossbauer parameters: Isomer shift, Quadrupole splitting and Magnetic splitting. Experimental method of study of Mossbauer effect, Application of Mossbauer effect in condensed matter physic.

Brief introduction Magnetic circular X-ray dichorism and magnetic Compton scattering

Text and Reference Books

1. Azaroff: X-ray Crystallography
2. Weertman and Weertman: Elementary Dislocation Theory.
3. Verma and Srivastava: Crystallography for Solid State Physics
4. C.Kittel: Solid State Physics
5. Azaroff and Beurger: The Powder Method

6. Buerger: Crystal Structure Analysis

7. M. Ali Omar: Elementary Solid State Physics

8. The Physics of Quasicrystals, Eds. Steinhardt and Ostulond

9. Handbook of Nanostructured Materials and Nano-technology (Vol. 1 to 4), Ed. Hari Singh Nalwa

10. Thomas: Transmission Electron Microscopy

11. Tolansky: Multiple Beam Interferometry

12. Heavens: Thin Films

13. Chopra: Physics of Thin Films

14. Aschroft and Mermin: Solid State Physics

15. Chaikin and Lubensky: Principles of Condensed Matter Physics

16. Madelung: Introduction to Solid State Theory

17. Callaway: Quantum Theory of Solid State

18. Huang: Theoretical Solid State Physics

19. Kittel: Quantum Theory of Solids

PAPER-IV B
NONLINEAR DYNAMICS AND CHAOS

UNIT I

Chaotic dynamics, Classical linear and non-linear vibration theory, maps and flows- A mathematical model of biological population growth (Logistic map) and model of convecting fluids (Lorenz model), Determinism unpredictability and divergence of trajectories (Butterfly effect). Identification of chaotic vibration, non-linear system elements, random inputs, time history, phase plane, Fourier spectrum and autocorrelation, Poincare maps and return maps. Bifurcations-route to chaos, quasi-periodicity and mode locking, transient chaos, conservative chaos, Lypunov exponents and fractal dimensions, strange non-chaotic motions.

UNIT II

Geometry of mappings and classification of map dynamics, quasi-periodic and stochastic motion, Impact oscillator maps, Fractal orbits. Local stability of 2D maps, Global dynamics of 2-D maps – linear transformation, folding in 2D maps, composition of maps. Saddle manifolds, tangles and chaos, From 2D to 1D maps-kicked rotor, Circle map, Henon map. Period-doubling root to chaos – qualitative features, poincare maps, bifurcation diagrams, quantitative measures, Feigenbaum numbers, amplitude and subharmonic spectra scaling. Measure of chaos-

Lypunov exponents, probability density functions (PDF) and numerical calculation of PDF, PDF and Lyapunov exponents. 3D flows and maps-Lorentz model for fluid convection, Duffing equation and "Japanese attractor", a map from a 4D conservative flow.

UNIT III

Empirical criteria for chaos in different types of forced oscillations, Theoretical predictive criteria-period doubling criterion, homoclinic orbits and horshoe maps, Shil'nikov Chaos, intermittent and transient chaos, Chirikov's criterion for conservative chaos and criterion for multiple potential well. Lypunov exponents-numerical calculation of largest Lyapunov exponent, Lyapunov spectrum, Lyapunov exponent for continuous systems and Hyperchaos.

UNIT IV

Examples of fractals-Koch curve, Cantor set, Devil's staircase and fractal dimensions. Measure of fractal dimensions - pointwise dimension, correlation dimension, information dimension and Lyapunov dimension. Fractal generating maps- iterated linear maps and maps on complex plane. Fractal dimension of strange attractors. Multifractals-fractals within fractals and experimental multifractals, optical measurement of fractal dimensions and application of fractals in physical sciences.

UNIT V

Hamilton's equation and Hamiltonian, phase space, constants of motion and integrable Hamiltonians, non-integrable systems, KAM theorem and period doubling, Henon-Heiles Hamiltonian, area preserving maps - Chirikov standard map and Arnold cat map, dissipative standard map, application of Hamiltonian dynamics.

Text and Reference Books:

1. Chaotic and fractal dynamics - F. C. Moon (John Wiley and Sons, 1992).

2. Chaos and non-linear dynamics – R. C. Hilborn (Oxford University Press, 2000).

3. Chaos-An introduction to dynamical systems – K. Alligwood, T. Sauer and J. A.Yorke (Springer Verlag, New York, 1997).

4. Chaos in dynamical systems – E. Ott (Cambridge University Press).

5. Chaos in classical and quantum mechanics – M. C. Gutzwiller (Springer Verlag, New York, 1990).

PAPER-IV C
COMMUNICATION ELECTRONICS AND ATMOSPHERIC SCIENCE

UNIT - I

Antenna:

Radiation from an antenna, Radiation Resistance of antenna, polar diagram of resonant and non resonant antenna, polar diagram of resonant and non- resonant antenna(Quarter wave vertical) and half wave dipole ,effect of ground on polar pattern, antennae gain, efficiency ,effective length , radiation resistance, beam width, aperture area.

Directional Characteristics of Antenna:

Antenna Array, Broad side array, end fire array, principle of pattern multiplication, folded dipole, Parasitic element, Yagi antenna, antenna with Parabolic reflector, Horn antenna.

UNIT - II

Radio Wave Propagation:

Communication Frequency Bands, Electromagnetic radiation in free space, surface wave attenuation and horizontal polarization, waves propagation modes at the different frequency bands, effect of curvature of the earth on ground wave propagation. Space wave propagation, atmospheric ducting, non standard tropospheric micro wave and millimeter wave scatter

propagation, attenuation by rain, fog, snow, ice and atmospheric gases.

Sky wave propagation through the ionosphere , critical frequencies, effect of the earth's magnetic field on sky wave propagation, dielectric constant of ionized gas, Maximum Usable Frequency, skip distance, Height of reflection of radio waves, Faraday Rotation

UNIT – III

Communication Systems:

(a) Angle Modulation:

Narrow band, Wide band and multiple frequency modulation, square wave ,linear and non linear modulation, remarks only on Phase Modulation, power contents of carrier and side bands in Angle modulated carriers, Noise reduction characteristics of angle modulation, generation and demodulation of FM waves.

(b) Pulse Modulation and Digital Communication:

Pulse Amplitude Modulation, other forms of Pulse Modulation, TDM, FDM, bandwidth requirement for transmission of PAM signal, coded system and its comparison with uncoded system, sampling theorem, quantisation, efficiency of PCM system, elements of digital communication, detection of binary signal, the matched filter decision threshold in matched filter, maximum likelihood receiver, basic phase shift and quardrature. Modulation and demodulation.

UNIT - IV

Atmospheric Science :-

(a) General description of the Sun, solar structure, sun's outer layers, photosphere, chromosphere, corona, solar activity and sun spot cycles, solar radiation EUV and X- rays photon flux near the earth, solar wind, flares, solar magnetic field, interplanetary magnetic field.

(b) Atmospheric Structure and Solar radiation: Temperature structure and nomenclature of the atmosphere, atmospheric pressure, density and composition, mean molecular weight, chemical and dynamical effect, intensity of incoming solar radiation, attenuation of solar radiation intensity, molecular absorption, scattering and albedo, radiation energetic of the atmosphere. Elementary chemical kinetics, composition and chemistry of Middle Atmosphere and Thermosphere. Radiative transfer, Thermal effects of radiation. Photochemical effects of radiation . Modeling of radiative effects of Aerosols. Sratospheric chemistry of Ozone.

UNIT – V

Atmospheric Science Measurements & Techniques

(a) Photochemical process in the ionosphere and morphology of different regions, the balance of ionization and production of ionization, Chapman theory for grazing incidence, corpuscular ionization,

reaction, chemistry and morphology of D-region , E-region and F- region, ionospheric irregularities. Night airglow, Day airglows, Twilight airglows.

(b) Atmospheric Measurements (Basic technique and principles only)

Ionosonde, characteristics of transmitter and receiver, recording of ionograms, interpretation of ionograms and determination of N(h) profile, Absorption Measurement Technique (A-1 technique), Ionospheric Irregularities study using Closely Spaced Receiver Technique and Ionospheric Scintillation. Measurement of Total Electron Content using Satellite based technique. Coherent and Incoherent Scatter Radar for ionosoheric studies, MST Radar system, Lidar, (overview and technological feature), sunphotometer for measurement of Total Ozone Content, Water Vapour Content and Aerosols.

Reference Books:-

1. Solar Terrestrial Physics, A K Asofu and Chapman.
2. Aeronomy of the Middle Atmosphere, Guy Brasseur and Susan Solomon.
3. An Introduction of Atmospheric Physics, G. Fleagle, Joost, A. Businer.
4. Minor Constituents in the Middle Atmosphere, Tatsuo Shimazaki.
5. The Upper Atmosphere and Solar and Terrestrial Realtions, J.K.Hargreaves.

6. Electromagnetic waves and Radiating System, Jordan

7. Antennas and Radio Wave Propagation, R.E. Collin.

8. Electronics Communication Systems, B.P.Lathi.

9. Electronics Communication, Kennedy.

10. Digital Communication, J.J.Proakis.

11. Introduction of Ionospheric Physics, Risbeth and Garriot.

12. Space Physics , S. Deogonkar.

PAPER-IV D
INFORMATICS AND COMPUTER VISUALIZATION

UNIT-I

Introduction to Information Theory and Queuing theory, Data communication: Theoretical model of communication, Application of Fourier series and Fourier transforms in data communication. Analog/ Digital communication, Serial/Parallel, Simplex/ Duplex, Sychronous/Asynchronous, Bit/buad rates. Parity and error control. Signal to Noise ratio

Modulation types, techniques and standards of digital signals. Base band and carrier communication, detection, Interference, Noise signals and their characterization, Phased locked loops. Introduction and evolution of telecommunication. Transmission media: Twisted pair, cable, Optical fiber, wireless, satellite and infrared.

Computer Hardware basics, CPU, Memory and I/O devices used in Modern computers. Computer buses and Standards, Common Interface Standards: RS 232C, Centronics, USB . Modems.

UNIT-II

Computer Networking : Network types and architecture (Broadcast, Multicast, LAN,MAN, WAN, toplogy) Protocols, Interfaces and services, X.25, ISDFN, ATM, VPN, Frame relay, wireless transmission. OSI and

TCP/IP models. Bridges, switches and Routers. Routing, congestion and flow control, tunneling. Data Link protocols, Multiple access protocols, TCP,UDP, transport layer error recovery, application layer services and protocols. IP addressing, Network security.

UNIT-III

Evolution of Internet, Internet architecture: goals and key issues related to Internet working technologies, Internet connectivity (dial up,dedicated lines, board band, DSL, radio, VSAT). Domain Name Scheme, technology and tools relevant for Web access, Internet security.

Multimedia, techniques of data compression, voice, video, Interactive video on demand over the Internet, mobile computing. Fundamentals of Network Management (Basic concepts only).

UNIT-IV

Object Oriented Programming concepts: (C++ or Java language may be used to teach the concepts) Classes, Data Abstraction and Objects, Inheritance, recursion. Java Applets, creation of custom components, Images and threads

UNIT-V

Introduction to computer graphics, applications, hardware and software. Fundamental ideas behind modern computer graphics. Two dimensional Graphics

: Line, circles, ellipses translation, rotation, scaling and shearing. Shading methods. Introduction to virtual environments, Basic technologies, methodologies for processing digital images by computer.

Computer visualization: Visualization, information Visualization, Scientific Visualization. Scientific Visualization Techniques, Analysis Data for Visualization Scalar Visualization Techniques, Applications of Visualization to Design and Analysis, Case studies :

Computer Networks ,Tannanbauem, PHI

Handbook of Virtual Environments. Kay Stanney, ed., Lawrence Erlbaum Associates, 2002

PAPER-IV E
ADVANCED DIGITAL ELECTRONICS

UNIT-1

Boolean Algebra and Logic gates: Axiomatic definition, basic theorems and properties, Boolean functions, canonical and standard forms, simplification of Boolean functions-two, three, four, five and six variable maps, product of sums, NAND and NOR and other two level implementations, Don't care and tabulation method. Digital Integrated circuits, Digital logic gates, IC digital logic families and its characteristics

Combinational Logic: Design procedures, adders, subtracters, code conversion, multilevel NAND and NOR circuits, Exclusive-OR and equivalent functions, Combinational logic with MSI and LSI circuits, binary parallel adder, decimal adder, magnitude comparator, decoders, multiplexers, ROM, PLA

UNIT-II

Sequential Logic : Flip-Flops, triggering of Flip-Flops, analysis of Clocked sequential circuits, state reduction and assignment, Flip-Flop excitation tables and design procedure, design of counters Design with state equations

UNIT-III

Registers: Register with parallel load, Shift registers. Serial transfer, bi-directional shift register with parallel load, serial addition.

Ripple Counters: Binary up-Down counters, Binary counters with parallel load,timing sequences and Johnson counter

Memory Unit: Memory Read/Write operations, random Access memory, Integrated circuit memory, magnetic core memory.

Register Transfer Logic : Inter Register transfer, bus transfer, memory transfer, arithmetic, logic and shift micro operations. Conditional control statements, fixed point binary data, over flow, arithmetic shifts, decimal data, floating point data,non-numeric data, instruction codes, instruction code formats, design of a simple computer

UNIT-IV

Microprocessor Architecture and Microcomputer systems : Microprocessor architecture and its operation, memory, input and output, a computer system, logic devices for interfacing.

The 8085 Microprocessor : pinout and classification of signals, Microprocessor communication and bus timings, control signal generation, functional block diagram of 8085 microprocessor, the ALU, the 8085 based microcomputer system, machine cycle and bus timings, Op-code fetch machine cycles, memory read/ Write machine cycles, memory interfacing.

Programming 8085 : Registers, accumulator, flags, program counter and stack pointer, instruction classification, instruction formats, op-code format.

The 8085 Instruction Set : Data transfer instructions, arithmetic instructions, logical instructions, branch instructions, machine control instructions, addressing modes.

Assembly Language Programming: Simple programmes (including loops,counters,indexing and time delay techniques) of about 50 byte length, stack and subroutines

UNIT-V

Interfacing Peripherals and Applications: Basic interfacing concepts, interfacing devices, I/O mapped I/O and Memmory mapped I/O.

The 8085 interrupts : RST instructions, multiple interrupts and priorities, vectored interrupt.

Interfacing Data Converters : Basic concepts only A/D and D/A conversion techniques and converters.

Programmable Devices: Block diagram, chip enable/ select logic, port address, control word/status word formats and definitions of 8155/8156, 8355/8755, 8279, 8255, 8253 and 8259 programmable devices.

Serial I/O and Data Communication: Basic concepts of serial I/O, RS 232C, standard, Serial I/O using programmable chips, data Communication buses-S-100 bus, IEE488 bus and CAMAC standard.

Microcontrollers: Different types, processor architecture, microcontrollers memory types, features of microcontrollers, 8051 processor architecture

Recommended Books:

1. Digital Logic and Computer design by M.Morris Mano, PHI New Delhi, 1989

2. Microprocessor Architecture, Programming and applications with 8085/8080A by Gaonkar, Wiley Eastern Ltd, New Delhi 1988

PAPER-IV F
X-RAY & NUCLEAR SPECTROSCOPY

UNIT-I

X-ray spectroscopy: Nature of X-ray emission and absorption spectra, Mosely's law, energy levels, selection and intensity rules, fine structure of X-rays, spin doublets, irregular doublets, multiple structure and satellite, explanation of absorption spectra.

Pair production, coherent scattering, incoherent scattering, Compton effect, internal conversion and Auger effect.

Application of X-ray in condensed Matter

Experimental methods to determination of crystal structure : cubic and non cubic crystals (powder method), Crystal structure of single crystals. Powder spectra analysis

X R F method for elemental analysis.

UNIT-II

Scintillation Spectrometry: Choice of detectors, properties of different organic and inorganic scintillators, Geometry, disturbing influences on gamma-ray spectra, determination of response function, analysis by peeling method, total absorption spectrometer, anti compton shields, measurements of beta ray spectra.

Semiconductor Detectors: Si(Li),Ge(Li), HPGe, Guard ring structure detectors, semiconductor detector applications in reaction charged particle, alpha particle, electron, gamma and neutron spectroscopy.

Beta-Ray Spectrometry: Design and working of semi-circular, double focusing and sector type spectrometers.

UNIT-III

Nuclear Instrumentation:

Photomultipliers: General characteristics, Design of voltage divider circuits, noise. Current and voltage pulses and shapes.

Preamplifiers: Voltage, Current and charge sensitive preamplifiers, Noise sources and characteristics, connection between detector and preamplifier, selection of components for low noise performance, selection of preamplifier.

Amplifiers: Pulse shaping- RC, Gaussian, delay line circuits, pole zero cancellation, Base line restorer, pile up rejection. Amplifier specifications and types.

Pulse Amplitude Analysers: Discriminators, SCA, analog to digital conversion, multichannel analysers. methods of processing digital data. Standardisation in nuclear electronics-NIM and CAMAC standards, brief idea of electronics for 4 gamma detector system

Coincidence techniques: coincidence techniques, chance, true and true to chance coincidence ratio, resolution correction for chance coincidence, slow fast coincidence system.

Timing Techniques: Loss of resolution, jitter, walk. Constant fraction discrimination, Time to amplitude converter, Timing with scintillation and semiconductor detectors.

UNIT-IV

Nuclear Spectroscopic Methods:

Disintegration schemes: General procedures- preparation of source material, calibration of instruments, search for gamma-rays and measurement of their energy, determination of relative intensity, measurement of gamma-rays, Fermi plots.

Life Time Measurements: Direct timing methods, delayed coincidence and centroid shift, recoil and Doppler shift methods.

Resonance Fluorescence of Gamma-Rays: Resonance scattering of gamma-rays. Cross-section (No derivation), survey of experimental methods. Mossbauer spectro-scopy: Basic aspects, principle and theory, Lamb-Mossbauer factor, experimental procedure, Mossbauer parameters-isomer shift, quadrupole and magnetic splitting. Applications of Mossbauer effect in Nuclear Physics

Internal Conversion: Role of internal conversion in nuclear spectroscopy, Internal conversion studies at very high resolution- Multipolarities from conversion line intensity ratios, application to nuclear level

schemes. Natural widths of conversion lines, relative and absolute energy standards. Classification of nuclear transition rates.

UNIT-V

Angular Distribution of Nuclear Radiation: Naive theory of gamma-gamma directional correlation of a free nuclei, theoretical results of gamma- gamma and Beta-gamma direction correlation, experimental procedures, influence of extra nuclear fields, General theoretical description (No derivation). Attenuation coefficients for static electric, magnetic and combined interaction (No derivation) Determination of g-factors of excited nuclear states and determination of static quadrupole coupling. Time dependent perturbation(elementary ideas) brief introduction to Nuclear orientation and in beam gamma ray spectroscopy.

Recommended Books:

1. X-ray diffraction procedures ,Klug and Alexander
2. Elements of X-ray diffraction, Cullity
3. Powder Method in X-ray crystallography, Azaroff.
4. Alpha, Beta and Gamma ray Spectroscopy, Vol I & II, Kai-Siegbahn, North Holland, 1975
5. Perturbed Angular correlation, Karlson,Mathias an Siegbahn
6. Mossbauer Effect ,Weirtheim
7. Radiation Detector Systems, edited by S.K. Kataria, Oxford Publishing Co., 1992.

PAPER-IV G
ADVANCED SOLID STATE PHYSICS

UNIT-I

Group theory in Solid State Physics :

Point group of first and second kind, character table and representation methods to generate lattice in two and three dimensions, space groups, their nomenclature and classification, semi direct product and the concept of symorphic groups. Assymorphic groups. Special point of the Brillouine zone, space group representations, A two dimensional example, method of character of space groups.

UNIT-II

Double Groups and their Representations:

Time reversal symmetry and Kramer degeneracy, introduction to the enumerations and classification of magnetic point groups and space groups and their characters.

Symmetry Groups:

Permutational symmetry, Youngs diagrams,tableau and Hook Yamanochi symbols, irreducible representations and their Kronecker reduction. Application to normal modes of vibrations of molecules(simple selection rules for infrared and Raman transition) basic function and Microscopic crystal tensors.

UNIT-III

Electron Phonon Interaction:

The deformation Potential Interaction, polarons, phonon cloud, relaxation time, interaction with longitudunal optical phonons, Polaron effective mass, electron interaction in metals.

Transport properties:

The Boltzman equations, electrical conductivity, relaxation time, impurity scattering, ideal resistance, thermal conductivity, thermo electric effects, lattice conduction, phonon drag, magneto resistance, influence of open orbits.

UNIT-IV

Superconductivity :

Indirect electron-electron interaction via phonons, bound electron pairs in Fermi gas, BCS reduced Hamoiltonian, solution of the BCS equation by computation of motion method, Electrodynamics of superconductors, coherence length, quantised magnetic flux in superconductors.

Binary alloys:

Lause theorem, Friedel sum rule, rigid band theorem, electrical resistivity, long range oscillation of electron density, virtual states, localised magnetic states in metals. Anderson model, indirect exchange interaction via conduction electrons.

UNIT-V

Neutron Diffraction by Crystals:

Born approximation, differential scattering cross section and density correlation function, coherent and incoherent elastic nuclear scattering, electronic and magnetic scattering of neutrons, Elastic paramagnetic and ferromagnetic scattering.

Mossbauer Effect:

Background concepts: Natural line width, Recoil Energy Loss, Resonance and Resonance Fluoresence, Doppler Broadening, Einstein Solids, Recoil-free emission of gamma rays, Mossbauer effect and its Observation, Theory of Mossbauer effect, Mossbauer Spectrometer, source and absorber, Mossbauer spectra and parameters.

Recommended Books:

1. Quantum Theory of Solid-Kittel
2. Quantum Theory of Solid-Ziman
3. Group Theory in Solid state Physics- Falicov
3. Group Theory and its applications in Physics-Hammermesh.
4. An introduction to Mosssbauer Spectroscopy-L.May, Plenum press

PAPER-IV H
QUANTUM FIELD THEORY

UNIT-I

Photon and Electromagnetic field

Particles and field, the electromagnetic field in the absence of charges, the classical field, harmonic oscillator, the quantized radiation field, the electric dipole interaction, the electromagnetic field in the presence of charges. Classical elctrodynamics, Quantum electrodynamics, radiative transitions in atoms, Thomson scattering, The Schrodinger, Heisenberg interaction pictures.

Langrangian Field Theory:

Relativistic notation, Classical Langrangian field theory, Quantised Langrangian field theory, symmetries and conservation laws.

UNIT-II

The Klein Gordan Field:

The real Klein-Gordan field, The complex Klein Gordan field, Covariant commutation relation, the meson propagator.

The Dirac field:

The number representation for fermions, The Dirac equation, second quantization, The fermion propagator, The electromagnetic interaction & gauge invariance.

Photons covariant theory:

The classical field, covariant quantisation, the photon propagator.

UNIT-III

The S-matrix Expansion:

Natural dimensions and units,The S-matrix expansion, Wick's theorem.

Feynman Diagrams and Rules in QED:

Feynman diagrams in configuration space,Feynman diagrams in momentum space,The first order terms, Compton scattering; Electron-electron scattering, closed loops, Feynman rules for QED; Leptons.

QED Processes in Lowest Order:

The cross section, Spin sums, Photon polarization sums, Lepton pair production in (e+q) collisions, Bhabha scattering, Compton scattering, Scattering by an external field, Bremsstrahlung, The infra-red divergence.

UNIT-IV

Radiative Corrections:

The second order radiative correction of QED, The photon self energy, The electron self energy, external line renormalization, the vertex modification, application, the anomalous magnetic moments, the Lamb shift. The infra-red divergence. Higher order radiative corrections, renormalizability.

Regularizations:

Mathematical preliminaries, Some standard integrals, Feynman parameterization, cut-off regularization, the electron mass shift, dimensional regularization, introduction, general results, vacuum polarization, the anomalous magnetic moment.

Weak Interactions:

Introduction, leptonic weak interactions, the free vector Boson field, the Feynman rules for the IVB theory, decay rates. Applications of IVB theory, Muon decay, Neutrino scattering, the leptonic decay of the W Boson. Difficulties with the IVB theory.

UNIT - V

Gauge theory of Weak Interaction:

The simplest gauge theory, QED, Global phase transformations and conserved weak currents, the gauge invariant electro-weak interaction, properties of the gauge Bosons, lepton and gauge Boson massses, Two gauge transformation results, the transformation law. The SU(2) gauge invariance.

Spontaneous Symmetry Breaking:

The Goldstone model, the Higgs model, the standard electro-weak theory.

The Standard Electro-Weak Theory:

The Langrangian density in the unitary gauge, Feynman rules, elastic neutrino-electron scattering, electron-positron anhilation, the Higgs Boson.

Recommended Books:

1. Quantum field theory, Mandl and Shaw, John-Wiley & Sons, 1984.

PAPER-IV I
ASTRONOMY AND ASTROPHYSICS

UNIT-I

Astronomy and Astrophysics :

Basic parameters in Astronomical observations (Magnitude scale, Coordinate system), Stellar classification- H.R.D Diagram- Saha's equation, Jean's criteria for stellar formation, Stellar Evaluation- Galaxy Classification.

Cosmology: Cosmological models, observations, cosmic violence (in nucleus of the Galaxy), Cosmic background radiation, Elementary particles and cosmos, Big-Bang

Model inflationary Universe (flatness and horizontal problem), Relativistic and cosmic

Geometry of space – time and universe, Bios and cosmos (Genesis of life on the earth-solar System-comet-milky–way as an abode of life).

UNIT-II

Astronomical Instruments and Observation Techniques :

Telescopes- f/no-Plate Scale – Types of Telescopes-seeing Conditions, Diffraction

Limited Resolution – Photometer, Spectrometers (Interferometers, Gratings), Imaging

Detectors (MCPs, CCDs, and Ir Arrays) – High angular Resolution Techniques (Speckle, Lunar Occultation , adaptive optics).

UNIT-III

Optical and near IR studies of Stars and Galaxies :

Spectral Energy Distribution (in Optical and Bands) in Stars – Rotation of stars – Study of Binary Stars – Gaseous Nebulae – Extinction curve of Interstellar Matter, dust- Rotation, Curve of galaxies – Spectral Energy Distribution – Coloer –Color Studies (Imaging of Galaxies in Different bands)

UNIT-IV

High Energy astronomy

Atmospheric transmission- Detection Techniques for X–rays and Gamma–rays – X-ray

Telescopes- Imaging and Spectroscopy- Radiation Processes - Accretion Disks in Black Holes and X-rays Binaries- Active Galactic Nuclei.

Dark Matter : Evidences of dark matter- Dark matter components in our galaxy, in Halos of the spiral galaxy, in clusters of candidates in darkmatter. Baryonic and non-Baryonic candidates in darkmatter.

Star evolution : White and brown Dwarf – Neutron star –Super nova- pulsar- Black Holes.

UNIT-V

Multi wave – length detection techniques in Astronomy.

Radio Telescopes - Aperture System- IPS Technique – Very long Base Interferometry (VLBI)- Pulsars – Radio galaxies – Distribution of H1 gas in Galaxies – Radiation mechanism.

Black hole Observation (Gravitational lens – Schwarzschild radius –Singularity), X-rays and Gamma rays bursters through cosmic flux detection using photo – multipliers Tubes – Hubbles' law and Hubbles' constant (Red shift – distance - age of the Universe Measurements) – Galactic Structure – Rotation and spiral (Optical – radio – X–rays – Gamma radiation observation).

Text Books

J. D. Kraus, W.N. sen, J.A.Hoegbom, M.Kundu

M. Longair, J.K. Davis

K.D. Abhayakar, F. Shu, M. Harwit

C.R. Kitchin, I. McLean, G.Walker

PAPER-V : PRACTICAL-I
NUCLEAR PHYSICS PRACTICALS

Note:

1. Students are required to do at least ten experiments.
2. Students are required to give at least one seminar on experiments allotted to them.

LIST OF EXPERIMENTS

1 Study of absorption coefficient for gamma-rays

2. Determination of end point energy of alpha particles
3. Determination of the range and energy of alpha particles using spark counter.
4. Determination of end point energy of beta rays
5. Study of gamma-ray spectra using scintillation spectrometer (a) Calibrate a scintillation spectrometer (b) Measurement of unknown energy (c) Study of energy resolution.
6. Coincidence circuit (a) Determination of resolving time (b) Determi-nation of strength of Co-60 source.
7. To determine the operating voltage, slope of the plateau and dead time of a G.M. counter.
8. Determination of dead time of G.M counter system.

9. Study of G.M counter and random events.

10. Feather' analysis using G.M. counter.

11. Study of Proportional detector (a) Calibrate proportional counter system (b) Study of resolution

12. Study of X-ray Laue pattern of cubic crystals

13. Study of X-ray Debye Scherer Powder spectra of cubic materials.

14. To determine the operating voltage of a photomultiplier tube and to find the photopeak efficiency of Na (TI) crystal of a given dimensions for gamma rays of different energies.

15. To determine the energy resolution of a NaI (TI) detector and to show that it is independent of the gain of the amplifier.

16. To calibrate a gamma ray spectrometer and to determine the energy of a given gamma source.

17. To determine the mass attenuation coefficient of gamma rays in a given medium.

18. To study the Compton scattering using gamma rays of suitable energy.

19. To study the various modes in multichannel analyzer and to calculate the energy resolution, energy of gamma ray.

20. To determine the beta ray spectrum of Cs-137 source and to calculate the binding energy of K - shell electron of Cs-137.

21. To study Rutherford scattering using aluminium as scatterer and Am-241 as a source.

22. To measure the efficiency and energy resolution of HPGe detector.

23. Alpha spectroscopy with surface barrier detector-energy analysis of an unknown gamma source.

24. The proportional counter and low energy X-ray measurements.

25. X-ray fluorescence with a proportional counter, Neutron activation analysis.

26. Identification of particles by visual range in nuclear emulsion.

27. Construction and testing of a single channel analyzer circuit.

28. Decoding and display of the outputs from the IC-7490.

PAPER-VIA : PRACTICAL-II
CONDENSED MATTER PHYSICS

1 Students are required to do at least ten experiments.

2. Students are required to give at least one seminar on experiments allotted to them.

LIST OF EXPERIMENTS

1. Measurement of lattice parameters and indexing of powder patterns.
2. Determination of orientation of crystal by back reflection Laue method
3. To prepare and X-ray characterization of a compound/alloy
4. Determine Curie temperature of a ferromagnetic material
5. To determine magnetoresistance of a bismuth crystal
6. To grow and X-ray characterization of organic crystal
7. To prepare and study superconducting material
8. Study of Hall effect
9. Study of simulation of dispersion of phonons in simple systems

10. To study the thermal diffusivity of Teflon
11. Analysis of neutron diffraction data
12. Measurement of A.C susceptibility
13. Measurement of electrical conductivity
14. Study of any iron containing material by Mössbauer effect
15. Measurement of dielectric constant
16. Band Structure Calculations

PAPER-VI B (PRACTICAL-II)
NON-LINEAR PHYSICS AND CHAOS LAB

1. Students are required to do at least eight experiments.
2. Students are required to give at least one seminar on experiments allotted to them.

LIST OF EXPERIMENTS

1. Using a P.C., experimentally find the first four critical values for period doubling, in the logistic equation :

   $x_{n+1} = \lambda x_n(1-x_n)$

   Find the first two approximations to the Feigenbaum number.

2. A dynamical system that exhibits period doubling and chaos is the set of three first order differential equation (R ösler).

   $\dot{x} = -y-z, \quad \dot{y} = x+ay, \quad \dot{z} = b+z(x-c)$

   Choose b=2, c=4, and explore the parameter in the range $0.3 \leq a \leq 0.4$ and look for period doubling. For the case a=0.398, plot a return x_{n+1} vs x_n map. Compare with the logarithmic equations.

3. A return map, x_{n+1} shows a bilinear relationship.

   F (x)= a+bx x<1

   F (x) = c-dx x>1

   if b>o, d>o show that the Lyapunov exponent is positive when b,d>1. Sketch a few iterations of the map in the (x_{n+1}, x_n) plane.

4. A damped harmonic oscillator can be represented mathematically by the following differential equation and solution :

   $\ddot{x} + 2\gamma \dot{x} + x = 0$

   $x(t) = c_o e^{-2\gamma t} \text{Cos}\,\{(1-\gamma)^{½}\ t+\phi_o\}$

   Sketch the solution in the phase plane (x,y,=x). Define a poincare

   Section when x>0, y=0. Assume that r is small $(\gamma^2 << 1)$ and Show that the resulting map takes the form :

   $x_{n+1} = \lambda x_n$ and $\lambda < 1$

5. Investigate the properties of the cubic map

   $x_{n+1} = y_n \quad y_{n+1} = -bx_n + dy_n - y_n^3$

   Find the fixed points and determine their stability as function of The parameters b,d. Iterate this map for b = 0.2,· d = 2.5, 2.65, 2.77.

6. Investigate the fixed points and stability as a function of the control parameter of the cubic map:

   $x_{n+1} = \lambda x_n (1-x^2_n)$

7. Use P.C. to enumerate the critical values of in the logistic Equation:

   $x_{n+1} = \lambda x_n (1-x_n)$

   and show that the sequences of values λ_n and an and apporach the universal number :

$$\lim_{n \to \infty} \frac{\lambda_n - \lambda_{n-1}}{\lambda_{n+1} - \lambda_n} = \delta = 4.6692$$

$$\lim_{n \to \infty} \frac{a_n}{a_{n+1}} = 2.5$$

8. Another first–order iterated map that exhibits period doubling is the sine map

$$x_{n+1} = \lambda \sin (\pi x_n), \quad 0 \le x_n \le 1$$

Show that this map exhibits a period doubling sequence and verify that:

$$\lim_{n \to \infty} \frac{\lambda_n - \lambda_{n-1}}{\lambda_{n+1} - \lambda_n} = \delta = 4.6692$$

$$\lim_{n \to \infty} \frac{a_n}{a_{n+1}} = 2.5$$

PAPER-VI C : PRACTICAL–II COMMUNICATION ELECTRONICS AND AERONOMY PRACTICALS

1. Students are required to do at least eight experiments.
2. Students are required to give at least one seminar on experiments allotted to them.

LIST OF EXPERIMENTS

1. To study the Amplitude Modulated wave and detection of AM waves.
2. To study the Frequency Modulated Wave and its detection.
3. To study the Pulsed Coded Modulated and its detection.
4. To study the polar diagram of dipole antennae.
5. To find (a) frequency of a wave (b) standing wave ratio by Letcher Wire
6. Determination of apparent height of ionospheric E and F region.
7. Measurement of Solar UV-B and Infra red radiation and determination of Total Ozone, Water Vapour and Aerosols.
8. Study of characteristics of Klystron.
9. To study of characteristics of Radio Receiver.
10. Measurement of VHF Satellite Signal for ionospheric scintillation studies.

PAPER-VI D : PRACTICAL-II
INFORMATICS AND COMPUTER VISUALIZATION

1. Students are required to do at least eight experiments.
2. Students are required to give at least one seminar on experiments allotted to them.

Section-A : Computer Hardware and Networking

1. To study PCM-TDM, TDM-PAM
2. To study frequency modulation
3. To study sampling and Reconstruction (TDM-PAM)
4. To study delta modulation, adaptive delta modulation, sigma modulation and demodulation techniques
5. To study PSK, QPSK modulation Techniques
6. To study computer boards, cards, devices and RS 232, USB Interfacing,
7. To generate PAM Wave form
8. Optical Communication (Optical Fiber based Experiments)
9. Design and study of a structured network
10. Study of Router system
11. Configuration and study of Network Operating systems

Section-B : Computer Graphics and Visualization

1. Computer Programming using C++
2. Using Java Applets
3. Programming drawing lines, circles and ellipses using C++
4. Translation, rotation, filling, shearing of objects
5. Using MATLAB for Visualization

PROJECTS

Students are required to undertake project work on Computer Networking or Computer Graphics and Visualization.

PAPER-VIE : (PRACTICAL-II)
ADVANCED DIGITAL ELECTRONICS PRACTICALS

1. Students are required to do at least eight experiments.
2. Students are required to give at least one seminar on experiments allotted to them.

LIST OF EXPERIMENTS

Section-A (Laboratory experiments)

1. Design and study of BCD to seven segment decoder circuit and 4 & 16 decoder circuit
2. Design and study of 4 bit full adder
3. Design and study of 4 bit register with parallel load and design and study of 4 bit bidirectional shift register
4. Microprocessor programming using trainer kit and Machine coding
5. Assembly language programming using assembler for 8085
6. Interfacing Analog to Digital Converter with Microprocessor
7. EPROM Programming
8. Interfacing Memory with Microprocessor

9. Interfacing Display with Microprocessor
10. Study of decoder circuits for microprocessor

Section-B

Candidates are required to complete one project and submit it in the examination with a project report:

List of projects:

1. Temperature controller
2. 8 bit analog to digital converter
3. Microprocessor controlled display
4. Signal generator
5. Stepper motor controlling
6. Serial communication between Pc/XT and Microprocessor trainer
7. Digital Voltmeter
8. Digital frequency meter
9. Data Acquisition system
10. Digital IC tester

PAPER-VI F : (PRACTICAL-II)
X-RAY AND NUCLEAR SPECTROSCOPY PRACTICALS

1. Students are required to do at least eight experiments.
2. Students are required to give at least one seminar on experiments allotted to them.

LIST OF EXPERIMENTS

1. Study of X-ray Debye-Scherrer powder pattern of non-cubic crystals
2. X-ray diffraction powder pattern analysis
3. Study and analysis of Gamma-ray Scintillation spectra
4. Study of Mossbauer effect
5. Study of angular correlation of gamma-rays
6. Design and study of pulse shaping circuits
7. Design and study of photo multiplier tube voltage divider circuits
8. Design and study of voltage and charge sensitive preamplifiers
9. Design and study of decade counter circuits
10. Study of performance of an analog to Digital converter
11. Study and Analysis of semiconductor detector gamma spectra
12. Study and analysis of beta ray scintillation spectra
13. Study of life time of excited state of Ta-181.

PAPER-VI G (PRACTICAL–II)

ADVANCED SOLID STATE EXPERIMENTS

1. Students are required to do at least eight experiments.
2. Students are required to give at least one seminar on experiments allotted to them.

SECTION – A

(Students are required to do at least five experiments from this section).

1. X-ray diffraction studies of cubic and non – cubic crystals by Powder method.
2. Orienting single crystals with the help of X – ray diffraction.
3. Resistivity measurement of a material (compound) at different Temperatures using four probe method.
4. Preparation of a compound and a binary alloy and measuring its conductivity.
5. Study of a superconducting material – Resistivity at low temperature.
6. Determination of Curie temperature of a ferromagnetic material.
7. Mossbauer study of iron compound at room temperture.

SECTION-B
(COMPUTATIONAL)

Students are required to do at least five computational problems based On topics covered in the optional paper IV G.

PAPER–VI H (PRACTICAL–II)
QUANTUM FIELD THEORY

NOTE: Students who offer paper IV H as optional paper are required to offer Paper VIH

1. Students are required to do at least eight experiments.
2. Students are required to give at least one seminar on experiments allotted to them.

COMPUTATIONAL LAB

Students are required to learn one computer language and perform at least 10 computational problem based on the topic covered in the optional Paper IVH

PAPER-VII : PRATICAL-II
ASTRONOMY & ASTROPHYSICS LAB

1. Students are required to do at least eight experiments.
2. Students are required to give at least one seminar on experiments allotted to them.

LIST OF EXPERIMENTS

1. Detection of Secondary Cosmic radiation using ground based Scintillation counters.
2. Study of High- energy Cosmic flux bands.
3. Determination of Primary Cosmic flux energy from energy spectrum of Secondary cosmic radiation.
4. Study of image processing of Stellar objects using Charge Coupled Device (CCD) camera.
5. Experiment with a slit, prism, and sunlight to produce a spectrum to identify dark Lines of H, Ca, Fe and Na.
6. Study of well defined dark lines in continous spectrum of full Moon.

Mohanlal Sukhadia University
Udaipur (Raj.)

Syllabus

Scheme of Examination and Courses of Study

FACULTY OF SCIENCE

M.Sc. PHYSICS

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