PERIYAR UNIVERSITY, SALEM-636011

M.Sc. BRANCH III (B)-PHYSICS

CHOICE BASED CREDIT SYSTEM (CBCS)
REGULATION AND SYLLABUS

(For the candidates admitted from 2008-2009 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

The two-year post-graduate program in M.Sc Physics consists of four semesters.

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 (CBCS) 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 (Choice Based Credit System) under semester system with internal assessment according to the syllabus prescribed from time to time.

Total marks	- 2000
For each paper	-100 Marks (Int. 25 + Ext. 75)
Project	- 200 Marks

05. DISTRIBUTION OF CREDIT POINTS

The minimum credit requirement for a two – year Master's Programme shall be 90 Credits. The break-up of credits for the programme is as follow:

Core Courses	:	Minimum 74 credits
Elective Courses	:	Minimum 16 credits

06. STRUCTURE OF THE COURSE

Semester	Code	Course Title	Hours per week	Credit	Exam. Hrs	Marks		
						Int.	Ext.	Total
I	PPHCC01	Mathematical Physics	5	5	3	25	75	100
	PPHCC 02	Classical and Statistical Mechanics	5	5	3	25	75	100
	PPHCC 03	Advanced Electronics	5	5	3	25	75	100
	PPHCC04	Practical -I Advanced Electronics (Examination at the end of Even Semester)	4	4	4	40	60	100
	PPHEC01	Elective – I	4	4	3	25	75	100
II	PPHCC 05	Electro Magnetic Theory	5	5	3	25	75	100
	PPHCC 06	Quantum mechanics – I	5	5	3	25	75	100
	PPHCC 07	Spectroscopy	5	5	3	25	75	100
	PPHCC08	Practical -II Advanced Physics experiments	4	4	4	40	60	100
	PPHEC02	Elective - II	4	4	3	25	75	100
III	PPHCC 09	Condensed Matter Physics	5	5	3	25	75	100
	PPHCC 10	Quantum Mechanics – II	5	5	3	25	75	100
	PPHCC 11	Micro Processors and Micro controllers	5	5	3	25	75	100
	PPHCC12	Practical -III Microprocessor and Microcontroller Experiments (Examination at the end of Even semester)	4	4	4	40	60	100
	PPHEC03	Elective – III	4	4	3	25	75	100
IV	PPHCC 13	Nuclear and Particle Physics	5	5	3	25	75	100
	PPHCC 14	Communication systems	5	5	3	25	75	100
	PPHEC04	Elective – IV	4	4	3	25	75	100
	PPHCC15	Project Work	7	7	-	-	-	200
		Total	90	90				2000

07. EXAMINATION

For the purpose of uniformity, particularly for interdepartmental transfer of credits, there will be a uniform procedure of examination to be adopted by all teachers offering courses. There will be three test and seminars and one End semester examination during each semester. The practical examination for P.G. Course should be conducted at the end of even semester.

The distribution of marks between Sessional Evaluation and End Semester will be 25% and 75% respectively. The sessional evaluation is distributed to test, seminar and attendance as 15% & 5% and 5% respectively.

08. QUESTION PAPER PATTERN

Question paper pattern for University Examinations

Time - 3 Hours

Maximum - 75 Marks

Passing Minimum - 38 Marks

Part – A (5x5=25 Marks)

Answer all questions

(Either or Type)

Part – B (5x10=50 Marks)

Answer all questions

(Either or Type)

09. PASSING MINIMUM

In order to pass a paper 50 % Minimum is compulsory both in the internal and external.

A candidate who has secured a minimum 50 marks (internal -12 and external -38) in all the courses prescribed in the programme and earned a minimum of 90 credits will be considered to have passed the Master's programme.

10. COMMENCEMENTS OF THIS REGULATION

These regulation and syllabus shall take effect from the academic year 2008 – 2009, that is, for students who are admitted to the first year of the course during the academic year 2008-2009 and there after.

List of Elective Courses

1. PPHEC01 - Bio-Physics
2. PPHEC02 - Nano Science
3. PPHEC03 - Photonics
4. PPHEC04 - Crystal Physics
5. PPHEC05 - Energy Physics
6. PPHEC06 - Non-Linear Dynamics

MATHEMATICAL PHYSICS

PAPER CODE: PPHCC01

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-Applications 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 (a) Special function and differential equations

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

(b) Dirac delta function and green's function

Dirac-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.

UNIT-V Group theory

Definition-Symmetric operation-symmetry elements-subgroups-reducible-Irreducible representation-Orthogonality theorem-Character table(C_2v,C_3v,D_2h)

Books for Study

1. F.A.Cotton,Chemical application of Group Theory,Wiley Eastern Ltd.
2. P.K.Chattopadhyay, Mathematical Physics,Wiley Eastern Ltd,N.Delhi(1990)
3. B.D.Gupta, Mathematical Physics, Vikas Publishing House Pvt.Ltd.(2004), New Delhi
4. Sathyaprakash,Mathematical Physics,Sultan Chand & Sons,New Delhi(2004)
5. Puramik,Group theory and Molecular Vibrations, Sultan Chand Sons, New Delhi.
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 Pragasan, Meerut, 11th Edition (1996).
8. K.V.Raman, Group Theory, Tata McGraw Hill.
9. 10. L.A. Pipes and Henvil, Applied Mathematics for Engineers and Physicists, International Students Edition, McGraw Hill Ltd., Singapore(1970)

CLASSICAL AND STATISTICAL MECHANICS

PAPER CODE:PPHCC02

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 & Kumar,Classical Mechanics, Tata Mc Graw Hill (2005)

2. Satya Prakash, Classical Mechanics, Pragati Prakashan, Meerut (2005)

3.Gupta & Kumar, Statistical Mechanics, Pragati Prakashan, Meerut (2005)

4. B.K.Agarwal & Malvin Einster, Statistical Mechanics, New Age International Publishers, New Delhi (2002)

5. H. Golstein, Classical Mechanics, Narosa Publishing Hous, New Delhi (1985)

6. Paul Fieisher,Objects in motion-Principles of Classical Mechanics(Secrets of the Universe),Lemer Publications(2001)

ADVANCED ELECTRONICS

PAPER CODE:PPHCC03

UNIT – I

Semiconductor Special Devices

JFET – Construction, characteristics - common source amplifier-Design guide lines – MOSFETS – depletion and enhancement mode MOSFETS – MOSFETS as switches –UJT - relaxation oscillator – SCR – Tunnel diode, Gunn diode, PIN diode – IMPATT diode – DIAC and TRIAC – construction and characteristics.

UNIT – II

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.

UNIT – III

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 – IV

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 – V

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 –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.

Books for Study

1. Gupta & Kumar , Hand book of Electronics, Pragati Prakashan, Meerut
2. D. Roy Choudhary, Linear Integrated Circuits, New Age Publications.
3. William Cooper, Electronic measurements and instrumentations, TMG Hill.
4. G.K. Mithal, Electronic devices and Circuits, Khanna Publishers – New Delhi.
5. A.K Sawhney, A Course in Electrical and Electronics Measurements and instrumentations, Dhanpat rai & sons, New Delhi.
6. K.R. Botkar, Integrated Circuits, Khanna Publishrs, Delhi.
7. Jacob Millman & Christor. S.C. Halkias, Integrated Electronics – Analog & Digital Circuits and Systems, Tata Mc Graw Hill
8. Gayakwad , Operational amplifier, TMG Hill

PRACTICAL - I

ADVANCED ELECTRONICS EXPERIMENTS

PAPER CODE:PPHCC04

1. FET characteristics and Design of FET amplifier
2. UJT characteristics and Design of Saw tooth wave oscillator
3. Characteristics of Tunnel diode and Gunn diode
4. Design of square wave generator using IC 741 and Timer 555 ICs – 555 IC as VCO
5. Design of Monostable multivibrator using the IC s 741 and 555 timer- study of frequency divider
6. Design of schmitt's Trigger using the ICs 741 and 555 timer – squarer
7. Analog computer circuit design – solving the simultaneous equations
8. Design of second order Butterworth active filter circuits – Low pass, High pass and Multiple feed back band pass filters
9. Binary addition and subtraction – 7483 IC
10. Multiplexer and Demultiplexer
11. Decoders and Encoders
12. Counters and shift registers – 7476/7473 IC
13. BCD counter – Decoding and Display
14. Design of binary weighted and R/2R Ladder DAC using the IC 741
15. Construction of ADC using DAC, comparator and counter.

ELECTROMAGNETIC THEORY

PAPER CODE:PPHCC05

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 -Prantice Hall of India Pvt.Ltd.- New Delhi, (2000)
2. J.D.Jackson-Classical Electrodynamics- III Edition -John Wiley (2000)
3. Paul Corson and Dale R.Corson -E Electromagnetic waves and fields- III Edition -CBS Publishers and Distributers, New Delhi(2000)
4. M.A.Wazed Miah-Fundamentals of Electromagnetics -TMC Publishing-New Delhi(1998)
5. B.B.Laud-Electromagnetics- Prantice Hall of India Pvt.Ltd.- New Delhi(2000)
6. N.Narayana Rao-Basic Electromagnetics with Applications -Prentice Hall of India Pvt.Ltd.- New Delhi(2002)
7. Umesh Sinha- Electromagnetic Theory and applications -Tech. India Publications, New Delhi(2000)
8 Edward C. Jordan and Keith G.Balmain-Electromagnetic waves and radiating systems- III Edition -Prantice Hall of India Pvt.Ltd. New Delhi(2000)
9.John R.Reitz-Foundations of Electromagnetic Theory-VI Edition, Narosa Publishing House, New Delhi(2000)

QUANTUM MECHANICS-I

PAPER CODE:PPHCC06

UNIT-I

Quantum mechanical concepts of waves and particles

Material particles and matter waves-experimental evidences-de-Broglie wave length-quantum description of a particle: wave packets-wave velocity and group velocity-behavior of wave packet-uncertainty principle and its application- Gaussian wave packet-equation of motion: Schrodinger equations – physical interpretation of wave function – normalised and orthogonal wave functions- expansion theorem-admissibility conditions-stationary states-expectation values-probability current density-Ehrenfest's theorem. Momentum representation: momentum wave function-significance-superposition of plane waves-free particle- formulation of Schrodinger equation.

UNIT-II

Operator and matrix formulation of quantum mechanics

Operator formalism: Linear vector space- eigen values and eigen functions-Postulates of quantum mechanics- operators-Poisson brackets-commutation relations- Schwartz inequality. Martix formalism: Hilbert space-operators as matrices-matrix form of wave function-unitary transformation-eigen value problem-Equations of motion: Schrodinger, Heisenberg and interaction pictures. State space-Dirac's Bra and Ket vectors-coordinate and momentum representations-projection operator-matrix theory of harmonic oscillator.

UNIT-III

Particles in simple Potentials – Applications of Schrodinger equation

Potential step and rectangular potential barrier–applications alpha decay-triangular barrier-Solutions for Particle in 3D-infinitely deep potential well –square well potential (concept)- Application: Confined

levels in semiconductor transistors. Periodic potential: Bloch theorem-Kronig –Penny model for Band structure- Harmonic oscillator.

Particles in spherically symmetric potentials

Concept of spherical symmetric potential- Harmonic oscillator-One electron atom: Hydrogen atom problem-radial equation-energy eigen values-degeneracy-normal state. Application to doping of semiconductors – excitation in semiconductors.

UNIT-IV

Identical particles and spin

Physical meaning of identity-symmetry and antisymmetric wave functions and their construction-distinguishability- Pauli's exclusion principle-Slater's determinant-spin matrices-commutation relations-density operator and density matrix-symmetric and antisymmetric wave functions hydrogen molecule.

Angular momentum

Commutation relation of total angular momentum-spin angular momentum-commutation relations components-eigen value spectrum-combination of angular momentum states: Clebsch Gordan coefficients – calculation of CG for $j_1=½$, $j_2=½$ and p-state of electron.

UNIT-V

Approximation methods: Time independent perturbation theory

Stationary perturbation theory – non-degenerate case-Normal helium atom- Harmonic oscillator – Zeeman effect-degenerate case-Stark effect in hydrogen atom.

Variational method

Ground state of Helium atom-Deutron problem. WKB approximation: validity of WKB approximation-solution near turning points-connection formulas- Application to bound states-emission of electrons from a metal.

Books for Study

1. Quantum mechanics, Sathya Prakash, Kedar Nath Ram Nath and Co. Publications.
2. A Text book of Quantum mechanics, P.M. Mathews and K.Venkatesan, Tata McGraw Hill Publications.
3. Quantum mechanics, Vol. I, Claude Cohen-Tannoudji, Bernard Diu, Frank Laloe, John Wiley Interscience Publications.
4. Quantum mechanics-Fundamentals and Applications to Technology, Jasprit Singh, John Wiley –Interscience Publications.
5. Quantum Mechanics (5^{th} edition)-Theory and application by A.K.Ghatak and Lokanathan, Macmillan India Ltd Publication.
6. Quantum mechanics, G. Aruldhas, Prentice Hall of India Publications.
7. Quantum mechanics, Leonard I. Schiff, McGraw – Hill Publications.
8. Quantum mechanics,Eugen Merzbacher, John Wiley –Interscience Publications.

SPECTROSCOPY

PAPER CODE:PPHCC07

UNIT-I

Vibrational Spectroscopy

Symmetry of polyatomic molecules and molecular vibrations-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.

UNIT-II

IR-Spectroscopy

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

UNIT-III

RAMAN SPECTROSCOPY

FT Raman spectroscopy – degree of depolarization – structure determination using IR and Raman spectroscopy – Resonance Raman spectroscopy – Coherent anti – Stokes Raman spectroscopy – Inverse Raman and surface Enhanced Raman spectroscopy – principles, techniques and applications – non-linear Raman spectroscopy.

UNIT-IV

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-V

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.

Books for Study

1. D.N.Sathyanarayana- Vibrational Spectroscopy and Application - New Age International Publication(2004)
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)
4. B.P.Straughan and Walkar, Spectroscopy Vol.1,Chapman and Hall (1976)
5. B.P.Straughan and Walkar, Spectroscopy Vol.2,Chapman and Hall (1976)
6. Atta-Ur-Rahman, Nuclear Magnetic Resource, Springer Verlag (1986)
7. H.S.Randhava, Modern molecular spectroscopy, McMilan India Ltd., (2003)

8. Raymond Chang, Basic Principles of spectroscopy, Mr Graw Hill Koyakusha Ltd., (1980)
9. D.A.Long, Raman Spectroscopy, Mc Graw Hill , International Book Company.

PRACTICAL – II

ADVANCED PHYSICS EXPERIMENTS

PAPER CODE:PPHCC08

1. Young's modulus – Elliptical and Hyperbolic fringes
2. Stefan's constant
3. Susceptibility – Guoy and Quincke's methods
4. Hydrogen spectrum & Solar spectrum – Rydberg's constant
   Rydberg's constant
5. F.P. Etalon
6. L.G Plate
7. Michelson's Interferometer
8. Arc Spectra Fe-Hg (or) Cu-Hg (or) Brass-Hg
9. Molecular spectra ALO band or CN band
10. Solar constant
11. Ultrasonic interferometer - compressibility
12. Temperature coefficient of thermistor & Semiconductor – Band gap energy
13. Hall effect - semiconductor
14. GM Counter
15. Laser experiments:
    i) Diffraction at straight edge
    ii) Interference – Lloyd's single mirror method
    iii) Interference using optically plane glass plate and laser
    iv) Diffraction at a circular aperture

CONDENSED MATTER PHYSICS

PAPER CODE:06PPH09

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

Free Electron 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.

Band theory

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 – 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.

UNIT – III

Crystal growth and characterization

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 – Working principles of Scanning Electron Microscope (SEM), Electron Probe Micro Analysis (EPMA), Energy Dispersive Analysis of X-rays (EDAX), Electron Spectroscopy for Chemical Analysis (ESCA) and Auger Electron Spectroscopy (AES). – Slow evaporation - solution growth – Gel method

UNIT – IV

Super Conductivity

Critical temperature – isotope effects – Meissner effect – Critical fields – type I and type II superconductors – thermodynamics of super conducting transitions – the London equations and penetration depth – Cooper pair – BCS theory – energy gap – Flux quantization – persistent currents – Ginsberg – Landau theory – interface energy and flux penetration – single particle tunneling – Josephson tunneling – Josephson effects – SQUIDS – Introduction to T_c super conductor- $YBa_2Cu_3O_7$ (Copper Oxide)

UNIT-V

Nano-structured and Non-Crystalline Solids

Definitions-Nano-Crystalline and non-crystalline Materials-XRD patterns-General Methods of preparation of Nano structured metals, Alloys and semiconductors by Physical and chemical routes-Inert Gas condensation technique and Sol-Gel process-Particle size estimation by XRD,SEM,AFM-Techniques-Size quantization effects, Band gap expansion(Blue shifts)in semiconductors, Charge transfer processes,

Quantum Wells, wires and Dots-density of states-Application of nano materials with specific examples.

Non-crystalline (amorphous) semiconductors-Band structure and conduction mechanism-Preparation techniques applications.

Books for Study

1. C.Kittel-Introduction to Solid state Physics,John Wiley and Sons,New Delhi
2. Neil.W.Ashcroft & N.David Mermin:Solid state Physics-International student Edition,Philadelphia
3. Singhal-Solid state Physics Kedarnath Ramnath & Co., (2005)
4. Gupta & Saxeena-Solid state Physics, Pragati Praashan,Meerut, 9th edition,(2004)
5. Rose,A.C.Innes and Rhoderick, E.H.Introduction to Superconductivity, Pergamon,Oxford(1976)
6. S.O. Pillai – Solid State Physics,New Age Publication,New Delhi, 2nd edition(2001)
7. A.J.Dekker, Solid State Physics, MacMilan, Madras(1971)

QUANTUM MECHANICS-II

PAPER CODE:PPHCC10

UNIT-I

Approximation methods: Time dependent perturbation theory

First order perturbation– constant perturbation- transition probability: Fermi-Golden rule-Harmonic perturbation- adiabatic approximation-sudden approximation.

Application Semi classical theory of radiation: - emission and absorption of radiation- electric dipole approximation- Einstein's transition probabilities and A & B coefficients -selection rules. Quantisation of radiation field- interaction with matter-spontaneous and stimulated emissions.

UNIT-II

Theory of Collisions and Scattering

Two particle collisions: center of mass and laboratory coordinate system-Scattering cross-sections-scattering angle.

Formulation of scattering theory-Green's function-Born approximation and its condition for validity-screened Coulomb potential-Gaussian potential-Partial wave analysis: optical theorem-Ramsaur-Townsend effect-phase shifts- low energy scattering: scattering length and effective range-integral equation-scattering by square well potential – coulomb field- identical particles.

UNIT-III

Relativistic theory of quantum mechanics

Klein-Gordon equation for a free particle-plain wave solution-charge and current density-Dirac relativistic equation –Plane wave solutions-probability density and current density-spin orbit interaction-magnetic moment of electron-spectrum of hydrogen atom-negative energy state of electron-Dirac equation in covariant form.

Elements of field Quantization

Lagrangian field theory-Non-relativistic fields-relativistic fields: Klein-Gordon, Dirac and electromagnetic fields-interacting fields.

UNIT-IV

Atomic and molecular structure

Central field approximation - wave functions-shells and subshells-Thomas Fermi statistical method – Hartree's method of self consistant fields - application to Helium atom- Hartree Fock approximations-Hund's rules-atomic structure-effect of magnetic field hydrogen atom-weak and strong magnetic field.

UNIT-V

Quantum theory of valence bond

Covalent, ionic and vanderwals interaction-molecular orbital method-LCAO approximation-MO treatment of hydrogen molecule-bonding and antibonding orbitals-diatomic molecular orbitals-electronic configuration of molecules in the MO concept-VB method-Hilter-London theory of hydrogen molecule-hydrogen molecule in VB method-directed bonds-sp, sp^2, sp^3 hybridizations.

Books for Study

1 P.M. Mathews and K.Venkatesan, A Text book of Quantum mechanics, Tata McGraw – Hill Publications.

2 Sathya Prakash, Quantum mechanics, Kedar Nath Ram Nath and Co. Publications.

3 Jasprit Singh, Quantum mechanics-Fundamentals and Applications to Technology, John Wiley –Interscience Publications

4 A.K.Ghatak and Lokanathan, Quantum Mechanics (5^{th} edition)-Theory and applications, Macmillan India Ltd Publication.

5. Leonard I Schiff, Quantum mechanics, McGraw – Hill Publications.

6. Eugen Merzbacher, Quantum mechanics, John Wiley –Interscience Publications.

7. Claude Cohen-Tannoudji, Bernard Diu, Frank Laloe, Quantum mechanics , Vol. I, John Wiley Interscience Publications.
8. G. Aruldhas, Quantum mechanics, Prentice Hall of India Publications.

MICROPROCESSORS AND MICROCONTROLLERS

PAPER CODE:PPHCC11

UNIT I

Architecture and Programming of 8085

Architecture of 8085 – organization of 8085 - control, data and address buses – registers in 8085 – addressing modes of 8085 – instruction set of 8085 - instruction types (based on number of bytes, based on operation) - data transfer, arithmetic, logical, branching, stack and I/O instructions **-** timing and sequencing - instruction cycle, machine cycle - halt state, wait state – timing diagram for opcode fetch, memory read and write cycles.

Assembly language programming - simple programs using arithmetic and logical operations – Interrupts - Maskable and Non - maskable, hardware and multilevel interrupts.

UNIT II

Data transfer schemes and interfacing

Memory interfacing and I/O interfacing – address space – address space partioning – data transfer schemes – programmed data transfer – Direct memory access – serial data transfer – types of interfacing devices – Programmable peripheral interface 8255 – programmable DMA controller 8257 – programmable communication interface 8257 USART –8251-programmable interrupt controller 8259 – programmable interval timer 8253 – programmable keyboard display 8279 – interfacing of ADC and DAC – wave form generation – LED interface – 7 segment Display interface – stepper motor interface –Keyboard Interface-traffic light controller.

UNIT III

Applications of microprocessors

Microprocessor based process control – closed loop control – open loop control - example for closed loop control – crystal growth control - microprocessor based temperature monitoring systems – limit settings – operator panel – block diagram.

UNIT IV:

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.

UNIT V

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. Aditya P. Mathur, Introductions to Microprocessors, Tata-Mc Graw Hill Company, II Edition.
2. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, Wiley Eastern.
3. Douglas V. Hall, Microprocessors and Interfaces, Tata-Mc Graw Hill Company. (1999).
4. Kenneta J. Ayala, The 8051 Microcontroller, Penram International-India.
5. Gilmore, Microprocessors, Tata McGraw Hill Edition. (1998)
6. Aditya P. Mathur, Introductions to Microprocessors, Tata-Mc Graw Hill Company, III Edition.
7. Lance A. Leventhal, Introductions to Microprocessors Software, Hardware Programming, Prentice Hall of India.
8. Kenneth L. Short, Microprocessor and Programmed Logic, Prentice Hall of India.

PRACTICAL – III

MICROPROCESSORS AND MICROCONTROLLERS EXPERIMENTS

PAPER CODE:PPHCC12

1. Addition, Subtraction, Multiplication and Division – 16 bit numbers
2. Sum of a series of 8 – bit numbers solving expressions
3. Finding the largest / smallest number in a data array & Arranging a series of numbers in Descending /Ascending order.
4. Square, Square root and factorial of a number
5. Code conversions and temperature conversion
6. Clock programs
7. Interfacing of an 8 – bit DAC and wave form generation [square, Rectangular, Saw tooth, triangular and sine waves].
8. Interfacing of ADC – DAC and comparator
9. Interfacing of ADC 0809
10. Interfacing of LED – study of counters
11. Interfacing of seven segment display – Display of Alphanumeric character
12. Stepper motor interfacing
13. Traffic light controller
14. Hex – key board interface
15. Microcontroller based experiments
    a. Arithmetic operations
    b. Array operations
    c. Code conversion

    (Option 18 compulsory)

NUCLEAR AND PARTICLES PHYSICS

PAPER CODE:PPHCC13

UNIT I

Nuclear Model: Nuclear stability – Mass parabolas – Nuclear shell model – Liquid drop model – Optical model – Collective model.

Nuclear Forces: Exchange forces – Yukawa's meson theory – Yukawa potential – Ground state of deuteron – Magnetic moment – Tensor forces – Scattering length – Phase shift, Scattering amplitude – low energy n-p scattering – effective rage – spin dependence and charge independence of nuclear forces.

UNIT II

Radio active decays : Neutrino hypothesis – Fermi's theory of beta decay – Selection rules-Non conservation of parity in beta decay – Gamma decay – Selection rules – internal conversion – Nuclear isomerism

Nuclear detectors: Basic principle of particles detectors – Proportional counters – Geiger Muller counters – BF3 counters – Solid state and semiconductor detectors – Scintillation counter.

UNIT III

Nuclear fission: Characteristics of fission – Mass and Energy distribution of nuclear fragments – Nuclear chain reactions – Four factor formula – 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 – Pinch effects – Laser fusion techniques.

UNIT IV

Nuclear Reactions: Energetics of reactions – Q equation – level widths in nuclear reaction – Nuclear reaction cross section – Partial wave analysis – Compound nucleus mode – Resonance scattering – Breit – Wigner one level formula – Direct reactions – stripping and pick up reactions.

Scattering Process: 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. 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)
4. H.A. Enge, Introduction to Nuclear Physics, Addision Wesley, New York (1971)
5. W.S.C Williams, Nuclear and Particles Physics, Clarendon Press, London (1981)

COMMUNICATION SYSTEMS

PAPER CODE:PPHCC14

UNIT - I

Pulse-Modulation Systems

Sampling theorem – Low – Pass and Band – Pass signals, PAM, Channel BW for a PAM signal. Natural sampling. Flat–top sampling, Signal recovery through Holding, Quantization of signals, PCM transmission, quantization of noise, differential PCM Delta Modulation, Adaptive Delta modulation, CVSD. Signal to noise ratio in PCM and Delta Modulations – ASK, FSK, BPSK, DPSK, QPSK, QASK, MSK and QAM.

UNIT - II

Computer Communication System

Types of networks, Design features of computer communication networks – ISDN, LAN, Time Division Multiple Access (TDMA), Frequency division multiple Access (FDMA), ALOHA, slotted ALOHA and Carrier sense multiple Access (CSMA) Introduction to CDMA & WCDMA

UNIT - III

Fiber Optics Communication

Intensity modulation / direct detection, optical transmitter circuit, Optical receiver circuit, system design considerations. Digital Systems & Planning considerations, Analog systems, distribution systems, Advanced multiplexing strategies.

UNIT - IV

Microware Communication Systems

Propagation modes, Microwave communication system. Analog Microware Communication - Digital hierarchies, Digital Microware systems, Bandwidth efficiency, Digital Radio systems, Hybrid Microware systems.

Unit - V

Satellite communications

Orbital Satellites, Geostationary Satellites, Orbital Patterns, Look angles, orbital classifications, Spacing and frequency allocation, Radiation pattern, foot prints, satellite system link models, satellite system parameters, satellite system link equation, Link budget. Non-ideal system parameters. INSAT communications satellites. Multiple Accessing Frequency Hopping, Channel capacity.

Books for Study

1. Taub and schilling, “Principles of Communication Systems”, Second edition, Tata McGraw Hill (1991)
2. Simon Haykin, “Communication system”, Third Edition John Wiley & sons, Inc. (1994)
3. Wayne Tomasi, “Advanced electronics communication Systems”, fourth Edition, Prentice Hall, Inc., (1998)
4. M. Kulakarni, “Microwave and Radar Engineering”, Umesh Publications, 1998 Dennis Roddy, “Satellite Communications”, Second Edition, Mcgraw- Hill, (1996)
5. John M.Senior, “Optical Fiber Communications”, Second Edition, PHI, (1999)
6. Gerd Keise, “Optical Fiber Communications”, Second Edition, McGraw-Hill International Editions, (1991)

Project Work

Subject Code : PPHCC15

(Topics to be decided by Student / Supervisor)

Dissertation	:	160 Marks
(i) 2 Reviews	:	40+40 = 80 Marks
(ii) Report Valuation	:	80 Marks
Viva	:	40 Marks

ELECTIVE COURSES

BIO-PHYSICS

PAPER CODE:PPHEC01

UNIT-I

Chemical bonding, energies and transport process

Quantum mechanics-Pauli's exclusion principle- ionization energy-electron affinity-chemical bonding- electronegativity –strong bonds-secondary bonds. Energies-forces-bonds: interatomic potentials for strong and weak bonds-bond energies.

Rates of reaction: Free energy-internal energy-thermodynamics-statistical mechanics- reaction kinetics- water, acids, bases and aqueous reactions. Transport process: Diffusion –viscosity-thermal conduction.

UNIT-II

Techniques and methods

X-ray diffraction and molecular structure-NMR-Scanning Tunneling microscopy-atomic force microscopy-optical tweezers-patch clamping-molecular dynamics.

UNIT-III

Biomolecules and biological energy

Biological polymers: Nucleic acids-DNA-RNA-conformation-proteins-protein folding.

Biological Membranes: Historical background-membrane chemistry and structure-membrane physics. Biological energy: Energy consumption-respiration-photosynthesis-ATP synthesis.

UNIT-IV

Movement of organisms

Bacterial motion-chemical memory in primitive organisms-muscular movement-human performance.

Excitable membrane, nerve signals and memory

Excitable membranes: Diffusion and mobility of Ions-resting potential

Nerve signals: Passive response-Nerve impulses (action potentials)-nervous system.

Memory: Hebbian learning –Neural networks-Auto-association.

UNIT-V

Control of movement

Primary of movement-Ballistic control in a simplified visual system-more sophisticated-modes of control-structure of muscle fibres-central pattern generators-conditioned reflexes-volition-and Free will-consciousness-Passive verses active in mental processing-relevant anatomy and physiology-intelligence and creativity**.**

Book for Study

1. Rodyney M.J.Cotterill, Biophysics: An introduction, John Wiley and sons Publications.
2. Roland Glacer, Biophysics, Springer Publications.
3. P.K.Srivastava, Elementary Biophysics An introduction, Narosa Publishing House.
4. M.V.Volkenshtein, Biophysics, Mir Publications, Moscow.
5. Vasantha Pattabi and N. Gautham, Biophysics, Narosa Publishing House.

NANOSCIENCE

PAPER CODE:PPHEC02

UNIT-I

Introduction to the Nanoworld: Introduction – Historical perspective on Nanomaterial – Classification of Nanomaterials – nanorods – nanotubes – nanoparticles – Nanobiotechnology.

UNIT-II

Metals, Semiconductors and Ceramics Nanocrystals: Reduction of size – synthesis of metal nanoparticles and structures – Routes to arrangements – Background on Quantum Dot semiconductors – background on reverse Micellar solution – Synthesis of Semiconductors – Cadmium Telluride Nanocrystals – Cadmium sulfide Nanocrystals – Alloy Semiconductors – 2D and 3D super lattices of Silver sulfide nanocrystals – Synthesis of Ceramics – Bondings and defects – Chemical, Physical and Mechanical properties of Ceramics.

UNIT-III

Nanoparticles and Magnetism: Magnetism in particles or reduced size and dimensions – variations of magnetic moment with size – magnetism in clusters of non magnetic solids – magnetic behaviour of small particles – Diluted Magnetic Semiconductors (DMS) – Fe – DMS and IV-VI Mn DMS and their applications – intermetalic compounds – binary and ternaries and their magnetic properties. Importance of nanoscale magnetism.

UNIT-IV

Chemical and Catalytic Aspects of Nanocrystals: Nanomaterials in Catalysis – Nanostructure Adsorbents – Nanoparticles as new chemical reagents – nanocrystal superlattices.

Specific Heats and Melting Points of nanocrystalline Materials specific Heat of nanocrystalline Materials – melting points Nanoparticles materials.

UNIT-V

Application of Nanotechnology: Structural and Mechanical materials – Colorants and Pigments – Carbon Nano tubes – Applications – Electronics and Magnetic applications – Nano–Lithography. Nanobiotechnology – DNA – Chips, DNA array devices, drug delivery systems.

Books for Study

1. Kenneth . J.Klabunde, Nanoscale materials in Chemistry, A John willey & sons, Inc., Publication, (2001)
2. J.de Jongh, Physics and Chemistry of Metal Cluster compounds, Kluwer Academic Publishers, Dordrecht, (1994)
3. V.Henrich, P.A.Cox, metal Oxides, Cambridge Universiyty Press, New Yourk, (1994)
4. Ed. George C. Hadjipanyis and Gary A.Prinz, NATO ASI Series, science and Technology of Nanostructured Magnetic Mateials, Plenum Press, New York, (1991)
5. D.Jiles, Introduction to Magnetism and Magnetic Materials, Chapman and Hall, London, (1991)
6. Christof M.Niemeyaer, Chad A. Mirkin, Nanobiotechnology : Concepts, Applications and Perspectives, (2004)

PHOTONICS

PAPER CODE:PPHEC03

UNIT – I

Introduction to Photonics

Description : Photonics and light technology – Scientific topics of Photonics – Technical topics – Properties of photonics – speed – Energy – Frequency – Wavelength – Moments – Mass – timing – Uncertainty principle for photons – Position and momentum – Energy and time – Frequency and time – Uncertainty of field strength – Gaussian beams – Ray matrices – Deriving Ray matrices – Ray matrices of some optical elements.

UNIT – II

Linear interaction between light and matter

Refraction – Dispersion – Absorption – Emission – Measurement of absorption – Polarization in refraction and reflection - Relation between reflection absorption and refraction – Birefringence – Optical activity – Diffraction – Diffraction at a one dimensional slit – Diffraction at a two dimensional slit – Diffraction at a circular aperture – Diffraction at one dimensional gratings- Diffraction at a two dimensional gratings – Diffracting at optically thin and thick gratings – Light scattering processes – Rayleigh scattering – Mie scattering – Brillouin scattering – Raman scattering.

Unit – III

Non – Linear interaction of Light and matter

Non-linear polarization of the medium – second order effects – Generation of second harmonic – Phase matching – Type I and Type II phase matching – Quasi phase matching – Frequency mixing – Parametric amplifiers and oscillator – Pockel's effect – Electro optical beam deflection – Third order effects – Generation of third harmonics – Kerr effect –Spatial solitons – Stimulated Raman scattering (SRS) – Inverse Raman scattering (IRS) – Stimulated Raman Gain spectroscopy

(SRGS) – coherent antistokes Raman scattering (ARS) – Higher order non – linear effects.

UNIT-IV

Lasers

Principle – Pump mechanism – Quantum defect and efficiency – Electrical pumping in diode lasers – Lamp pumping – chemical pumping – Laser resonators – Stable resonators – unstable resonators – Threshold – Gain and power of laser beams – Laser intensity and power – Q switching – Generation of nano second pulses – Active Q switching – passive Q switching – Theoretical description of Q switching – Solid state lasers – Nd:YAG Nd:YVO – Nd Glass laser – Gas lasers- Ar and Kr ion lasers – Dye lasers – pulsed dye lasers – Laser safety.

UNIT-V

Non – Linear optical spectroscopy

Non – Linear transmission measurements – Experimental method – Evaluation of the nonlinear absorption measurement – Variation of excitations wavelength – Variation of excitation pulse width – Variation of spectral width of excitation pulse – Non-Linear emission measurements – Time resolved measurements – White Light generation with fs duration – white light generation with ps duration - Fluorescence in the ns range.

Book for Study

1. Ralf Men Zel , Photonics – Linear and Nonlinear interactions of Laser light and matter , Springer, New Delhi (2004).
2. R.W.Boyd, Non linear Optics, Academic press (1992)
3. P.N.Butcher, The elements of non – linear optics, Cambridge University press (1990)
4. M.C.Gupta, Hand book of photonics, CRC Press, New York (1997).
5. H.M.Gibbs, Non – linear photonics, Springer – New York (1990)

CRYSTAL PHYSICS

PAPER CODE:PPHEC04

UNIT-I

Nature and symmetries of crystals

Crystalline state–chemical bonding-nature of bonding-covalent, ionic, metallic, hydrogen and van der Waals bonds-symmetry. Space lattices and unit cell –crystal systems-centered lattices - non-primitive lattices-Bravais lattices-close-packing. Crystallization: methods of growing crystals-choosing crystals-absorption.

UNIT-II

Morphology and angular relations

Crystal faces and internal arrangement-Miller indices of crystal face-laws of rational indices- Miller indices-Application of Miller indices to crystal geometry-Miller Bravais indices.

Point groups and space groups

Point groups-crystal class. Plane lattices- Plane groups-compound symmetries-screw axes-Glide Planes-internal symmetry elements- space groups and symbols-simple illustration for triclinic-monoclinic and orthorhombic systems.

UNIT-III

X-rays and Reciprocal lattice

X-ray sources-construction and geometry-mono and polychromatic x-rays- synchrotron radiation sources -Laue and Bragg's x-ray diffraction.

Reciprocal lattice: Geometrical construction-mathematical relations-Reciprocal lattice for bcc and fcc lattices- Application of the reciprocal lattice: X-ray diffraction Construction of Brillouin Zone and Wigner seitz cell.

UNIT-IV

Powder and single crystal x-ray diffraction

Powder diffraction**:** Powder method-significance and diffraction geometry-measurement of Bragg angles and inter planar spacing-accurate parameter determination-indexing of powder photographs-analytical and graphical methods-interpretation-application.

Single crystal x-ray diffraction**:** Single crystal oscillation and rotation methods- Experimental arrangement – goniometer- diffraction geometry - reciprocal lattice coordinates: Bernal chart-technique for crystal orientation-interpretation of oscillation (rotation) photographs-determination of unit cell-use of oscillation method-moving film methods. Electron and neutron diffraction-electron diffraction methods for the observation of imperfections.

UNIT-V

Beyond ideal crystal

Ordering types-crystal twins-Modulated crystal structures-quasicrystals-mathematical basis-a periodic tilting-embedding quasi crystals-liquid crystals-Para crystals.

Physical Properties of crystals

Crystal anisotropy and tensors- electrical properties of crystals- elastic properties-piezoelectricity- modeling of structural and elastic behaviour-defects.

Books for study

1. O. N. Srivastava, A. R. Verma, Crystallography Applied to Solid State Physics, 2nd edition, New age International Publications. (Chapters: 1, 2, 3,5, 6, 10)
2. Stout and Jensen, X-ray structure determination (2nd edition), John Wiley Publications. (Chapters: 1 and 4).
3. C. Giacovazzo, Fundamentals of crystallography, Oxford University Press Publications. (Chapters: 4 and 10)
4. Azarrof , Powder Diffraction,
5. Klug and Alexander, Powder Diffraction.

ENERGY PHYSICS

PAPER CODE:PPHEC05

UNIT-I

Introduction to energy sources

Energy sources and their availability – prospects of renewable energy sources.

Solar radiation and its measurements

Solar constant – Solar radiation at the Earth's Surface – solar radiation Geometry – solar radiation measurements – solar radiation data – estimation of average solar radiation – solar radiation of tilted surfaces.

UNIT-II

Solar cells

Solar cells for direct conversion of solar energy to electric powers – Solar cell parameter – Solar cell electrical characteristics – Efficiency – Single crystal silicon solar cells – Polycrystalline silicon solar cells – cadmium sulphide solar cells.

UNIT-III

Applications of solar energy

Solar water heating – space heating and space cooling – solar photo voltaics – agricultural and industrial process heat – solar distillation – solar pumping – solar furnace – solar cooking – solar green house.

UNIT-IV

Wind Energy

Base principles of wind energy conversion wind data and energy estimation – Base components of wind energy conversion systems (WECS) types of wind machines – Generating systems – Schemes for electric generation – generator control – load control – applications of wind energy.

UNIT-V

Energy from Biomass

Biomas conversion Technologies – wet and Dry process – Photosynthesis.

Biogas generation: Introduction – basic process and energetic – Advantages of anaerobic digestion – factors affecting bio digestion and generation of gas.

Classification of Biogas plants

Continuous and batch type – the done and drum types of Bio gas plants-biogas from wastes fuel properties of biogas utilization of biogas.

Books for study

1. Kreith and Kreider, Priciples of solar Engineering, Mc Graw Hill Publication.
2. A.B.Meinel and A.P.Meinel, Applied Solar Energy.
3. M.P. Agarwal, Solar Energy, S.Chand & Co.,
4. S.P.Sukhatme, Solar Energy, Tata McGraw Hill (1998).
5. G.D.Rai, Non-Conventional Energy Sources, Khaunna Publishers, Delhi. (2005).

NONLINEAR DYNAMICS

PAPER CODE:PPHEC06

UNIT-I

Introduction to Nonlinear Dynamical Systems

The notion of nonlinearity – superposition principle and its validity – linear and nonlinear oscillators – autonomous and nonautonomous systems – equilibrium points – phase space classification of equilibrium points.

UNIT-II

Chaos

Simple bifurcations – the logistic map – period doubling phenomenon – onset of chaos-bifurcation scenario in Duffing oscillator – chaos in conservative systems : Poincare surface of section – Henon – Heiles systems – Lyapunov exponents.

UNIT-III

Solitons

Nonlinear dispersive system – cnoidal and solitary waves – the scott Russels Phenomenon and K-dV equation – Fermi – Pasta – Ulam Numerical experiment – Numerical experiment of Zabusky and Kruskal – birth of soliton.

UNIT-IV

Tools to solve Non- Linear Equations

Integrability and methods to solve soliton equations the notion of Integrability – Painleve' analysis – Lax pair – Inverse Scattering Transform method – Bilinearization procedure – examples – Korteweg – de – Vires – Nonlinear Schordinger equations.

UNIT-V

Applications of Non-Linear Dynamics

Applications – Chaos and secure communications – soliton in condensed matter system – Non linear optics and biological systems.

Books for Study

1. M. Lakshmanan and S. Rajasekar, Nonlinear dynamics: Integrability Chaos and Patterns, Springer – Verlag, Berlin(2003)
2. P. G. Drazin, Nonlinear systems, Cambridge University Press, Cambridge(1992)
3. P.G. Drazin and R.S. Johnson, Solitons: An introduction, Cambridge University Press, Cambridge(1989)
4. M.J. Ablowitz and P.A. Clarkson, solutions, Nonlinear Evolution Equations and Inverse Scattering, Cambridge University Press, Cambridge(1991)