JAYARAJ ANNAPACKIAM COLLEGE FOR WOMEN (AUTONOMOUS)

A Unit of the Sisters of St. Anne of Tiruchirappalli

Accredited with 'A' Grade (3rd Cycle) by NAAC

DST - FIST Supported College Since 2015

(Affiliated to Mother Teresa Women's University, Kodaikanal)

PERIYAKULAM – 625 601, THENI DT.
TAMIL NADU.

M.SC. PHYSICS
2017 - 2020

DEPARTMENT OF PHYSICS

PROGRAMME OUTCOMES - P.G

PO. NO.	UPON COMPLETION OF THIS PROGRAMME THE STUDENTS WILL BE ABLE TO
1.	Endow with in-depth knowledge, analyze and apply the understanding of their discipline for the betterment of self and society.
2.	Synthesize ideas from various disciplines, enhance the interdisciplinary knowledge and extend it for research.
3.	Gain confidence and skills to communicate orally/verbally in research platforms and state a clear research finding.
4.	Develop problem solving and computational skills and gain confidence to appear the competitive examination.
5.	Enhance knowledge regarding research by accumulating practical knowledge in specific areas of research.
6.	Achieve idealistic goals and enrich the values to tackle the societal challenges.

PROGRAMME SPECIFIC OUTCOMES - P.G.

PSO. NO.	UPON COMPLETION OF THIS PROGRAM THE STUDENTS WILL BE ABLE TO	PO MAPPED
1.	Apply the principles, phenomena and mechanisms involved in Physics to evaluate and interpret effectively	PO-1
2.	Apply appropriate resources and available modern technology in the multidisciplinary context.	PO-1 PO-2
3.	Develop critical thinking and problem solving skills to pursue scientific research and Carry out independent project, present and publish their findings.	PO-3 PO-4
4.	Design, apply and analyze the knowledge of Physics through experiments.	PO-5
5.	Equip themselves to prepare and appear for qualifying/competitive examinations	PO-6

P.G. PHYSICS COURSE PATTERN (2017 - 2020)

Sem.	Code	Title of the Paper	Hours	Credits
I	17PPH1C01	Classical and Nonlinear Dynamics	6	5
	17PPH1C02	Mathematical Physics - I	6	5
	17PPH1C03	Thermodynamics and Statistical Physics	6	5
	17PPH1E1A/ 17PPH1E1B	Advanced Electronics / Applied Physics	6	4
	17PPH1P01	Practical - I	6	5
		Total	**30**	**24**
II	17PPH2C04	Mathematical Physics - II	6	5
	17PPH2C05	Solid State Physics - I	6	5
	17PPH2E2A/ 17PPH2E2B	Microprocessor and Microcontroller / Crystal growth and Thin film Characterization	6	4
	17PPH2P02	Practical - II	6	4
	17PPH2I01	IDC: Biomedical Instrumentation	4	3
	17PGS2S01	Soft Skills	2	1
		Total	**30**	**22**
III	17PPH3C06	Quantum Mechanics - I	6	5
	17PPH3C07	Solid State Physics - II	6	5
	17PPH3C08	Electrodynamics and Plasma Physics	6	5
	17PPH3E3A/ 17PPH3E3B	Numerical Methods and MATLAB / Nanomaterials	6	4
	17PPH3P03	Practical - III	6	4
		Total	**30**	**23**
IV	17PPH4C09	Quantum Mechanics - II	6	5
	17PPH4C10	Nuclear and Particle Physics	6	5
	17PPH4C11	Molecular Spectroscopy	6	5
	17PPH4R01	Project	12	6
	17PPH4A01	Comprehensive Examination	-	2*
		Total	**30**	**21**
		Total for all semesters	**120**	**90+2**

*** Extra Credit**

INTERNAL QUESTION PATTERN

Time: 2 Hours **Marks: 60**

SECTION - A

Answer any 4 questions out of 5 (4x4=16)

SECTION - B

Answer any 2 questions (either - or type) (2x10=20)

SECTION - C

Answer any 2 questions out of 3 (2x12=24)

(Marks obtained will be converted to 30)

EXTERNAL QUESTION PATTERN

Time: 3 Hours **Marks: 60**

SECTION - A

Answer 6 questions out of 10 (2 questions from each unit) (6x3=18)

SECTION - B

Answer 3 questions out of 5 (1 question from each unit) (3x6=18)

SECTION - C

Answer 3 questions out of 5 (1 question from each unit) (3x8=24)

CLASSICAL AND NONLINEAR DYNAMICS

Semester: I **Hours: 6**

Code : 17PPH1C01 **Credits: 5**

COURSE OUTCOMES:

- Describe the motion of a system using Lagrangian and Hamiltonian formalisms.
- Demonstrate the conceptual understanding of variational principle and canonical transformations.
- Explain the intricacies of moving frames and rigid body dynamics.
- Analyze and distinguish the behaviour of linear and non-linear dynamical systems.
- Identify various types of bifurcations in 1D and 2D systems and construct bifurcation diagrams and Interpret the conditions for the occurrence of chaos

UNIT I: LAGRANGIAN AND HAMILTONIAN DYNAMICS

Constraints - Generalized co-ordinates - Principle of Virtual Work - D'Alembert's principle - Lagrange's equations from D'Alembert's principle - Procedure - Lagrange's equation in presence of non-conservative forces - Generalized potential - Hamilton's principle and Lagrange's equations.

Generalized momentum & Cyclic co-ordinates - Conservation theorems - Hamiltonian function - Hamilton's equations - Examples - Routhian. **(18 Hours)**

UNIT II: VARIATIONAL PRINCIPLE AND CANONICAL TRANSFORMATIONS

Calculus of variations and Euler-Lagrange's equations - Deduction of Hamilton's principle from D'Alembert's principle - Modified Hamilton's principle - Hamilton's equations from modified Hamilton's principle - Lagrange's equations from variational principle for non-conservative systems - Lagrange's method of undetermined multipliers - Physical significance - Examples - Δ variation - Principle of least action.

Canonical & Legendre transformations - Generating functions - Procedure - Conditions - Bilinear invariant condition. Poisson's & Lagrange's brackets - Relation between them - Angular momentum - Invariance - Phase space - Liouville's theorem. **(18 Hours)**

UNIT III: SMALL OSCILLATIONS AND RIGID BODY DYNAMICS

Potential energy and equilibrium - 1D oscillator - Two coupled oscillators - Normal coordinates and normal modes - Examples. General theory of small oscillations - Secular and eigenvalue equation - Linear tri-atomic molecule.

Generalized co-ordinates of a rigid body - Reference systems - Euler's angles - Angular velocity - Angular momentum and Inertial Tensor- Principal moments of inertia - Rotational Kinetic energy - Symmetric bodies - Euler's equations.

(18 Hours)

UNIT IV: LINEAR AND NONLINEAR SYSTEMS

Dynamical systems - Nonlinearity - Mathematical implications, Working definition, Effects - Linear and Nonlinear oscillators - Free, damped, forced - Primary and Secondary resonances - Jump phenomenon - Autonomous and Non-autonomous systems - Phase trajectories - Equilibrium points - Stability, Classification. **(18 Hours)**

UNIT V: BIFURCATIONS AND CHAOS

Simple bifurcations - Saddle Node - Pitchfork - Transcritical - Hopf - Discrete Dynamical Systems - Logistic map - Equilibrium points and their stability - Periodic solutions or cycles - Period doubling phenomenon - Onset of chaos - Bifurcation diagram - Cobweb diagrams. **(18 Hours)**

BOOKS FOR STUDY

1. Classical Mechanics - J. C. Upadhyaya - Himalaya Publishing House, Mumbai, 2003.

   UNIT - I: Chapter - 2: 2.1 to 2.11, Chapter - 3: All sections

   UNIT - II: Chapter - 5: 5.1 to 5.11, Chapter - 6: 6.1 to 6.6, Chapter - 7: All sections

   UNIT - III: Chapter - 9: 9.1 to 9.6, Chapter - 10: 10.1 to 10.11

2. Nonlinear Dynamics - Integrability, Chaos and Patterns - M. Lakshmanan & S. Rajasekhar - Springer (India) Private Limited, New Delhi, 2003.

   UNIT - IV: Chapter - 1: All sections, Chapter - 2: 2.1, 2.2, Chapter - 3: 3.1 to 3.4

   UNIT - V: Chapter - 4: 4.1, 4.2

BOOKS FOR REFERENCE

1. Classical Mechanics - H. Goldstein - Narosa Publications, New Delhi, 1984.
2. Classical Mechanics - N. C. Rana & P. S. Joag - Tata Mcgraw Hill Publications, New Delhi, 1999.
3. Nonlinear Oscillations & Chaos - M. Daniel - Narosa Publications, New Delhi, 2002.
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics- Sears and Salinger- Narosa Publishing House, New Delhi, 1998.

MATHEMATICAL PHYSICS-I

Semester: I **Hours: 6**

Code : 17PPH1C02 **Credits: 5**

COURSE OUTCOMES:

- Explain and apply vector analysis in various applications.
- Compare and analyze various theorems of complex analysis.
- Use matrix theory in the determination of Eigen values and vectors and apply them in polynomials
- Formulate physical laws in terms of Tensors and simplify them using coordinate transformations
- Expand a function in Fourier series and relate to integral transforms

UNIT I: VECTOR ANALYSIS

Differential Vector Operators: Gradient- Divergence- Curl- Circular Cylinder Coordinates - Area law of planetary motion- Navier-Stokes Term- - Spherical Polar Coordinates- $\nabla, \nabla., \nabla X$ for a central force- Magnetic Vector Potential.

(18 Hours)

UNIT II: COMPLEX ANALYSIS

Complex Algebra- Permanance of the Algebraic form- Complex Conjugation - Function of a ComplexVariable- De Moivre's formula- Cauchy Riemann conditions- Analytic Functions- Cauchy's Integral Theorem- Contour Integrals- Stoke's Theorem Proof- Cauchy- Goursat Proof- Multiply Connected Regions- Cauchy's Integral Formula - Derivatives- Morera's Theorem- Laurent Expansion- Taylor's Expansion- Schwarz Reflection Principle- Analytic Continuation- Laurent Series- Singularities- Poles- Branch Points. **(18 Hours)**

UNIT III: MATRIX THEORY

Determination of eigen values-Eigen vectors and their properties- Diagonalization of matrix - Eigen vectors of commuting matrices- Differential equation to eigen value problem- Cayley Hamilton theorem - Minimal polynomial - Condition for diagonalizability - Diagonalization of normal matrices- Matrix polynomial.

(18 Hours)

UNIT IV: TENSORS

Occurrence of tensors in physics- Notation and conventions - Contravariant vectors- Tensors of second rank- Equality and null tensor- Addition and substraction - Outerproduct of tensors - Inner product of tensors - Contraction of a tensors- Symmetric and anti-symmetric tensors- The kronecker delta - The metric tensor- Contravariant metric tensor - Associate tensor. **(18 Hours)**

UNIT V: INTEGRAL TRANSFORMS

Fourier transform- Few properties of Fourier transform (shifting property, convolution property, parseval's theorem)- Fourier transform of derivatives - Development of the inverse Fourier transform - Laplace transforms- Properties of Laplace transforms- Laplace transform of derivatives- Inverse Laplace transform - Properties of Inverse Laplace transform **(18 Hours)**

BOOKS FOR STUDY:

1. Mathematical methods for physicists, G.B. Arfken & H.J.Weber ELSEVIER , A division of Reed Elsevier India Pvt. Ltd, VI 2004
2. Matrices and tensors in Physics, A.W. Joshi - New age International Publishers Revised III Edition, 2002.
3. Mathematical Physics with Classical mechanics by Satya Prakash - Sultan chand and Sons, Fourth Revised and enlarged edition 2002

DETAILED REFERENCE:

Mathematical methods for physicists, G.B. Arfken & H.J.Weber ELSEVIER, A division of Reed Elsevier India Pvt. Ltd, VI 2004

UNIT I : Chaper 2: 2.2-2.5,

UNIT II: Chapter 6: 6.1-6.6,

Matrices and Tensors in Physics, A.W. Joshi. New age International publishers Revised III Edition, 2002.

UNIT III: Chaper 9: 9.1-9.4, Chapter 10: all sections

UNIT IV: Chapter 15: 15.1-15.5, Chapter 16: 16.1-16.7, Chapter 18: 18.1-18.3

Mathematical Physics with classical mechanics by Satya Prakash - Sultan chand and Sons, Fourth Revised and enlarged edition 2002

UNIT V: Chapter 9.1-9.4, 9.9-9.11, 9.15, 9.17

BOOKS FOR REFERENCE:

1. The Mathematics of physics and chemistry by Margenau & Murphy
2. Fourier Transforms in Physics- D.C. Champeney wiley Eastern Ltd. July 1988.
3. Applied Mathematics for engineers and Physicists by Louis. A. Pipes and Lawrence R. Harvill III edn. McGraw - Hill International

THERMODYNAMICS AND STATISTICAL PHYSICS

Semester: I **Hours: 6**

Code : 17PPH1C03 **Credits: 5**

COURSE OUTCOMES:

- Describe fundamental laws of thermodynamics and distribution functions for classical and quantum statistics.
- Analyze various forms of ensembles.
- Describe the relation between various kinds of phase transitions.
- Explain the occurrence of irreversible processes and transport theory in gases.
- Deduce the equations governing fluctuations in thermodynamics

UNIT I: FUNDAMENTAL LAWS

Laws of thermodynamics - thermodynamic potentials and reciprocity relations - thermodynamic equilibrium - Nernst's heat theorem - Chemical potential.

Identical particles and symmetry requirements - Bose-Einstein Statistics - Fermi-Dirac Statistics - Maxwell-Boltzmann Statistics - Evaluation of the constants α and β - Results of three statistics . **(18 Hours)**

UNIT II: METHOD OF ENSEMBLES

Microcanonical ensemble - Perfect gas in microcanonical ensemble - Gibbs paradox - Partition function and its correlation with thermodynamic quantities - Gibbs canonical ensemble - Thermodynamic functions for canonical ensemble - Partition function and their properties - Perfect monatomic gas in canonical ensemble - Grand canonical ensemble - Partition function and thermodynamic functions for grand canonical ensemble - Perfect gas in grand canonical ensemble - Comparison of ensembles. **(18 Hours)**

UNIT III: PHASE TRANSITION

Phase transition - Phase transitions of first and second kind - Critical exponent - Yang and Lee theory - The Ising model - Bragg-Williams approximation - One dimensional Ising model.

Energy and Pressure of the gas - Gas degeneracy - Bose Einstein Condensation - Thermal properties of Bose Einstein gas - Liquid Helium. **(18 Hours)**

UNIT IV: TRANSPORT THEORY AND IRREVERSIBLE PROCESSES

Boltzmann transport equation - Lorentz solution - Chambers equation - Sommerfeld theory - Electrical and thermal conductivity - Magnetoresistance - Viscosity - Hall effect. Onsager relations - Proof - Applications. **(18 Hours)**

UNIT V: FLUCTUATIONS IN THERMODYNAMICS

Fluctuations in Energy, Pressure, Volume and Enthalpy - Probability - Brownian movement - Fokker Plank equation - Solution of Fokker Plank equation - Fourier analysis of random function - Wiener-Khintchine theorem - Electrical noise - Nyquist's theorem. **(18 Hours)**

BOOK FOR STUDY

Statistical Mechanics - S. L. Gupta & V. Kumar - 27th edition - Pragati Prakashan, Meerut, 2014.

UNIT I: Chapter - A: A-1 to A-7; Chapter - 6: 6.1 to 6.5

UNIT II: Chapter - 3: 3.0, 3.0-2 to 3.0-4; 3.1, 3.1-3 to 3.1-5; 3.2, 3.2-1 to 3.2-3

UNIT III: Chapter - 8: 8.0 to 8.4; Chapter - 13: 13.1 to 13.7

UNIT IV: Chapter - 10: 10.1 to 10.8; Chapter - 11: 11.0 to 11.2

UNIT V: Chapter - 12: 12.1 to 12.10

BOOKS FOR REFERENCE

1. Fundamentals of Statistical and Thermal Physics - Fredrick Reif - Tata McGraw Hill Publications, New Delhi, 1988.
2. *Statistical mechanics and properties of matter* - theory and applications - *E. S. R. Gopal* - Halsted Press (Wiley-Interscience), New York, *1974.*
3. Statistical Mechanics - K. Huang - John Wiley & Sons, New York, 1988.
4. Statistical Physics - L. D. Landau & E. M. Lifshitz - Pergamon Press, London, 1989.

ADVANCED ELECTRONICS

Semester: I **Hours: 6**

Code : 17PPH1E1A **Credits: 4**

COURSE OUTCOMES:

- Discuss the electrical characteristics of basic analog circuits.
- Describe the principles and types of optoelectronic devices.
- Analyze the equivalent circuit and various configurations of Op Amp.
- Analyze linear circuits and compute the parameters of Op Amps
- Design different types of filters and oscillators using Op Amps.

UNIT I: ANALOG CIRCUITS

The Ideal Diode-The Second approximation - The Third approximation - DC Resistance of a Diode- Load lines- **The Zener diode** - The Loaded Zener regulator - Second approximation of a Zener diode- Load Lines - The Schottky diode - **JFETS**-Basic ideas - Drain Curves - The Transconductance curves - JFET Amplifiers - The JFET Analog Switch - **MOSFETs** - The Depletion mode MOSFET - The enhancement mode MOSFET - The Ohmic region - **Thyristors**- The four layer diode - Bidirectional Thyristors. **(18 Hours)**

UNIT II: OPTO ELECTRONICS:

Light emitting diodes - Photodetectors -Physical principle - Spectral response - Detector materials - Types of Photo detectors : Photo conductor - PN-Photodiode - PIN Photodiode - Avalanche Photodiode - Photo transistors - Photodarlington Transistor - Noise in Photodiodes . **(18 Hours)**

UNIT III: FUNDAMENTALS OF OPERATIONAL AMPLIFIERS:

Interpreting a typical set of data sheets - The ideal Op-Amp - Equivalent circuit of an Op-Amp - Ideal voltage transfer curve - Open-loop Op-Amp configurations- Voltage-series feedback amplifier - Voltage-shunt feedback amplifier - Differential amplifiers - PSpice simulations. **(18 Hours)**

UNIT IV: OP-AMP PARAMETERS AND LINEAR CIRCUITS:

Input offset voltage -Input bias current and Input offset current - Total output offset voltage - Thermal drift - Effect of variation in power supply voltages on offset voltage - Change in Input offset voltage and Input offset current with time - Frequency response - Compensating networks - Frequency response of internally compensated Op-amps - Frequency response of Noncompensated OP-amps. **(18 Hours)**

UNIT IV: ACTIVE FILTERS AND APPLICATIONS:

Active filters - First-order Low-Pass Butterworth filter - Second-order Low-Pass Butterworth filter - First-order High-Pass Butterworth filter - Second-order High-Pass Butterworth filter -Square wave generators - Triangular wave generators - Sawtooth wave generators - Voltage-controlled oscillator-Phase locked loops-Voltage regulators. **(18 Hours)**

BOOKS FOR STUDY:

1. Electronic principles- Malvino sixth edition- Tata Mc Graw Hill Edition.
2. Optical communications components and systems - JH Franz and VK Jain,Narosa publishing house, New Delhi,2006.
3. Op-amp and Linear Integrated Circuits, Ramakant & A.Gayakwad - Fourth edition- PHI Learning Private Limited, New Delhi-110001.

DETAILED REFERENCES:

1. Electronic principles- Malvino sixth edition - Tata Mc Graw Hill Edition

   UNIT I: Chapter 3: 3.2-3.4, 3.9, 3.10, Chapter 5: 5.1-5.3, 5.7, 5.9 , Chapter 13: 13.1-13.3, 13.7, 13.8, Chapter 14: 14.1-14.3, Chapter 15: 15.1,15.5

2. Optical communications components and systems - JH Franz and VK Jain, Narosa publishing house, New Delhi, 2006.

   UNIT II: Chapter 2 : 2.3 , Chapter 6: 6.1.1 - 6.1.3,6.2.1- 6.2.6 , 6.3.1- 6.3.4

3. Op-amp and Linear Integrated Circuits, Ramakant & A.Gayakwad -Fourth edition- PHI Learning Private Limited, New Delhi.

   UNIT III: Chapter-2: 2.1 - 2.6, Chapter-3: 3.3 - 3.6

   UNIT IV: Chapter- 4: 4.1 - 4.8, Chapter-5: 5.2 - 5.5

   UNIT V: Chapter-7: 7.2 -7.6, 7.15 -7.18, Chapter-9: 9.5, 9.7

BOOKS FOR REFERNCE:

1. Integrated Circuits & Semiconductor Devices - G.J.Deboo & C.N.Burrous - Mc Graw Hill, Kogakusha Ltd, 1977.
2. Integrated Electronics - Millman Halkias, Tata Mc Graw Hill Publishers, 1998.

APPLIED PHYSICS

Semester: I **Hours: 6**

Code : 17PPH1E1B **Credits: 4**

COURSE OUTCOMES:

- Discuss ultrasonics and its applications.
- Analyze the properties of materials and its related applications
- Describe the working of electromagnetic devices and their applications.
- Compute the structure of the molecules applying group theory.
- Analyze vibrations of molecules in different systems.

UNIT I: ULTRASONICS

Ultrasonics as a means of communication - testing of material by ultrasonics - dispersive and colloidal effects of ultrasonics - separation of mixtures by ultrasonic cutting and machinery of hand materials - Biological effects - imaging method in medicine. **(18 Hours)**

UNIT II: ELECTRONIC DEVICES

Electro - optic effects - material properties related to get these effects -important ferroelectric, liquid crystal and polymeric materials for these devices.

(18 Hours)

UNIT III: ELECTROMAGNETIC DEVICES

Piezoelectric, electrostrictive and magnetostrictive effects, important material exhibiting these properties and their applications in sensors and actuator devices - Acoustic Delay lines, piezo electric devices - Surface acoustic wave devices.

(18 Hours)

UNIT IV: GROUP THEORY

Symmetry elements and operations - point group - character tables - deduction of the number of normal modes vibrations of different symmetry types - Applications to molecular structure. **(18 Hours)**

UNIT V: NORMAL COORDINATE ANALYSIS

Molecular vibrations - Types of force fields - Wilson's FG matrix method of evaluation potential constants-Applications to planner XY2 and XY3 systems- force constants and group frequencies. **(18 Hours)**

COURSE BOOKS:

1. Ultrasonics series I-VIII Optical electronics- W.Mason, Ajoy Ghatak & K. Thyagarajan, Cambridge University Press, 1998
2. Molucular Vibrations Wilson, Decius & Cross

BOOKS FOR REFERENCE:

1. Fundamentals of Ultrasonics Blitz Ultrasonics Vighrous
2. Chemical Applications of Group Theory Willey inter science

PRACTICAL - I

Semester: I **Hours: 6**

Code : 17PPH1P01 **Credits: 5**

COURSE OUTCOMES:

- Apply the mathematical concepts/ equation to obtain quantitative results and construct analog circuits
- Analyze magnetic properties of materials
- Apply the principles of optics to determine the mechanical properties of materials.
- Construct electronic circuits for various applications
- Work with analog and digital circuits

LIST OF PRACTICALS:

1. Applications of IC 555 timer
2. Karnaugh map.
3. Multiplexer and De-Multiplexer
4. Dielectric loss using CRO
5. Waveform generator
6. Analog Computation
7. Elastic constants - Elliptical fringes
8. Elastic constants - Hyperbolic fringes
9. Quincke's method
10. Anderson's bridge.

MATHEMATICAL PHYSICS-II

Semester: II **Hours: 6**

Code : 17PPH2C04 **Credits: 5**

COURSE OUTCOMES:

- Identity and discuss molecular symmetry and various properties of Group theory
- Formulate the character tables of groups and explain reducible, irreducible representations.
- Solve the partial differential equations and apply them in different coordinate systems
- Derive special functions and the recurrence relations.

UNIT I: MOLECULAR SYMMETRY IN GROUP THEORY

Defining properties of a group - Some examples of groups - Subgroups - Classes - Molecular symmetry and the symmetry groups - Symmetry elements and operations - Symmetry planes and reflections - The inversion centre - Proper axes and proper rotations - Improper axes and improper rotations - Products of symmetry operations - Equivalent symmetry elements and equivalent atoms - General relations among symmetry elements and operations - Symmetry elements and optical isomerism - The symmetry point groups - Symmetries with multiple higher order axes - A systematic procedure for symmetry classification of molecules - Illustrative examples - classes of symmetry operations **(18 Hours)**

UNIT II: GROUP THEORY

Representations of groups - "The Great Orthogonality Theorem" and its consequences - Five Important Rules- Illustration of Five Rules- Important Practical Relationship - Character tables - Character Table for D4- Representations for cyclic groups - Wave functions as bases for irreducible representation - The direct product. **(18 Hours)**

UNIT III: DIFFERENTIAL EQUATIONS

Partial Differential Equations (PDE) - Examples of PDE's- Classes of PDE's and Charecteristics- Nonlinear PDE's- Boundary Conditions- First order Differential Equations - Separation of variables - Exact Differentiil Equations -Linear First Order ODE's- Singular points - Seperation of variables- Cartesinan Coordinates- Circular Cylindrical Coordinates- Spherical Polar Coordinates- Singluar Points- Series solutions - Frobenius method- Symmetry of Solutions- Limitations of Series Approach- Bessel's Equation-Regualr and Irregular Singularities- Fuchs' Theorem. **(18 Hours)**

UNIT IV: SPECIAL FUNCTIONS I

Bessel function- Bessel functions of the first kind - Recurrence relation- Bessel's Differential equation- Integral representation- Bessel function of Nonintegral Order- Orthogonality- Normalization- Bessel Series- Continuum Form- Modified Bessel Functions- Recurrence Relations- Spherical Bessel function - definitions- Limiting Values- recurrence Relations- Orthogonality. **(18 Hours)**

UNIT -V: SPECIAL FUNCTIONS II

Legendre Function- Legendre Polynomials- Linear Electric Multipoles- Vector Expansion- Extension to Ultraspherical Polynomials- Recurrence relations and special properties- Differential Equations- Special Values- Parity- Upper and Lower Bounds - Orthogonality- Expansion of Functions, Legendre Series- Spherical Harmonics- Azimuthal Dependence - Orthogonally- Polar Angle Dependance- Spherical Harmonics- Laplace Series, Expansion Theorem- Hermite function- recurrence Relations- Alternate Representations- Orthogonality- quantum Mechanical Simple Harmonic Oscillator- Lauguerre functions- Associated Laguerre Polynomials. **(18 Hours)**

BOOKS FOR STUDY

1. Chemical Applications of group theory by F. Albert Cotton - II Ed, Wiley Eastern Ltd.
2. Mathematical methods for physicists, G.B. Arfken & H.J.Weber ELSEVIER , A division of Reed Elsevier India Pvt. Ltd, VI 2004

DETAILED REFERENCE

1. Chemical Applications of group theory - F. Albert Cotton - II Ed. Wiley Eastern Ltd.

UNIT I & II: Chapters: 2, 3, 4 & 5, Secs: 2.1- 2.4, 3.1- 3.15, 4.2- 4.5, 5.1, 5.2

2. Mathematical methods for physicists, G.B. Arfken & H.J. Weber ELSEVIER , A division of Reed Elsevier India Pvt. Ltd, VI 2004

UNIT III: Chapter 9: 9.1-9.5

UNIT IV: Chapter 11: 11.1-11.2, 11.5, 11.7.

UNIT V : Chapter 12: 12.1-12.3, 12.6, Chapter: 13: 13.1-13.2

BOOKS FOR REFERENCE:

1. Applied Mathematics for Engineers and Physicists- A.Pipes & R. Harvil- IIIedition- McGraw Hill international Book company- New Delhi.
2. Mathematical Physics with Classical mechanics by Satya Prakash - Sultan chand and Sons, Fourth Revised and enlarged edition 2002
3. Elements of Group Theory for Physicists, A. W. Joshi, , III Edition, Wiley Eastern Limited, 1975.

SOLID STATE PHYSICS-I

Semester: II **Hours: 6**

Code : 17PPH2C05 **Credits: 5**

COURSE OUTCOMES:

- Classify the crystals and analyze the diffraction of crystals in reciprocal lattice space.
- Analyze the nature of binding forces and mechanical forces in crystals
- Analyze the thermal vibrations of crystals and compute various parameters related to it
- Compute the energy bands with different methodologies
- Differentiate semiconductors and compute carrier concentrations and energy bands

UNIT I: CRYSTAL STRUCTURE & RECIPROCAL LATTICE

Classification of solids - Periodicity in Crystalline solids - Lattice translational vectors -Unit and Primitive cells - Bravais lattices - Symmetry operations - Crystal indexing -Miller Indices - direction in crystals - Atomic Packing factor - Density and lattice constant - Common crystal structure - Diffraction of wave by crystals - scattered wave amplitude -Brillouin Zones - Fourier analysis of the Basis - Quasi crystals. **(12 Hours)**

UNIT II: CRYSTAL BINDING AND ELASTIC CONSTANTS

Crystals of inert gases - ionic crystals - covalent crystals - metals - hydrogen bonds atomic radii - analysis of elastic strains - elastic compliance and stiffness constants - elastic waves in cubic crystals. **(12 Hours)**

UNIT III: PHONONS

Vibrations of crystals with monatomic basis - two atoms per primitive basis - Quantization of elastic waves - phonon momentum - inelastic scattering by phonons- phonon heat capacity - anharmonic crystal interactions - thermal conductivity. **(12 Hours)**

UNIT IV: FREE ELECTRON FERMI GAS & ENERGY BANDS

Energy levels in 1 D - Effect of temperture on the FD distribution - free electron gas in 3D heat capacity of the electron gas - electrical conductivity and Ohm's law - motion in magnetic fields - thermal conductivity of metals - nano structures - nearly free electron model - Bloch function - Kronig - Penney model- wave equation of electron - periodic potential - number of orbital in a band. **(12 Hours)**

UNIT V: SEMI CONDUCTOR CRYSTALS

Band gap - equation of motion - intrinsic carrier concentration - impurity conductivity - thermoelectric effects - semi metals - super lattices . **(12 Hours)**

BOOKS FOR STUDY:

1. Solid State Physics - Rita John - McGraw Hill Edition, First Edition
2. Solid State Physics - Charles Kittel - Wiley Eastern Limited, VII Edition (1996)

DETAILED REFERENCES:

Solid State Physics - Rita John - McGraw Hill Edition, First Edition

UNIT I : Chapter 2: 2.1 - 2.12, 2.15 - 2.20

Solid State Physics - Charles Kittel - Wiley Eastern Limited, VII Edition (1996)

UNIT I : Chapter 2

UNIT II : Chapter 3

UNIT III: Chapter 4 & 5

UNIT IV: Chapter 6 & 7

UNIT V : Chapter 8

BOOKS FOR RERERENCE:

1. Solid State Physics - S.O. Pillai - Wiley Eastern Limited, 1994 Edition
2. Solid State Physics- Ajay Kumar Saxena, Macmillan India Ltd.

MICROPROCESSOR AND MICROCONTROLLER

Semester: II **Hours: 6**

Code : 17PPH2E2A **Credits: 4**

COURSE OUTCOMES:

- Discuss evolution of microcontrollers from microprocessors.
- Describe the instruction set and write programs using FAR procedures.
- Use interfacing techniques in various applications
- Analyze the internal architecture and resources of 8051 microcontroller.
- Design software programs using the instruction set of 8051

UNIT I: INTRODUCTION

Computers, microcomputers and microprocessors - an introduction - computers, 8086, 8018, 80188, 80286 microprocessors, introduction, 8086 internal architecture - introduction to programming the 8086.-8086 family assembly language programming - introduction, program development steps, constructing the machine codes for 8086 instructions, writing programs for use with an assembler, assembly language program development tools. **(18 Hours)**

UNIT II: INSTRUCTION SET AND PROGRAMMING

More practice with simple sequence programs - Converting two ASCII number codes to packed BCD - FLAGS, JUMPS and WHILE DO implementation - 8086 unconditional jump instruction - Conditional jump. IF -THEN, IF -THEN - ELSE, AND MULTIPLE IF - THEN - ELSE programs - writing and using procedures - writing and calling FAR procedures - writing and using assembler MACROS.

(18 Hours)

UNIT III: INTERFACING

Digital interfacing and applications - programmable parallel ports and handshake input/output, interfacing a microprocessor to keyboards, interfacing to alphanumeric ports to high power devices, optical motor shaft encoders.

(18 Hours)

UNIT IV: INTEL 8051 MICROCONTROLLER - HARDWARE ARCHITECTURE

Architecture - Memory organization - Special Function Registers - Pins and Signals - Timing and Control - Port Operation - Memory Interfacing - I/O Interfacing - Programming the 8051 Resources - Interrupts. **(18 Hours)**

UNIT V: INTEL 8051 MICROCONTROLLER - INSTRUCTION SET AND PROGRAMMING

Programmers Model of Intel 8051 - Operand Types - Operand Addressing - Data Transfer Instructions - Arithmetic Instructions - Logic Instructions - Control Transfer Instructions - Case Study - Traffic Light Control. **(18 Hours)**

BOOKS FOR STUDY

1. D. V. Hall - Microprocessors and Interfacing, Programming and Hardware, 7th Edition - Tata McGraw Hill Publications, New Delhi - 1995.
2. Krishnakant - Microprocessors and Microcontrollers Architecture, Programming and system design 8085, 8086, 8051, and 8096 - PHI Learning Private Ltd, New Delhi - 2007.

BOOKS FOR REFERENCE

1. Ramesh S. Gaonkar - Microprocessor: Architecture, Programming and Applications with the 8085, V Edition - Penram International Publishing Pvt. Ltd - 2010.
2. R. Theagarajan - Microprocessor and Microcontrollers - Scitech Publications Pvt. Ltd - 2004.

DETAILED REFERENCE

D. V. Hall - Microprocessors and Interfacing, Programming and Hardware, 7th Edition - Tata McGraw Hill Publications, New Delhi - 1995.

UNIT I: Chapters 2 & 3 - All sections, Pages 24 - 71.

UNIT II: Chapters 4 & 5 - Pages 72 - 86, 104 - 141.

UNIT III: Chapter 9 - All sections, Pages 261 - 310.

Krishnakant - Microprocessors and Microcontrollers Architecture, Programming and system design 8085, 8086, 8051, and 8096 - PHI Learning Private Ltd, New Delhi - 2007.

UNIT IV: Chapter 9: 9.1 - 9.11

UNIT V : Chapter 10: 10.1 - 10.8, Chapter11: 11.1, 11.2

CRYSTAL GROWTH AND THIN FILM CHARACTERIZATION

Semester: II **Hours: 6**

Code : 17PPH2E2B **Credits: 4**

COURSE OUTCOMES:

- Discuss the different techniques of crystal growth
- Investigate the various factors of nucleation for crystal growth.
- Analyze the crystal structure and morphology using different characterization techniques.
- Describe different thin film deposition techniques.
- Discuss the applications of thin films in various fields

UNIT I: CRYSTALLIZATION FROM SOLUTION

Main categories of crystal growth methods - Chemical Physics of crystal growth - Solid growth techniques - Melt growth techniques -Solution growth methods - Vapour phase growth -Choosing a crystal growth method.

Solution method: Basic requirements - Crystallization apparatus - Saturation and seeding - factors that influence the perfection of the final crystal - Control of crystal - Control of Crystal morphology. **(18 Hours)**

UNIT II: CRYSTAL GROWTH IN GEL MEDIA

Various methods of gel growth - Growth mechanism - Nucleation control - Morphology of various gel growth crystals.

Crystal pulling: Material consideration - Crystal growth - Solid solutions and impurities - Growth control - Special techniques. **(18 Hours)**

UNIT III: STRUCTURAL CHARACTERIZATION OF CRYSTALS

Different probes for structure analysis - Principles of X-ray diffraction - Experimental methods in structure analysis - Structure determination - Structure refinement.

Crystalline perfection and Electrical characterization - Volume, area, line and point defects - Threshold concentration of defects in crystals - Methods of defecting imperfections - Two probe method to determine dielectric constant, electrical conductivity and thermo electric power. **(18 Hours)**

UNIT IV: THIN FILM DEPOSITION TECHNIQUES

Thermal evaporation - Flash, Arc, Laser and Electron beam evaporation - Sputtering mechanism - Sputtering yield - DC sputtering - RF sputtering - Glow discharge sputtering - Chemical methods - Spray pyrolysis - Electro-deposition - Anodization - Solution growth -study of vacuum coating unit - MBE - Laser ablation. **(18 Hours)**

UNIT V: THIN FILM APPLICATIONS

Material selection - Design and fabrication of thin film resistor - Thin film capacitor -Thin film diode - Thin film transistor - Transparent conducting oxide thin films - Semiconducting oxide thin films - Thin film solar cells - CdS and Cu_2S based solar cells - CdS/Cu_2S and CdS/Cu in Se_2 solar cells - Thin film mask blanks for VLSI - Thin film sensors for gas detection. **(18 Hours)**

BOOKS FOR STUDY

1. P. Santhana Raghavan and P. Ramasamy - Crystal Growth: Processes and Methods- Kru Publications - 2000.
2. A. Goswami - Thin film Fundamentals - New Age International Publishers, New Delhi - 2014.

BOOKS FOR REFERENCE

1. Brian R. Pamplin - Crystal Growth, II edition - Pergamon Press, Oxford - 1980.
2. Heinz K. Heinsch - Crystals in Gels and Liesegang Rings - Cambridge University Press -1938.
3. Donald L. Smith - Thin Film deposition, Principles and Practice - McGraw Hill Inc., - 1995.
4. O. S. Heavens - Thin film Physics - Methuen & Co., London - 1970.
5. K. L. Chopra - Thin film phenomenon - McGraw Hill, New York - 1990.

PRACTICAL - II

Semester: II **Hours: 6**

Code : 17PPH2P02 **Credits: 4**

COURSE OUTCOMES:

- Carryout the experiments with advanced instruments/ recent technology
- Write and execute programs with INTEL 8085 μP
- Construct electronic circuits for various applications

1. Mod-3, Mod-5, Mod-10 Counter
2. Diode Characteristics
3. Shift register & Ring counter
4. Microprocessor- Largest & Smallest elements in array
5. Microprocessor- Ascending & Descending order
6. D/A Counter
7. Wein's bridge & Phase shift Oscillator
8. Spectrometer-Charge of an Electron
9. Hall effect in Semiconductor.
10. Nanofluid Interferometer

BIOMEDICAL INSTRUMENTATION

Semester: II **Hours: 4**

Code : 17PPH2I01 **Credits: 3**

COURSE OUTCOMES:

- Explain the characteristics of bio potential recorders.
- Discuss the requirements and design of artificial heart valves
- Describe the model and mechanical function of diagnostic instruments
- Explain the working of operation theatre equipments.
- Illustrate the advanced techniques in biomedical instrumentation.

UNIT I: BIOPOTENTIAL RECORDERS

Characteristics of the recording system - Electrocardiography - Origin of cardiac action potential - ECG lead configuration - ECG recording set up - Phonocardiography - Echocardiography electroencephalography - origin of EEG - Action potentials of the brain - Evoked potentials. **(12 Hours)**

UNIT II: PHYSIOLOGICAL ASSIST DEVICES

Pace makers - Energy requirements to excite heart muscles - methods of stimulation, ventricular asynchronous pacemakers - artificial heart valves - requirements for the design of artificial heart valves - different natural heart valves - different types of artificial heart valves. **(12 Hours)**

UNIT III: DIAGNOSTIC INSTRUMENTS

Heart - Lung machine - mechanical function of the heart - model of the heart - lung machine - oxygenators - bubble oxygenators - film oxygenators - Blood pumps - Kidney machine - Renel function - Dialysis - Extra corporeal Dialysis - Intracorporeal Dialysis Ventilators -Servo controlled Ventilators - Anesthesia machine - Flowmeters - Rotameter -Turbine flowmeter. **(12 Hours)**

UNIT IV: OPERATION THEATRE EQUIPMENT

Blood flow meter - Electromagnetic Blood flow meter - Ultrasonic Blood flow meter based on transit time principle - Ultrasonic doppler Blood flow meters - Laser based doppler Blood flow meters - NMR Blood flow meters - Cardiac output measurements - Fick's method, Measurement of Cardiac output by impedance change - Spirometer. **(12 Hours)**

UNIT V: ADVANCES IN BIOMEDICAL INSTRUMENTATION

Endoscopes - Cryogenic surgery - Nuclear imaging technique - Computer tomography Scanner -Magnetic resonance imaging (MRI) - Fourier transform NMR - Magnetic relaxation and MRI parameters - MRI instrumentation - Positron emission tomography (PET) - Digital substraction Angiography (DSA) - Bio feedback instrumentation - Bio materials - Permanent implant - Transient implant. **(12 Hours)**

BOOK FOR STUDY

Dr. M. Arumugam - Bio medical Instrumentation - Anuradha Publications - 2006.

DETAILED REFERENCE

Dr. M. Arumugam - Bio medical Instrumentation - Anuradha Publications - 2006.

UNIT I : Chapter 4 : 4.2, 4.3 - 4.3.1, 4.3.2, 4.3.3, 4.3.7, 4.3.8, 4.4, 4.4.1

UNIT II: Chapter 5: 5.2, 5.2.1, 5.2.2, 5.2.3, 5.4, 5.4.1, 5.4.2, 5.4.3.

UNIT III: Chapter 5: 5.7, 5.7.1, 5.7.2, 5.7.3, 5.7.4, 5.8, 5.8.1, 5.8.2,

Chapter 6: 6.8, 6.9, 6.9.1

UNIT IV: Chapter 6: 6.10, 6.10.1, 6.10.2, 6.10.3, 6.10.4, 6.11, 6.12.2.

UNIT V : Chapter 10: 10.4, 10.5, 10.6, 10.7, 10.10.3, 10.10.4, 10.10.8, 10.11, 10.12, 10.13, 10.14

BOOKS FOR REFERENCE

1. R. S. Khandpur - Handbook of Biomedical Instrumentation - Tata Mc Graw-Hill, New Delhi - 1999.
2. Leslie Cromwell, Fred J. Weibell & Erich A. Pfeiffer - Biomedical Instrumentation and Measurements, II edition - Prentice Hall of India Private Limited, New Delhi - 2003.

SOFT SKILLS

Semester: II **Hours: 2**

Code : 17PGS2S01 **Credit: 1**

COURSE OUTCOMES:

- Develop their social, interpersonal, cognitive, ethical, professional, reading and communication skills.
- Increase their self-esteem and confidence.
- Achieve their short and long term goals.
- Prepare and formulate their resumes wisely.
- Face the mock group discussions and interviews with a challenge and choose their right career.

UNIT I: SOFT SKILLS

Introduction - Soft skills - Importance of soft skills - Selling your soft skills - Attributes regarded as soft skills - Soft skills - Social - Soft skills - Thinking - Soft skills - Negotiating - Exhibiting your soft skills - Identifying your soft skills - Improving your soft skills - will formal training enhance your soft skills - Soft Skills training - Train yourself - Top 60 soft skills - Practicing soft skills - Measuring attitude. **(6 Hours)**

UNIT II: CAREER PLANNING

Benefits of career planning - Guidelines for choosing a career - Myths about choosing a career - Tips for successful career planning - Developing career goals - Final thoughts on career planning - Things one should know while starting career and during his/her career. **(6 Hours)**

UNIT III: ART OF LISTENING AND SPEAKING

Two ears, one mouth - Active listening - Kinds of Listening, Common - poor listening habits - Advantages of listening - Listening Tips. Special features of Communication - Process - Channels of Communication - Net Work - Barriers - Tips for effective communication and Powerful presentation - Art of public speaking - Public Speaking tips - Over coming fear of public speaking. **(6 Hours)**

UNIT IV: ART OF READING AND WRITING

Good readers - Benefits - Types - Tips - The SQ3R Technique - Different stages of reading - Rates of Reading - Determining a student's reading rate - Increasing reading rate - Problems with reading - Effective reader - Importance of writing - Creative writing - Writing tips - Drawbacks of written communication. **(6 Hours)**

UNIT V: PREPARING CV / RESUME

Meaning - Difference among Bio-data, CV and Resume - The terms - The purpose of CV writing - Types of resumes - Interesting facts about resume - CV writing tips - CV/Resume preparation - the dos - CV/Resume preparation - the don'ts - Resume check up - Design of a CV - Entry level resume - The content of the resume - Electronic resume tips - References - Power words - Common resume blunders - Key skills that can be mentioned in the resume - Cover letters - Cover letter tips. **(6 Hours)**

COURSE BOOK:

Dr. K. Alex, Soft Skills, Chand & Company Pvt. Ltd., New Delhi.

REFERENCE BOOK:

1. Dr. T. Jeya Sudha & Mr. M.R. Wajida Begum : Soft Skills/Communication Skills, New Century Book House (P) Ltd., Chennai.
2. S. Hariharen, N. Sundararajan & S.P. Shanmuga Priya : Soft Skills, MJP Publishers, Chennai.

SOFT SKILLS

Semester: II **Hours: 2**

Code : 17PGS2S01 **Credit: 1**

QUESTION PATTERN

Part - A	3 Questions to be answered out of 5	Each Carries 4 marks	12 Marks
Part - B	2 Questions to be answered out of 4	Each Carries 9 marks	18 Marks

The Components of Internal Assessment for Soft Skill are as follows

Components	Marks
Test - I	30
Test - II	30
Mock Interview	30
Communication Skill	10
Total	**100**

QUANTUM MECHANICS - I

Semester: III **Hours: 6**

Code : 17PPH3C06 **Credits: 5**

COURSE OUTCOMES:

- Describe the characteristic features of various quantum systems.
- Analyze the conditions on the Schrodinger wavefunction and the basic postulates of quantum mechanics
- Develop the general formalism for exact solutions of eigen value problems
- Compare the quantum mechanical treatments of the scattering of a particle and mutual scattering of two particles
- Explain various aspects of angular momentum based on quantum theory.

UNIT I: SCHRODINGER EQUATION AND STATIONARY STATES

Inadequacy of classical concepts - Black body radiation - Specific heats of solids - Photoelectric effect - Compton effect - Schrodinger equation - Free particle in 1D - Generalization to 3D - Particle subject to forces. Normalization and Probability Interpretation - Box Normalization - Conservation of Probability - Expectation Values: Ehrenfest's Theorem - Admissibility Conditions - Time Independent Schrödinger equation - Particle in a Square Well Potential - Bound states - Non-localized states. **(18 Hours)**

UNIT II: WAVE MECHANICS

Schrödinger equation and Probability Interpretation for N Particle system - Fundamental Postulates of Wave Mechanics - Adjoint of an Operator - Degeneracy - Eigenvalue problem - Self Adjoint operators - Dirac Delta Function -Observables - Closure - Physical interpretation - Momentum Eigen functions - Uncertainty Principle - Minimum value for Uncertainty Product - Removal of degeneracy - Evolution of System with Time. **(18 Hours)**

UNIT III: EXACTLY SOLUBLE EIGENVALUE PROBLEMS

Simple harmonic oscillator -Schrodinger equation and Energy eigenvalues - Energy eigenfunctions - Properties of Stationary states - Abstract Operator method - Coherent States - Angular momentum operators - Eigenvalue equation for L^2 - Eigenvalues and Eigenfunctions - Spherical harmonics. Hydrogen Atom - Energy levels - Stationary State Wavefunctions - Discussion of Bound States.

(18 Hours)

UNIT IV: SCATTERING THEORY

Differential and Total Cross-sections - Scattering Amplitude - Green's Functions - Born Approximation - Validity - Born Series - Eikonal approximation - Partial Wave Analysis - Phase Shifts - Optical theorem - Potentials of finite range - Low energy scattering - resonant and non resonant scattering. **(18 Hours)**

UNIT V: ANGULAR MOMENTUM

Eigenvalue spectrum - Matrix representation of J in the |jm> basis - Spin angular momentum - Diamagnetism - Addition of Angular momenta - Clebsch-Gordan Co-efficients - Spin wavefunctions for a system of two spin-1/2 particles - Addition of Spin and Orbital Angular momenta. **(18 Hours)**

COURSE BOOK:

P. M. Mathews & K. Venkatesan - A Textbook of Quantum Mechanics, Second Edition (Seventh Reprint 2014) - McGraw Hill Education (India) Private Limited, New Delhi.

UNIT I : Chapter 1: 1.3 to 1.6, Chapter 2: 2.1 to 2.12

UNIT II : Chapter 3: 3.1 to 3.14

UNIT III : Chapter 4: 4.1 to 4.9, 4.15 to 4.17

UNIT IV : Chapter 6: 6.1 to 6.13

UNIT V : Chapter 8: 8.1 to 8.9

BOOKS FOR REFERENCE:

1. L. I. Schiff - Quantum Mechanics, III edition - Tata McGraw Hill, New Delhi - 1968.
2. Bjorken & Drell - Relativistic Quantum Fields - Tata McGraw Hill, New Delhi - 1965.
3. J. J. Sakurai - Advanced Quantum Mechanics - Pearson Education Inc., New Delhi - 2008.
4. S. L. Kakani and H. M. Chandalia - Quantum Mechanics - Sultan & Sons, New Delhi - 2007.
5. Chatwal Anand - Quantum Mechanics - Himalaya Publishing House, Mumbai - 2007.

SOLID STATE PHYSICS - II

Semester: III **Hours: 6**

Code : 17PPH3C07 **Credits: 5**

COURSE OUTCOMES:

- Compute the energy bands of crystals with theoretical and experimental methods.
- Analyze the optical properties of crystals and various types of interactions in solids.
- Describe the properties and applications of superconductors and theories related to it
- Discuss the various magnetic properties of crystals.
- Analyze the dielectric properties and imperfections in crystals

UNIT I: FERMI SURFACES AND METALS

Construction of Fermi surfaces - Electron orbits, Hole orbits and open orbits-calculation of Energy bands - Tight binding method - Wigner Seitz method - Cohesive energy - Pseudopotential methods - Experimental methods in Fermi surface studies - Quantization of orbits in a magnetic field - De-Hass Van Alphen effect - External orbits-Fermi surface of copper-Fermi surface of Gold-Magnetic breakdown. **(18 Hours)**

UNIT II: PLASMONS, POLARITONS, POLARONS AND EXCITONS

Dielectric function of the e-gas - Plasma optics - Dispersion relation for electromagnetic waves - Transverse optical modes in a plasma - Transparency of Alkali metals in the Ultraviolet - Longitudinal Plasma Oscillations - Plasmons - Electrostatic screening - Screened Coulomb potential - Pseudopotential Component U(o)- Mott-Metal insulator transition - Creening and phonons in metals-LST relation - electron-electron interaction - electron-phonon interaction - Peierls instability of linear metals - Optical reflectance - Kramers-Kronig relations - Conductivity of collisionless electron gas - Electronic interband transitions - Excitons - Frenkel Excitons - Alkali Halides - Molecular crystals - Mott-Wannier Excitons - EHD - Raman effect in Crystals - Energy loss of fast particles in a solid.

(18 Hours)

UNIT III: SUPER CONDUCTIVITY

Experimental survey - Occurrence of Superconductivity - Destruction of superconductivity by magnetic fields- Meissner effect - Heat capacity- Energy gap-Microwave Infrared properties - Isotope effect - Theoretical survey - Thermodynamics of the superconducting transition - London equation - Coherence Length - BCS theory - BCS ground state - Flux quantization in a superconducting ring - Duration of persistent currents - Type-II superconductors - Vortex state - Estimation of Hc1 & Hc2 - Single particle tunneling - Josephson superconducting tunneling - DC & AC Josephson effects - Macroscopic quantum interference - High-temperature superconductors - Critical fields and critical currents - Hall number - Fullerenes. **(18 Hours)**

UNIT IV: DIAMAGNETISM, PARAMGNETISM AND FERROMAGNETIC ORDER

Langevin diamagnetism equation - Quantum theory of diamagnetism - Para-magnetism - Quantum theory of para-magnetism - Cooling by isentropic demagnetization - Paramagnetic susceptibility of conduction electrons- Ferromagnetic Order - Curie point and the exchange integral - Temperature of the saturation magnetization - saturation magnetization at absolute - Quantization of spin waves - Thermal excitation of Magnons-Neutron magnetic scattering - Ferrimagnetic order - Anti ferromagnetic order - Ferro magnetic domains - Anisotropy energy- Transition region between domains - Solitons - origin of domains - Coercivity and hysteresis - Single domain particles - Magnetic bubble domain. **(18 Hours)**

UNIT V: MICROSCOPIC ELECTRIC FIELD AND LATTICE VACANCIES

Microscopic electric field - Local electric field at an atom - Dielectric constant and polarizability - Structural phase transitions - Ferro electric crystals - Displace transitions - Lattice vacancies - Diffusion - Color centers -Dislocations - Shear Strength of crystals - Slip - Dislocations - Burgers vector - Stress fields of dislocations - Low-angle grain boundaries - Dislocation Densities - Dislocation multiplication slip - strength of Alloys - Dislocation and crystal growth - Whiskers - Hardness of materials **(18 Hours)**

COURSE BOOK:

Charles Kittel - Solid State Physics, VII edition - Wiley Eastern Ltd. - 1996.

UNIT I : Chapter 9

UNIT II : Chapter 10 & 11

UNIT III : Chapter 12

UNIT IV : Chapters 14 & 15

UNIT V : Chapters 13, 18, 20

BOOKS FOR REFERENCE:

1. S. O. Pillai - Solid State Physics - Wiley Eastern Ltd. - 1994.
2. Ajay Kumar Saxena - Solid State Physics - Macmillan India Limited - 2006.

ELECTRODYNAMICS AND PLASMA PHYSICS

Semester: III **Hours: 6**

Code : 17PPH3C08 **Credits: 5**

COURSE OUTCOMES:

- Revise the fundamental laws of electromagnetic theory and deduce Maxwell's equations
- Analyze the propagation of electromagnetic waves in various media
- Discuss the radiation of EM waves.
- Describe the concepts of plasma and its parameters.
- Describe the various applications of plasma.

UNIT I: BASICS OF ELECTROMAGNETISM

Coulomb's law, Gauss law, Poisson's law - The equations of Poison's and Laplace - conductors - Potential energy - charge distribution - Conservation of electric charge - electric charge - Biot savart law - vector potential - Ampere's circuital law.

MAXWELL'S EQUATIONS

The potentials V and A - Lorenz condition - the divergence of E and the non - homogeneous wave equation for V and A - the curl of B - Maxwell's equations Duality - Lorentz Lemma - The nonhomogeneous equations for E and B propagation of EM waves in free space, non-conducting and conducting medium - good conductors. **(18 Hours)**

UNIT II: PROPAGATION OF EM WAVES

Propagation of plane EM waves in low pressure ionized medium -the Laws of Reflection and Snell's Law of Refraction - Fresnel's equations - Reflection and Refraction at the Interface between two nonmagnetic nonconductors - Total Reflection at an Interface between two nonconductors - Reflection and Refraction at the surface of a Good conductor - Propagation through different interfaces - propagation through Coaxial line -through rectangular wave guides. **(18 Hours)**

UNIT III: RADIATION OF EM WAVES

Retarded potentials -Oscillating electric dipole - magnetic dipole and quadrapole field radiation - half wave antenna - point charge radiation - relativistic electrodynamics - Reciprocity theorem. **(18 Hours)**

UNIT IV: INTRODUCTORY PLASMA PHYSICS

Basic concepts of plasma, concepts of temperature - Debye shielding - the plasma parameter - criteria for plasmas applications in plasma. **(18 Hours)**

UNIT V: PLASMA APPLICATIONS

Motion of charged particle in electromagnetic fields - **E** and **B** uniform and non-uniform fields, time varying fields - Adiabatic invariants. **(18 Hours)**

COURSE BOOKS:

1. Electromagnetic Fields & Waves, Dale Corson & Paul Lorrain, CBS Publishers, New Delhi, Reprint 2001
2. Elements of Plasma Physics, S. N. Goswami, New Central Book Agency (P) Ltd., Culcutta, 1995

UNIT I : Chapter 2:2.1,2.5, 2.6, 2.7, 2.8,2.14 , Chapter 7: 7.2,7.7,
Chapter 10: 10.1, 10.3 - 10.10 (all sections)
Chapter 11: 11.1 - 11.5. (Book 1)

UNIT II : Chapter 11: 11.6, Chapter 12 : 12. 1 - 12.5,
Chapter 13 :13.2, 13.3 (Book 1)

UNIT III: Chapter: 10.2, 10.2.1,
Chapter: 14.2 -14.2.1, 14.2.2, 14.2.3, 14.5.14.6. 14.8. (Book 1)

UNIT IV: Chapter 1: 1.1 -1.8, Chapter 4 :4.5, Chapter 3 :3.7, 3.2,
Chapter 7 : 7.1, 7.2 (Book 2)

UNIT V : Chapter 2: 2.1 - 2.3 - 2.3.1 - 2.3.3, 2.6, 2.1(Book 2)

BOOKS FOR REFERENCE:

1. Introduction to Plasma Physics & Controlled Fusion (Volume I), Francis, F. Chen, Plenum Press, New York, Edition II, 1995
2. Electrodynamics, David Griffiths, Pearson Education, III Edition,1998

NUMERICAL METHODS AND MATLAB

Semester: III **Hours: 6**

Code : 17PPH3E3A **Credits: 4**

COURSE OUTCOMES:

- Compute the roots of polynomial and transcendental equations and apply interpolation techniques.
- Solve algebraic equations and analyze curve fitting using various methods.
- Solve second order differential equations and compute numerical integration using different rules.
- Apply MATLAB software to solve simple problems
- Write program using MATLAB software for solving numerical methods

UNIT I: POLYNOMIAL AND TRANSCENDENTAL EQUATIONS

Basic properties of equations - Synthetic division - Bisection method - Regula Falsi method - Secant method - Iteration method - Aitken's method - Newton Raphson method.

INTERPOLATION

Equal intervals: Newton's forward and backward interpolation formula - Unequal intervals: Lagrange's formula. **(18 Hours)**

UNIT II: CURVE FITTING

Laws reducible to linear law - Method of least squares - Fitting a curve - Method of group averages Method of moments.

SIMULTANEOUS ALGEBRAIC EQUATIONS

Direct methods of solution: Cramer's rule, Matrix inversion method, Gauss elimination method, Gauss-Jordan method, Factorization method - Iterative methods of solution: Jacobi's method, Gauss Siedel method, Relaxation method.

(18 Hours)

UNIT III: ORDINARY DIFFERENTIAL EQUATIONS

Picard's method - Taylor's Series method - Euler's method - Modified Euler's method - Runge's method - Runge Kutta method - Predictor Corrector methods.

NUMERICAL INTEGRATION

Trapezoidal rule - Simpson's 1/3 rule - Simpson's 3/8 rule - Boole's rule - Weddle's rule - Errors in quadrature formulae. **(18 Hours)**

UNIT IV: MATLAB FUNDAMENTALS

The MATLAB environment - Assignment - Mathematical Operations - Use of Built-in functions - Graphics.

PROGRAMMING WITH MATLAB

M-files - input-output - Structured Programming - Nesting and indentation - Passing function to M-files. **(18 Hours)**

UNIT V: NUMERICAL METHODS WITH MATLAB

Solving small numbers of equations: Graphical method, Determinants and Cramer's rule, Elimination of unknowns - Naive Gauss Elimination - Matrix inverse - Linear least squares regression - Newton interpolating polynomial - Trapezoidal rule - Simpon's rule - Runge Kutta method. **(18 Hours)**

COURSE BOOKS:

1. Dr. B. S. Grewal - Numerical methods in Engineering & Science, Nineth Edition - Khanna Publications, Delhi - Fourth reprint: 2011.
2. Steven C. Chapra - Applied Numerical Methods with MATLAB for Engineers and Scientists, Special Indian Edition - Tata McGraw-Hill, New Delhi - Seventh reprint: 2010.

   UNIT I : Chapter 2: 2.1 - 2.4, 2.7 - 2.11,
   Chapter 7 : 7.1 - 7.3, 7.11, 7.12 (Book 1)

   UNIT II : Chapter 5 : 5.2 - 5.7, 5.9 - 5.11, Chapter 3: 3.3 - 3.5 (Book 1)

   UNIT III : Chapter 10: 10.1 - 10.8, Chapter 8: 8.4 - 8.6 (Book 1)

   UNIT IV : Chapter 2 : 2.1 - 2,5, Chapter 3 : 3.1 - 3.5 (Book 2)

   UNIT V : Chapter 9 : 9.1, 9.2, Chapter 11 : 11.1, Chapter 13 : 13.2
   Chapter 15 : 15.2, Chapter 17 : 17.3, Chapter 20 : 20.4 (Book 2)

BOOKS FOR REFERENCE:

1. H. K. Jain, S. R. K. Iyengar and R. K. Jain - Numerical methods for Scientific and Engineering Computation, IV edition - New Age International (P) Limited, Publishers, New Delhi - 2002.
2. J. N. Sharma - Numerical Methods for Engineers and Scientists - Narosa Publishing House, New Delhi - 2004.
3. P. Kandasamy, K. Thilagavathy and K. Gunavathy - Numerical Methods - S. Chand & Company Ltd, New Delhi - 2003.
4. E. Balagurusamy - Numerical Methods - Tata McGraw Hill Publishing Company Limited, New Delhi - 2005.

NANOMATERIALS

Semester: III **Hours: 6**

Code : 17PPH3E3B **Credits: 4**

COURSE OUTCOMES:

- Explain the various methods of synthesis and characterization of nanomaterials.
- Discuss the recent advancements of nanomaterials and composites.
- Describe the experimental techniques for the fabrication of nanomaterials
- Analyze and interpret the properties of nanomaterials using different characterization techniques
- Analyze the usage of nanomaterials for innovative applications

UNIT I: INTRODUCTION OF NANOMATERIALS

Emergence of Nanotechnology - Bottom-Up and Top-Down Approaches - Challenges in Nanotechnology.

PHYSICAL CHEMISTRY OF SOLID SURFACES

Surface Energy - Chemical Potential as a Function of Surface Curvature - Electrostatic Stabilization - Surface Charge density - Electric potential at the proximity of solid surface - Van der Waals attraction Potential- Interaction between two particles : DLVO theory - Steric Stabilization. **(18 Hours)**

UNIT II: SPECIAL NANOMATERIALS

Carbon Fullerenes and Nanotubes - Micro and Mesoporous Materials - ordered and random mesoporous - Zeolites - Core-Shell Structures (metal oxide-metal polymer - oxide polymer) - Organic-Inorganic Hybrids (Class I & II) - Intercalation Compounds - Nanocomposites and Nanograined Materials.

(18 Hours)

UNIT III: NANOSTRUCTURES FABRICATED BY PHYSICAL TECHNIQUES

Lithography (photo - phase shifting - electron beam - x ray - FIB - Neutral atomic beam lithography) - Nanomanipulation and Nanolithography (STM, AFM, NSOM) - Soft Lithography - microcontact printing - molding - nano imprint- Dip pen nanolithography- Assembly of Nanoparticles and Nanowires (capillary forces - dispersion interactions - shear force - electric field - covalently linked - gravitational field - template assisted assembly) - Other Methods for Microfabrication. **(18 Hours)**

UNIT IV: CHARACTERIZATION AND PROPERTIES OF NANOMATERIALS

Structural Characterization - XRD - SAXS - SEM - TEM - SPM - Gas Adoption- Chemical Characterization - Optical- Electron Spectroscopy - Ionic Spectrometry - Physical Properties of Nanomaterials - Melting points and lattice constants - Mechanical - Optical properties - Surface Plasmon resonance - Quantum Size effects - Electrical Conductivity - Surface Scattering - Change of electronic structure - Quantum Transport - Effect of microstructures - Ferroelectrics and dielectrics - Superparamagnetism. **(18 Hours)**

UNIT V: APPLICATIONS OF NANOMATERIALS

Introduction - Molecular Electronics and Nanoelectronics - Nanobots - Biological Applications of Nanoparticles - Catalysis by Gold Nanoparticles - Band Gap Engineered Quantum Devices - Quantum well devices - Quantum dot devices- Nanomechanics - Carbon Nanotube Emitters - Photoeletrochemical Cells - Photonic Crystals and Plasmon Waveguides. **(18 Hours)**

COURSE BOOK:

Nanostructures and Nanomaterials - Synthesis, Properties and Applications, Guozhong Cao - Imperial College Press, London, 2004.

UNIT I : Chapter 1: 1.2 - 1.4, Chapter 2: 2.1 - 2.5

UNIT II : Chapter 6: 6.1 - 6.7

UNIT III : Chapter 7: 7.1 - 7. 6

UNIT IV : Chapter 8: 8.1 - 8.4.6

UNIT V : Chapter 9: 9.1 - 9.10

BOOKS FOR REFERENCE:

1. Lynn. E. Foster - Nanotechnology - Science, Innovation & Opportunity - Pearson Education, Inc., New Delhi - 2008.
2. U. Kumar - Nanotechnology - A fundamental approach -- Agrobios (India), Jodhpur - 2008.
3. W. I. Atkinson - Nanotechnology - Jaico Publishing House, Mumbai - 2009.
4. T. Pradeep - Nano: The Essentials - Tata McGraw Hill Education Private Limited, New Delhi - 2010.

PRACTICALS - III

Semester: III **Hours: 6**

Code : 17PPH3P03 **Credits: 4**

COURSE OUTCOMES:

- Carryout the experiments with advanced instruments.
- Write and Execute the programs with INTEL 8085 μP and interface them with displays
- Construct electronic circuits for various applications

LIST OF PRACTICALS

1. Four probe method
2. Anderson's bridge - Mutual Inductance (Various distances)
3. Optical fibre experiments
4. Laser experiments
5. Active filters using IC 741
6. Digital Comparators
7. Microprocessor - Code conversion
8. Microprocessor - Interfacing
9. A/D Converter
10. Refractive indices of fluids using Nanofluid meter

QUANTUM MECHANICS - II

Semester: IV **Hours: 6**

Code : 17PPH4C09 **Credits: 5**

COURSE OUTCOMES:

- Revise the fundamental concepts of quantum mechanics
- Formulate approximate methods to solve eigen value problems
- Explain the concepts of propagators and perturbation method to solve time evolution problems
- Discuss the manifestation of spin and development of Dirac equation
- Describe the use of quantization formalism of electromagnetic field

UNIT I: APPROXIMATION METHODS FOR STATIONARY STATES

Perturbation theory for discrete levels: Non-degenerate - Degenerate - Applications. Variational method: Ground State energy - Application to excited states - Exchange interaction. WKB approximation: Bohr-Sommerfeld Quantum Condition - Applications. **(18 Hours)**

UNIT II: EVOLUTION WITH TIME

General Solution of Schrodinger equation - Propagators - Sudden Approximation - Perturbation theory - Transition Amplitude - Selection rules - First and Second Order transitions with Constant Perturbation - Scattering of a particle by a Potential - Inelastic Scattering - Double Scattering by two non-overlapping scatterers. **(18 Hours)**

UNIT III: PERTURBATION THEORY AND ALTERNATIVE PICTURES

Harmonic perturbations - Interaction of an atom with EM radiation - Dipole Approximation - Einstein's Coefficients - Schrodinger picture - Heisenberg picture - Matrix mechanics - Electromagnetic wave as Harmonic Oscillator - Spontaneous emission - Interaction picture - Scattering operator. **(18 Hours)**

UNIT IV: RELATIVISTIC QUANTUM MECHANICS

Klein-Gordon equation - Limitations - Dirac equations - Dirac matrices - Plane wave solutions - Spin of the Dirac particle - Negative energy states - Dirac particle in EM fields - Dirac equation in Central field - Spin magnetic moment - Spin Orbit Energy. **(18 Hours)**

UNIT V: QUANTUM FIELD THEORY

Lagrangian field theory - Non-relativistic fields - Relativistic fields: Klein-Gordon field, Dirac field, Electromagnetic field - Interacting fields. **(18 Hours)**

COURSE BOOKS:

1. P. M. Mathews & K. Venkatesan - A Textbook of Quantum Mechanics, Second Edition (Seventh Reprint 2014) - McGraw Hill Education (India) Private Limited, New Delhi.
2. V. K. Thankappan - Quantum Mechanics, Third edition - New Age International Publishers - 2012.

   UNIT I : Chapter 5: 5.1 to 5.13 (Book 1)

   UNIT II : Chapter 9: 9.1, 9.2, 9.4, 9.7 to 9.13 (Book 1)

   UNIT III : Chapter 9: 9.14 to 9.22 (Book 1)

   UNIT IV : Chapter 10: 10.1 to 10.11, 10.16, 10.17 (Book 1)

   UNIT V : Chapter 11: All sections. (Book 2)

BOOKS FOR REFERENCE:

1. L. I. Schiff - Quantum Mechanics, III edition - Tata McGraw Hill, New Delhi - 1968.
2. Bjorken & Drell - Relativistic Quantum Fields - Tata McGraw Hill, New Delhi - 1965.
3. J. J. Sakurai - Advanced Quantum Mechanics - Pearson Education Inc., New Delhi - 2008.
4. S. L. Kakani and H. M. Chandalia - Quantum Mechanics - Sultan & Sons, New Delhi - 2007.
5. Chatwal Anand - Quantum Mechanics - Himalaya Publishing House, Mumbai - 2007.

NUCLEAR AND PARTICLE PHYSICS

Semester: IV **Hours: 6**

Code : 17PPH4C10 **Credits: 5**

COURSE OUTCOMES:

- Explain the various decay processes in nuclear reactions.
- Describe the properties of Gamma radiation.
- Analyze the concepts of various Nuclear Models and principles of detectors.
- Classify elementary particles and explain their interaction with matter.
- Discuss the nature and effects of cosmic rays

UNIT I: ALPHA AND BETA DECAY

Determination for q/m for the α-particle - Range of α-particles - Energy of α-particles - Range - Velocity - Energy - Half Life Relations - Alpha Decay - Energy - Mass Number - Alpha particle spectra - Gamow's theory of α-decay - Advances in the theory of α-decay - Beta spectroscopy - The Neutrino - Energy - Half life relationships - Fermi theory of β-decay - Classification of Beta Transitions - General theory of beta-decay - Electron Capture - Violation of Parity Conservation in Beta decay. **(18 Hours)**

UNIT II: GAMMA RADIATION

Measurement of gamma ray energies - Multipole Radiations - Internal Conversion - Internal pair creation - Nuclear Isomerism - Coulomb Excitation - Angular Distribution and Directional correlation in γ-emission - Measurements of Lifetimes of Nuclear States - Nuclear Resonance Fluorescence - Mossbauer Effect.

(18 Hours)

UNIT III: NUCLEAR MODELS

Fermi Gas model - Liquid drop model - Shell model - Extreme Single Particle model - Single Particle model - Collective Nuclear model - Unified model - Superconductivity model - Ionization chamber - Semiconductor Detectors - Regions of multiplicative operation - Proportional counter - Geiger Muller Counter - Scintillation Counters - Cerenkov Counters - Cloud Chamber.

(18 Hours)

UNIT IV: ELEMENTARY PARTICLES

Classification of elementary particles - Leptons - Baryons - Fundamental interaction in nature - Gravitational interaction - Electromagnetic interaction - Weak interaction - Strong interaction - Particle instability - Conservation laws - Resonances. **(18 Hours)**

UNIT V: COSMIC RAYS

Discovery of cosmic rays - Nature of cosmic rays - Origin of cosmic rays - Soft and hard components - Variations in cosmic rays - Geomagnetic effect of cosmic rays - Theory of cosmic ray shower - Discovery of muons - Interactions of muon with matter - Discovery of the π meson - Origin of cosmic rays. **(18 Hours)**

COURSE BOOKS:

1. D. C. Tayal - Nuclear Physics - Himalaya Publishing House - 2014.
2. S. L. Kakani and Shubra Kakani - Nuclear and Particle Physics - Vinod Vasishtha for Viva Books Pvt. Ltd. - 2008.

UNIT I : Chapter 5: 5.1- 5.8, Chapter 6: 6.1- 6.9 (Book 1)

UNIT II : Chapter 7: 7.1 - 7.11 (Book 1)

UNIT III : Chapter 9: 9.1 - 9.8, Chapter 4: 4.2 - 4.9 (Book 1)

UNIT IV : Chapter 9: 9.3 - 9.7 (Book 2)

UNIT V : Chapter 10: 10.1-10.6, 10.10 -10.11, 10.13 -10.15 (Book 2)

BOOKS FOR REFERENCE:

1. Irving Kaplan - Nuclear Physics - Narosa Publishing House, New Delhi - 2002.
2. S. B. Patel - Nuclear Physics - New Age International Publishers, New Delhi - 2012.
3. Srivastava - Fundamentals of Nuclear Physics - Rastogi Publications, New Delhi - 2011.

MOLECULAR SPECTROSCOPY

Semester: IV **Hours: 6**

Code : 17PPH4C11 **Credits: 5**

COURSE OUTCOMES:

- Classify the electromagnetic spectrum and discuss the rotation of the molecules
- Discuss the vibrations of the molecules of different elements
- Analyze the electronic spectra of molecules.
- Interpret the structure of molecules using IR and Raman spectra.
- Describe the principles of nuclear magnetic resonance spectroscopy and its recent applications.

UNIT I: ROTATION OF MOLECULES

Classification of Molecules - Interaction of Radiation with Rotating Molecule- Rotational Spectra of Rigid Diatomic Molecules - Isotope Effect in Rotational Spectra - Intensity of Rotational Lines - Non-Rigid Rotator - Vibrational Excitation Effect - Liner Polyatomic Molecules - Symmetric Top Molecules - Asymmetric Top Molecules - Stark Effect - Quadruple Hyperfine Interaction - Interstellar Molecules - Microwave Spectrometer - Information Derived from Rotational Spectra.

(18 Hours)

UNIT II: INFRARED SPECTROSCOPY

Vibrational Energy of a Diatomic Molecule - Infrared Spectra - Preliminaries - Infrared Selection Rules - Vibrating Diatomic Molecule - Diatomic Vibrating Rotator - Asymmetry of Rotation - Vibration Band - Vibration of Polyatomic Molecules - More About Anharmonicity - Fermi Resonance - Hydrogen Bonding- Rotation - Vibration Spectra of Polyatomic Molecules - Normal Modes of Vibration in Crystal-Solid State Effects - Interpretation of Vibrational Spectra - Group Frequencies - Inversion Vibration of Ammonia - IR Spectrophotometer - Instrumentation - Sample Handling Techniques - Fourier Transform Infrared Spectroscopy - Applications. **(18 Hours)**

UNIT III: ELECTRONIC SPECTRA OF DIATOMIC MOLECULES

Vibrational Coarse Structure - Vibrational Analysis of Band Systems - Deslandres Table - Progressions and Sequences - Information Derived from vibrational Analysis - Franck - Condon Principle - Intensity of Vibrational Electronic Spectra - Rotational Fine Structure of Electronic - Vibration Spectra - The Fortrat Parabolae - Dissociation - Predissociation - Electronic Angular Momentum in Diatomic Molecules - Photoelectron Spectroscopy. **(18 Hours)**

UNIT IV: RAMAN SPECTROSCOPY

Theory of Raman Scattering - Rotational Raman Spectra - Vibrational Raman Spectra - Mutual Exclusion Principle - Raman Spectrometer - Sample Handling Techniques - Fibre Coupled Raman Spectrometer - Fourier Transform Raman Spectrometer - Polarization of Raman Scattered Light - Single Crystal Raman Spectra - Structure Determination Using IR and Raman Spectroscopy - Raman Investigation of Phase Transitions - Proton Conduction in Solids - Raman Spectral Study - Industrial Applications - Resonance Raman Scattering - Raman Microscopy. **(18 Hours)**

UNIT V: NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

Magnetic properties of Nuclei - Resonance Condition - NMR Instrumentation - Additional Experimental Techniques - Relaxation Process - Bloch Equations.

SURFACE ENHANCED RAMAN SCATTERING:

Surfaces for SERS Study - Enhancement Mechanisms - Surface Selection Rules - Representative Spectra - SERS Microprobe - Applications of SERS. **(18 Hours)**

COURSE BOOK:

Molecular Structure and Spectroscopy - G.Aruldhas, PHI Learning Private Limited New Delhi, 2009.

UNIT I : Chapter 6: 6.1 - 6.15

UNIT II : Chapter 7: 7.1 - 7.19

UNIT III : Chapter 9: 9.1 - 9.12

UNIT IV : Chapter 8: 8.1 - 8.17

UNIT V : Chapter 10: 10.1 - 10.6, Chapter 14: 14.1 - 14.7

BOOKS FOR REFERENCE:

Fundamentals of Molecular Spectroscopy, Colin N. Banwell, Tata McGraw- Hill College - IV Edition - 1994.

PROJECT

Semester: IV **Hours: 12**

Code : 17PPH4R01 **Credits: 6**

COURSE OUTCOMES:

- Survey the literature in their specified fields
- Choose the methodology
- Prepare the flowchart of their work
- Execute the work in a proper way and interpret their findings
- Prepare the report, present and publish their findings.

- Selection of the Project
- Literature Survey
- Data Collection
- Preliminary work
- First Review
- Incorporation of the suggestions
- Second Review
- Completion of the project
- Report writing
- Submission of the report and Preparation of Power point
- Preparation for Viva-voce

COMPREHENSIVE EXAMINATION

Semester: IV **Credits: 2**

Code : 17PPH4A01

COURSE OUTCOMES:

- Explore Physics concepts in depth
- Choose the apt answer among th implausible answers
- Train themselves for self learning
- Implement the problems solving skills in competitive exams
- Equip themselves for NET/SET/JRF exams