M Phil Syllabus

S. No	*Code*	*Course Name*	*Type*	*Credits*	*Page*
1	*PHYS-601	Research Methodology	HC	4	
2	*PHYS-602	Advanced Condensed Matter Physics	HC	4	
3	PHYS603	Laser Spectroscopy and its Applications	SC	3	
4	PHYS-604	Magnetism and Magnetic Materials	SC	3	
5	PHYS-605	Fiber Optics Communication	SC	3	
6	PHYS-606	Advanced Computational Physics	SC	3	
7	PHYS-607	Magnetic Nano-particle	SC	3	
8	PHYS-608	Quantum Optics and Quantum Information Processing	SC	3	
9	PHYS-609	Solid State Spectroscopy	SC	3	
10	PHYS-610	Ion Beams in nanotechnology	SC	3	
11	PHYS-611	Nonlinear Science: Solitons and Chaos	SC	3	
12	PHYS-612	Semiconductor :Laser Physics	SC	3	
13	PHYS-613	Acoustic, Dielectric Techniques and its Applications to Solutions	SC	3	
14	PHYS-614	Biophysics	SC	3	
15	PHYS-615	Solid State Ionics	SC	3	
17	*PHYS-650	M Phil Project Dissertation	HC	15	
18	*PHYS-651	Viva Voce	HC	3	

* Compulsory Subjects

D E P A R T M E N T O F P H Y I C S
P O N D I C H E R R Y U N I V E R S I T Y

Phys 601 Research Methodology

Unit I: (10 Lectures)

Representing numbers in a computer – machine precision – errors and approximations – concept of computer language – Fortran language syntax – Matlab syntax – Mathematica syntax – flow chart.

Unit II: (10 Lectures)

Matrices and linear system of equations – Gauss-Jordan elimination method – Gauss method to compute the Inverse – LU decomposition – Cholesky decomposition – QR decomposition, Gauss-Seidel iterative method – eigen values and eigen vectors of a real symmetric matrix by Jacobi's method.

Unit III: (5 Lectures)

Numerical differentiation and integration – trapezoidal rule – Simpson' rule – Gaussian quadrature formula.

Unit IV: (10 Lectures)

Numerical solution of ordinary differential equations solution by Taylor's series – Euler's method – Runge Kutta method with Runge's coefficients. Numerical solution of partial differential equations using finite difference method.

Unit V: (10 Lectures)

Random number generator – Importance sampling – Metropolis algorithm – Monte Carlo simulation.

Unit VI: (5 Lectures)

Curve fitting – evaluation of linear parameters – weighter least square fitting – Binomial, poission, Normal distribution, X^2 and goodness of fit-student – distribution.

Unit VII: (5 Lectures)

Preparation of technical papers and thesis writing – art of writing of scientific article – writing a thesis – presentation of data – symbols – the observations – tables and figures – equations – the style – sentence length – word length – page and chapter format – referencing.

Text Books For Mehtodology:

01	A hand book of methodology of Research	Rajammal P.Devadas and K.Kulandaivel	Sri Ramakrishnan Mission Vidyalaya Press, Coimbatore.
02	Thesis and Assignment writing.	Jonathan Anderson et al.	
03	Writing a technical paper.	Donald H. Manzel et al.	
04	Research – How to plan,speak and write about it.	C.Hawkins and M..sorgi.	Narosa.

Text Books NMCP:

01	Applied Numerical methods for the micro computer.	Terry E. Shoup.	Prentice Hall Inc., Englewood Cliffs,New Jeney 07632 (1984).
02	Introduction to Numerical methods and Fortran programming.	Mc Calla, Thomas R.	John wiley & sons, Inc.N.York 1967.
03	A First course in Numerical Analysis.	Rabston, Anthony.	Mc Gow Mill Co., New York 1965.
04	Software for Numerical Methods.	Evous, D.J.	Academic Press Inc. New York, 1974.
05	Numerical Analysis and algorithm	E.V. Krishnamurthy.	Wiley Eastern ,1982.
06	Introduction methods of Numerical analysis.	S.S.Sastry.	Prentice Hall of India P. Ltd.,797,1977.
07	Numerical analysis for Scientists & Engineers.	Jain, M.K.	SBW Publishers, Delhi 1971.

08	Numerical methods in Fortran.	John M. Mc Cormick and Marico G.Salvadori.,	Prentice – Hall., 1987.

References:

01	Numerical analysis.	Hartree D.R.	Oxford Main Press,London,1952.
02	Numerical Mathematical Analysis.	Scarbourogh J.B.	John University Press. Baltmure,1950.
03	Numerical Solution of Partial.	Smith. G.D.	Oxford university Press,London,1965.
04	Introduction to applied numerical analysis.	R.W.Hamming.	Mc Grow Mill Book Co., 1971.
05	Ordinary Differential Equations – A computational Approach.	C.E.Roberts J.	Prentice Mall Iue. 1979.

Phys 602 Advanced Condensed Matter Physics

Crystal symmetry and physical properties, Point and space group, Introduction to magnetic space groups Tensors representating of physical properties e.g. stress, strain, piezo electricity, elasticity Dielectric tensor – non –linear optical coefficients Electro optic and photo elastic tensors. Second order effects in general.

Crystal binding:

Formation of solids – types of bonding – cohesive energy vanderwaal forces – Madelung energy.

Defects Solid State:

Thermo dynamics of point defects, Influence of defects on physical properties, Conductivity,diffusion,Application of defect solid state.

Optical Properties of solids:

Photo absorption process in solids - Interbond absorption phonon - phonon interactions – photo emission process – Phosphorescence – Thermo luminescence – colour centers – excitons.

Super conductivity:

Super conductivity of metals and alloys – phenomenogical theory of super conductivity, BCS theory - Josephson junctions – High T_c oxides superconductors – Materials preparation – Characterization – Applications – Present status.

Liquid Crystals:

Liquid crystalline State – Example of lytrophic and thermotrophic mesophases – Smetic, Nematic and Isotropic transitions – Cholestyral liquid crystal – order parameter – Maier – Saupe theory – applications of liquid crystals.

References:

01	Symmetry and its Applications in Science	Boardman A. D., O'Conner D. E. and Young D. A.	London McGraw Hill 1973
02	Introduction to Crystallography	Philips	ELBS Publication
03	Physical Properties of Crystals [Their representation by tensors and matrices]	J. F. Ney	Clarendon Press Oxford
04	Introduction to Solids	Leonid V. Azaloff	Tata McGraw Hill Publishing Company
05	Introduction to Solid State Physics	C. Kittel	Wiley Eastern University Edition
06	Liquid crystals	S.Chandrasekar	Cambridge Univ.

(PHYS 604) MAGNETISM AND MAGNETIC MATERIALS

Unit I: Theoretical Background:

(i) Fundamentals:

Concept of magnetic moments- magnetic orderings- phase transitions- magnetic susceptibility- magnetization- co-ercive field and remanance

(ii) Disordered magnetics:

Basic relations characterizing the behaviour of a substance in magnetic field- tensors of diamagnetic and paramagnetic susceptibility- classification of magnetic substances- diamagnetism- paramagnetism.- paramagnetism.

(iii) Ordered magnetics:

Different types of magnetic structures in crystals- ferromagnetism, antiferromagnetism and ferromagnetism- magnetic symmetry- basic type of interaction in ordered magnetics- molecular field theory- the Curie and Neel points. Domain structure of ferromagnetic crystals and magnetization processes.

(iv) Anisotropy of ferromagnetic crystals:

Peculiarities of the description of ferromagnetic crystals- magnetostriction anisotropy in ferromagnetic of different symmetry - magnetic anisotropy energy corresponding to zero strains zero stresses -equilibrium directions of spontaneous magnetization- magnetic anisotropy measurement.

(v) Magneto-elastic effect

Unit II: Materials of interest

Soft magnetic materials- hard magnetic materials- thin films- ferrites- weakly ferrimagnetic crystals (canted antiferromagnetics)- reorientation transition- layered magnetic thin films- multilayer- DMS,GMR,CMR (Nano particle)

Unit III: Synthesis mechanisms

Preparation of materials for magnetic study- composition- chemical reaction- Kinetics of reaction- Hume Rothery rule- phase transformation – Solid solutions-n Vegards law- magnetic phase transition- laboratory techniques- chemical identification to conduct chemical reaction- sample preparation for different studies- ceramic method- furnace operation- temperature control- pellet preparation – Sol-Gel , Co-precipitation- ball milling.

Unit IV: Characterization

Particle size density- porosity- lattice constant using X-ray-Mossbauer spectroscopy, NMR, FMR, MOKE, MCD, - Hall Effect field measurement - VSM (Low and high field magnetic field and temperature).

UnitV: Latest developments and applications

Essentials of crystal field theory- exposure to Ligand field theory- Magnetic sensors- Magnetic multi layer- Magnetic recording media- Stoners model- Andersons model explaining electrical conduction of ferrites (Localized bands) - Neutron scattering -Manganite

Books:

1. MAGNETISM Principles And Applications- DEREK CRAIK , John Wiley & Sons LTD- 1995
2. Ferrite Materials- Science and Technology – B.Viswanathan, VRK Murthy, Narosa Publishing house 1990
3. Modern Crystallography - L.A.Shuvalov Springer Verlag, Berlin Helidelberg New York 1981
4. Fundamentals of Solid State Physics - B.S.Saxena, P.N.Saxena, R.C.Gupta, Pragati Pragasam Meerut 18th edition 2000

REFERNCES

1. Ruderman M.A, and Kittel C, Phys.Rev, 96(1954)99
2. Blasses G, J.Phys. Chem. Solids, 27(1966)383
3. Becker J.J, J.Appl. Phys, 41(1970)1055
4. Traves D, J.Appl. Phys, 36(1965)1035

PHYS-605 FIBRE OPTICS COMMUNICATIONS

LINEAR AND NONLINEAR WAVES:
Simple pendulum-Small and large oscillations-Duffing oscillator-Dissipative effects-Physical applications-Solitons-Methods to solve solitons -Soliton equations (K-dV, mK-dV, Sine-Gordon and nonlinear Schrodinger equation).

(9)

MAXWELL EQUATIONS AND WAVEGUIDES:
Maxwell equations-Refractive index-Frequency and intensity dependence of polarisation-Dielectric susceptibility-First order and higher order susceptibilities – Wave equation – Wave propagation in a conducting and anisotropic media .

(9)

OPTICAL FIBRES:
Fiber materials-Glass fibres-Plastic clad glass fibre-Plastic fibres-Fibre fabrication-Outside vapour phase oxidation-Vapour phase axial deposition-Modified chemical vapour deposition -Optical losses-Dispersion –Model birefringence.

(9)

NONLINEAR EFFECTS IN FIBRE:
Self phase modulation(SPM) – Cross phase modulation(XPM) – Self steepening and focusing effects – Nonlinear retarded effects (SRS & SBS) – optical and spatial Solitons – Mathematical modeling – Wave length and time division multiplexing-Femtosecond solitons- SIT solitons(basic ideas).

(9)

SOLITONS IN OPTICAL COMMUNICATIONS:
Generation and transmission of optical Solitons – Soliton Switching – Soliton reshaping – Pulse amplification and compression– Modulation instability – Dark Solitons.

(9)

TOTAL : 45

BOOKS FOR STUDY AND REFERENCE

1.*Optical fibre communication*- G.Keiser, McGraw-Hill Series, 2nd Edition,1983

2.*Solitons: An Introduction* – P.G.Drazin and R.S.Johnson, Cambridge University Press 1989.

3.*Nonlinear Fibre Optics* – G.P.Agrawal, Academic Press, 1995

4.*Solitons in Optical Communications* –A.Hasegawa and Y.Kodama, Oxford Press,1995.

5. *Waves called Solitons: Concepts and Experiments*- M. Remoisenet – Springer Verlag, 1992

Proposed M.Phil. guide paper syllabus (2007) by. Dr. R.N. Bhowmik

Topic: Magnetic Nanoparticle

Code: Physics-625

Section I: Classification of magnetic materials (Diamagnet, Paramagnet, Ferromagnet, Antiferromagnet and Ferrimagnet). Basic concepts of spontaneous magnetization, Curie Temperature, Saturation magnetization and Neel Temperature. Origin of various kinds of magnetic anisotropies. Domain theory and its application in magnetic hysteresis. Single domain particle, multi-domain particle, and nanoparticle.

Section II. Various techniques for nanomaterials synthesis (specially, chemical route and mechanical milling/alloying route) and their aspects. Understanding of nanomaterials of various dimensions. Possible applications of magnetic nanoparticles.

Section III. Proposed models for magnetic nanoparticles and applications. Variation of magnetic parameters (e.g. Particle Magnetization, particle anisotropy, magnetic ordering temperature) with particle size. Inter-particle interactions and surface magnetism.

Section IV. Special topics (preliminary idea): Superparamagnetism, Collective magnetic Oscillation, Exchange bias effect, Magnetic Quantum Tunneling effect, Magneto- resistance and magnetic nanoparticle.

PHYS 608

QUANTUM OPTICS & QUANTUM INFORMATION PROCESSING

UNIT : 1 Quantum theory of radiation; Quantization of free electromagnetic field; Fock states, Lamb shifts, Quantum beats, coherent & squeezed states of the field, Quantum distribution theory & partially coherent radition (Q-representation and Wigner- Weyle distribution)

UNIT : 2 Field- Field and Photon – Photon interferometry, First & second order Coherence; photon detection & quantum coherence functions. Photon counting & Photon statistics; Classical & Quantum description of TWO source interference, Atom-field interaction- Semiclassical & Quantum theory.

UNIT : 3 Laser without inversion & other effects of atomic coherence &interference Resonance flurescence Quantum theory of laser- density operator approach and Heisenberg- Langevein approach Theory of microMasers. Atom optics.

UNIT : 4 EPR paradox; hidden variable & Bell’s theorem; Quantum calculation of the correlation in Bell’s theorem; Bell’s theorem without inequalities (GHZ equality). Quantum Cryptography (Bennett- Brossard protocol) Qantum Non demolition measurement.

UNIT : 5 Quantum circuits; Quantum search algorithm, Quantum Computers- Physical realization, Condition for quantum computation, Different implementation schemes for quantum computation; Quantum information theory (Distinguishing Quantum states, Data compression, Classical& Quantum information & noisy Quantum channels), Entanglement as physical resonance, Quantum key distribution and security of quantum key distribution.

Book:

1. Quantum optics by M.O.Scully & M.Suhail Zubairy
2. Quantum Computation & Quantum Information by M A Nielsen & I L Chuang
3. The Quantum theory of light by Rodney Loudon

DEPARTMENT OF PHYSICS
PONDICHERRY UNIVERSITY

Phys 609 Solid State Spectroscopy [4 credits – HC]

1. Atomic Spectroscopy - Free Ion

The Free-ion; free ion terms for d^2 and f^2 configuration; Spin-orbit Coupling; Energy level states for d^2 and f^2 configuration; Ground states for f^N configuration; Rare-earth free-ions; Coloumb and Spin-orbit energies - Intermediate coupling. [Chapter III of Figgis and Chapter II of Hufner]

2. Ligand Field - Introduction

The concept of ligand field; The scope of ligand field theory; The Physical properties affected by ligand fields; Ligand fields and f electron systems; The magnetic properties of actinide element compounds. [Chapter I and Chapter XIII of Figgis]

3. Group Theory

Sketch of Group theory; Kramer's degeneracy ; Crystal field splitting - D_{3h} symmetry; Product of two representations - Selection rules; Examples of selection rules - D_{3h} symmetry; Applications of theoretical results to the analysis of experimental data. [Chapter III of Hufner].

4. Optical Spectra of Rare Earth Ions

Judd-Ofelt theory for the parametrization of intensities; Radiative properties; Upconversions in rare earths; Luminescent properties of Eu^{3+} and Tb^{3+} ions. [Chapter III of Hufner].

5. Trivalent Rare Earth Ions in Crystal Field

Introduction; Parametrization of crystal field splittings; The spin Hamiltonian; Examples of crystal field parametrization; Model description of the crystal field. [Chapter III of Hufner]

6. Rare Earth Lasers

Introduction; Principles of laser action; Typical rare earth lasers; Nd:YAG and Nd:glass lasers; Energy level scheme of the Nd in YAG [Chapter XI of Hufner]

7. Optical Instruments and Spectral Analyses

Spectrographs and Spectrophotometers for UV, VIS and IR regions; Absorption and Emission spectra; Temperature dependent spectra; Axial, Sigma and Pi polarization spectral measurements.

Text Books for References

1.Introduction to Ligand Fields by B.N.Figgis, Wiley Eastern Limited, New Delhi (1976).
2.Optical Spectra of Transparent Rare Earth Compounds by S.Hufner, Academic Press, London (1978).

PHYS 610: ION BEAMS IN NANOTECHNOLOGY

Unit – I: Introduction: Effect of size on material properties, Quantum size effect and density of states, low dimensional systems and their applications. Introduction to microscopy: SEM, STM, AFM, TEM and their application in nanotechnology.

(12 hours)

Unit – II: Ion – Solid interactions: Stopping and range of ions in solids, elastic collisions and kinematics, swift heavy ions, Coulomb explosion and thermal spike models, Nanotrack formation and its applications in nano technology.

(10 hours)

Unit – III: Ion beam techniques: RBS, ERDA, NRA and PIXE, Ion channeling, defect analysis, lattice location and lattice strain measurements, Quantum well intermixing and band-gap tuning.

(12 hours)

Unit – IV: Ion beams in nano-technology: Ion irradiation of surfaces, surface roughness, formation of nanopores, hillocks and self assembled nanodots, embided nanoparticles and their applications in optoelectronics, Focused ion beams, nano-scale fabrication, ion beam milling and nanolithography.

(14 hours)

Books: “Fundamentals of nanoscale film analysis” , T. L. Alford, L.C. Feldman and J. W. Mayer, Springer USA, 2007.

Handbook of nano-structured materials and nanotechnology”, Ed. H.S. Nalwa, Acad. Press, CA, 2000.

PHYS-611 NONLINEAR SCIENCE : SOLITONS AND CHAOS

1. **GENERAL**: Linear waves-ordinary differential equations(ODEs)-Partial differential equations(PDEs)- Methods to solve ODEs and PDEs.- Numerial methods –applications-Nonlinear oscillators-Nonlinear waves-Nonlinear ODEs-Nonlinear PDEs.

2. **COHERENT STRUCTURES** : Solitons - Generation soliton equations – AKNS Method, Backlund transformation, Hirota bilinearization method, Painleve analysis.

3. **SOLITONS IN PHYSICAL SYSTEMS** : Derivation of Korteweg-de-Vries(K-dV) equation, Modified K-dv equation, Nonlinear Schrodinger equation and Burger's equation – Physical significance.

4. **CHAOS IN PHYSICAL SYSTEMS**: Classical chaos - phase space - fixed point analysis - Hamiltonian theory - period doubling phenomena-Fractals – Pattern formation - Duffing oscillator- Nonlinear oscillator – Standard map - integrable mapping- Non integrable mappings Kepler's problem - order and chaos – Simple applications of chaos in physical systems - Quantum chaos-Applications.

5. **APPLICATIONS:** Nonlinear optics-Fluid dynamics-Magnetic systems-Liquid crystals-Biomolecules- Medical physics-Plasma and Astro physics-Electronic circuits-Optical communications.

References:

1. M.Lakshmanan (Ed.,) Introduction to Solitons, Springer-Verlag, 1988.

2. M.J.Ablowitz and H.Segur, *Solitons and Inverse Scattering Trasform*, Philadelphia(1981).

3. P.G.Drazin and R.S.Johnson, *Solitons : An Introduction*, Cambridge University Press,1989.

4. A.J. Licthenberg and M.A. Lieberman *Regular and Stochastic Motion*, Spinger Verlag, Berlin (1983)

5. J.M.T Thompson and H.B. Stewart, *Nonlinear Dynamics and Chaos*, John Wiley and Sons,1989.

6. A.S. Davydov, *Solitons in Molecular Systems*, 2ed.,Kluwer Academic Publishers.

7. A.Hasegawa and Y.Kodama, *Solitons in Optical Communications,* Oxford Press, 1995.

PHYS SEMICONDUCTOR LASER PHYSICS

Unit 1, Essential Semiconductor Physics
Band theory, doping, heavy doping, recombination and generation of photons, non-equilibrium carrier statistics. Refractive index of a semiconductor laser cavity.

Unit -2, Laser Fundamentals
Population inversion in semiconductors, p-n homo junction laser and its output characteristics, active region and threshold current, optical properties of the junction, gain in semiconductors.

Unit – 3, Double Hetero Structure
Materials and growth techniques – brief outlook, electronic properties of hetero-junctions, optical properties of hetero-junctions, lateral mode control.
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Unit – 4, Quantum Wells
Semiconductor quantum wells, density of states in 2-D systems, optical transitions, gain, strained quantum wells, optical and electrical confinement.

Unit – 5, Diode Laser Modelling
Rate equations of idealised diode laser, gain compression, small signal rate equations, real laser diodes: InGaAsP/InP quantum well lasers, three level rate equation models for quantum well SCH lasers.

Books :

Diode Lasers, *D. Sands*, Institute of Physics, UK (2005).
Diode lasers and photonic intergrated circuits, *L. A. Coldren and S. W. Corzine*, John Wiley & Sons, Inc., 1995.
Semiconductor lasers – Part – I., (Fundamentals), Ed., *Eli Kapon*, Academic Press, 1999.

D E P A R T M E N T O F P H Y S I C S
P O N D I C H E R R Y U N I V E R S I T Y

Phys 614 Biophysics
[4 credits – HC]

Unit I: Life and Its Physical Basis (10 Lectures)

What is life? – Life and energy – Forces and energies at nanometer scales – Intermolecular interactions and electrostatic screening – Chemical bonding and stability of molecules – Chemical composition of living systems.

Unit II: Thermodynamic basis of life (10 Lectures)

Heat, temperature, chemical equilibrium, Boltzmann distribution – Energy type and the second law of thermodynamics – Brownian motion – Chemical kinetics and catalysis – Metabolism in animals and photosynthesis in plants.

Unit III: The Cell (15 Lectures)

The cell as a basic unit of life's organization – The components: membranes, cytoskeleton, organelles – The central role of macromolecules: proteins, nucleic acid, carbohydrates – Surface tension and mechanical properties of cell membranes – The cell interior as a tough neighborhood: Brownian motion and viscosity and their influence on particle motion in the cell – Basic structure of prokaryotic and eukaryotic cells, mitochondria and the generation of ATP – Energy and information flow in the cell.

Unit IV: Proteins: Structure and Function (10 Lectures)

From linear polymer to functioning molecular machine: the role of weak interactions – The structural organization within proteins: primary, secondary, tertiary, and quaternary levels of organization – Varieties of proteins: globular and fibrous – The stability of proteins as measured by free energy and denaturation – Motions within proteins – how enzymes work – Proteins as binding machines: measurement of binding and thermodynamic analysis.

Unit V: Nucleic Acid and Genetic Information (10 Lectures)

Deciphering the genetic code – Why a double helix – How structure stores information – The replication process – From DNA to RNA to protein – How DNA is packed in the cell nucleus.

Text Books & References:

01	Biophysics: An Introduction	Rodney M. J. Cotterill	John Wiley & Sons Canada, Ltd., 2002
02	Biophysics	Rolland Glaser	Springer Verlag, Heidelberg, 2001
03	Newton rules biology : a physical approach to biological problems	C.J. Pennycuick	1992
04	Basic biophysics for biology	Edward K. Yeargers	1992
05	Energy flow in biology; biological organization as a problem in thermal physics	Harold J. Morowitz	
06	Introduction to environmental biophysics	Gaylon S. Campbell, John M. Norman	1998

M.PHIL DEGREE EXAMINATION- PHYSICS

Phys-615 Solid State Ionics

Unit I:

Types of Ionic solids- Fast Ionics Solids-Point Deffect type-Sub Lattice type – Fast Ionic materials – alkali metal ion conductors - β aluminas- Silver ion conductors- Cation conductors- Oxygen ion conductors – Halide ionconductors – Proton conductors – Electronic conductors with ionic transport.

Unit II:

Various methods of preparation of amorphous/glassy, poly and single crystalline materials – thermal evaporation – sputtering – glow – discharge decomposition – chemical vapour deposition – melt quenching – gel dissociation – crystal growth technique – x-ray diffraction and differential thermal analysis-Glass transition – factors determining glass transition temperatures – structure – microscopic structure – modeling – microscopic structure – examples.

Unit III

Point Defect Type: Point defect type super ionic conductors – transport mechanism through defects – jump frequency – ionic conductivity and diffusion co-efficients – defect concentration – pure and doped crystals – impurity vacancy association – coulomb interactions-Application of transport theory to fluoride and Oxygen ion conductors: Molten Sub-lattice type: Molten Sub-lattice type solid state ionic conductors – Hyper mann's theory – Rices Strassler & Toouch's theory – Welch Dieme's theory – Lattice gas theory – Path Probability and Moute Carlo Methods – Ionic Percolation theory – Jahn Teller Model-Dynamics- ion transport – free ion model – domain model – jump diffusion model and frequency dependent conductivity.

Unit IV

Macroscopic properties – electrical conductivity – diffusion thermo electric power-Microscopic properties – x- ray diffraction studies – a.c. conductivity – dielectric relaxation – NMR – ESR – far IR – Mossbauer Spectroscopy – Raman Scattering – Photo Electron Spectroscopy – Ultrasonic attenuation – velocity.

Unit V

Thermodynamic studies – general aspects of solid state batteries – electrolyte – compatibility between electrode substance and solid electrolytes – electrode structure – interface between electrode and solid electrolyte – High temperature fuel cells – solid state potentiometer gauges for gaseous species – coulometer – electro-chemical capacitor – eletrochromic display system.

Text Book:

A.R. West, Solid State Chemistry

S. Chandra, Superionic Solids

Principles of Electronic Ceramics, L. L. Hench and J. K. West, (JohnWiley & Sons, New York, 1990).