JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

ANANTAPUR

Course Structure and Syllabi for Pre Ph.D

PHYSICS (2009-10)

PART - I

Choose any **one** subject of the following

S.NO	PAPER	PAPER CODE
1.	**Classical and Statistical Mechanics**	**09PH56101**
2.	**Solid State Physics**	**09PH56102**
3.	**Electromagnetic Theory**	**09PH56103**
4.	**Quantum Mechanics**	**09PH56104**
5.	**Physics of Semi Conducter Devices**	**09PH56105**

PART II

Choose any **one** subject of the following

S.NO	PAPER	PAPER CODE
1.	Nano Science And Technology	09PH56201
2.	Condensed Matter Physics	09PH56202
3.	Crystal Structures	09PH56203
4	Lasers, Holography and Fiber Optics	09PH56204
5	Physics of Amorphous, Dielectric And Ferroelectric Materials	09PH56205
6	Material Science and Applications	09PH56206
7	Remote Sensing and Applications	09PH56207
8	Synthesis and Characterisation of Nano Material	09PH56208
9	Nuclear and Particle Physics	09PH56209
10	Atomic and Molecular Physics	09PH56210
11	Applied Spectroscopy	09PH56211
12	Photonics	09PH56212
13	Thin Film Technology	09PH56213
14	Solar Energy	09PH56214
15	Digital Signal Processing	09PH56215

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANTAPUR

ANANTAPUR

Pre-Ph.D - PHYSICS

(09PH56101) CLASSICAL AND STATISTICAL MECHANICS

UNIT - I

Lagrangian Mechanics

Newtonian Mechanics of one and many particle systems: Conservation laws: Constraints and their classification: Degrees of freedom: Generalized coordinates: Principle of virtual work, D'Alemberts principle: Lagrange's equations of motion:

UNIT - II

Hamiltonian Mechanics

Hamiltonian principle: Hamilton's equation of motion: Physical significance of Hamiltonian, Principal of least action.

UNIT – III

Canonical Transformations and Hamilton - Jacobi Theory

Canonical Transformations; generating function; properties: Condition for transformation to be canonical; Illustration of canonical transformation: Poisson - Brackets - Bracket notation Lagrange-Brackets and their properties. The Hamiltonian - Jacobi equation- Application to harmonic oscillator problems.

UNIT –IV

Motion in a Central Force Field

Central force - Motion in a central force field- Inverse square law of forces: Kepler's laws of planetary motion; Rutherford scattering -Angular momentum and Torque – Euler's equations of a rigid body: Motion of symmetrical top; Larmor precision; Examples of Gyroscope.

UNIT- V Ensembles

Concept of ensembles – Types of ensembles (Canonical , Microcanonical,and Grand canonical) - Ensemble average - Liouville's Theorem – Ideal gas treatment with various ensembles – Comparison of various ensembles.

UNIT – VI Statistical Mechanics and thermodynamics

Entropy – Equilibrium conditions – Quasistatic processes – Entropy of an ideal Boltzmann gas using the micro canonical ensembles – Gibbs paradox – Sacku-tetrode equation Entropy and probability.

UNIT - VII Partition Functions

Canonical partition function – Molecular partition function – Transnational partition function – Rotational partition function – Vibrational partition function – Electronic and Nuclear partition functions – Applications of vibrational partition function to solids.

UNIT – VIII Maxwell – Boltzmann, Bose – Einstein and Fermi – Dirac Statistics

Maxwell - Boltzmann distribution - Distribution of velocities – Bose – Einstein distribution – Bose – Einstein condensation –Liquid helium- Fermi - Dirac distribution – Electrons in metals – Magnetic susceptibility of free electrons – White dwarfs

Reference:

1. **Classical Mechanics** by N.C. Rana and P.S. Joag (Tata Mc-graw Hill, NewDelhi) 1991
2. **Classical Mechanics** by H. Goldstein (Addison Wesley, London) 1980
3. **Classical Mechanics** by J.C.Upadhyaya,Himalaya Pub. House, Mumbai
4. **Classical Mechanics** by Gupta, Kumar and Sharma
5. **Statistical Mechanics** by R.K. Agarwal, M. Eisner,New Age International (P) Ltd. NewDelhi
6. **Statistical Mechanics and properties of Matter** by ESR Gopal, MacMillan Co. NewDelhi
7. **Statistical and Thermal Physics** by F. Reif
8. **Elementary Statistical Mechanics** by C.Kittel

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ANANTAPUR

Pre-Ph.D - PHYSICS

(09PH56102) SOLID STATE PHYSICS

UNIT – I: Lattice energy and Latting Vibrations

Lattice energy- Lattice energy calculations for general and ionic crystals- Lattice vibrations: Mono and diatomic one dimensional infinitely long lattices – Vibrational spectra – Infrared absorption in ionic crystals – Vibrational spectra of finite lattice – Quantization of lattice vibrations – Phonons – Properties.

UNIT – II: Electron theory of solids

Clasical theory of elctron conductivity – drawbacks – Quantum theory of elctron conductivity – Fermi level energy – Fermi – Dirac distributions and effect of temparature.

UNIT – III: Transport phenomena

Concept of electrical and thermal resistivity – different types of recombination Mechanism - Expression for thermal and electrical conductivities for metals – Lorenz number - Different scattering mechanisms – Matheissens rule- Formulation of Boltzmann transport equation – Relaxation time approximation – Distribution function.

UNIT – IV: Band theory of solids

Motion of electron in periodic potential – Bloch function(Qualitative) - Kroning-Penny model(Quantitative)– Formation of energy bands in solids — Brillouin zones – Different schemes of representation of E vs K curves – Distinction between metals, insulators and semiconductors- Concept of effective mass.

UNIT – V: Semiconductors

Intrinsic and extrinsic semiconductors – Expression for position of Fermi levels and carrier concentrations – Variation of Fermi level with temperature and carrier concentration – Carrier mobility, conductivity and their variation with temperature – Direct and indirect band gap semiconductors – Hall effect and its applications - Drift and Diffusion.

UNIT – VI: Superconductivity

Concept of zero resistance – Magnetic behavior – Meissner effect – isotope effect – specific heat behavior – London's equations – Penetration depth (Qualitative) – Type I and type II superconductors - BCS theory –Josephson junctions –Applications of superconductors – High T_C superconductors –Properties.

UNIT – VII: Elastic properties

Hooke's law – Elastic constants of cubic crystals – Elastic waves in cubic crystals – Measurement of Elastic constants of cubic crystals

UNIT – VIII: Thermal properties

Specific heat of solids – Einstein's model – Debye model – Thermal conductivity due to phonons

And electrons.

References:

1. **Solid State Physics** by C. Kittel, John willey & Sons, NewYork
2. **Solid State Physics** by A.J. Dekkar, Macmillan, London
3. **Solid State Physics** by R.L.Singhal, Kedarnath & Ramnath Co. Meerut
4. **Elementary Solid State Physics** by M. Ali Omar
5. **Solid state and semiconductor Physics** by J.P.McKelvey, Harper& Row, NewYork
6. **Solid State Electronic Devices** by B.G. Streetman
7. **High T_C Superconductivity** by C.N.R. Rao and S.V. Subramanyam
8. **Solid State Physics** by S.O. Pillai
9. **Solid State Physics** by S.L. Kakani and C. Hemarajan
10. **Elementary Language of Solid State Physics** by Stiddard

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ANANTAPUR

Pre-Ph.D - PHYSICS

(09PH56103) ELECTROMAGNETIC THEORY

UNIT – I:

Maxwell's Equations: The equation of continuity for Time-Varying Fields – Inconsistency of Ampere's Law – Maxwell's equations – Conditions at a Boundary surface.

UNIT – II:

Electromagnetic Waves: Solution for free-space conditions – Uniform plane – Wave propagation – Uniform plane waves – The Wave Equation for a conducting medium – Sinusoidal Time Variations – Conductors and Dielectrics – Polarization – Directions cosines

UNIT – III

Reflection by a perfect conductors by normal and oblique incidence – Reflection by a perfect Dielectric – Normal and oblique Incidence –Reflection at the surface of a conductive medium – Surface impedance – The Transmission – line Analogy.

UNIT – IV:

Poynting Vector and the flow of power: Poynting's theorem –Significance of Poynting vector – Instantaneous, Average and Complex Poynting Vector – Power Loss in a plane conductor.

UNIT – V

Guided Waves: Waves between parallel planes – Transverse Electric Waves – Transverse Magnetic Waves – Characteristics of TE and TM Waves – Transverse Electromagnetic Waves – Velocities of propagation – Attenuation in parallel – plane Guides

UNIT- VI

Wave Impedances – Electric Field and current Flow within the conductors – Transmission lines – Circuit Representation of the parallel –plane transmission line along with losses.

UNIT – VII:

Wave Guides: Rectangular guides – Transverse Magnetic waves in Rectangular guides – Transverse electric waves in rectangular guides – Impossibility of TEM wave in wave guides

UNIT – VIII:

Bessel functions – Solution of the Field equation – Cylindrical co-ordinates – TM and TE waves in circular guides – wave impedances and characteristics impedance – Attenuation factor of wave guides.

References:

1. **Electromagnetic wave and Radiating Systems** by 2nd Edition, Edward C, Jordan, Keith G. Balman.
2. **2000 solved problems in Electromagnetics** by Syed Nasar, Schaum Series.
3. **Introduction to Electrodynamics** by D.J. Griffiths, Prentice-Hall, India
4. **Electromagnetics by** B.B. Laud, Wiley-Eastern, New Delhi

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Pre-Ph.D - PHYSICS

(09PH56104) QUANTUM MECHANICS

UNIT - I: Formulation and Simple Problems

Postulates of quantum mechanics-Schoedinger's time independent wave equation - Eigen values and Eigen functions for finite potential well and step barrier – Quantum mechanical tunneling-Simple harmonic oscillator– Wave functions in coordinate and momentum representation

UNIT - II: Angular Momentum

Motion in a central potential- Orbital angular momentum- L_x,L_y,L_z,L^2,L_+, and L_- – operators-commutation relations- Eigen values and Eigen functions of L^2 and L_z- Spin angular momentum and Pauli's spin matrices

UNIT - III: Approximate Methods:

Time independent perturbation theory for non-degenerate levels: The perturbed harmonic oscillator, the normal Helium atom, The Stark effect of the plane rotator. Time dependent perturbation theory: Transition to continuum (Fermi Golden rule).-The WKB approximation.

UNIT - IV: Scattering Theory

Quantum theory of scattering – Partial wave analysis – Scattering by a rigid sphere – Greens function in scattering theory. Born approximation – Validity of Born approximation – Optical theorem.

UNIT: V – Quantum Dynamics

Equations of motion- Schrodinger Picture- Heisenberg Picture- Interaction Picture- Equivalence of various Pictures- Poisson and Commutation brackets- Their Properties

UNIT: VI- Identical Particles and Molecules

Identical particles- Indistinguishability of Identical particles- Construction of Symmetric and Anti-symmetric wave functions- Pauli's Exclusion Principle- Hydrogen molecule- Spin-orbit interaction

UNIT – VII: Relativistic Quantum Theory

Klein – Gorden Equation – Probability Current Density – Inadequacies of K.G. Equation – Dirac's Relativistic Equation for a Free Particle - Dirac`s Matrices – Dirac`s Equation in Co-variant form

UNIT –VIII: Quantization of Wave Fields

Concept of Field - Method of Canonical Quantization: Lagrangian Formulation of Field, Hamilton Formulation of Field - Second Quantization – Field equation - Quantization of Non-relativistic Schroedinger equation

References:

1. **Quantum Mechanics** by S.L. Kakani and H.M. Chandalia.
2. **Advanced Quantum Mechanics** by B.S. Rajput, Pragatiprakasan, NewDelhi
3. **Quantum Mechanics by** V.K. Thankappan, Wiley Eastern Limited
4. **A Textbook of Quantum Mechanics** by P.M. Mathews and K. Venkatesan, Tata Mc Graw Hill Publishing Company.
5. **Quantum Mechanics** by S.L. Gupta, V. Kumar, H.V. Sharma and R.C. Sharma Jai Prakash Nath and Company.
6. **An introduction to Quantum Mechanics by** P.T. Mathews Mc Graw Hill Publishing Company.

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Pre-Ph.D - PHYSICS

(09PH56105) PHYSICS OF SEMICONDUCTOR DEVICES

UNIT-I

p-n Junctions: Description of p-n Junction action – Junction in equilibrium- application of bias – energy band diagrams.– Expression for Depletion layer capacitance -Static I-V characteristics of p-n junction diodes: The ideal diode model- Derivation of ideal diode equation.

UNIT - II

Electrical breakdown in p-n junctions: Zener and Avalanche breakdown in p-n junctions, Distinction between the Zener and Avalanche breakdown, Applications of breakdown diodes.

UNIT- III

Junction Transistors:

Bipolar junction transistor – Construction – operation – principle – I-V Characteristics –

Various configurations (CB,CE,CC) - Applications

UNIT - IV

Optoelectronic Devices: Introduction of Luminescence - Light Emitting Diodes (LEDs), Photo detectors- junction photodiode - Photo detectors- junction photodiode - principle of operation - Semiconductor lasers – principle of operation - Solar cell – principle of operation – p-n homojunction Si solar cell – device configuration –electrical characteristics

UNIT-V

Majority carrier diodes: Tunnel diode- I-V characteristics, equivalent circuits as an oscillator and amplifier. **Microwave devices: Varactor diode- basic principle, equivalent circuit, Figure of merit and applications. p-i-n diode operation and its applications.**

UNIT – VI

Junction field-effect transistors: JFET – Construction - Principle of operation,-I-V Characteristics- Applications of JFET - Basic Structures and the operating principle of MOSFET, - I-V characteristics MOSFET - Applications

UNIT –VII

Power rectifiers and Thyristors:SCR – operation – characteristics - Power rectifiers, Thyristors, Some special thyristor structures, Bidirectional thyristors, Field-controlled thyristor.

UNIT - VIII

Technology of Semiconductor Devices: Crystal growth and Wafer preparation, Methods of p-n junction formation, Growth and deposition of dielectric layers, Planar technology, Masking and lithography, Pattern definition, Metal deposition techniques.

References:

1. **Introduction to Semiconductor Materials and Devices** by M.S.Tyagi, John Wiley & Sons (Asia) Pvt. Ltd., Singapore, 2000.
2. **Microwave Devices and circuits** by SAMUEL Y.LAO, Prentice-Hall of India, 1999.
3. **Microwave and Radar Engineering** by M.Kulkarni, UMESH publications, New Delhi, 1999.
5. **Physics of Semiconductor Devices** by S.M.Sze, 3rd Edition , Oct.2006, John Wiley
6. **Solid State Electronic Devices** by B.G. Streetman, PHI, New Delhi,
7. **Introduction to Semiconductor devices** by M.S. Tyagi, John Wiley & Sons
8. **Optical electronics** by Ajoy Ghatak and K. Thygarajan, Cambridge Univ.Press.

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Pre-Ph.D - PHYSICS

(09PH56201) NANOSCIENCE AND TECHNOLOGY

Unit – I:

Introduction – origin of Nanotechnology – Nan materials – Types of nonmaterial's – Surface area to volume ration – Quantum confinement effect – band theory of nonmaterial's – Physical and chemical properties of nonmaterial's.

Unit – II:

Synthesis and Characteristics of Nanomaterialss – Sol-gel technique – Combustion synthesis – ultrasonic precipitation process –chemical vapour deposition — XRD –Atomic force Microscopy – Scanning electron Microscopy – Transmission electron Microscopy – X – ray Photoelectron Spectroscopy (XPS)

Unit – III:

Allotropes of Carbon – Graphene – Properties of Graphene – Applications of graphene – Fullerenes – Fullerene synthesis and purification – Properties of fullerenes.

Unit – IV:

Carbon nanotubes – Structure – Types of Carbon nanotubes – Synthesis of Carbon nanotubes – Purification of Carbon nanotubes – Properties of Carbon nanotubes – Applications of Carbon nanotubes.

Unit – V:
Colloid – Colloidal Gold nano particles – Nanocomposite – Nanocrystals – Nanostructure – Quantum dots – Fabrication of Quantum dots – Applications of Quantum dots.

Unit – VI:
Nano electronics – Fabrication of integrated circuits – Microelectromechanical systems (MEMS) - Nanoelectromechanical systems (NEMS) – Nano wire - Nano circuits – Quantum wire – Quantum well.

Unit – VII:
Molecular nanotechnology **–** Molecular Assembler – Molecular machine – Nanorobotics – Molecular modeling.

Unit – VIII:

Nanoengineering devices – Lab on chip (LOC) – Micromachinery – Nanomotor – Nanopore – Nanosensor – Synethic molecular motors.

References:

1. **Nano: The essentials** by T.Pradeep (Tata Macgraw Hill, NewDelhi)
2. **Principles of Nanotechnology** by Phani kumar (Scitech Publications, Chennai)
3. **Nanotechnology** by Schmid etal (Spriger International edition)
4. **Nanomaterials** by A.K.Bandhyopadhyay (New Age International Pub. NewDelhi)
5. **Fundementals of Nanoelectronics** by George W. Hanson (Perason education, NewDelhi)
6. '**MEMS & Microsystems: Design & Manufacture"** by Tai-Ran Hsu, (Tata Macgraw Hill, NewDelhi)

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Pre-Ph.D - PHYSICS

(09PH56202) CONDENSED MATTER PHYSICS

UNIT – I

Crystal Physics and Point defects in crystals: crystalline soilds – unit cells and direct lattice – three dimensional Bravias lattice – Structures of Simple cubic – BCC – FCC -Classification of imperfections – Point defects – Schottky and Frenkel defects -Expressions for equilibrium defect concentrations.

UNIT – II

Line defects – Dislocations – Edge and Screw dislocations – Burger vector – Role of dislocations in crystal growth – Frank-Reed mechanism of dislocation multiplication – Mechanism of creep.

UNIT-III

Ferromagnetism:Classification – Weiss field theory – Temperature dependence of spontaneous magnetization – Heisenberg model – Exchange interaction – Ferromagnetic domains – Magnetic bubbles – Bloch wall–Hysteresis - Ferrites – Structure – Applications.

UNIT-IV

Crystal growth : Nucleation and growth – Homogeneous and heterogeneous nucleation – Classification of crystal growth techniques – Melt growth techniques – Bridgman, Czochralski,techniques.

UNIT – V

Characterization -Necessity of characterization – Chemical analysis – Working principles of Electron Probe Micro Analysis (EPMA), Energy Dispersive Analysis of X-rays (EDAX), Electron Spectroscopy for Chemical Analysis (ESCA) - XRD - TEM

UNIT-VI

Photoconductivity: Excitons – Weakly bound and tightly bound – Photoconductivity – Simple model – Influence of traps – Space charge effects – Determination of photoconductivity.

UNIT – VII

Luminescence – Various types – Thermoluminescence, Electroluminescence, Photoluminescence, Cathodoluminescence and Chemiluminescence - Excitation and emission – Decay mechanisms – Applications.

UNIT-VIII

Functional materials: Materials for solid state batteries – preparation – Characterisation – Applications – Conducting Polymers - preparation – Characterisation – Applications – Smart and intelligence materials - preparation – Characterisation – Applications

References:

1. **Introduction to Solid State Physics by** Charles Kittel VII edition
2. **Solid State Physics** by A.J.Dekker (McMillan Pub.)
3. **Material Science and Engineering by** V.Raghavan
4. **Crystal Growth by** B.R.Pamplin (Pergmon Press)
5. **Crystal Growth from high temperature solutions** by D.Elwell and H.J.Scheel, (Academic Press)
6. **Fundamentals of Solid State Physics** by Saxena, Gupta, Saxena, (Pragathi publications, Meerut).
7. **Solid State Physics** by R.L.Singhal (Kedar Nath Ram Nath & Co. Pub)
8. **Solid State Physics by** H.C.Gupta (Vikas Publishing House)
9. **Elementary Solid State Physics by** M.Ali Omar (Addison Wesley)

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Pre-Ph.D - PHYSICS

(09PH56203) CRYSTAL STRUCTURES

UNIT I:

Crystal size and perfection: Grain size, Particle size, Crystal perfection and Depth Of X-ray penetration

UNIT II:

Crystal structures: space lattice – Basis – Unit cell – Lattice parameters – Bravais lattices – Crystal systems – structures – Simple cubic – Body centred cubic – Face centred cubic crystals

UNIT - III

Determination Crystal Structure: Preliminary treatment of data, indexing pattern of cubic crystals, Effect of cell distortion on the powder pattern, Determination of atom position, Example of structure determination.

UNIT IV:

Precise Parameter measurement: Debye-Scherrer cameras, Back-reflection Focusing cameras, Pinhole cameras, diffractometers, Method of least squares, Coben's methods, calibration method.

UNIT V:

Phase Diagram Determination: General principles, Solid solutions, Determination of solvus curves (disappearing phase method), Determination of solvus curves (parametric method).

UNIT VI:

Order-Disorder Transformations: Long range order in $AUCu_3$, Other examples of long range order, detection of Super lattice, Short-range order and clustering.

UNIT VII:

Chemical analysis by Diffraction: Qualitative analysis and Quantitative analysis (Multi phase).

UNIT VIII:

Scanning Electron Microscopy and X-ray Micro analysis: SEM instrumentation, Specimen/Electron interactions, Detectors, Resolution and magnification, operating conditions,

Specimen preparation and elemental analysis by EDS (Energy Dispersive Spectroscopy) and WDS (wavelength Dispersive Spectroscopy)

References:

1. **Industrial X-ray interpretation** by Justin G. Schneeman, Published by Intex publishing Company, Evanston, Illinois
2. **"Elements of X-ray Diffraction",** by B.D. Cullity, Addison-Wesley publishing company.
3. **"X-ray and Neutron diffraction",** by G.E.Bacon, Pergamon press
4. **"Industrial applications of X-ray Diffraction",** by Frank H. Chungand Deane K.Smith, Marcel Dekker, Ine.
5. **Scanning Elecctron Microscopy and X-ray Microanalysis Grahame Lawes by** Editor Aarthur M. James published by Jhon Wiley & Sons.
6. **Scanning Elecctron Microscopy of polymers and Coatings** by L.H.princel John Wiley and Sons
7. **Electron and Ion Microscopy and Microanalysis Principles and Applications** by Lawrence E.Murr, Mareel dekker Ine.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANTAPUR

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Pre-Ph.D - PHYSICS

(09PH56204) LASERS, HOLOGRAPHY AND FIBER OTICS

UNIT – I:

Lasers : Introduction to lasers – Coherence: Time coherence – Space coherence -Absorption - Spontaneous and stimulated emission – Einstein coefficients – Population inversion – Pumping schemes – Threshold condition for laser oscillation – Role of feedback (Laser cavity) - Losses and Q-factor

UNIT – II:

Laser devices: Ruby laser, He-Ne laser – Co_2 laser - GaAs laser – Laser applications.

UNIT – III:

Holography: Introduction to Holography – Basic theory of Holography – Recording and reconstruction of Hologram – Diffuse object illumination – Speckle pattern – Fourier transform Holography – Applications of Holography.

UNIT – IV:

Fourier optics: Introduction – Two dimensional Fourier transforms – Transforms of Dirac-delta function – The convolution integral – convolution theorem- Spectra and correlation – Parsevels formula

UNIT – V:

Fiber Optics: Elementary Discussion of Propagation in Fiber: Introduction to Fiber propagation using a Ray Model. Material Dispersion. -Combined effect of Material & Multipath Dispersion.

UNIT VI:

RMS pulse widths and frequency, Response. - Attenuation Mechanisms.- Damage by Ionizing Radiation. The Optimum Wavelength for silica Fibers. All plastic and polymer clad-silica (PCS) Fibers.

UNIT VII:

The Manufactures & Assessment of Silica Fibers: Fiber production Methods. Cables, Splices & connectors. Fiber Assessment. Comparisons between Optical Fibers and conventional Electrical Transmission Lines.

UNIT VIII:

Electromagnetic Wave-Propagation In Graded-Index Fibers: Modes in graded-Index Fibers. The equivalence of the WKB Approximation & Ray Model. Intermodal Dispersion in graded-Index Fibers. Intermodal Dispersion in graded-Index Fibers. Total Dispersion in Graded Index

Fibers. Intermodal Dispersion in graded-Index Fibers. Total Dispersion in Graded Index Fibers. Mode coupling.

References:

1. **Modern Optics by** Fowels
2. **Optical Electronics** by Ghotak and Thyagarajan
3. **Laser and their Applications by** M.J. Beesly, Taylor and Francis, 1976
4. **Lasers and Non-Linear Optics by** B.B. Laud, Wiley Eastern Ltd., 1983
5. **Optics** by E. Hecht, Addison Wiley, 1974
6. **Optical Fiber Communications by** Gerel Keiser, McGraw Hill Book, 2000
7. **Optical Communication system** by John Gower
8. **Optical fiber communications** by john senior

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Pre-Ph.D - PHYSICS

(09PH56205) PHYSICS OF AMORPHOUS, DIELECTRIC AND FERROELETRICS MATERIALS

Unit-I: IONICS AND SUPERIONICS:

Superionic solids, classification of superionic solids, materials and structures, structural characterization,

UNIT – II: Thermodynamic properties, Ionic transport (microscopic nature), Ion dynamic, applications superionic solids with special reference to solid state batteries.

UNIT-III: PHYSICS OF AMORPHOUS MATERIALS

Introduction and preparation techniques, Glasses and glass transition, Structure of glass, atomic ordering in amorphous materials, Optical properties of amorphous materials**,** Applications of amorphous materials.

UNIT-IV: DIELECTRICS:

Dielectric polarization – Electronic – Ionic - Dipolar polarizations – local field – clausius Mosotti relation

UNIT - V

Single relaxation times, Debye's equations and Cole-Cole plots, Distribution of relaxation times, Cole-Davidson plots, Random approximation, Variation of dielectric properties with frequency, temperature, pressure, and composition. (Dielectric properties of mixtures), Dielectric properties of glasses and polymers.

UNIT - VI

Measurement of dielectric properties, Scherring bridges, Q-meters and LCR meters and impedance analysers. Review of piezoelectricity and piezoelectric materials, lead based piezoelectric materials and applications.

UNIT-VII: FERROELETRICS:

Review of types of ferroelectrics and their important features methods of preparation of bulk ceramic ferroelectrics. Characterization of ferroelectrics, small signal dielectric measurements, method of measuring spontaneous polarization, Hysteresis - pyrolectricity, polarization reversal.

UNIT – VIII: Theories of ferrolectricity, Dipole theory, Devonshire theory and pseudospin theory. Application of ferroelectric materials, piezoelectric transducers, pyroelectric detectors, electro-optic application. Second harmonic generators, SAW devices and memory devices.

References:

1. **Materials science and engineering** by V.Raghavan
2. **Solid state physics** by Kittel
3. **Materials science and Engineering** by W.D.Cellister
4. **Materials science and Engg** by S.M.Srivasthava.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANTAPUR

ANANTAPUR

Pre-Ph.D - PHYSICS

(09PH56206) MATERIAL SCIENCE AND APPLICATIONS

Unit 1: Dielectrics

Macroscopic description of the static dieletric constant, the electronic and ionic polorizabilities of molecules. Orientational Polarization, Measurement or dielectric constant of a solid, the internal field of Lorentz, Clausius-Mosotti relation, elementary ideas on dipole relaxation.

Unit 2: Ferroelectrics

Classification of ferroelectric crystals- Ba TiO_3 and KDP, Dielectric theory of ferro electricity, spontaneous polarization and ferroelectric hysteresis.

Unit3: Crystal growth and characterization techniques

Nucleation and growth – Homogeneous and heterogeneous nucleation – Classification of crystal growth techniques – Melt growth techniques - Characterization -Necessity of characterization – Chemical analysis – Working principles of Electron Probe Micro Analysis (EPMA), Energy Dispersive Analysis of X-rays (EDAX), Electron Spectroscopy for Chemical Analysis (ESCA) - XRD – TEM

Unit 4 : Characterization of Thin Films: Surface analytical techniques: Auger Electron Spectroscopy (AES), X-ray Photoelectron Spectroscopy (XPS), Secondary Ion Mass Spectroscopy (SIMS) and Rutherford Back Scattering (RBS)

Unit 5: Magnetic properties

Quantum theory of diamagnetism, origin of permanent magnetic moment, Theories of paramagnetism, paramagnetic cooling, spontaneous magnetization, Weiss theory of spontaneous magnetization,

Unit 6:

Nature and origin of the Weiss molecular field, Heisenberg exchange interaction, Hysteresis. The Block wall, Neel's theory of Antiferromagnetism. Ferromagnetism, Ferrite's and their applications (basic concepts on**ly).**

Unit 7: Superconductivity

Occurrence of Superconductivity, Experimental observations, Persistent currents, Effect of magnetic fields, Meissner effect, Type I and Type II super conductors, Intermediate states, Entropy and heat capacity, energy gap, Isotope effect, Thermal conductivity.

Unit 8:

Theoretical explanations, London's equation, Penetration depth, Coherence length Cooper Pairs, Elements of BCS theory, Giaver tunneling Josophson effects (basic ideas)

References:

1. **Applied physics** by Dr.M. Chandra shekher & Dr. P. Appala Naidu
2. **Materials science** by M.Arumugam
3. **Materials science & Engineering** by W.D.Callister (Jr)

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Pre-Ph.D - PHYSICS

(09PH56207) REMOTE SENSING AND APPLICATIONS

UNIT I

Photography and Photogrammetry : Fundamentals of Aerial photography systems. Basic principles of Aerial photos, Types of Aerial Photos, scale, Ground coverage, Photographic resolution, Radiometric characteristics.

UNIT II

Fundamentals of Photogrammetry : Geometry of Aerial photos. Relief and Tilt displacements, stereoscopy, parallax equation, flight planning – measurement of heights and determination of slopes. Concepts of stereophotogrammetry, Aerial Triangulation and orthophotography.

UNIT III

Remote Sensing : Principles and basic concepts of remote sensing, physics of remote sensing. Effects of Atmosphere, Principles and Geometry of scanners, CCD arrays and platforms. Spectral reflectance of Earth's surface features in different wavelength regions of electromagnetic spectrum.

UNIT IV

Rainfall estimation techniques, cyclone analysis techniques & synoptic weather analysis using visible, Near Infrared, Middle infrared and thermal Infrared data sets analog as well as digital mode.

UNIT V

Laser & Microwave remote sensing : principles and basic concepts of microwave sensing – SLAR, SAR, Geometric characteristics, spatial resolution, Radar Grammetry.

UNIT VI

Ground data collection for interpretation and analysis Principles of Image interpretation – Types of Imagery, their formation and characteristics, elements of interpretation techniques of visual interpretation.

UNIT VII

Digital image processing : Digital Image, Digital Image data formats, Band sequential; Band Interleaved and its characteristics. Image processing systems considerations and characteristics – Image enhancements techqnieques – Image reduction and magnification, contrast enhancements, rationing, spatial filtering, edge enhancements.

UNIT VIII

Principles of pattern recognition – Basic concepts, multispectral; Recognition, classification etc. Digital photogrammetry – Artificial intelligence / Expert system – Digital Elevation and Terrain modeling.

References :

1. **"Text Book of Photogrammetry"** by Rampal, K.K. Oxford & IBM (1982)

2. **"Remote Sensing : Methods & Applications"** by Hard R. Michael, Johnwiley (1987)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANTAPUR

ANANTAPUR

Pre-Ph.D - PHYSICS

(09PH56208) SYNTHESIS AND CHACTERISATION OF NANOMATERIALS

Unit-I:

Introduction to synthesis of nano materials, Bottom-up approach and Top-down approach with examples. Physical methods: Inert gas condensation, Arc Discharge, RF-plasma, plasma arc technique, electric explosion of wires, lasers ablation, laser pyrolysis, ball milling, molecular beam epitaxial, electro deposition

Unit-II:

Chemical methods: Nanocrystals by chemical reduction, photochemical synthesis, electrochemical synthesis, nanocrystals of semiconductors and other materials by arrested precipitation, emulsion synthesis, sonochemical routes

Unit-III:

Thermolysis route – spary pyrolysis and solved metal atom dispersion, sol-gel method solvothermal and hydrothermal routes, solution combustion synthesis, CVD method and other variants

Unit-IV:

Biological methods use of bacteria, fungi, actinomycetes for nano-particle synthesis-magnetotic bacteria for natural synthesis of magnetic nano-particles, role of plants in nano particle synthesis.

Unit-V:

Compositional and structural Characterization techniques: X-Ray Photoelectron Spectroscopy(XPS),X-Ray topography, Energy Dispersive X-Ray Analysis(EDAX),Principles and applications of X-Ray Diffraction: Small angle X-Ray Diffraction and Wide angle X-Ray Diffraction; Electron Diffraction, Electro probe microanalysis(EPMA), Ion beam techniques: SIMS & RBS

Unit-VI:

Surface Characterization Techniques: Scanning electron microscopy (SEM), Transmission electron microscopy, Basic principles and applications of scanning probe techniques (SPM), Atomic force microscopy, and scanning tunneling microscopy.

Unit-VII:

Spectroscopic techniques: UV-Visible spectroscopy, Infrared (IR) & Fourier Transform infrared (FTIR) Spectroscopy, Raman Spectroscopy techniques: Photo luminescence Spectroscopy

Unit-VIII:

Electrical Characterization Techniques: Hall Measurement, capacitance, and voltage measurements, I-V analysis .Magnetic & Dielectric Characterization: SQUID, , Dielectric measurements, impedance and ferroelectric measurements

References:

1. **Inorganic Materials Synthesis and Fabrication** by J.N.Lalena, D.A.Cleary, E.E.Carpenter, N.F.Dean, John Wiley & Sons Inc.
2. **Introduction Nano Technology** by Carless P.Poole Jr and Frank J.Owens. Wiley India Pvt Ltd.
3. **The chemistry of Nanomaterials: Synthesis, Properties and Appliocations, Vol-I** By C.N.R.Rao, A Muller and A.K.Cheetham.
4. **Nano: The Essentials – Understanding Nano Science and Technology** by T.Pradeep, Tata Mc.Graw Hill
5. **Characterization of nanostructured materials** by Z.L.Wang
6. **Principles of Instrumental analysis** by D.A.Skoog, F.L.Hollen and T.A.Niemann
7. **Encyclopedia of nanotechnology** by M.Balakrishna Rao and K.Krishna Reddy, Vol I to X, Campus books
9. **Nanotechnology: Principles and Practices** by Sulabha K.Kulkarni- Capital Publising Company

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANTAPUR

ANANTAPUR

Pre-Ph.D - PHYSICS

(09PH56209) NUCLEAR AND PARTICLE PHYSICS

UNIT – I:

Nuclear Forces: Characteristics of nuclear forces – Ground state of Deuteron – Proton – Proton scattering – Neutron – Proton scattering – Meson theory of nuclear forces.

UNIT – II:

Nuclear Models: Introduction – The liquid drop model – Bethe-Weizacker semi-empirical binding energy equation and its applications – Nuclear shell model – Energy levels and calculation of angular momentum – Collective model.

UNIT –III:

Nuclear Reactions: Types of nuclear reactions – Compound nuclear reactions – Nuclear cross section – Resonance theory – Briet Wigner formula.

UNIT – IV:

Nuclear interactions: Direct and compound nuclear reaction mechanisms- cross sections in terms of partial wave amplitudes–compound nucleus–Scattering Matrix–Reciprocity theorem– Breit- Wigner one – level formula- Resonance scattering.

UNIT – V:

Nuclear Decays: Nuclear transformations – Radioactive decay – Alpha decay – Gamow's theory – Beta decay – Fermi theory –Selection rules – Interaction of gamma radiation with matter – Photo electric effect – Compton scattering – Pair production.

UNIT – VI:

Nuclear Accelerators: Introduction – Linear accelerators – Drift tube and Wave guide accelerators – Low energy circular accelerators – Cyclotron and Betatron – High energy circular accelerators – Synchrotron and Microtron

UNIT – VII:

Nuclear Reactors: Nuclear fission and fusion reactions – Nuclear chain reactions – Four factor formula – The critical size of a reactor – General aspects of reactor design – Classification of reactors – Power reactors (elementary aspects only)

UNIT – VIII:

Elementary particles: Discovery and classification of elementary particles – Types of interactions – Conservation laws – Iso-spin, parity, charge conjugation – Time reversal – CPT theorem – Properties of leptons, mesons and baryons – Elementary particle symmetries (SU_2 and SU_3 symmetries) – Quark model – Search for Higg's particle – elementary ideas.

References:

1. **Nuclear Physics** by Irving Kaplan, Narosa Pub. (1998)
2. **Nuclear Physics – Theory and experiment** by PR Roy and BP Nigam, New Age Int. (1997)
3. **Atomic and Nuclear Physics (Vol.2)** by S.N.Ghoshal, S.Chand &Co. (1994)
4. **Nuclear Physics** by D.C.Tayal, Himalaya Pub. (1997)
5. **Atomic and Nuclear Physics** by R.C.Sharma
6. **Nuclei and Particles** by E.Segre

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Pre-Ph.D - PHYSICS

(09PH56210) ATOMIC AND MOLECULAR PHYSICS

UNIT - I

Atomic Spectra: Introduction: The hydrogen atom (one electron atom) and the three quantum numbers-Spectra of hydrogen atom- Spectra of alkali elements-fine structure- Elements with more than one valence electron- Forbidden transitions and selection rule

UNIT – II

Space quantization- The Stern-Gerlach (S-G) experiment- Experimental setup to demonstrate S-G effect using a thermal evaporation system and magnetic field - Coupling schemes: Spectral terms and term symbols based on electron configuration - LS coupling -JJ coupling- Hund's rule of multiplicity - Pauli's exclusion principle

UNIT - III

Zeeman Effect: Introduction: Zeeman effect, Normal and anomalous Zeeman effect, Experimental details, The magnetic moment of the atom and Lande's 'g'-factor, Zeeman effect in sodium atom, The Lande g-formula for LS and JJ coupling –

UNIT - IV

Stark effect: The Paschen-Back effect, splitting of sodium lines and selection rules, Stark effect, Experimental details, Weak and strong field effects, Width of spectral lines.

UNIT - V

Types of spectra: Introduction – rotational, vibrational, electronic spectra of diatomic molecules –types of molecules – linear, symmetric top, asymmetric top and spherical top molecules – rotational spectra of a diatomic molecule as rigid rotator – energy levels and spectra of non-rigid rotor

UNIT - VI

Rotational energy: rotational analysis of electronic spectra- evaluation of rotational constants - effect of isotopic substitution on rotational levels – Stark splitting of rotational lines – Stark modulated microwave spectrometer – applications of rotational spectroscopy :

UNIT - VII

Molecular spectroscopy: Introduction – vibrational spectra of diatomic molecule – diatomic molecule as simple harmonic oscillator – anharmonic oscillator – energy levels and spectrum – molecule as vibrating rotator – PQR branches – progressions and sequences – vibrational analysis of electronic spectra

UNIT – VIII

Frank-Condon principle – intensity distribution in absorption and emission spectra - effect of isotopic substitution on vibrational bands – IR spectrometer – FTIR spectroscopy – principle – interferometer arrangement – advantages - applications of vibrational spectroscopy

References:

1. **Introduction To Atomic Spectra** by H.E. White, McGraw-Hill Kogakusha. Ltd., New Delhi.(1934).
2. **Fundamentals Of Molecular Spectroscopy** by C.N. Banwell and E.M.McCash,Tata McGraw-Hill Publishing Company Ltd., New Delhi. (1994)
3. Spectroscopy by Volume I and III, B.P. Straughan and S. Walker, John Wiley & Sons Inc., New York. (1976).
4. **Introduction To Molecular Spectroscopy** by G.M. Barrow, McGraw-Hill Book Company, Inc., New York. (1962).
5. **Spectra Of Diatomic Molecules by** G. Herzberg, D.Van Nostrand Company Inc., New York. (1950).
6. **Molecular Spectroscopy by** J.M. Brown, Oxford Science Publications, Oxford. (1998).
7. **Molecular Structure And Spectroscopy** by G. Aruldhas, Prentice-Hall of India, Pvt., New Delhi, (2005).

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Pre-Ph.D - PHYSICS

(09PH56211) APPLIED SPECTROSCOPY

UNIT I

Molecular Spectroscopy: Introduction – Rotational structure of electronic bands of diatomic molecules – Fortrat diagram – General relations – Combination relations for $^1\Sigma - ^1\Sigma$ and $^1\Sigma - ^1\pi$ bands – Evaluation of rotational constants with reference to above transition.

UNIT - II

Isotope effect in electronic spectra of diatomic molecules – Vibrational effect and rotational effect. Potential energy curves and dissociation energy and pre-dissociation energy. Vibrations of polyatomic molecules: CO_2 and H_2O).

UNIT- III

Raman Spectroscopy: Introduction – Theory of Raman Scattering – Rotational Raman Spectra – Vibrational Raman Spectra – Mutual Exclusion Principle – Laser Raman Spectroscopy – Polarization of Raman Scattered Light – Single Crystal Raman Spectra

UNIT – IV

Raman Investigation of Phase Transitions – Resonance Raman Scattering – Structure Determination using FTIR and Raman Spectroscopy. Fourier Transform (FT) Raman Spectroscopy and its additional advantages over the conventional Raman Spectroscopy, Surface enhanced Raman Scattering-Coherent Anti-Stokes Raman Spectroscopy.

UNIT - V

Spectrophotometry: Introduction – Beer's law – Absorptivity – UV and visible absorption – Instrumentation – Essential parts of spectrophotometer – Gratings and prisms – Radiant energy sources – Filters – Photosensitive detectors – Barrier layer cells – Photo emissive cells – Photomultiplier tubes

UNIT - VI

IR spectrophotometry – Fourier Transform Infrared (FTIR) Spectrometer – Molecular structure – Qualitative and Quantitative analysis – The most sensitive lines of the elements – Method of identifying elements – Microphotometer

UNIT - VII

Fluorescence and Phosphorescence Spectroscopy: Introduction – Normal and Resonance Fluorescence – Intensities of Transitions – Non-radioactive decay of fluorescent molecules – Phosphorescence and the nature of the triplet state – Population of the triplet state – Delayed Fluorescence – Excitation spectra – Experimental methods

UNIT - VIII

High Resolution Spectroscopy: Introduction – Light detectors – Single photon counting technique – Phase sensitive detectors – Laser optogalvanic spectroscopy –Laser cooling and its applications

References:

1. **Molecular spectra and Molecular structure Volume I by**
   G. Herzberg (2nd Edition, Van. Nostrand London)
2. **Fundamentals of Molecular Spectroscopy by**
   C.N. Banwell (Tata Mc Graw-Hill Publishing Company Ltd, 1983)
3. **Spectroscopy by**
   Straughan and Walker (volume 2 and Volume 3, John Wiley and Sons, 1976)
4. **Molecular Structure and Spectroscopy** by
   G. Aruldhas (Printice-Hall of India, Pvt. Ltd., 2001
5. **Instrumental Methods of Analysis by**
   Willard, Merritt, Dean and Settle (CBS Publishers, New Delhi,(2001)
6. **High Resolution Spectroscopy** by
   J.M. Hollas
7. **Fundamentals of Molecular Spectroscopy** by
   C.N. Banwell (Tata Mc Graw-Hill Publishing Company, New Delhi, 1983)

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Pre-Ph.D - PHYSICS

(09PH56212) PHOTONICS

UNIT-I

Properties of laser Radiation: Introduction, Laser line width, Laser frequency stabilization, Beam divergence, Beam coherence, Brightness, Focusing properties of laser radiation, Q-switching, Methods of Q-switching: Electro-optic Q-switching, Acoustic-optic Q- Mode locking, Methods of mode locking: Active and passive mode locking techniques.

UNIT - II

Opto-electronic devices: Introduction, P-N junction diode, Hetero-junction, Double hetero-junction, Quantum well, Quantum dot and Super lattices; LED materials, Device configuration and efficiency, Light extraction from LEDs, Quantum well lasers; Avalanche photodiodes(APDs), Phototransistor, Modulated barrier photodiode, Schottky barrier photodiode.

UNIT - III

Modulation of Light: Introduction, Birefringence, Electro-optic effect, Pockels and Kerr effects, Electro-optic phase modulation, Electro-optic amplitude modulation, Electro-optic modulators:scanning and switching, Acousto-optic effect, Acousto-optic modulation, Raman-Nath and Bragg modulators.

UNIT IV

Fiber Optic Components: Connector principles, Fibre end preparation, Splices, Connectors, Source coupling, Distribution networks, Directional couplers, Star couplers, Switches, Fiber optical isolator, Wavelength division multiplexing, Time division multiplexing, Fiber Bragg gratings.

UNIT – V

Fiber optic sensors: Advantages of fiber optic sensors, Intensity modulated sensors, Mach-Zehnder interferometer sensors, Current sensors, Chemical sensors –Fiber optic rotation sensors.

UNIT VI

Integrated Optics: Introduction – Planar wave guide – Channel wave guide – Y-junction beam splitters and couplers - FTIR beam splitters – Prism and grating couplers – Lens wave guide – Fabrication of integrated optical devices - Integrated photodiodes – Edge and surface emitting laser – Distributed Bragg reflection and Distributed feed back lasers - Wave guide array laser.

UNIT VII

Optical Signal Processing

Introduction, Effect of lens on a wavefront, Fourier transform properties of a single lens, Optical transfer function, Vanderlugt filter, Image spatial filtering, Phase-contrast microscopy, Pattern recognition, Image de-blurring, Optical neutral networks, Optical bistability, Optical transistor

UNIT VIII

Photonic Crystals

Basics concepts, Theoretical modeling of photonic crystals, Features of photonic crystals, Methods of fabrication, Photonic crystal optical circuitry, Nonlinear photonic crystals, Photonic crystal fibers, Photonic crystals and optical communications, Photonic crystal sensors.

References:

1. **Lasers: Principles and applications and** J.Wilson And J.F.B.Hawkes, Prentice, Hall of India, New Delhi, 1996.
2. **Laser fundamentals** and W.T.Silfvast, Foundation books, New Delhi, 1999.
3. **Semi conductor opto electronics devices and** P. Bhattacharya, Prentice – Hall of India, New Delhi, 1995
4. **Optical fiber communications** and John M. Senior, Prentice-Hall of India, New Delhi, 2001
5. **Fibre Optic Communication** by Joseph C. Palais, Pearson Education Asia, India, 2001
6. **Introduction To Fibre Optics by** A.Ghatak And K.Thyagarajan, Cambridge University Press, New Delhi, 1999
7. **Optical Guided Wave Signal Devices** by R.Syms And J.Cozens. Mcgraw Hill,1993.
8. **Optical Electronics** by A Ghatak and K. Thyagarajan, Cambridge University Press, New Delhi, 1991
9. **Fundamentals of Photonics** by B.E.A. Saleh and M.C. Teich, John Willy and Sons, 1991
10. **Nanophotonics** by P.N.Prasad, Wiley Interscience, 2003.
11. **Biophotonics** by P.N.Prasad, Wiley Publications, 2004.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANTAPUR

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Pre-Ph.D - PHYSICS

(09PH56213) THIN FILM TECHNOLOGY

UNIT-I

Production and measurement of vacuum: Principle of low, medium and highvacuum pumps – Rotary and root pumps – diffusion, turbo molecular pump – ion pump, titanium sublimation pump – measurement of vacuum – Pirani gauge and Penning gauge

Preparation of Thin Films: Physical Methods : Vacuum evaporation: Types of evaporation sources – Resistive heating, electron beam evaporation, Two-source evaporation – Flash evaporation – Laser ablation – Reactive evaporation – Sputtering technique

UNIT - II

Preparation of Thin Films: Chemical Methods: Electroplating – Spray pyrolysis – chemical vapour deposition (CVD); Sol-Gel process; – Screen printing – Plasma Chemical vapour deposition (PCVD) – Metal organic chemical vapor deposition (MOCVD)

UNIT - III

Growth and Thickness Measurements of Thin Films: Condensation, Nucleation and growth of thin films – Langmuir Frenkel theory of condensation – Theories of thin film nucleation – Capillarity theory – Statistical or Atomistic theory – Comparison of the nucleation theories – The four stages film growth – Incorporation of defects during growth.Thickness measurement : - Quartz crystal thickness monitor

UNIT-IV

Characterization of Thin Films: Surface analytical techniques: Auger Electron Spectroscopy (AES), X-ray Photoelectron Spectroscopy (XPS), Secondary Ion Mass Spectroscopy (SIMS) and Rutherford Back Scattering (RBS)

UNIT – V

Imaging and optical analytic techniques : Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM) Optical analytical techniques: Fourier Transform Infrared Spectroscopy (FTIR)-Photo Luminescence (PL)

UNIT-VI

Transport Properties of Thin Films: Metallic films: Sources of resistivity in metallic conductors – sheet resistance and temperature coefficient of resistance of thin films – Influence of thickness on the resistivity of structurally perfect thin films – Fuchs Sondhemier theory – hall effect – Annealing, agglomeration and oxidation.

UNIT-VII

Optical Properties of Thin Films: Reflection and transmission at an interface – Reflection and transmission by single film – Reflection from an absorbing films- Optical absorption – Determination of optical constants by ellipsometry

UNIT-VIII

Applications of Thin Films

Thin film resistors – Thin film capacitors –Thin film solar cells – Gas sensors – Transparent conducting coatings - Thin films for superconducting devices –: hard coatings, Photolithography

References:

1. **"Hand book of thin film technology" by** L.I.Maissel and R.L.Glang, Mc Graw Hill Book Co., 1970.
2. **"Thin Film Phenomena" by** K.L.Chopra by Mc Graw Hill Book Co., New York, 1969.
3. **"Hand Book of Technologies for Films and Coatings" by** R.F.Bunshah, Noyes publication, 1996.
4. **"The Materials Science of Thin Films" by** M. Ohring, Academic Press, New York, 1992.
5. **"Hand Book Technologies of Films and Coatings" by** R.F.Bunshah, Noyes publication, 1996.
6. **"Hand book of thin film technology"** by L.I. Maissel and R.L. Glang, Mc Graw Hill Book Co., 1970.
7. **"Thin Film Phenomena" by** K.L.Chopra by Mc Graw Hill book Co., New York, 1969.
8. **"The Materials Science of Thin Films" by** M.Ohring, Academic Press, New York, 1992.

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Pre-Ph.D - PHYSICS

(09PH56214) SOLAR ENERGY

UNIT-I

Solar and Thermal Radiation: Spectral distribution of Extra-terrestrial radiation – Solar Constant-Concept of Zenith Angle and Air-Mass- Definitions of Declination, Hour Angle, Solar and Surface Azimuth Angles. Direct, Diffuse and Total Solar Radiations

UNIT-II

Flat-Plate Collectors: General description of a flat-plate collector- Liquid heating type flat-plate collector-Energy balance equation and efficiency. Temperature distribution in the flat-plate collectors-Collector over-all heat-loss coefficient- Definitions of fin efficiency - Collector efficiency factor, Collector heat-removal factor and Collector flow-factor

UNIT-III

Concentrating Collectors: Types of Concentrating Collectors - non-imaging and imaging concentrators-single axis and two-axis tracking – Definitions of Aperture, Rim-angle, Concentration ratio and Acceptance angle. Thermal performance of Linear Parabolic Trough Concentrator with an uncovered receiver.

UNIT-IV

Solar Thermal Energy Applications: Thermal Energy Storage - Sensible heat storage- Latent Heat storage and Thermochemical storage. Principles of Solar Water Heating System- Natural and Forced Circulation types-sizing of domestic water system.

UNIT-V

Solar cells: Photovoltaic effect, Types of interfaces, homojuction, heterojunction and Schottky barrier - Choice of semiconductor materials for fabrication of homojunction solar cells. equivalent circuit of a solar cell. Solar cell output parameters -Fill-factor, conversion efficiency, quantum efficiency.

UNIT – VI

Silicon Photovoltaics

Preparation of metallurgical grade and solar grade silicon - Single crystal silicon ingot growth – Float Zone and Czochrolski methods – silicon wafer fabrication – wafer to cell formation - I-V characteristics and spectral response of single crystal silicon solar cells. Factors limiting the efficiency of silicon solar cells

UNIT – VII

Thin Film Solar Cells

Amorphous Silicon – differences in properties between crystalline silicon and amorphous(a-Si) silicon. a-Si deposition by glow discharge method – electrial and optical properties of a-Si. Amorphous Silicon solar cell configurations. GaAs thin film solar cells - cell configuration - efficiency

UNIT-VIII

Solar Photovoltaic Systems: Photovotaic Module Assembly: Description of steps involved in the fabrication of Silicon Photovoltaic Module - Performance of Photovoltaic Module - Module Protection - Modules in series and in parallel -

References:

1. **Solar Thermal Energy Engineering** by J.A.Duffie and W.A.Beckman, John Wiley & Sons (1990)
2. **Solar Energy Utilization** by G.D.Rai , Khanna Publishers.
3. **Principles of Solar Energy Engineering** by Kreith and Kreider
4. **Treatise on Solar Energy – Vol I** - by H.P.Garg, John Wiley.
5. **Applied Solar Energy** by Meinel and Meinel
6. **Solar Cells** by Charles E.Backus, IEEE Press.
7. **Fundamentals of Solar Cells** by Farenbruch and Bube
8. **Solar Electric Systems** by G.Warfield(Ed) Hemisphere Pub(1983)
9. **Terrestrial Solar Photovoltaics** by Bhattacharya.
10. **Solar Cells** by Martin A Green
11. **Thin Film Solar Cells** by K.L.Chopra and Das, Plenum

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ANANTAPUR

Pre-Ph.D - PHYSICS

(09PH56215) DIGITAL SIGNAL PROCESSING

UNIT-I

Introduction: Signal Processing Example – Structure of Special Digital Signal Processors – Other Realizations of Digital Filters – Implementation of Digital Filters – Advantages of Digital Filters and Processing.

UNIT -II

Fundamentals of Discrete-Time systems: Introduction – Basic Definitions – Important Discrete-Time Signals – Discrete-Time systems – Fourier Transform of sequences – Sampling of Continuous-Time Signals – Digital filter with A/D and D/A.

UNIT-III

The Z Transform: Definition of the Z Transform – Inverse Z Transform – Relationships Between System Representations – Computation of Frequency Response – Solution of Linear Constant Coefficient Difference Equations.

UNIT-IV

Analog Filter Design: Introduction – Butterworth Filters – Chebyshev Filters – General Filter Forums.

UNIT - V

Digital Filter Design: Discrete-Time Filters – Design by Using Numerical Solutions of Differential Equations – Analog Design Using Digital Filters – Design of Digital Filters Using Digital-to-Digital Transformations – Impulse Invariant Design – FIR Filter Design.

UNIT – VI

Frequency response of digital filter: The Euler equation – frequency scaling – Computing DSP frequency response

UNIT-VII

The Discrete Fourier Transform

Introduction – Continuous-Time Fourier Series – Discrete-Time Fourier Series – The Discrete Fourier Transform – Computation of the Discrete Fourier Transform –

UNIT _ VIII

Fast Fourier Transform – Interpretation of DFT Results – DFT-Fourier Transform Relationships – Discrete Fourier Transforms of Sinusoidal Sequences.

References:

1. **"Fundamentals of Digital Signal Processing" by** Lonnie C. Ludeman, John Wiley & Sons (Asia) Pte. Ltd, 2003.
2. **"Elements of Digital Signal Processing"** by Prof. N. Sarkar, 2/e, Khanna Publishers,2000.
3. **Steve White, "Digital Signal Processing"** by 1/e, Vikas Publishing House, 2002.
   O. P. Verma, "Digital Signal Processing", 1/e, Dhanpat Rai & Co,