SEMESTER – I STATISTICAL MECHANICS PPH701

UNIT-I: FOUNDATIONS OF STATISTICAL MECHANICS (15 Hours)

Phase space- States of a system- Micro canonical ensemble- Density of states- Livouville's theorem- Statistical equilibrium- Relation between statistical and thermo dynamical quantities- Boltzmann entropy relation- Classical ideal gas- Entropy of mixing- Gibb's paradox.

UNIT-II: PARTITION FUNCTION (15 Hours)

Canonical and grand canonical ensembles - Partition function - Relation between partition function and thermo dynamical quantities - Entropy – Helmoltz free energy – Total energy – Enthalpy - Gibb's potential – pressure - specific heat C_V .

UNIT-III: STATISTICS OF SYSTEMS OF INDEPENDENT PARTICLES (15 Hours)

Quantum picture – Maxwell Boltzmann, Bose Einstein and Fermi Dirac statistics - Limit of applicability of the three distribution laws - MB ideal gas - Equipartition law of energy - Classical real gas - Maxwell's law of distribution of velocities – most probable speed, mean speed, root mean square speed.

UNIT-IV: QUANTUM STATISTICS (15 Hours)

Ideal BE gas - Gas degeneracy - BE condensation - λ transition in He^4 – Theory of super fluidity (London, Tisza and Landau) – Photon gas - Plank's law of radiation - Phonon gas - Einstein and Debye's models for specific heat of solids. Ideal FD gas - Gas degeneracy - Electron gas - Thermionic emission – Pauli's theory of paramagnetism - White dwarfs.

UNIT-V: FLUCTUATIONS AND TRANSPORT PROPERTIES (15 Hours)

Fluctuations in Energy, pressure, volume & enthalpy - density fluctutation- Correlation of space-time dependent fluctuation- Fluctuation dissipation theorem - Transport properties – Boltzmann transport equation-Random walk- Brownian motion.

TEXT BOOKS:-

1. Agarwal B.K. and Melvin Eisner, *Statistical Mechanics*, New Age International Publishers.
2. Gopal ESR, *Statistical Mechanics & Properties of Matter*, The Macmillan Co. of India Ltd.
3. Kerson Huang, *Statistical Mechanics*, Wiley Eastern Ltd.
4. Laud B.B, *Fundamentals of statistical Mechanics*, New Age International Publishers
5. Gupta and Kumar, *Elements of Statistical Mechanics*, Meerut, Pragathi Prakasham

REFERENCE BOOKS:-

1. Landau and Lifshitz, *Statistical Physics*
2. Ralph Baierlein, *Thermal Physics*, Cambridge University Press
3. Gupta M. C, *Statistical Thermodynamics*, New Age International Publishers

SEMESTER – I CLASSICAL & WAVE MECHANICS - PPH702S

Objectives

- To acquire knowledge of Lagrangian formulations.
- To understand the concepts of Hamiltonian formulations.
- To study dynamics of rigid bodies.
- To understand the concepts of relativistic & wave mechanics.

UNIT-I: PRINCIPLES AND LAGRANGIAN FORMULATION (15 Hours)

Mechanics of a particle and system of particles – conservation laws – constraints - generalised co-ordinates – D'Alembert's principle and Lagrange's equations and Hamilton's principle - Lagrangian equation of motion from Hamilton's principle – conservation theorems and symmetry properties-Invariance & Noether's theorem (without proof)-Applications.

UNIT-II: HAMILTONIAN FORMULATIONS (15 Hours)

Hamilton's canonical equation – proof of principle of least action – general equations of canonical transformations -Cyclic Co-ordinates- Hamilton - Jacobi differential equation – Legrange brackets and Poisson brackets – Action angle variables – the Kepler problem in action angle variable.

UNIT-III: RIGID BODY DYNAMICS (15 Hours)

Angular momentum – rotational kinetic energy and moment inertia of a rigid body – Euler's angle – moments and products of inertia – Eulers' equation – Motion of a symmetrical top under the action of gravity. Theory of small oscillations – frequencies of free vibration and normal - coordinates – Linear tri atomic molecules.

UNIT-IV: RELATIVISTIC MECHANICS (15 Hours)

Lorentz transformations – Lorentz transformations in real four dimensional spaces – covariant four dimensional formulations – force and energy equations in relativistic mechanics – Lagrangian and Hamiltonian formulation of relativistic mechanics.

UNIT-V: WAVE MECHANICS (15 Hours)

Inadequacy of Classical Mechanics - Evolution of quantum mechanics - Schrödinger equation for a free particle in one dimension - Equation of continuity – Ehrenfest's theorem - Uncertainity relation - General formalism of wave mechanics.

TEXT BOOKS:-

1. Rana.N.C & Joag, P.S, *Classical Mechanics*, Tata McGraw Hill
2. Herbert Goldstein, *Classical Mechanics*, Narosa Publications
3. Ghatak and Loganathan A.K, *Quantum Mechanics,* Macmillan
4. Mondal, *Classical Mechanic,* Prentice Hall of India.
5. Aruldhas, *Quantum Mechanics*, Prentice Hall of India.

REFERENCE BOOKS:-

1. Bhatia V.B, *Classical Mechanics*, Tamil Nadu Book House
2. Mathews P.M and Venkatesan, *Quantum Mechanics,* Tata Mc Graw Hill

SEMESTER – I MATHEMATICAL PHYSICS - PPH703S

UNIT-I: VECTOR SPACES **(15 Hours)**

Euclidean, space-Linear combination of vectors- Linearly dependent and independent sets- Basis and dimension- Inner product space- Orthogonal basis- Linear transformation.

UNIT-II: MATRICES AND TENSORS **(15 Hours)**

Matrices - Elementary matrices and a method for finding inverse orthogonal and unitary matrices - Independent elements of a matrix - Eigen values and eigen vectors - Diagonalisation - Complete orthonormal sets of functions. Tensors - Fundamentals of tensors - Operations with tensors – Addition – Subtraction - outer product – Contraction - inner product - quotient law.

UNIT-III: FOURIER AND LAPLACE TRANSFORMS **(15 Hours)**

Fourier series- Fourier series arbitrary period – Half-wave expansions - partial sums - Fourier integral and transforms - Fourier Transform of delta function - Laplace transform - first and second shifting theorems - Inverse Laplace transforms by partial functions - Laplace transforms of derivative and integral of a function.

UNIT-IV: COMPLEX VARIABLES **(15 Hours)**

Complex variable theory - Single and multi valued functions - The Cauchy-Reiman differential equations - Cauchy's integral theorem and integral formula - Residue and Cauchy's residue theorem - Lioville's theorem – Applications of the evaluation of definite integrals.

UNIT-V: SPECIAL FUNCTIONS **(15 Hours)**

Gamma and beta functions - Legender, Bessel, Hermite and Lagaurre equations - Generating functions - Series solutions and recurrence relations - Physical applications.

TEXT BOOKS:-

1. Sathyapraksh. R, *Mathematical Physics.*
2. Arfken G, *Mathematical Methods for Physics*
3. Joshi A.W, *Matrices and Tensors for Physicists.*
4. Rainville E.D, *Special Functions.*
5. Bell W.W, *Special Functions.*
6. Spiegel, *Fourier Laplace Transforms,* Schaum's Outline Series.
7. Complex Variables - Spiegel, Schaum's Outline Series

REFERENCE BOOKS:-

1. Kreyszig E, *Advanced Engineering Mathematics.*
2. Reily K.F Hobson M.P. and Bence S.J, *Mathematical Methods for Physicists and Engineers.*
3. Howard Anton, *Elementary Linear Algebra,* John Wiley Sons

SEMESTER – I ELECTRONIC DEVICES - EPPH704T & APPLICATIONS

Objectives

- To acquire knowledge of PN junction diode and special diodes
- To understand the concepts of various semiconductor transistors & devices
- To study microwave devices
- To understand the concepts Op-amps and its applications.

UNIT-I: PHYSICS OF DEMICONDUCTOR DEVICES (15 Hours)

P-N Junction diode: Basic Device technology (principles) – Depletion region and depletion capacitance - V-I characteristics - Junction Breakdown - Transient behaviour and Noise - Solar Cell.

Metal semiconductor contacts: Schottky Barriers – Ohmic Contacts **-** MIS diode **- special diodes:** Varactor diode – Tunnel diode – LED.

UNIT-II: TRANSISTOR & THYRISTORS (15 Hours)

Some fact about Bipolar transistors – Transistor as an amplifier – JFET - Pinch off voltage – VI characteristics - low frequency response and high frequency response FET amplifiers – applications of JFET – working principle of MOSFET & MESFET- UJT operation – characteristics - application - SCR – VI characteristics - applications – TRIAC – operation - characteristics – applications.

UNIT-III: NEGATIVE CONDUCTANCE MICROWAVE DEVICES (21 Hours)

Transit time devices: IMPATT diode – QWITT diode – TRAPATT diode - Gunn diode - The transferred electron mechanism – Formation and drift of space charge domains - modes of operation in resonance circuit - Fabrication and applications.

UNIT-IV: OP AMP- LINEAR AND NON LINEAR CIRCUITS (15 Hours)

Differential amplifiers – its transfer characteristics - Voltage amplifier- Current amplifier- Voltage follower- Frequency response of OP AMP. **Nonlinear application:** Log and antilog amplifiers - Half wave and full wave rectifiers - Clippers - Voltage comparator.

UNIT-V: Op-amp APPLICATIONS (15 Hours)

Sample and hold circuit - Schmitt trigger - Peak detector - active filters - low pass, high pass, band pass – band reject and all pass filters – **Oscillators:** Wien Bridge, phase-shift, square wave oscillators- phase locked loop amplifier.

TEXT BOOKS:-

1. SZE SM, 1985, *Semiconductor Devices – Physics and Technology*, Wiley.
2. Streetman B.G., *Solid State Electronic Devices,*(4th Edition), Prentice Hall of India
3. Milman and Halkins, 1993, *Integrated Electronics*, Tata McGraw hill.
4. Gayakwad R.A., *OP AMPS and Linear Integrated Circuits,* (3rd Edn), Prentice Hall of India.
5. Liano S.L., *Microwave Devices and Circuits*, Prentice Hall of India.

REFERENCE BOOKS:-

1. Tyagi M.S., *Introduction to Semiconductor devices*, John Wiley & Sons.
2. Joseph Lindemeyer and Charles Y. Wrigley, 1965, *Fundamentals of semiconductor Devices,* D.Van Nostrand Company.

Gutpa Y.C., *Microwave Electronics,* John Wiley.

SEMESTER – I GENERAL PRACTICAL – I - PPHG101

(Any ten out of the given 12 experiments**)**

1. Determination of Stephan's constant
2. Young's Modulus by elliptical fringes.
3. Young's Modulus by hyperbolic fringes
4. Determination of band gap in semiconductor.
5. Hydrogen spectrum – Rydberg's constant
6. Viscosity of liquid – Meyer's disc
7. Solar spectrum – Hartmanns interpolation formula
8. Absorption spectrum of Iodine
9. Specific charge of an electron.
10. Biprism – Wave length and thickness
11. Fiber Optics Experiment
12. Ultrasonic diffraction

SEMESTER – I ELECTRONICS PRACTICAL – I - PPHE101

(Any ten out of the given 12 experiments**)**

1. FET Characteristics and amplifier design
2. UJT characteristics and applications
3. SCR characteristics and applications
4. Op-amp – Inverting, non-inverting amplifier – Voltage follower- summing, difference, average amplifier – differentiator and integrator.
5. Op-amp solving simultaneous equations
6. Diac and Triac Characteristics and Applications.
7. Up-down counters – Design of modulus counters
8. IC 555 – Astable multivibrator and voltage controlled oscillator
9. IC 555 – Monostable multivibrator, frequency divider
10. Op-amp I to V and V to I converters
11. Clock Oscillator using digital ICs
12. Power amplifier – Transistor.

SEMESTER – II ELECTORMAGNETIC THEORY PPH805

UNIT-I ELECTROMAGNETIC WAVES (15 Hours)

Maxwell's equations and their physical significance-Equation of continuity – Displacement current – Poynting theorem and Poynting vctor- electromagnetic waves in free space, conducting and non-conducting medium.

UNIT-II REFLECTION AND TRANSMISSION OF E.M. WAVES (15 Hours)

Boundary conditions at the surface of discontinuity – reflection and refraction of electromagnetic waves at the interface of non conducting media – Fresnel's equations – electric field vector E parallel and perpendicular to the plane of incidence – reflection and transmission coefficient at the interface between two non conducting media-

UNIT-III WAVE GUIDES AND GUIDED WAVES (15 Hours)

Transverse electric waves – Transverse magnetic waves- Characteristics of TE and TM waves- Transverse electromagnetic waves- attenuation in parallel plane guides- attenuation of TE waves, TM waves and TEM waves- Rectangular wave guides- TE waves and TM waves- Q factor of waveguides.

UNIT-IV ANTENNA AND WAVE PROPAGATION (15 Hours)

Radiation field due to Hertzian dipole antenna- Radiation resistance of short dipole antenna- quarter wave monopole and half wave dipole- effective length of a half wave dipole- Radiation pattern of a dipole antenna. Space wave propagation - characteristics of Radio waves, VHF, UHF and microwaves.

UNIT-V RELATIVISTIC ELECTRODYNAMICS (15 Hours)

Lorentz transformation- consequences- transformation of differential operators- invariance of D'alemert's operator- four vector-Lorentz transformation of space and time in four vector form.- Transformation of electromagnetic potentials A & ϕ - Maxwell's equation in covariant tensor form

TEXT BOOKS:-

1. Narayana Rao, *Basic electromagnetics with applications*, Prentice Hall
2. Griffiths, *Introduction to electrodynamics*, Prentice Hall of India.
3. Chakraborty B, *Principles of Electrodynamics*, Books and allied Kolkata.
4. Landah & Lifschitz, *Electrodynamics of continuous media.*

REFERENCE BOOKS:-

1. Sengupta P, *Classical Electrodynamics*, New Age International publishers
2. David. I. Griffiths, *Introduction to electrodynamics*, Prentice Hall of India

SEMESTER – II NUCLEAR AND PARTICLE PHYSICS PPH806T

UNIT-I NUCLEAR MODELS (15 Hours)

Liquid drop model- Bohr Wheeler theory fission- Experimental evidence for shell effects- Shell model-Spin orbit coupling- Magic numbers- Angular Momenta and parities of nuclear ground states- Qualitative discussion and estimates of transition rates- magnetic moments and Schmidt lines- Collective model of Bohr and Mottelson- oblate and prolate deformation of Nucleus.

UNIT-II NUCLEAR FORCE (15 Hours)

Central force and tensor forces- Ground state of deuteron- Magnetic and quadrupole moments- Charge independence and spin dependence of nuclear forces-n-p scattering and p-p scattering at low energies-effective range theory- High energy nucleon- nucleon scattering-Exchange forces- Meson theory of nuclear forces.

UNIT-IV NUCLEAR REACTIONS (15 Hours)

Types of reactions and conservation laws- energetics of nuclear reactions- reaction dynamics- Q – value equation- scattering and reaction cross section- compound nucleus- scattering matrix- fission and controlled fission reactions, fission reactors – fission explosives - fusion, solar fusion – thermonuclear reactions and weapons.

UNIT-IV NUCLEAR DECAY (15 Hours)

Beta decay- Fermi theory of beta decay- Shape of the beta spectrum- Total decay rate- Angular momentum and parity selection rules- Comparative half-lives-allowed and forbidden transitions- Selection rules- Parity violations- Two component theory of neutrino decay- Detection and properties of neutrino- Gamma decay.

UNIT-V PARTICLE PHYSICS (15 Hours)

Baryons and Mesons- their properties, decay models- Strong, weak and electromagnetic interactions- Hadrons and Leptons, Tau-Theta puzzle- Strangeness-Gellman- Nishijima-relations-SU(3) classifications of Hadrons-Octets and decouplets-elementary ideas of Quarks – New particles.

TEXT BOOKS:-

1. Srivastava B.N, *Basic Nuclear Physics,* Pragathi Prakasan.
2. Tayal D.C, *Nuclear Physics,* Himalaya Publications.
3. Pandya M.L, *Elementary Nuclear Physics,* Kedar Nath Ram Nath.
4. Enge H.A, *Introduction to Nuclear Physics,* Addison-Wesley.
5. Concepts of Nuclear Physics – B.L. Cohen (Wiley-Eastern)
6. Griffiths D, *Introduction to Elementay Particles,* Harper and Row.

REFERENCE BOOKS:-

1. Elton, *Introductory Nuclear Theory,* Pitman.
2. Waghmare Y.R, *Introductory Nuclear Physics,* Oxford-IBH.
3. Kaplan I, *Nuclear Physics,* Narosa.
4. Kenneth S. Krane, I*ntroductory Nuclear Physics, Wiley-Eastern*

SEMESTER – II QUANTUM MECHANICS – I - PPH807T

UNIT-I: BASIC FORMALISM (15 Hours)

Postulates of quantum mechanics - Equation of continuity – Ehrenfest's theorem- Operator formalism - Linear operators, self adjoint operators - expectation value - stationary state - Hermitian operators for dynamical variables - eigen values and functions- orthonormality - commutation relations.

UNIT-II: APPLICATIONS (15 Hours)

One dimensional problems – Wells; Infinite square well and finite square well and barriers; Rectangular barrier - Harmonic Oscillator by Schrödinger equation and operator method (I&III D) - Rigid rotator - Hydrogen Atom.

UNIT-III: ANGULAR MOMENTUM (15 Hours)

Angular momentum operator - commutation rules - Eigen value spectrum - Ladder Operators - Momentum Eigen values and Eigen function - L2 Operators Eigen values and Eigen function - Spin matrices and wave function- combination of two angular momentum - Clebesh Gordon coefficients.

UNIT-IV: APPROXIMATION METHODS (15 Hours)

Perturbation theory - Non degenerate and degenerate cases- removal of degeneracy - application to ground state of anharmonic oscillator - Variation method - Hydrogen Molecule - Zeeman and Stark effects - WKB approximation.

UNIT-V: RELATIVISTIC QUANTUM MECHANICS (15 Hours)

The Klein-Gordon equation- probability density and current density- The Dirac's equation and Dirac's matrices- Plane wave solutions of the Dirac's equation- Spin as an inherent property of an electron- Covariant form of Dirac's equation- Gamma matrices and their properties- Positive and negative energy states and Dirac's explanation.

Text books:-

1. Ghatak and Loganathan A.K, *Quantum Mechanics,* Macmillan.
2. Mathews P.M and Venkatesan, *Quantum Mechanics,* Tata Mc Graw Hill.
3. Satya Prakash and Singh C.K, *Quantum Mechanics*.
4. Gupta S.L, Kumar V, Sharma R.C and Sharma H.V, *Quantum Mechanics,* Jai Nath & Co.
5. Chatwal and Anand, *Quantum Mechanics,* Himalaya & Co.

REFERENCE:-

1. Feynmann Lectures, *Quantum Mechanics,* Vol.- III.
2. Powel and Craseman, *Quantum Mechanics,* Addison-Wesley.
3. Gupta S.L. and Gupta I.D, *Advanced Quantum Mechanics and Field,* S. Chand & Co.
4. V. K. Thangappan, *Quantum Mechanics, New Age International Pvt. Ltd.*
5. *V. Devanadhan, Quantum Mechanics, Alpha Science.*

SEMESTER – II MOLECULAR PHYSICS - EPPH808T

Objectives

- To understand the concepts microwave and IR spectroscopy.
- To study Raman spectroscopy.
- To understand the concepts molecular quantum.
- To study the electronic spectra of molecules.
- To acquire knowledge of nuclear spectroscopy.

UNIT-I: ELECTRONIC SPECTRA OF MOLECULES (15 Hours)

Molecular quantum number – coupling of angular momenta - classification of states- electronic spectra of diatomic molecules - Frank condon principle - Vibrational structure of electronic bands - Rotational fine structure - Fortrat parabola and band head formation- Intensity distribution in an electronic band - dissociation energy.

UNIT-II: RAMAN SPECTROSCOPY (15 Hours)

Raman Effect - Molecular polarisability – Quantum theory – Pure rotational Raman spectra of diatomic and poly atomic molecules – Vibration - rotation Raman spectra of diatomic and polyatomic molecules - Application of Raman spectroscopy for the structure determination of H_2O molecule. Laser Raman spectroscopy – Basics.

UNIT-III: MICROWAVE (MW) AND INFRARED (IR) SPECTROSCOPY(15Hours)

Classification of rotating molecules – rotational spectra of linear and symmetric top molecules - Stark modulation MW spectrometer - IR spectrometer – diatomic molecules as harmonic and anharmonic oscillators- rotation –vibration spectra diatomic molecules – P,O and R branches- analysis of symmetric top molecules – Basic principles of FTIR spectrum.

UNIT-IV: NMR SPECTROSCOPY (15 Hours)

Concepts of NMR spectroscopy- Chemical shift- spin-spin coupling between two and more nuclei - application to structural determination of molecules- spin - spin and spin lattice relaxation processes - FTNMR – measurement of relaxation times by pulse sequence technique.

UNIT-V: ESR, NQR and MOSSBAUER SPECTROSCOPY (15 Hours)

Concept of ESR spectroscopy - effect of L-S coupling - Lande splitting factor 'g" – Hyperfine and fine structure.General principles of NQR spectroscopy and its applications. Mossbauer spectroscopy - recoilless emission and absorption - Mossbauer spectrometer- Isomer shift – Nuclear quadrupole splitting - Zeeman splitting.

TEXT BOOKS:-

1. Banwell CN and McCash E.M, 1994, *Fundamentals of Molecular Spectroscopy*, 4th Edition, Tata McGraw-Hill Publications, New Delhi.
2. Aruldas G, 2001, *Molecular structure and spectroscopy*, Prentice,-Hall of India Pvt.Ltd., New Delhi.
3. Satyanarayana D.N, 2004, *Vibrational spectroscopy and applications*, New age international Publications, New delhi.
4. Atta U Rahman, 1986, *Nuclear Magnetic Resonance*, Spingerr Verlag, Newyork.
5. Towne and Schawlow, 1995, *Microwave Spectroscopy*, McGraw- Hill,
6. D.A.Lang, *Raman Spcetroscopy*, McGraw- Hill international, N.Y.
7. Jenkens and white, Basics of Spectroscopy.

REFERENCE:-

1. Raymond Chang, 1980, *Basic Principles of spectroscopy*, McGraw- Hill, Kogakusha,Tokyo.
2. Straughan B.P. and Walker, *Spectroscopy-Vol* 1, Chapman and Hall, Londan, 1996.
3. Straughan B.P. and Walker, *Spectroscopy-Vo*l 2, Chapman and Hall, Londan, 1996.
4. Straughan B.P. and Walker, *Spectroscopy-Vol 3*, Chapman and Hall, Londan, 1996.
5. Hore P.J, *Nuclear Magnetic Resonance* – Oxford Science Publications 1995.

SEMESTER – II GENERAL PRACTICAL -II - PPHG202

(Any ten out of the given 12 experiments**)**

1. Brass alloy arc spectra.
2. Laser – study of laser beam parameter.
3. Laser – Thickness of the enamel coating on a wire by diffraction
4. Electrical resistance of a metal / alloy by four probe's method.
5. F.P etalon using spectrometer.
6. Permittivity of a liquid using – RFO
7. Spectrum photo – Cu, Fe – Arc spectra
8. Determination of Plank's constant.
9. Caushy's Dispersion constant
10. Dielectric constant – Wavemeter
11. Microwaves – Gunn diode
12. Ultrasonic interferometer.

SEMESTER – II ELECTRONICS PRACTICAL – II - PPHE202

(Any ten out of the given 12 experiments**)**

1. A / D converter using comparator LM 336
2. D/A convertor using comparator LM 336
3. JFET and MOSFET applications
4. Shift registers
5. Schmitt trigger
6. Phase shift oscillator
7. Wein bridge oscillator
8. Multiplexer and Demultiplexer
9. Half adder, full adder, Half subtractor and full subtractor using IC 7400
10. Power amplifier – Using IC.
11. Study of Transducers.
12. Study of Modulation and Demodulation.