Annexure – 7

PERIYAR UNIVERSITY
Salem – 636 011.

Periyar Institute of Distance Education (PRIDE)

M.Sc. BRANCH III (B)-PHYSICS

REGULATION AND SYLLABUS

(For the candidates admitted from 2007-2008 onwards)

PERIYAR UNIVERSITY, SALEM-636011

PERIYAR INSTITUTE OF DISTANCE EDUCATION (PRIDE)
M.Sc. BRANCH III (B)-PHYSICS

REGULATION AND SYLLABUS
(For the candidates admitted from 2007-2008 onwards)

01. OBJECTIVES OF THE COURSE

The recent developments in physical sciences, has been included in the enriched M.Sc., (Physics) Syllabus to meet out the present day needs of academic and Research, Institutions and Industries.

02.DURATION OF THE PROGRAMME

Two-years post-graduate program under non-semester pattern.

03. ELIGIBILITY

A candidate who has passed the B.Sc., Degree Examination in Branch III Physics Main or B.Sc., in Applied Physics or B.Sc., Physics-(Vocational) of this University or an examination of some other university accepted by the syndicate as equivalent thereto shall be permitted to appear and qualify for the M.Sc. Physics Degree Examination of this University after a course of two academic years.

04.COURSE OF STUDY

The course of study for the degree shall be in BRANCH III (B)-Physics under non-semester system without internal assessment according to a syllabus prescribed from time to time.

Total marks	-1000
For each paper	-100 Marks
Project	-100 Marks

05. STRUCTURE OF THE COURSE

S.No	Year	Paper Code	Title of the paper	Marks
1	I	Paper 1	Mathematical Physics	100
2		Paper 2	Classical and Statistical Mechanics	100
3		Paper 3	Electronics	100
4		Paper 4	Condensed matter Physics	100
5		Practical	Practical I General Experiments	100
6	II	Paper 5	Electro Magnetic Theory	100
7		Paper 6	Quantum mechanics	100
8		Paper 7	Spectroscopy	100
9		Practical	Practical II Electronics Experiments	100
10		Project	Project 75 and Viva 25	100
			Total Marks	1000

06. EXAMINATION

The theory examination shall be three hours duration to each paper at the end of each year. The candidates failing in each subject(s) will be permitted to appear for each failed subject(s) in the subsequent examination.

The practical examination for P.G. Course should be conducted at the end of each year.

07. QUESTION PAPER PATTERN

Question paper pattern for University Examinations

Time - 3 Hours

Maximum - 100 Marks

Passing Minimum - 50 Marks

Part – A (5x5=25 Marks) Part – B (5x15=75 Marks)

Answer all questions

(Either or Type)

08. PASSING MINIMUM

In order to pass a paper 50 % Minimum is compulsory

09. CLASSIFICATION OF SUCCESSFUL CANDIDATES

Candidates who obtain not less than 75 percent of the marks in the aggregate shall be deemed to have passed the examination in First class with Distinction provided they pass all the examinations prescribed for the course at the first appearance.

Candidate who secure not less than 60 percent of the aggregate marks in the whole examination shall be declared to have passed the examination in the First class provided they pass all the examinations prescribed for the course within the period of two academic years from the year of completion of the course.

Candidates who secure not less than 50 percent of the aggregate marks in the whole examination but below 60 percent shall be declared to have passed the examination in the second class provided they pass all the examinations prescribed for the course within a period of two academic years from the year completion of course.

Candidates who pass all the examinations prescribed for the course in the first appearance only are eligible for ranking.

10. COMMENCEMENTS OF THIS REGULATION

These regulation and syllabus shall take effect from the academic year 2007 – 2008, that is, for students who are admitted to the first year of the course during the academic year 2007-2008 and there after.

11. TRANSITORY PROVISION

Candidates who are admitted to the P.G. Course of study before 2007 – 2008 shall be permitted to appear for the examinations under those regulation for a period for three years i.e. up to and inclusive of the examination of April / May 2010. Thereafter they will be permitted to appear only under regulations then in force.

FIRST YEAR

MATHEMATICAL PHYSICS

PAPER 1

UNIT-I Vector space and Tensors

Vector Space-Definitions-Linear independence of Vector-Bilinear and quadratic forms-change of basis-Schmidt's orthogonalisation processes-Swartz inequality-Application of vectors to hydrodynamics the equation of flow in solids.

Tensors-N-dimensional space–superscripts-subscripts-coordinate transformations kronecker delta symbol-properties of kronecker generalized kronecker delta Tensors of higher ranks-Algebric operation of Tensors-symmetric and asymmetric Tensors-Application of Tensors-Dynamics of a particle-Elasticity-Rigid bodies

UNIT-II Fourier's and Laplace's integral transforms.

Fourier transform – properties of Fourier's transform-Fourier transform of a derivative- Fourier's Sine and cosine transform of a derivative-Finite Fourier transforms-Simple application of Fourier transforms-Laplace transforms- properties of Laplace transform-Laplace transforms of a derivative of a function- Laplace transforms of integral-Inverse Laplace transform- Properties of inverse Laplace transform –convolution theorem-Application of Laplace transform.

UNIT-III Complex variable

Function of complex variables-limit-continuity-Differentiability-Analytic function-Cauchy-Rieman condition-Differential equation-Cauchy Integral theorem – Cauchy Integral formula- Moreva's theorem – Liouville's theorem – Taylors series – Laurent's series – singularities of an analytical

function – Residues-Cauchy Residue theorem – Evaluation of definite integrals – contour integration.

UNIT – IV Special function and differential equations

Gamma and Beta functions-Liouville problem-solution for Bessel-Legendre-Lagure and Hermite differential equation-properties-Generating functions-Rodrigue's formula-orthogonal properties-recurrence relation

UNIT-V Dirac delta function and green's function

Direct-Delta function-Three dimensional delta function-Green's function – for one dimensional case-Symmetry properties of green function-Green's function for poisson equation-Quantum mechanical scattering problem.

Books for Reference:

1. L.A.Pipes and Henvil,Applied Mathematical for Engineers and Physics,International Students edition, McGraw Hill, Ltd, Singapore(1970)
2. E.Kreyszig, Advanced Engineers Mathematics, 8thedition, Wiley,NY(1999)
3. M.D.Greenbey, Advanced Engineering Mathematics, 2nd Edition, Printice-Hall International, NJ (1998).
4. Charlie Harper, Introduction to Mathematical Physics, Prince-Hall, India Pvt., Ltd. (1993)
5. Murray R.Spiegel, Theory and Problems of Laplace Transforms-Schaum's outline series, McGraw-Hill International Edition (1986)

Books for Study:

1. P.K.Chattopadhyay Mathematical Physics,Wiley Eastern Ltd,N.Delhi(1990)
2. B.D.Gupta,Mathematical Physics Vikar Publishing House Pvt.Ltd.(1995)
3. Sathyaprakash,Mathematical Physics,Sultan Chand & Sons,New Delhi(2004)

4. Puramik,Group theory and Molecular Vibrations, Sultan Chand New Delhi.
5. H.Anton, Elementary linear Algebra
6. A.K.Ghatak, I.G.Goyal and A.J.Chua, Mathematical Physics, Mc-Milan, New Delhi (1995).
7. S.S.Rajput, Mathematical Physics, Pragati Pragasam, Meerut,

CLASSICAL AND STATISTICAL MECHANICS

PAPER 2

A.CLASSICAL MECHANICS

UNIT – I

Elementary Principles – D'Alembert's principle – Lagrange's equation – Hamilton's equation – Lagrangian and Hamiltonian

Two body central Force Problem

Equations of motion and first integrals – Kepler's laws – scattering by a central potential – transformation from center of mass to laboratory frame.

Special relativity in classical mechanics

Relativistic Lagrangian and Hamiltonian for a particle – space, time and energy – momentum – four vectors – center of mass system for relativistic particles – invariance of Maxwell's equations.

UNIT II

Kinematics of Rotation

Orthogonal transformations – Euler poles – Rotating frames of reference and coriolis force

Mechanics of Rigid bodies

Angular momentum and kinetic energy – moment of inertia tensor – Euler's equations of motion – Torque free motion – Motion of a symmetric top under gravity.

UNIT III

Canonical Transformations

Canonical transformations and their generators – simple examples – poisson brackets

Hamilton Jacobi Theory

Hamilton – Jacobi equations – Action angle variables – Application to kepler problem

Small oscillations

Formulation of the problem – Transformation to normal coordinate – Linear triatomic molecule

B. STATISTICAL MECHANICS

UNIT IV

Classical Statistical Mechanics:

Postulates – Liouville's theorem – Micro canonical, canonical and grand canonical – examples – Partition function and entropy of ideal gas – Gibb's paradox.

Quantum Statistical Mechanics

Liouville's equation – Postulates of quantum statistical mechanics – Bose-Einstein, Fermi-Dirac distributions

UNIT V

Ideal Bose gas:

Equation of state – Bose-Einstein condensation – Landau's theory of liquid Helium II – Black body radiation – Phonons

Ideal Fermi gas

Equation of state – free electron gas in metals – heat capacity – Pauli's Para magnetism – Thermionic emission.

Books for Study:

1. Gupta & Kuma,Classical Mechanics, Tata Mc Graw Hill (2005) Edn
2. Satya Prakash, Classical Mechanics, Pragati Prakashan (2005)
3. Gupta & Kumar, Statistical Mechanics, Pragati Prakashan (2005)
4. B.K.Agarwal & M.Eisner, Statistical Mechanics, Wiley Eastern (1988)

Books for Reference:

1. H.Goldstein, Classical Mechanics, Narosa Publication (2001)
2. Landau & Lifshitz, Mechanics.
3. Landan & Lifshiltz, Statistical Mechanics.
4. K.Huang ,Thermal Physics.
5. J.L.Synge & B.A.Griffith, Principles of classical Mechanics.

ELECTRONICS

PAPER 3

UNIT – I

Operational amplifier and analog computation

Operational amplifiers –characteristics and parameters– Mathematical operations – logarithmic – antilog amplifiers – Analog multiplier and divider – solutions to simultaneous equations –differential equations, harmonic oscillator, damped harmonic oscillator, rocket launching.

UNIT – II

Wave form generators and Active filters

Sine wave oscillation with phase shift and wein's networks-Comparator-Schmitt Trigger-Astable and Monostable operations-Triangular wave generator.

Active filters-Butterworth filters design-Second order law-Low,High and Band pass filters-Band notch filter.

UNIT – III

Data Converters

Digital to analog Converters - Binary weighted – Resistor, DAC – R/2R ladder DAC – Successive approximation method –Single slope and Dual slope ADC-– counter type-Resolution, Accuracy and Linearity.

UNIT –IV

Memories and Measuring Instruments

Static shift register memory – Dynamic MOS shift register memory – CMOS shift register memory – Charge Coupled Device (CCD) – Practical CCD Memory – Content Addressable Memory (CAM) –Magnetic recording technique – magnetic tape – magnetic bubble memory – magnetic disk storage – floppy disk – Winchester disk – compact disk (CD) – digital audio CD – laser CD.

Q meter – Dual trace oscilloscope – sampling oscilloscope – analog recorders – XY recorders – Digital recorders – Digital displays – wave analyzers and spectrum analyzer – Digital voltmeter and multimeters – Electronic counters.

UNIT V:

Architecture of Microcontroller 8051

Introduction – comparison between microcontroller and microprocessors – architecture of 8051 – key features of 8051 – Memory organization – data memory and program memory – internal RAM organization – special

function registers – control registers – I/O ports – counters and timers – interrupt structure.

Programming the Microcontroller 8051

Instructions set of 8051 – arithmetic, logical, data move, jump and call instructions - addressing modes – immediate, register, direct and indirect addressing modes – assembly language programming – simple programs to illustrate arithmetic and logical operations (sum of numbers, biggest and smallest in an array) – software time delay.

Books for study:

1. Hand book of Electronics – Gupta & Kumar – Pragati Prakashan, New Delhi.
2. Electrical Measurements and Measuring instruments – Golding and Widdis – Wheeler Co – New Delhi 1986.
3. Linear Integrated Circuits – D. Roy Choudry, Shail Jain.
4. Electronic measurements and instrumentations – William Cooper – TMG Hill.
5. Kenneta J. Ayala,The 8051 Microcontroller, Penram International-India.
6. P.S.Manohara,P.S.Kannan, Microcontroller based system design, Scitech Publicationd Pvt. Ltd.

Books for Reference :

1. Electronic devices and Circuits – G.K. Mithal Khanna Publishers – New Delhi.
2. A Course in Electrical and Electronics Measurements and instrumentations – A.K Sawhney - Dhanpat rai & sons, New Delhi.
3. Integrated Circuits – K.R. Bothkar.
4. Integrated Electronics – Analog & Digital Circuits and Systems – Tata Mc Graw Hill – Jacob Millman & Christor. S.C. Halkias.
4. Operational amplifier – Gayakwad – TMG Hill
5. Rajkamal, Microcontroller Architecture, Programming interfacing and system design, Pearson edition

CONDENSED MATTER PHYSICS

PAPER 4

UNIT – I

Lattice Dynamics:

Monoatomic lattices – Brillouin zones – group and phase velocity – lattice with 2 atoms per primitive cell – quantization of lattice vibrations – phonon momentum – lattice heat capacity – Einstein's model and Debye's model of specific heat Thermal expansion and thermal conductivity – Unclapp processes.

Imperfections in Crystals

Point defects – lattices vacancies and interstitial atoms (Schottkey defect) – Frenkel defect – colour centers-F Centre – line defects – edge dislocation – screw dislocations – dislocations motion – strain due to dislocation motion – strain fields around dislocation – plane defects – grain boundaries dislocation.

UNIT – II

Transport phenomena and Band theory

Drude theory of metals – Hall effect – Fermi electron gas in 3D – Heat capacity – Non equilibrium distribution function – Boltzmann transport equation – electrical and thermal conduction – Wiedemann – Franz law – de Hass Van Alphen effect – oscillatory phenomenon and Landau levels.

Bloch's theorem – Kronig penny model – Brillouin zones – crystal momentum of an electron – wave function near zone boundary – Fermi surface – density states – electrical resistivity – band gap – equation of motion for an electron in an energy band – holes – effective mass – intrinsic and extrinsics carrier concentration – impurity conduction.

UNIT – III

Semiconductor Physics

Concept and importance of Fermi surface-Construction of two dimensional fermi surface-Crystal momentum and origin of effective mass-Experimental methods of Fermi surface studies-Quantization of orbits in a magnetic field.

Expression for position of Fermi levels and carrier concentrations-Variation of Fermi level with temperature- Carrier mobility, Conductivity and their variation with temperature-Direct and Indirect band gap semiconductors-Differences and examples-Hall effect continuity equation-Drift and Diffusion-Einstein relation-Generation, Recombination and life of non-equilibrium carriers-Heyness-Schockley experiment.

UNIT – IV

Ferro magnetism and Superconductivity:

Classification and properties of ferroelectrics – Spontaneous polarization –Ferroelectric domains – Thermo dynamics of Ferro Electric Transition – Classification – Weiss field theory – Temperature dependence of spontaneous magnetization – Heisenberg model – Exchange interaction – Exchange integral – Ferromagnetic domains – Magnetic bubbles – Bloch wall – Thickness and energy – Ferromagnetic spin waves – Quantization – Magnons – Dispersion relations – Ferrites – Structure.

Super Conductivity:

Thermodynamics of super conducting transitions – the London equations and penetration depth – Cooper pair – BCS theory – energy gap – Flux quantization – persistent currents – Ginsberg – Landau theory – Josephson tunneling – Josephson effects – SQUIDS.

UNIT – V

Crystal growth and Nano crystalline solids

Nucleation and growth – Homogeneous and heterogeneous nucleation – Classification of crystals growth techniques – Melt growth techniques – Bridgemann, Czechrolski, Liquid encapsulation Czochralski and Zone melting techniques – Necessity of characterization – Chemical analysis.

Definitions-Nano-Crystalline and non-crystalline Materials-General Methods of preparation of Nano structured metals, Alloys and semiconductors by Physical and chemical routes-Inert Gas condensation technique and Sol-Zel process- Quantum Wells, wires and Dots-density of states.

Books for Study and Reference:

1. C.Kittel-Introduction to Solid state Physics(John Wiley and Sons)
2. Neil.W.Ashcroft & N.David Mermin:Solid state Physics-International student Edition (Thomson)
3. Singhal-Solid state Physics Kedarnath Ramnath & Co., (2005)
4. Gupta & Saxeena-Solid state Physics, Pragati Praashan, 9th edition,(2004)
5. Buckl.W-Super Conductivity-fundamentals and applications.
6. Rose,A.C.Innes and Rhoderick, E.H.Introduction to superconductivity (Pergamon,Oxford,1976)
7. Subrahmanyam – High Temperature super conductors (Wiley Eastern)
8. Merlin D.M. – Magnetism in solids
9. Bates – L.F. – Magnetism

10. S.O. Pillai – Solid State Physics,New Age Publication, 2nd edition,(2001)
11. Omar – Solid State Physics,Pearson Education,Inc.,(2004)
12. Narlikar and Ekbote – Introduction to super conductivity
13. Solid state Physics,MacMilan……A.J.Dekker
14. Solid State Physics,Vikas Pub.House,1995……H.C.Gupta
15. Elementary Solid State Physics, Addison Wesley…M.Ali Omar
16. Introduction to Superconductivity, Pergamon……A.C.Rose Innes and E.H.Rhoderic

PRACTICAL – I

GENERAL EXPERIMENTS

(Any Ten experiments to be done)

1. Young's modules – Elliptical and Hyperbolic fringes
2. Stefan's constant
3. Coefficient of Linear expansion – Airwedge method.
4. B – H Loop using Anchor Ring
5. Susceptibility – Guoy and Quincke's methods
6. Hydrogen spectrum – Rydberg's constant
7. Solar spectrum – Rydberg's constant
8. F.P. Etalon
9. L.G Plate
10. Michelson's Interferometer
11. Arc Spectra Fe-Hg (or) Cu-Hg (or) Brass-Hg
12. Molecular spectra ALO band or CN band
13. Viscosity of liquid – Meyer's Disc
14. Solar constant
15. Ultrasonic interferometer - compressibility
16. Temperature coefficient of thermister
17. Semiconductor – Band gap energy
18. Hall effect - semiconductor
19. GM Counter
20. Laser experiments:
    i) Diffraction at straight edge
    ii) Interference – Lloyda single mirror method
    iii) Interference using optically plane glass plate and laser
    iv) Diffraction at a circular aperture
21. Experiments on optical fiber
22. Microwave test bench – Dielectric measurements of liquid / solid

Books for Reference:

1. D.Chattopathyay, P.C.Rakshit and B.Saha – An advanced course in practical physics, 6th Edn. (Books and allied, Kolkatta, 2002).
2. Chauhan and Singh, Advanced practical Physics, Chand & Co, New Delhi.

Second Year

ELECTROMAGNETIC THEORY

PAPER 5

UNIT-I

ELECTROSTATICS

Gauss Law –Poisson & Laplace equations- Solution of Laplace equation in spherical polar coordinate- conducting sphere-multipole expansion-Electrostatic energy-Dielectrics-Polarization and Displacement vectors-Boundary conditions-Dielectric sphere in a uniform field- Molecular polarisability and electric susceptibility-Electrostatic energy in dielectric medium- Clausius- Mossotti equation.

UNIT-II

MAGNETOSTATICS

Biot- Savart's law-divergence and curl of magnetic induction-magnetic vector potential-Ampere's circuital law-magnetic field of a localized current distribution-magnetic moment and force on a current distribution in an external field- magneto static energy-magnetic induction and magnetic field in macroscopic media-boundary conditions-uniformly magnetized sphere.

UNIT-III

ELECTROMAGNETICS

Faraday's law of induction-Maxwell's equation-Maxwell's displacement current-vector and scalar potential-Gauge transformation-Lorentz gauge-Coulomb gauge-Conservation laws for a system of changes-Poynting theorem.

UNIT-IV

WAVE PROPAGATION

Propagation of e.m wave in free space-non conducting medium-conducting medium-skin depth-reflection and transmission at dielectric boundaries-polarization-Guided waves-Wave guides-Propagation of waves

in a rectangular wave guide-inhomogeneous wave equation and retarded potentials-field and radiation due to an oscillating electric dipole.

UNIT-V

PLASMA PHYSICS

Plasma-Debye length-plasma oscillations-plasma behavior in a magnetic field-Boltzmann equation- magneto hydrodynamic equations-electron plasma oscillations-Debye shielding problem- plasma confinement in a magnetic field- pinch effect- magneto hydrodynamic waves- Alfven waves

Books for Study

1. David J Griffiths -Introduction to Electromagnetics- III Edition (2000)-Prantice Hall of India Pvt.Ltd.- New Delhi
2. J.D.Jackson-Classical Electrodynamics- III Edition (2000)-John Wiley
3. Paul Corson and Dale R.Corson -E Electromagnetic waves and fields- III Edition (2000)-CBS Publishers and Distributers, New Delhi
4. M.A.Wazed Miah-Fundamentals of Electromagnetics (1998)-TMC Publishing-New Delhi
5. B.B.Laud-Electromagnetics(2000)- Prantice Hall of India Pvt.Ltd.- New Delhi
6. N.Narayana Rao-Basic Electromagnetics with Applications (2002)-Prentice Hall of India Pvt.Ltd.- New Delhi

7. Umesh Sinha- Electromagnetic Theory and applications (2000)- Tech. India Publications, New Delhi

Books for Reference:

1.Edward C. Jordan and Keith G.Balmain-Electromagnetic waves and radiating systems- III Edition (2000)-Prantice Hall of India Pvt.Ltd.- New Delhi

2.John R.Reitz-Foundations of Electromagnetic Theory-VI Edition (2000)- Narosa Publishing House, New Delhi

QUANTUM MECHANICS

PAPER 6

Unit-1

Wave mechanical Concepts and formalism of quantum mechanics

Wave nature of particles – uncertainty principle-superposition-wave packet- time dependent Schrodinger equation- physical interpretation of wave function-Ehrenfest's theorem-time independent Schrodinger equation-admissibility conditions on the wave function. Postulates of quantum mechanics-simultaneous measurability of observables-Dirac notation momentum represtation.

Energy Eigen value problems: Square well potential –rigid and Finite walls - Potential barrier-α-paricle emission –Harmonic oscillator: Schrodinger and operator method. Three dimensional energy eigenvalue problems: particle in spherically symmetric potential- Hydrogen atom-hydrogenic orbital-square well potential-the Deutron.

Unit-2

Matrix formulation of quantum theory, identical particles and angular momentum

State vectors and functions-Hilbert space-Matrix theory of Harmonic oscillators-Schrodinger, Heissenberg and interaction pictures- coordinate and momentum representation-symmetry and conservation laws. Identical particles: symmetry and antisymmetric wave functions -spin and statistics - Pauli's exclusion principle-slater determinant-collision of identical particles.

Angular momentum operators-commutation relations-Eigen values and Eigen functions of L_2 and L_z –Eigen functions of J^2 and J_z – addition of angular momenta-Clebsch Gordan coefficients.

Unit -3

Time- independent perturbation theory and Approximation methods

Basic concepts-Nondegenerate energy levels-Anharmonic oscillator: First order correction-ground state of Helium- stark effect- Spin orbit interaction Zeeman effect.

Variation method: variational principle – excited states-Hellmann Feynman theorem-ground state of Helium- ground state of Deutron. WKB method- Connection formulas-validity of WKB method-barrier penetration.

Unit-4

Time – independent perturbation theory and Scattering

Time –independent perturbation theory : First order perturbation-Harmonic perturbation-transitions-Einsteins A & B coefficients - selection rules.

Scattering: scattering cross-section-scattering amplitude-partial waves-scattering by a central potential: Partial wave analysis-scattering by attractive square well potential-scattering length-phase shifts-Born approximation and its validity-Laboratory and centre of mass coordinate system.

Unit-5

Relativistic wave equations

Klein-Gordon equation and interpretation- Particle in a coulomb field-Dirac's equation for free particle-Dirac matrices and its covariant form–Probability density-Plane wave solution-negative energy states-spin of the

Dirac Particle –magnetic moment of the electron-spin orbit interaction - central potential-Hydrogen atom-lamb shift.

Books for study and reference

1. A Text book of Quantum Mechanics – P. M. Mathews and K. Venkatesan;
   Tata McGraw –Hill Publications
2. Quantum Mechanics – Satya Prakash; Kedar Nath Ram Nath and Co. Publications
3. Quantum Mechanics (5th Edition) – Theory and Applications by A. K. Ghatak and Lokanathan ; Macmillan India Ltd Publication.
4. Quantum Mechanics – Leonard I. Schiff ; McGraw-Hill International Publication.
5. Quantum Mechanics (2nd Edition)– V. K. Thankappan, New Age International (P) Ltd. Publication.
6. Quantum Mechanics (3nd Edition)- E. Merzbacher; John Wiley Interscience Publications.
7. Quantum Mechanics – G.Aruldhas, Printice Hall of India publications.

SPECTROSCOPY AND NUCLERAR PHYSICS

PAPER: 7

A.Spectroscopy

UNIT-I

Vibrational Spectroscopy

Symmetry of polyatomic molecules and molecular vibrations-Group theory and Selection Rules for Raman and IR vibrational normal modes-Calculation of normal modes for Raman and IR activity to C_{2v} and C_{3v} point groups – Representations for molecular vibrations-Internal and symmetry coordinates-Calculation of F-G matrix-Normal coordinate analysis for XY_2 bent symmetrical type molecule.

IR- SPECTROSCOPY

Principle and theory of Infrared spectroscopy-Far IR and Near IR absorption spectroscopy-Mid IR. FT-IR spectroscopy-Vibrational frequencies and qualitative analysis – sampling methods – Instrumentation - Applications

RAMAN SPECTROSCOPY

FT Raman spectroscopy – degree of depolarization – structure determination using IR and Raman spectroscopy – Resonance Raman spectroscopy – Coherent anti – Stokes Raman spectroscopy .

UNIT-II

NMR and ESR Spectroscopy

Basic principles of interaction of spin and applied magnetic field – concept of NMR spectroscopy – high resolution continuous wave NMR spectrometer – advantage of FT-NMR – Chemical shift – simple application to structural determination – first order and second order spectrum – double resonance and spin tickling

Origin of electron spin resonance – design of ESR spectrometer – hyper fine structure study – ESR study of anisotropic systems – Triplet states study of ESR – application of ESR to crystal defects and biological studies

UNIT-III

NQR and Mossbauer spectroscopy

Principles of NQR – Energy levels of quadrupole transistions for half integral spins – design of NQR spectrometer – application of NQR to chemical bonding and molecular structures

Principle of Mossbauer effect – schematic arrangements of Mossbauer spectrometer – isomer shift – quadrupole interaction – magnetic hyperfine interactions-applications to molecular and electronic structures.

B.Nuclear Physics

UNIT IV

Nuclear Reactions and Scattering Process:

Bohr Wheeler's theory of nuclear fission – Fission reactors –power and breeder type reactor – Nuclear fusion – Basic fusion process – Solar fusion – cold fusion – controlled thermonuclear reactions Energetics of reactions – Q equation – level widths in nuclear reaction – Nuclear reaction cross section .

The scattering cross section – scattering amplitude – Expression in terms of Green's function – Born approximation and its validity – Screened coulomb potential – Alpha particles scattering – Rutherford formula.

UNIT V

Elementary Particles: Four types of interactions and classifications of elementary particles – isospin – isospin quantum numbers – Strangeness and Hyper charge – Hadrons Baryons – Leptons – Invariance principles and symmetries – Invariance under charge – parity (CP), Time (T), and CPT – CPT violation in neutral K meson decay – Quark model SU (3) symmetry – Gellmann – Nishijama formula – Gauge theory of weak and strong interactions – charm, bottom and top quarks.

Books for Study

1. D.N.Sathyanarayana- Vibrational Spectroscopy and Application (2004)-New Age International Publication
2. G.Aruldas – Molecular Structure and Spectroscopy (2001) – Prentice Hall of India Pvt. Ltd – New Delhi
3. C.N.Banwell, Fundamentals of Molecular Spectroscopy. Tata Mc Graw Hill (1972)
1. R.R. Roy and B.P. Nigam, Nuclear Physics. New Age International, New Delhi (2005)
2. B.L.Cohen, concepts of Nuclear Physics, Tata McGraw Hill, New Delhi (1983)
3. H. Semat, Introduction to atomic and Nuclear Physics, Chapman and Hall, New Delhi (1983)

Books for Reference

1. B.P.Straughan and Walkar, Spectroscopy Vol.1,Chapman and Hall (1976)
2. B.P.Straughan and Walkar, Spectroscopy Vol.2,Chapman and Hall (1976)
3. Atta-Ur-Rahman, Nuclear Magnetic Resource, Springer Verlag (1986)
4. H.S.Randhava, Modern molecular spectroscopy, McMilan India Ltd., (2003)

5. Raymond Chang, Basic Principles of spectroscopy, Mr Graw Hill Koyakusha Ltd., (1980)
6. D.A.Long Raman Spectroscopy, Mc Graw Hill – International
7. G.Herzberg, Basic Principles of spectroscopy.
8. H.A. Enge, Introduction to Nuclear Physics, Addision Wesley, New York (1971)
9. W.S.C Williams, Nuclear and Particles Physics, Clarendon Press, London (1981)

Practical II

Advanced Electronics and Micro controller Experiments

Advanced Electronics Experiments (Any five experiments to be done)

1. FET characteristics and Design of FET amplifier
2. UJT characteristics and Design of Saw tooth wave oscillator
3. Design of square wave generator using IC 741 and Timer 555 ICs – 555 IC as VCO.
4. Design of Monostable multivibrator using the IC s 741 and 555 timer- study of frequency divider.
5. Design of schmidt's Trigger using the ICs 741 and 555 timer – squarer
6. Analog computer circuit design – solving the simultaneous equations.
7. Design of second order Butterworth active filter circuits – Low pass, High pass and Multiple feed back band pass filters
8. Binary addition and subtraction – 7483 IC
9. Counters and shift registers – 7476/7473 IC

10. BCD counter – Decoding and Display
11. Design of binary weighted and R/2R Ladder DAC using the IC 741
12. Construction of ADC using DAC, comparator and counter

Micro Controller Experiments (Any five experiments):

1. Interfacing of ADC 0809
2. Interfacing of LED – study of counters
3. Interfacing of seven segment display – Display of Alphanumeric character
4. Stepper motor interfacing
5. Traffic light controller
6. Hex – key board interface
7. Programmable counter / Interval Timer – 8253 Experiments.
8. Temperature Controller

9. Microcontroller based experiments

i) Arithmetic operations

ii) Array operations

iii) Code conversion

(Option 18 compulsory)

Project and Viva Voce

At the end of second year practical examinations project viva voice examinations will be held

Project: 75 Marks, Viva voce: 25 Marks , Total: 100