P.K.R. ARTS COLLEGE FOR WOMEN (AUTONOMOUS),

(Accredited with 'A' grade by NAAC - Affiliated to Bharathiar University, Coimbatore)

GOBICHETTIPALAYAM – 638 476

DEPARTMENT OF PHYSICS

MASTER OF SCIENCE

SYLLABUS

For the candidates admitted from the Academic Year

2018-2019 and onwards

Under CBCS PATTERN

P.K.R ARTS COLLEGE FOR WOMEN
(Accredited with 'A' Grade by NAAC)
An autonomous institution – Affiliated to Bharathiar University
MASTER OF SCIENCE - PHYSICS
Programme Scheme and Scheme of Examinations
(For students admitted from 2018-19 & onwards)

Part	Category	Course Code	Title of the Course	Contact Hrs / week	Exam Duration hrs.	Max. Marks			Credits
						CIA	ESE	Total	
			SEMESTER – I						
III	Core: I	18PHP01	Classical Mechanics	5	3	25	75	100	4
III	Core :II	18PHP02	Mathematical Physics	5	3	25	75	100	4
III	Core : III	18PHP03	Quantum Mechanics - I	5	3	25	75	100	4
III	Core : IV	18PHP04	Numerical Methods & MATLAB Programming	5	3	25	75	100	4
III	Core : V	18PHP05	Comprehension in Physics Paper-I (Online Exam) / Self Study	-	1½	-	100	100	1
III	Core : VI	18PHP06	Advanced Physics Practical-I	3	-	-	-	-	-
III	Core : VII	18PHP07	General Electronics Practical-I	3	-	-	-	-	-
III	Core : VIII Elective: I	18PHP08A/ 18PHP08B	Essentials of Nanoscience / Radiation Physics	4	3	25	75	100	4
			TOTAL	30				600	21
			SEMESTER – II						
III	Core: IX	18PHP09	Quantum Mechanics - II	5	3	25	75	100	4
III	Core: X	18PHP10	Advanced Electronics	5	3	25	75	100	4
III	Core: XI	18PHP11	Solar Physics	3	3	25	75	100	4
III	Core : XII	18PHP12	Comprehension in Physics Paper-II (Online Exam)/ Self Study	-	1½	-	100	100	1
III	Core :XIII	18PHP06	Advanced Physics Practical-I	5	4	40	60	100	4
III	Core : XIV	18PHP07	General Electronics Practical-I	5	4	40	60	100	4
III	Core : XV , Elective: II	18PHP13A/ 18PHP13B	Astronomy & Astrophysics/ Experimental Techniques	5	3	25	75	100	4
IV	Skill Enhancement Course : I	18SEPPH1	Cyber Security	2	-	100	-	100	2
			TOTAL	30				800	27
			SEMESTER – III						
III	Core : XVI	18PHP14	Atomic and Molecular Spectroscopy	5	3	25	75	100	4
III	Core :XVII	18PHP15	Nuclear Physics & Elementary Particles	5	3	25	75	100	4
III	Core: XVIII	18PHP16	Electromagnetic Field Theory	5	3	25	75	100	4

III	Core : XIX	18PHP17	Comprehension in Physics Paper-III (Online Exam)/ Self Study	-	1½	-	100	100	1
III	Core: XX	18PHPOE1	Concepts of Electrical Appliances	3	3	25	-	-	3
III	Core: XXI	18PHP18	Advanced Physics Practical-II	4	-	-	-	-	-
III	Core : XXII	18PHP19	General Electronics Practical-II	4	-	-	-	-	-
III	Core : XXIII Elective: III	18PHP20A/ 18PHP20B	Biomedical Instrumentation/ Thin Film Physics and Crystal Growth	4	3	25	75	100	4
IV	Skill Enhancement Course : II	18SEPPH2	Industrial Training	-	-	100	-	100	2
V	Proficiency Enhancement	18PEPPH1	Laser and its applications (self study)	-	3	-	100	100	2
			TOTAL	30				800	24
			SEMESTER – IV						
III	Core: XXIV	18PHP21	Condensed Matter Physics	6	3	25	75	100	4
III	Core: XXV	18PHP22	Thermodynamics and Statistical Mechanics	6	3	25	75	100	4
III	Core: XXVI	18PHP23	Electronic Communication Systems	6	3	25	75	100	4
III	Core: XXVII	18PHP24	Comprehension in Physics Paper-IV (Online Exam)/ Self Study	-	1½	-	100	100	1
III	Core: XXVIII	18PHP18	Advanced Physics Practical - II	5	6	40	60	100	4
III	Core : XXIX	18PHP19	General Electronics Practical-II	5	6	40	60	100	4
III	Core : XXX Project	18PHP25	Major Project and viva voice	2	-	50	150	200	3
			TOTAL	30				800	24
V	Competency Enhancement	On-line Course / Learning Object Repository		II – IV SEMSTER					2
		Certificate Course		II - IV SEMESTER					2
				Total Marks & Credits				3000	100

(Signature with Seal)
Head,
Department of Physics,
P.K.R. Arts College for Women,
Gobichettipalayam-638476.

SEMESTER-I

Course Code	Course Name	Category	L	T	P	Credit
18PHP01	**Classical Mechanics**	**Core**	75	5	-	4

Preamble

The aim is to provide the students, the knowledge and understanding of the fundamental concepts in the dynamics of system of particles, motion of rigid body, Lagrangian and Hamiltonian formulation of mechanics

Course Outcome

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Gain knowledge of core principles in Mechanics and Understand and apply Lagrange's equations to simple Physical systems	K1, K2, K3
CO2.	Describe and understand the motion of a mechanical system using Lagrange-Hamilton formulation.	K1, K2, K3
CO3.	Study the Hamilton Jacobi Method and Poisson Brackets	K1, K2, K3
CO4.	Understand the Kepler's Problem	K1, K2, K3
CO5.	Describe and understand planar and spatial motion of a rigid body	K1, K2, K3

UNIT I **(15 Hrs)**

Lagrangian Formulation: Constraints and Degrees of Freedom-Generalized Coordinates: Generalized Displacement, Velocity, Acceleration, Momentum, force & Potential-Variational technique and Euler Lagrange Differential equation-Hamilton's Variational principle-Lagrange's equation of motion from Hamilton's principle-D'Alembert's principle-Application of Lagrange's equation of motion: Linear Harmonic Oscillator-Simple Pendulum-Isotropic Oscillator.

UNIT II **(15 Hrs)**

Hamiltonian Formulation: Phase space-Hamiltonian-Hamilton's Canonical Equation of Motion-Physical Significance of H-Deduction of Canonical Equation from Variation principle-Application of Hamilton's equation of motion: Simple Pendulum, Linear Harmonic Oscillator, Isotropic Oscillator -Principle of Least Action and Proof-Canonical Transformations-Generating Function and different forms.

UNIT III **(15 Hrs)**

Hamilton –Jacobi Method: Hamilton Jacobi Method- Solution of Harmonic Oscillator Problem by HJ method-Particle falling freely-Damped Harmonic Oscillator-Poisson Brackets-Definition-Equation of motion in Poisson Bracket form-Jacobi -Poisson Theorem-Angular Momentum and Poisson's Bracket.

UNIT IV **(15 Hrs)**

Two Body Problems: Equivalent One body problem-General Features of central force motion-Stability of orbits and Conditions for closure- Kepler's Problem - Shapes of orbits-Inertial/Non inertial frames-Rotating Co-ordinate system-Effects of Coriolis force on moving bodies.

UNIT V **(15 Hrs)**

Rigid body dynamics: Euler's theorem-Euler's angles-Angular velocity of a rigid body-Angular momentum of Rigid Body-Moments and Products of Inertia-Principle Axis of Transformation-Torque Free Motion of a Rigid Body-Poinsot Solutions-The motion of a Symmetric Top under the action of Gravity-Stable and Unstable Equilibrium.

Books for Study:

1. Classical Mechanics-S.L.Gupta, V. Kumar & H.V.Sharma-Pragati Prakashan-Meerut, 2003
2. Classical Mechanics-H. Goldstein-Addison Wesley, London,1996

Books for Reference:

1. Elements of Statistical Mechanics-Kamal Singh & S.P. Singh-S. Chand & Company, New Delhi, 1999.
2. Elements of Statistical Mechanics-Gupta & Kumar-Pragati Prakashan-Meerut.

Course Code	Course Name	Category	L	T	P	Credit
18PHP02	**Mathematical Physics**	**Core**	75	5	-	4

Preamble

The aim is to provide the students firm foundation in various mathematical methods developed and used for understanding different Physics phenomena.

Course Outcomes

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Understand physical phenomena in different geometry	K1, K2, K3
CO2.	Study the complex variable and function and gain the knowledge about analytical function	K1, K2, K3
CO3.	Understand the linear vectors space and vectors operators which used in many area of Physics	K1, K2, K3
CO4.	Gain knowledge about Fourier series and Laplace transformation	K1, K2, K3
CO5.	Understand knowledge of group theory	K1, K2, K3

UNIT I **(15 Hrs)**

Special Functions: Legendre's Polynomials and Functions- Differential Equations and Solutions-Generating Functions- Orthogonality-Relation between Legendre Polynomial and their Derivatives Recurrence Relations- Bessel's Function-Differential Equation and Solution-Generating Functions-Recurrence Relations- Hermite function.

UNIT II **(15 Hrs)**

Complex Variable Theory: Functions of a Complex Variable-Single and Multi valued Functions-Cauchy-Reimann Differential Equation-Analytical Line Integrals of Complex Function-Cauchy's Integral Theorem and Integral Formula-Derivatives of an Analytic Function-Taylor's Variables Residue and Cauchy's Residue Theorem.

UNIT III **(15 Hrs)**

Linear Space: Definition of Vector Space-Linear Dependence-Linear Independence-Basis-Dimension of a Vector Space-Representation of Vectors and Linear Operators with respect to Basis-Schmidt Orthogonalization Process-Inner Product.

UNIT IV **(15 Hrs)**

Fourier Series & Laplace Transforms: Fourier Series-Dirichlet's Theorem-Change of Interval-Complex Form-Fourier Series in the Interval $(0, \infty)$ - Uses of Fourier Series.-Laplace Transform-

Definition-Properties-Translation Property-Inverse Laplace Transform-Properties, example problems.

UNIT V **(15 Hrs)**

Group Theory: Definition of Groups– Multiplication table – Subgroups, cosets and classes – Point and space groups – Homomorphism and isomorphism – Reducible and irreducible representations – Schur's lemma -- The great orthogonality theorem (qualitative treatment without proof) – Formation of character table of C2v and C3v -- Elementary ideas of rotation groups.

Books for Study:

1. Mathematical Physics- SathyaPrakash-Sultan Chand & Sons
2. Mathematical methods for Physicists-Arfken,weber&Harris - Academic Press- 7th edition
3. Elements of group theory for Physicists - A.W. Joshi, -Wiley Eastern, 2002

Books for Reference:

1. Mathematical Physics-B.D. Gupta-Vikas Publishing House, 3rd Edition, 2006
2. Mathematical Physics-B.S. Rajput- PragatiPrakashan- Meerut 17th Edition 2004
3. Mathematical Physics by P.K. Chattopadhayay-New Age International-New Delhi.
4. Mathematical Physics-P.P. Gupta, Yadav& Malik-KedarnathRamnath-Meerut
5. Numerical Methods in Science & Engineering-M.K. Venkataraman-National Publishing-Chennai,1986
6. Numerical Methods-A. Singaravelu-Meenakshi Publishing.

Course Code	Course Name	Category	L	T	P	Credit
18PHP03	**Quantum Mechanics-I**	**Core**	75	5	-	4

Preamble

The aim is to provide the students, knowledge in the concepts of Matrix formalism, the approximation methods and the Orbital and Spin angular momentum.

Course Outcome

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Understand and explain the differences between classical and quantum mechanics	K1, K2, K3
CO2.	Solve Schrodinger equation for spherically symmetric potentials	K1, K2, K3
CO3.	Apply variational method and time-independent perturbation theory to solve problems	K1, K2, K3
CO4.	Apply time-dependent perturbation theory to solve problems and understand probability of transition between the energy levels	K1, K2, K3
CO5.	Grasp the concepts of spin and angular momentum, as well as their quantization- and addition rules.	K1, K2, K3

UNIT I **(15 Hrs)**

Introduction and Matrix formalism: Inadequacy of classical Physics - Wave packets – Uncertainty relations-Schrodinger wave equation and probabilistic interpretation. Hilbert space – Dirac's bra and ket notation – Operators as matrices – Matrix form of wave functions – Unitary transformation: Change of basis – Properties of unitary transformations – Schrodinger picture – Heisenberg picture – Interaction picture

UNIT II **(15 Hrs)**

Spherically Symmetric Systems: Schrödinger's equation for spherically symmetric potentials – Three dimensional harmonic oscillator – Rigid rotator with free axis – Solution of wave equation and eigen function for the rotator – Rigid rotator in a fixed plane – The Hydrogen atom – φ, θ and r equations and their solutions – Energy eigen values for the hydrogen atom – Degeneracy – The normal state of hydrogen atom

UNIT III **(15 Hrs)**

Time independent Approximation Methods: Time Independent Perturbation Theory in Non-Degenerate Case-Ground State of Helium Atom- Degenerate Case-Stark Effect in Hydrogen-Variation Method & its Application to Hydrogen Molecule- WKB Approximation.

UNIT IV **(15 Hrs)**

Time Dependent Perturbation Theory: Time Dependent Perturbation Theory-First and Second Order Transitions-Transition to Continuum of States-Fermi Golden Rule-Constant and Harmonic Perturbation-Transition Probabilities-Selection Rules for Dipole Radiation-Collision-Adiabatic Approximation

UNIT V **(15 Hrs)**

Angular Momentum: Orbital Angular Momentum-Spin Angular Momentum-Total Angular Momentum Operators-Commutation Relations of Total Angular Momentum with Components-Ladder Operators-Commutation Relation of Jz with J_+ and J_- Eigen Values of J^2, Jz -Matrix Representation of J^2, Jz, J_+ and J_--Addition of Angular Momenta- Clebsch Gordon Coefficients-Calculation of Clebsch Gordon Coefficients for $j_1=1/2$, $j_2=1/2$.

Books for Study:

1. Quantum Mechanics-Gupta, Kumar & Sharma 23rd Edition, 2003-2004
2. Quantum Mechanics – Aruldhas-2002

Books for Reference:

1. Quantum Mechanics-Satyaprakash
2. Quantum Mechanics-L.I. Schiff- McGraw Hill, 3rd Edition, 1968
3. Quantum Mechanics-A. Devanathan-Narosa Publishing-New Delhi, 2005

Course Code	Course Name	Category	L	T	P	Credit
18PHP04	**Numerical Methods & MATLAB Programming**	**Core**	75	5	-	4

Preamble

The aim is to provide the students to develop appropriate numerical methods, prove results for various numerical root finding methods and to code various numerical methods in a modern computer language

Course Outcome

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Solving Differential equation by using various numerical methods	K1, K2, K3
CO2.	Definite integrals were calculated by using appropriate numerical methods	K1, K2, K3
CO3.	Coding various numerical methods in a modern computer language as MATLAB	K1, K2, K3
CO4.	Programming various loops in MATLAB	K1, K2, K3
CO5.	Interpret 2D and 3D Graphics in MATLAB	K1, K2, K3

UNIT I **(15 Hrs)**

Numerical Differentiation: Finding Roots of a Polynomial-Bisection Method-Newton Raphson Method-Solution of Simultaneous Linear Equation by Gauss Elimination Method (includes inverse of matrices)-Solution of Ordinary Differential Equation by Euler, Runge-Kutta Fourth Order Method for solving first order Ordinary Differential Equations.

UNIT II **(15 Hrs)**

Numerical Integration: Newton's cotes formula-Trapezoidal rule-Simpson's 1/3 rule-Simpson's 3/8 rule -Gaussian quadrature method-(2 point and 3 point formulae)-Giraffe's root square method for solving algebraic equation.

UNIT III **(15 Hrs)**

MATLAB Fundamentals: Introduction-MATLAB Features-Desktop windows: Command, Workspace, Command History, Array Editor and Current Directory -MATLAB Help and Demos- MATLAB Functions, Operators and Commands. Basic Arithmetic in MATLAB-Basic Operations with Scalars, Vectors and Arrays-Matrices and Matrix Operations-Complex

Numbers- MATLAB Built-In Functions- Saving and loading data – Plotting simple graphs-Illustrative Examples

UNIT IV **(15 Hrs)**

MATLAB Programming: Control Flow Statements: ***if, else, else if, switch*** Statements-***for, while*** Loop Structures-***break*** Statement-Input/output Commands-Script ”m” Files -Function ”m” Files-Controlling Output - Language specific features – Advanced Data objects . Applications – (Programs about Linear Algebra – Curve fitting and Interpolation – Data analysis and Statistics – Numerical Integration – Ordinary differential equations – Nonlinear Algebraic Equations).

UNIT V **(15 Hrs)**

MATLAB Graphics: 2D Plots-Planar Plots, Log Plots, Scatter Plots, Contour Plots- Using subplot to Layout multiple graphs -Multiple Figures, Graph of a Function-Titles, Labels, Text in a Graph- Line Types, Marker types, Colors-3D Graphics-Curve Plots-Mesh and Surface Plots-Handle Graphics – Saving and printing Graphs – Errors - Illustrative Examples.

Books for Study:

1. Kandasamy. P, Thilagavathi. K “Allied Mathematics”, Volume I and II, S.Chand and Company Ltd, New Delhi, 2004.
2. RUDRA PRATAP, Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers, Oxford University Press, 2003.

Books for Reference:

1. Numerical methods in Science and Engineering- M.K. Venkataraman-National Publishing Co. Madras, 1996
2. Engineering and Scientific Computations Using Matlab- Sergey E. Lyshevski-JohnWiley &Sons.
3. A Guide to Matlab for Beginners & Experienced Users-Brian Hunt, Ronald Lipsman, Jonathan Rosenberg-Cambridge University Press
4. Matlab Primer-Timothy A. Davis & Kermit Sigmon-Chapman & Hall CRC Press-London
5. Matlab Programming-David Kuncicky-Prentice Hall
6. An Introduction to Programming and Numerical Methods in MATLAB- S.R. Otto and J.P.Denier- Springer-Verlag-London
7. Numerical Methods Using Matlab-John Mathews & Kurtis Fink-Prentice Hall-New Jersey,2006
8. Introductory Methods of Numerical Analysis- S.S. Sastry-Prentice Hall, 2005
9. William John Palm, Introduction to Matlab 7 for Engineers, McGraw-Hill Professional, 2005.
10. Dolores M. Etter, David C. Kuncicky , Introduction to MATLAB 7, Prentice Hall, 2004.

Course Code	Course Name	Category	L	T	P	Credit
18PHP06	**Advanced Physics Practical - I**	**Core: Practical**	120	-	8	4

(Examination at the end of Second Semester)

Preamble

The aim is to provide the students better practical knowledge of general Physics experiments, learn about handling of experiments and to know about different equipments used.

Any Twelve Experiments

1. Young's Modulus-Elliptical Fringes (Cornu's Method)
2. Young's Modulus-Hyperbolic Fringes (Cornu's Method)
3. Viscosity of a Liquid-Mayer's Oscillating Disc
4. Stefan's Constant
5. Rydberg's Constant-Solar Spectrum
6. Thickness of Wire by Air Wedge and Diffraction
7. Determination of Audio Frequencies-Bridge Method
8. Thermionic Work Function
9. Thermal Conductivity-Forbe's Method
10. Electronic Charge 'e' by Millikan's Oil Drop Method
11. Electronic Specific Charge 'e/m' by Thomson's Method
12. Thermistor-Temperature Coefficient and Band Gap Energy Determination
13. Specific Heat of a Liquid-Ferguson's Method
14. Biprism on Optical Bench-Determination of Wavelength
15. He-Ne Laser –Measurement of Wavelength using reflectance grating.
16. Babinet's Compensator
17. LG Plate-Resolving Power
18. Thickness of the wire by diffraction
19. Fabry-Perot Interferometer-Study of Fine Structure
20. Geiger Muller Counter-Determination of Half Life of 'In'
21. MATLAB Programming-Roots of a Quadratic Equation & Solution of a System of Linear Equations
22. MATLAB Programming -Solution of Ordinary Differential Equations
23. MATLAB Programming -Runge-Kutta Method
24. MATLAB Programming -Newton-Raphson Method
25. MATLAB Programming-Mean, Median & Standard Deviation

26. MATLAB Programming-Curve Fitting & Interpolation
27. MATLAB Programming-Matrix Summation, Subtraction and Multiplication
28. MATLAB Programming-Matrix Inversion and Solution of Simultaneous Equations
29. He-Ne Laser – Measurement of refractive index of liquids.
30. He-Ne Laser – Power distribution measurement.
31. He-Ne Laser- Thickness of wire.

Course Code	Course Name	Category	L	T	P	Credit
18PHP07	General Electronics Practical – I	**Core: Practical**	120	-	8	4

(Examination at the end of Second Semester)

Preamble

The aim is to provide the students better practical knowledge of general Physics experiments, learn about handling of experiments and to know about different equipments used.

Any Fifteen Experiments

1. Design of Regulated and Dual Power Supply.
2. Basic Logic Gates-Digital IC's
3. Parameters of Op-Amp
4. Design of Wave Form Generators- using Op-Amp.
5. Design of Phase-Shift Oscillator- Op-Amp
6. Design of Wein's Bridge Oscillator- Op-Amp
7. Design of Active Filters- Op-Amp
8. Design of Differential Amplifier- Op-Amp
9. Sign Changer, Scale Changer, Adder and Subtractor- Op-Amp
10. Design of UJT Relaxation Oscillator
11. CRO-Differentiating, Integrating, Clipping and Clamping Circuits, Square Wave Testing
12. SCR-Characteristics and an Application
13. Source Follower
14. Amplifier-Inverting, Non-Inverting, Voltage Follower- Op-Amp
15. Characteristics of FET
16. Digital IC's- Counters
17. Schmitt Trigger using discrete components and OP-AMP/ Timer 555
18. D/A converter using Op. Amp
19. MATLAB Programming-Charging of an Capacitor in an RC Circuit with three Time Constants
20. MATLAB Programming- Full Wave Rectifier-Determination of (a) Peak-to-Peak Value of Ripple Voltage, (b) DC Output Voltage (c) Discharge Time of the Capacitor (d) Period of Ripple Voltage
21. MATLAB Programming- Plot of Voltage and Current of an RLC Circuit under Steady State Conditions
22. MATLAB Programming- NPN Transistor-Plotting Input & Output Characteristics
23. MATLAB Programming-Frequency Response of a Low Pass Op-Amp Filter Circuit

24. MATLAB Programming-Diode-Plot of Forward Characteristics & Load Line Plot - Estimation of Operating Point
25. MATLAB programming- Radioactivity decay graph

Course Code	Course Name	Category	L	T	P	Credit
18PHP08A	**Essentials Of Nanoscience**	**Core: Elective**	60	4	-	4

Preamble

The aim is to provide the students to understand the Atomic and Molecular Spectroscopy and to develop skills and capability for formulating and analyzing chemical compounds using Nanoscience

Course Outcome

On successful completion of the course, the student will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Appreciate the importance of Nanoscience	K1, K2, K3
CO2.	Recognize the different types of nanomaterials	K1, K2, K3
CO3.	Understand the properties of nanomaterials	K1, K2, K3
CO4.	Understand the molecular interactions of nanomaterials	K1, K2, K3
CO5.	Recognize the knowledge in Nanoscience	K1, K2, K3

UNIT I **(12 Hrs)**

Evolution of Nanoscience and Nanotechnology: History of Nanoscience and Nanotechnology – Ancient, Medieval and Modern period – Terms and Definitions – Scale of materials – macro, micro and nanoscale – pioneers and contributors in Nanoscience and nanotechnology – Fabrication methods – Top-down and bottom-up approaches (Principles and types) – Nanoscience and nanotechnology practiced by nature –Inspirations from nature – Natural nanomaterials – Inorganic, organic and biological origin.

UNIT II **(12 Hrs)**

Nanomaterials: Structure , properties and importance of the following Nanomaterials - Metallic nanoparticles – Semiconductor quantum dots, core-shell nanoparticles - carbon based nanomaterials – fullerenes, carbon nanotubes (single walled and multi walled) and graphenes –

Supramolecules – Dendrimers, micelles and reverse micelles – Nanoporous Materials. (Synthesis of the nanomaterials not included)

UNIT III **(12 Hrs)**

Polymeric Nanomaterials: Introduction to polymers – classification of polymers – types of polymerization processes – Block copolymers - Glass transition temperature of Polymers – Structure, properties and importance of selected synthetic and Biopolymers – Polystyrene, Polyvinyl alcohol, Polystyrene sulphonate, Polyethylene glycol, Polyhydroxy alkanoate, Polylactic acid and Chitosan – Conducting polymers – Introduction, principle of conduction and different types of conducting polymers.

UNIT IV **(12 Hrs)**

Properties at the Nanoscale – I: Comparison of properties at bulk and nano – Surface and Volume – Surface energy – Surface stabilization – Surface energy minimization mechanisms – Application of classical thermodynamics 133 to nanomaterials (Small system thermodynamics) – Chemical interactions at Nanoscale.- Primary interactions (Ionic, Covalent and Metallic bonds) – Secondary interactions – Electrostatic interaction, Hydrogen bonding, Van-der waals attraction, hydrophobic effect.

UNIT V **(12 Hrs)**

Properties at the Nanoscale – II: Optical properties in metals, semiconductors and insulators- Photoluminescence - Cathode luminescence- Electro luminescence- Fluorescence- Phosphorescence- Surface Plasmon resonance and optical properties in metallic nanoparticles – Quantum confinement and emission characteristics of semiconductor nanocrystals – optical properties of core-shell nanoparticles – Mechanical, thermal and electrical properties of carbon based nanomaterials (CNT & graphenes) – Guest-Host relationship and Molecular recognition in supramolecules.

Books for Study:

1. Gabor L.Hornyak, Joy Deep Dutta, Harry F.Tibbals and Hail K.Rao, Introduction to Nanoscience, New York, CRC press, 2008(Unit : I, IV & V).
2. Pradeep T, Nano:The Essentials: Understanding Nanoscience and Nanotecnology, New Delhi, Tata McGraw-Hill Publishing Company Limited, 2008 (Unit : II, III & V).
3. Rao C.N.R, Müller, Cheetham, The Chemistry of Nanomaterials, 1 and 2, Wiley- VCH Verlag GmBH & Co., Weinheim, 2004 (Unit: III).

Course Code	Course Name	Category	L	T	P	Credit
18PHP08B	**Radiation Physics**	**Core: Elective**	60	4	-	4

Preamble

The aim is to provide the students to gain deeper knowledge and understanding of Radiation Physics and to learn information about their principles and methods.

Course Outcome

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Know about the Radiation Physics.	K1, K2, K3
CO2.	Understand the wind energy and geo-thermal energy.	K1, K2, K3
CO3.	Suggest methods to store energy through Bio conversion and Ocean energy.	K1, K2, K3
CO4.	Use appropriate methods involved in Direct energy conversion.	K1, K2, K3
CO5.	Know advantages of Non-conventional Energy Resources.	K1, K2, K3

Unit I **(12 Hrs)**

Basic Radiation Physics: Introduction to radiation Physics- Atomic and Nuclear structure- Electron interaction- Photon interaction- Classification of forces in nature, fundamental particles, radiation- Atomic and nuclear structure- Bohr's model of the hydrogen atom- Radioactivity- Modes of radioactive decay- Electron Interaction- Photon Interaction.

Unit II **(12 Hrs)**

Radiation and Particle Detector: Interaction of particles and radiation with matter- Photoelectric and Compton effect- Gas Electron Multiplier (GEM)- Detection of neutrons- Surface photoemission detectors- Photo cathodes and Photo tubes- Semiconductor detectors.

Unit III **(12 Hrs)**

Radioactivity in the Environmental Media: Introduction to environmental radioactivity- Airborne radioactivity- Production and Propagation of Airborne radioactivity by tall & short

stacks- Water Activation- Geological Media Activation- The Propagation of Radio nuclides Through Geological Media.

Unit IV **(12 Hrs)**

Radioactivity in Medicine: Basics of radiotherapy- Linear accelerators- Measuring equipments- Treatment planning & process- Dependence of photon energy and atomic number- attenuation and absorption.

Unit V **(12 Hrs)**

Radiation Protection: Human Factors- Environmental Factors- Toxic Agents, such as radioactive Material- Organizational Plan for Radiation Protection- Radiation Lab Protection Procedures- Accident Anticipation- Mitigating Internal Radiation Hazards.

References:

Web References:

1. http://www.irsn.fr/FR/professionnels_sante/documentation/Documents/basic_radiation_physics.pdf
2. http://www.physics.ohio-state.edu/~klaus/s12-780/references/turku_lecturenotes.pdf
3. https://www-esh.fnal.gov/TM1834_PDF_Files/TM_1834_Revision_9B.pdf
4. http://www.imre.ucl.ac.be/rpr/sv2012/RDTH3120-partie1.pdf
5. http://www.ehs.washington.edu/rsotrain/radprotectionprinciples/table_of_contents.pdf

SEMESTER-II

Course Code	Course Name	Category	L	T	P	Credit
18PHP09	**Quantum Mechanics - II**	**Core**	75	5	-	4

Preamble

The aim is to make the students understand the Scattering theory, the applications to atomic and molecular structures and about the identical particles and their spin and quantum field theory.

Course Outcome

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Understand how to apply perturbation theory to describe scattering and partial wave analysis	K1, K2, K3
CO2.	Understand the application of approximation methods to atomic structure	K1, K2, K3
CO3.	Understand the form and construction of relativistic wave equations	K1, K2, K3
CO4.	Gain knowledge about Pauli's exclusion principle and symmetric and antisymmetric wave functions	K1, K2, K3
CO5.	Appreciate the need for quantum field theory	K1, K2, K3

Unit I **(15 Hrs)**

Scattering Theory: Scattering Amplitude - Expression in terms of Green's Function - Born Approximation and its Validity - Partial Wave Analysis - Phase Shifts – Scattering by Coulomb and Yukawa Potential

Unit II **(15 Hrs)**

Application to Atomic Structure: Central Field Approximation - Thomas Fermi Model – Hartree's Self Consistent Model – Hartree Fock Equation - Alkali Atoms - Doublet Separation – Intensities - Complex Atoms - Coupling Schemes

Unit III **(15 Hrs)**

Relativistic Wave Equation: Klein Gordon Equation - Plane Wave Equation - Charge and Current Density - Application to the study of Hydrogen Like Atoms - Dirac Relativistic Equation

for a Free Particle - Dirac Matrices - Dirac Equation in Electromagnetic Field - Negative Energy States.

Unit IV **(15 Hrs)**

Identical Particles and Spin: Identical particles – Symmetric and anti-symmetric wave functions – Construction of symmetric and antisymmetric wave functions – Pauli's exclusion principle – Physical significance – Pauli's spin operator – Commutation relations

Unit V **(15 Hrs)**

Quantum Field Theory: Quantization of Real Scalar wave Field – Quantization of Complex Scalar wave Field - Quantization procedure for particles - Classical Lagrangian Equation - Classical Hamiltonian Equation - Field Quantization of the Non - Relativistic Schrodinger Equation - Creation, Destruction and Number Operators.

Books for Study:

1. Quantum Mechanics-Gupta, Kumar & Sharma, 23rd Edition, 2003-2004
2. Quantum Mechanics-L.I. Schiff- McGraw Hill 3rd Edition, 1968
3. Quantum Mechanics-Aruldas, 2002
4. Quantum mechanics-Satya Prakash & Swathi saluja – Kedar Nath Ram Nath Publications.

Books for Reference:

1. A Text Book of Quantum Mechanics-P.M. Mathews & K. Venkatesan-Tata McGraw Hill 29th Reprint 2002
2. Quantum Mechanics-L.I. Schiff- McGraw Hill 3rd Edition, 1968
3. Quantum Mechanics-Devanathan-Narosa Publishing-New Delhi, 2005
4. Quantum Mechanics-A.K. Ghatak and S. Loganathan- McMilan India 4th Edition, 1999
5. Quantum Mechanics-Messiah (North Holland)1970
6. Quantum Mechanics-Merzbacher-John Wiley & Sons 3rd Edition, 2004
7. Principles of Quantum Mechanics-R.Shankar, Springer, 2005
8. Introduction to Quantum Mechanics – David J Griffiths- Addison Wesley – 2nd edition

Course Code	Course Name	Category	L	T	P	Credit
18PHP09	**Advanced Electronics**	**Core**	75	5	-	4

Preamble

The aim is to make the students to understand the concept of semiconductor devices, to gain knowledge about fabrication and characteristics of Integrated Circuits and to learn the concepts of advanced level of digital electronics

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand about the different semi conductor devices	K1, K2, K3
CO2	Learn the fabrication and characteristics of the Integrated circuit technology	K1, K2, K3
CO3	Understand the linear and non-linear analog systems	K1, K2, K3
CO4	know about flip-flops and Boolean algebra and solve equations using Karnaugh maps	K1, K2, K3
CO5	Design the Synchronous counters	K1, K2, K3

UNIT I **(15 hrs)**

Semiconductor Devices: Field effect transistors – JFET bias line and load line – MOSFET construction and Symbols – FET as a Voltage Variable Resistor-Common Source Amplifier at High Frequencies-Common Drain Amplifier at High Frequencies-Silicon Controlled Rectifier (SCR) Characteristics-SCR Power Control- Tunnel Diode -Optoelectronics: Photo Resistor-Photo Diode-Photo Transistor-LED-Photo Voltaic Effect-Solar Cells.

UNIT II **(15 hrs)**

Integrated Circuits-Fabrication and Characteristics: Integrated circuit technology – Basic monolithic circuits – Epitaxial growth – Masking and etching – Diffusion of impurities – Transistor for monolithic circuits – Monolithic diodes – Integrated resistors- Integrated capacitors – Monolithic circuit layout – Additional isolation methods – LSI and MSI – Metal semiconductor contact.

UNIT III **(15 hrs)**

Integrated Circuits as Analog System Building Blocks: Linear analog systems: Basic Op.Amp. applications – Sign changer – Scale changer – Phase shifter – Summing amplifier – Voltage to current converter – Current to voltage converter – DC voltage follower – Differential DC amplifier – Stable AC coupled amplifier – Analog integration and differentiation – Electronic analog computation

Nonlinear analog systems: Comparator – Sample and hold circuits – D/A converter: Binary weighted resister and ladder type – A/D converter: Successive type and Dual-slop converters

UNIT IV **(15 hrs)**

Flip-flops: S-R, Clocked S-R, D, J-K, T, Master-Slave J-K flip-flops – Their state diagrams and characteristic equations – Edge triggering in flip-flops

Logic gates: OR, AND, NOT, NOR and NAND gates, Exclusive OR gate – NAND and NOR as Universal gates.

Boolean algebra and Minimization Techniques: Basic laws of Boolean algebra – De Morgan's theorems – Adder, Subtractor, Comparator, Decoder / Demultiplexer - Sum of products and Product –of-sums - Karnaugh map (up to four variables only) –Don't care

UNIT V **(15 hrs)**

Synchronous Counters: Design of Synchronous Counters: Design of MOD-3, MOD-6 ,and MOD-10 counters using JK Master-slave flip-flops only – Register – 4 bit shift Register – Serial-in serial-out, Serial-in Parallel-out, Parallel-in Serial-out and Parallel-in Parallel-out – Design of four bit self-correcting ring counter using D-flip-flop

Books for Study:

1. Microelectronics-Millman & Grabel-McGraw Hill, 1982 (UNIT 1)
2. Integrated Electronics by Millman and Halkias, TMH Publications (UNIT 2&3)
3. Digital Circuits and Design by S. Salivahanan and S. Arivazhagan, Vikas Publishing (UNIT 4&5)

Books for Reference:

1. Handbook of Electronics by Gupta and Kumar
2. Digital Fundamentals-Floyd-UBS 1600
3. Digital Principles and Applications-Malvino & Leach- McGraw Hill
4. Principles of Electronics V K Metha
5. Applied Electronics R S Sedha

Course Code	Course Name	Category	L	T	P	Credit
18PHP11	**Solar Physics**	**Core**	45	3	-	4

Preamble

The aim is to provide the students an overview of the energy problem faced by the current generation, underline the importance of renewable energy sources and to get a thorough knowledge about renewable solar energy technology

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Get the knowledge about the introduction of Energy Sources	K1, K2, K3
CO2.	Learn the prospects of renewable Energy sources and its applications	K1, K2, K3
CO3.	Understand about Solar radiations and its measurements	K1, K2, K3
CO4.	Understand about Solar cells and conversion of solar energy to electric energy	K1, K2, K3
CO5.	Understand about the applications of conventional sources - Solar energy	K1, K2, K3

Unit I **(9 Hrs)**

Introduction to Energy Sources: Energy sources - World and Indian energy future - Types of energy sources - World energy futures - Energy sources and their availability.

Unit II **(9 Hrs)**

Renewable Energy: Prospects of renewable energy sources - solar energy - Its uses and barriers in the implementation of renewable energy systems. Indian research and perspectives.

Unit III **(9 Hrs)**

Solar Energy: Solar radiation at the Earth's Surface - Solar constant.

Solar Radiation Measurements: Solar energy measuring equipments – pyrheliometers – pyranometers.

Unit IV **(9 Hrs)**

Solar Cells: Solar cells for direct conversion of solar energy to electric energy - Solar cell parameter - Solar cell electrical characteristics - Efficiency - Single crystal silicon solar cells - Polycrystalline silicon solar cells - Cadmium sulphide solar cells.

Unit V **(9 Hrs)**

Applications of Solar Energy: Solar water heating - space heating and space cooling - solar photo voltaics - agricultural and industrial process heat - solar distillation - solar pumping- solar furnace - solar water heater - solar cooking - solar green house.

Books for study:

1. Non-Conventional Energy Sources, G.D. Rai, Standard Publishers Distributors,ISBN 9788186308295 (2004)
2. Solar Energy Utilization, G.D. Rai, Standard Publishers Distributors (1995)
3. Non-Conventional Energy Sources, B.H.Khan, Tata McGraw Hill, ISBN 0-07-060654-4(2006).
4. Non-Conventional Energy Sources and Utilisation, Er. R. K. RAJPUT, S.CHAND &COMPANY PVT . LTD, ISBN 81-219-3971-2 (2014)
5. Non-Conventional sources of Energy – G.D.Rai, Khanna Publishers, New Delhi.
6. Solar Energy Utilisation – G.D.Rai, Khanna Publishers, New Delhi, 3rd Edition, 1987.

Books for Reference:

1. Renewable Energy, Godfrey Boyle, Oxford University Press in association with the Open University, (2004), ISBN 9780199261789
2. F. Kreith and J.F. Kreider, Principles of Solar Engineering, Tata McGraw Hill (1978).
3. A.B. Meinel and A.P.Meinel, Applied Solar Energy, Addison Wesley Publishing Co.(1976).
4. M.P.Agarwal, Solar Energy, S. Chand and Co., New Delhi (1983).
5. S.P.Sukhatme, Solar Energy, Tata McGraw Hill (1997).

Course Code	Course Name	Category	L	T	P	Credit
18PHP13A	**Astronomy & Astrophysics**	**Core: Elective**	75	5	-	4

Preamble

The aim is to provide the students deeper knowledge and understanding of astronomy, learn information about stars and galaxies and to know about the destruction of stars.

Course Outcome

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the Science based on observations of universe	K1, K2, K3
CO2	Gain the knowledge about basics of stars and Galaxies	K1, K2, K3
CO3	know about Sun and its Composition	K1, K2, K3
CO4	Understand the classification of galaxies	K1, K2, K3
CO5	Know about the destruction of stars.	K1, K2, K3

UNIT I **(15 hrs)**

History of Astronomy: Introductory History of Astronomy-Ptolemy's Geocentric Universe-Copernicus' Heliocentric Universe-Tycho Brahe and Galileo's Observations-Kepler's Laws of Planetary Motion-Newtonian Concept Of Gravity-Highlights of Einstein's Special and General Theory Of Relativity-Curved Space Time-Evidence of Curved Space Time-Bending Of Light-Time Dilation

UNIT II **(15 hrs)**

Stars & Galaxies: Stars and Galaxies-Distances-Trigonometric Parallax-Inverse Square Law-Magnitude of Stars-Apparent Magnitude-Absolute Magnitude and Luminosity-Color and Temperature- Composition of Stars-Velocity, Mass and Sizes of Stars-Types of Stars-Temperature Dependence-Spectral Types-Hertzsprung-Russell (HR) Diagram-Spectroscopic Parallax

UNIT III **(15 hrs)**

Sun and its composition: The Sun-Its Size and Composition- Sun's Interior Zones-Sun's Surface-Photosphere-Chromosphere-Corona-Sun's Power Source-Fusion Reaction Mechanism.

UNIT IV **(15 hrs)**

Galactic astronomy: Milky way Hubble classification of galaxies-Spiral galaxies, Elliptical galaxies, Irregular galaxies, Dwarf galaxies; Masses of galaxies-Rotation curves of galaxies; Dark matter

UNIT V **(15 hrs)**

Lives and death of stars: Stellar Evolution-Mass Dependence-Giant Molecular Cloud-Protostar-Main Sequence Star-Subgiant, Red Giant, Supergiant-Core Fusion-Red Giant (Or) Supergiant- Planetary Nebula (Or) Supernova-White Dwarfs-Novae And Supernovae- Neutron Stars-Pulsars-Black Holes-Detecting Black Holes

Books for study:

1. Lectures on Astronomy, Astrophysics, And Cosmology-Luis A. Anchordoqu
2. Lecture Notes of Department of Physics, University of Wisconsin-Milwaukee
3. Astrophysics of the Solar System -K.D. Abhayankar
4. An Introduction to Planetary Physics - Kaula. W.M.
5. Astrophysics of the Sun - Harold Zirin.

Study material available in the website: www.astronomynotes.com

Course Code	Course Name	Category	L	T	P	Credit
18PHP13B	**Experimental Techniques**	**Core: Elective**	75	5	-	4

Preamble

The aim is to provide the students knowledge about the techniques behind various measuring instruments and to handle the various electronic measuring instruments.

Course Outcome

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Know about the errors and its types in measurements.	K1, K2, K3
CO2	Suggest filters for signal conditioning.	K1, K2, K3
CO3	Understand about the different types of transducers.	K1, K2, K3
CO4	Know applications about various electronic measuring instruments.	K1, K2, K3
CO5	Use appropriate methods for analyzing electronic waves	K1, K2, K3

Unit I **(15 Hrs)**

Measurement of errors: accuracy, precision, resolution, sensitivity -absolute and relative errors-Types of errors -gross error, systematic error and random error.

Standards of measurements: Classification of standards, time and frequency standards, electrical standards.

Unit II **(15 Hrs)**

Electrical Transducer Classification: Active and Passive transducers- selecting a good transducer – requirements of an electrical transducer – transducer types- resistive, inductive, capacitive and Piezoelectric transducer-Digital displacement transducers – thermistors.

Unit III **(15 Hrs)**

Amplifiers and Signal Conditioning: Instrumentation amplifiers-Isolation amplifiers-Chopper amplifiers-Voltage to frequency converters-Frequency multipliers-logarithmic amplifiers, S/H Circuits Active filters-Low pass, High pass, Band pass and Band stop filters.

Unit IV **(15 Hrs)**

Electronic Measuring Instrument: Q-meter-Vector impedance meter Digital frequency -Digital voltmeter -Phase meter-RF power and voltage measurement -Power factor meter -Vector

voltmeter. Display and Recording: X-Y Recorders-Magnetic Tape recorders-Storage Oscilloscope- cathode ray oscilloscope.

Unit V **(15 Hrs)**

Analysis: Wave Analyzers-Audio frequency Wave analyzer-Harmonic distortion analyzers-Resonant harmonic distortion analyzer-Heterodyne harmonic distortion analyzer-Fundamental suppression harmonic distortion analyzer-Spectrum analyzer.

Books for study:

1. Electrical & Electronics Measurement &Instrumentation -A.K. Sawhney
2. Modern Electronic Instrumentation – Kalsi.

Books for Reference:

1. Modern Electronic Instrumentation and Measurement Techniques -A.O. Hefnick and W.D. Cooper., Prentice Hall India Publications.
2. Introduction to Instrumentation and Control -A.K. Ghosh-Prentice Hall India Publications

Course Code	Course Name	Category	L	T	P	Credit
18SEPPH1	**Cyber Security**	**Skill Enhancement Course**	30	2	-	2

Preamble

The aim is to provide the students, the basics of cyber security and the security threats in day-to-day activities.

Course Outcomes

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic concepts of information security and its types.	K1
CO2	Obtaining the knowledge thoroughly on cyber security and its principles	K1
CO3	Deal with risk management and threats	K1,K2
CO4	Gain detailed knowledge on security issues in social media	K3,K4
CO5	Apply and work with cyber security applications in real world	K5,K6

Unit I **(6 Hrs)**

Information Security: History of Information Security - Need for Security.

Types of Security: Physical Security –Network Security –Personal Security –Operation Security –Communication Security - Information Security Threats.

Unit II **(6 Hrs)**

Introduction to Cyber Security

Cyber Security: Objectives- Roles- Differences between Information Security and Cyber Security.

Cyber Security Principles: Confidentiality- Integrity – Availability.

Unit III **(6 Hrs)**

Risks & Vulnerabilities

Risk Meaning: Risk Management –Problems of Measuring Risk -Risk Levels-Risk Analyzes-Risk Assessment –Response to Risk Terminology

Threats: Components of Threats-Types of Threats-

Vulnerabilities: Computing System Vulnerabilities –Hardware Vulnerabilities-Software Vulnerabilities-Data Vulnerabilities-Human Vulnerabilities.

Unit IV **(6 Hrs)**

Social media

Introduction to social media: What, Why –Pros and cons

Security issues in social media: Mail-Facebook-Whatsapp-Twitter-Preventive and control measures.

Unit V **(6 Hrs)**

Case study

Impact of social media: Education -Business- Banking-Mobile –Human Life- Present generation-Indian scenario.

References:

Web References:

1. https://m.youtube.com/watch?v=o6pgd8gLFHg
2. https://m.youtube.com/watch?v=3rl4ZjZpcHU
3. https://blog.barkly.com/10-fundamental-cybersecurity-lessons-for-beginners
4. https://5social media security risk and how to avoid them.html
5. https://10 cyber security twitter profiles to watch.html
6. https://cyber security in banking 4 trends to watch in 2017.html
7. https://gmail hacking security tips-indian cyber security solutions.html
8. https://why social media sites are the new cyber weapons of.html
9. EBook:A complete guide to Staying Ahead in the Cyber Security Game

SEMESTER-III

Course Code	Course Name	Category	L	T	P	Credit
18PHP14	**Atomic and Molecular Spectroscopy**	**Core**	75	5	-	4

Preamble

The aim is to provide the students, the skills and capability for formulating and analyzing chemical compounds using Atomic and Molecular Spectroscopy

Course Outcomes

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Develop knowledge in Atomic Spectra and Study the microwave spectra for various types of molecules.	K1, K2, K3
CO2	Describe and understand the concepts in vibration-rotation and Raman Spectroscopy	K1, K2, K3
CO3	Study the concepts behind the Fluorescence & Phosphorescence Spectroscopy	K1, K2, K3
CO4	Gain knowledge in relaxation process & chemical shift in molecular level	K1, K2, K3
CO5	Acquire knowledge in Hyperfine structures	K1, K2, K3

Unit I **(15 Hrs)**

Atomic Spectroscopy: Atoms in External Magnetic Fields -Normal Zeeman Effect-Anomalous Zeeman Effect-Magnetic Moment of Atom -Lande's g Formula- Paschen Back Effect- Stark Effect-Hyperfine Structure of Spectral Lines - Spectra of Hydrogen and Alkali Atoms

Microwave Spectroscopy-Experimental Methods-Theory of Microwave Spectra of Linear, Symmetric Top Molecules -Hyperfine Structure

Unit II **(15 Hrs)**

IR Spectroscopy: Practical Aspects-Theory of IR Rotation Vibration Spectra of Gaseous Diatomic Molecules- Applications-Basic Principles of FTIR Spectroscopy.

Raman Spectroscopy: Classical and Quantum Theory of Raman Effect- Rotation Vibration Raman Spectra of Diatomic and Polyatomic Molecules-Applications-Laser Raman Spectroscopy

Unit III **(15 Hrs)**

Fluorescence & Phosphorescence Spectroscopy - Electronic Excitation of Diatomic Species-Vibrational Analysis of Band Systems of Diatomic Molecules-Deslander's Table-Intensity Distribution-Franck Condon Principle- Rotational Structure of Electronic Bands-Resonance and Normal Fluorescence - Intensities of Transitions-Phosphorescence-Population of Triplet State - Experimental Methods-Applications of Fluorescence and Phosphorescence

Unit IV **(15 Hrs)**

NMR Spectroscopy - Quantum Mechanical and Classical Description - Bloch Equations - Relaxation Processes-Experimental Technique-Principle and Working of High Resolution NMR Spectrometer- Chemical Shift

Unit V **(15 Hrs)**

ESR Spectroscopy - Basic Principles-Experiments-ESR Spectrometer-Reflection Cavity and Microwave Bridge-ESR Spectrum-Hyperfine Structure

Books for Study:

1. Molecular Structure and Spectroscopy –G.Aruldhas
2. Fundamentals of Molecular Spectroscopy – C.B.Banwell

Books for Reference:

1. Spectroscopy: Volumes I,II and III-B.P.Straugham & S.Walker
2. Instrumental methods for chemical analysis – Gurdeep R. Chatwal, Sham K.Anand-Himalaya Publishing House

Course Code	Course Name	Category	L	T	P	Credit
18PHP15	**Nuclear Physics & Elementary Particles**	**Core**	75	5	-	4

Preamble

The aim is to provide the students, the concepts of Nucleus and elementary particles and to develop skills to find the binding energy, spin and parity values for various elements.

Course Outcomes

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Demonstrate knowledge about number of nucleons, spin, Parity, quadrupole moment and symmetry.	K1, K2, K3
CO2	Describe and understand the concepts in Radioactivity	K1, K2, K3
CO3	Study the Various Nuclear models	K1, K2, K3
CO4	Demonstrate knowledge in Nuclear fission and fusion	K1, K2, K3
CO5	Learn about the elementary Particles	K1, K2, K3

Unit I **(15 Hrs)**

Nuclear Properties: Nuclear Structure- Distribution of Nuclear Charge-Nuclear Mass-Mass Spectroscopy-Mass Spectrometer-Theories of Nuclear Composition (proton-electron, proton-neutron)- Tensor Force-Static Force-Exchange Force- Nuclear energy levels - Nuclear angular momentum, parity, isospin – Nuclear magnetic dipole moment – Nuclear electric quadropole moment - Ground state of deuteron

Unit II **(15 Hrs)**

Radioactive Decays - Alpha Decay: Properties of α Particles-Gamow‟s Theory of α Decay-Geiger Nuttal Law- α Ray Energies-Fine Structure of α Rays- α Disintegration Energy-Long Range α Particles.

Beta Decay: Properties of β Particles-General Features of β Ray Spectrum-Pauli‟sHypothesis-Neutrino Hypothesis-Fermi‟s Theory of β Decay-Forms of Interactions and Selection Rules.

Gamma Decay: Absorption of γ Rays by Matter-Interaction of γ Rays with MatterMeasurement of γ Ray Energies-Internal Conversion.

Unit III **(15 Hrs)**

Nuclear Reactions and Nuclear Models: Reciprocity theorem– Breit-Wigner formula – Resonance theory – Liquid drop model – Shell model -- Evidences for shell model -- Magic

numbers -- Harmonic oscillator – Square-well potential -- Spin-orbit interaction – Collective model of a nucleus.

Unit IV **(15 Hrs)**

Fission and Fusion Reactors: Characteristics of fission – Mass distribution of fragments – Radioactive decay processes – Fission cross-section – Energy in fission – Bohr-Wheeler's theory of nuclear fission – Fission reactors – Thermal reactors – Homogeneous reactors – Heterogeneous reactors – Basic fusion processes -- Characteristics of fusion – Solar fusion – Controlled fusion reactors.

Unit V **(15 Hrs)**

Particle Physics: Nucleons, leptons, mesons, baryons, hyperons, hadrons, strange particles - Classification of fundamental forces and elementary particles – Basic conservation laws – Additional conservation laws: Baryonic, leptonic, strangeness and isospin charges/quantum numbers – Gell-mann--Nishijima 23 formula - Invariance under charge conjugation (C), parity (P) and time reversal (T) – CPT theorem -- Parity nonconservation in weak interactions – Eight-fold way and supermultiplets – SU(3) symmetry and quark model.

Books for Study:

1. K. S. Krane, Introductory of Nuclear Physics (John-Wiley, New York, 1987).
2. S. B. Patel, Nuclear Physics: An Introduction (New Age, New Delhi, 2009).
3. D. C. Cheng and G. K. O'Neill, Elementary Particle Physics: An Introduction (Addison-Wesley, New York, 1979).
4. D.C. Tayal, Nuclear Physics (Himalaya Pub. House, New Delhi, 2011).
5. S.L. Kakani and S. Kakani, Nuclear and Particle Physics (Anshan Publ., New Delhi, 2009).

Books for Reference:

1. R.C. Sharma, Nuclear Physics (K. Nath and Co, Meerut, 2004). 2. B. L. Cohen, Concepts of Nuclear Physics (Tata McGraw Hill, New Delhi, 1988).

Course Code	Course Name	Category	L	T	P	Credit
18PHP16	**Electromagnetic Field Theory**	**Core**	75	5	-	4

Preamble

The aim is to provide the students, the theory for the fields produced by stationary and moving charges and charged systems and hence the propagation of electromagnetic fields.

Course Outcome

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Understand the basics of electrostatics	K1, K2, K3
CO2.	Understand the behavior of charges in electromagnetic field	K1, K2, K3
CO3.	Know the concepts of magneto statics	K1, K2, K3
CO4.	Understand and solve electromagnetic problems with the help of electrodynamic potentials	K1, K2, K3
CO5.	Understand the electrodynamics of radiating and relativistic systems	K1, K2, K3

Unit I **(15 hrs)**

Electrostatics: Coulomb's law-Gauss law-differential and integral representation-Electric field-Electric potential-Method of images-Multipole expansions.

Unit II **(15 hrs)**

Electrostatics in macroscopic media: Potential and Field due to an Electric Dipole-Dielectric Polarization-External Field of a Dielectric Medium-Gauss' Theorem in a Dielectric-Electric Displacement Vector D-Linear Dielectrics-Relations connecting Electric Susceptibility χ_e, Polarization P, Displacement D and Dielectric Constant-Boundary Conditions of Field Vectors-Molecular Field-Clausius Mosotti Relation for Non-Polar Molecules- Electrostatic Energy and Energy Density

Unit III **(15 hrs)**

Magnetostatics: Biot-Savart Law - Statement-Lorentz Force Law - Definition of B-Divergence and Curl of B Magnetic Scalar Potential (derivation of expression only)-Equivalence of Small Current Loop and Magnetic Dipole-Magnetic Vector Potential (derivation of expression only).

Unit IV **(15 hrs)**

Electromagnetics: Equation of Continuity-Displacement Current-Derivation of Maxwel's Equations - Physical Significance - Poynting Vector - Momentum in EM Field - Electro

Magnetic Potentials-Maxwell's Equations in terms of EM Potentials - Lorentz Gauge-Coulomb Gauge - Boundary Conditions at Interfaces.

Unit V **(15 hrs)**

Relativistic Electrodynamics: Four Vectors-Transformation Relation for Charge and Current Densities for Electromagnetic Potentials-Covariance of Field Equations in terms of Four Vectors-Covariant Form of Electric and Magnetic Field Equations-Covariance of Electromagnetic Field Tensor-Covariant Form of Lorentz Force Law.

Books for Study:

1. Electromagnetic Theory-Chopra & Agarwal-Nath & Co. 1984
2. Electrodynamics-Gupta, Kumar & Singh-Pragati Prakashan-Meerut 1600

Books for Reference:

1. Electromagnetic Theory & Electrodynamics-Satyaprakash-Kedarnath Ramnath & Co.Meerut
2. Classical Electrodynamics-J.D. Jackson-Wiley Eastern 3rd Edition, 2004
3. Principles of Electrodynamics-M. Schwartz-McGraw Hill.

Course Code	Course Name	Category	L	T	P	Credit
18PHPCO1	**Concepts of Electrical Appliances**	**Core: Optional**	45	3	-	3

Preamble

The aim is to provide the students knowledge and understanding of the fundamental concepts in Physics.

Course Outcomes

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Demonstrate knowledge in Electrical connections	K1, K2, K3
CO2.	Understand the concepts in Heating	K1, K2, K3
CO3.	Study about Welding	K1, K2, K3
CO4.	Study Some Applications of Transformers	K1, K2, K3
CO5.	Demonstrate complete knowledge in Domestic Electric Appliances	K1, K2, K3

Unit I **(9 hrs)**

Electrical Connections: Electrical charge - Current - Potential and measuring meters – Galvanometer- Ammeter- Voltmeter and multimeter – Electrical energy - Power - Watt - kWh - - AC and Dc - Single-phase and three phase connections - House wiring - overloading- Earthing - Short circuiting - Fuses - Colour code for insulation wires - Inverter - UPS -Generator - Motor - Circuit breaker - Electrical switches.

Unit II **(9 hrs)**

Heating: Electric heating-Modes of transfer of heat-Methods of electric heating–Resistance heating-Induction heating-High frequency eddy current heating-Dielectric heating-Resistance.

Unit III **(9 hrs)**

Welding: Electric arc welding - DC and AC - Welding Equipment –Energy storage welding occupational hazards due to chemical reactions – Industrial heating and welding.

Unit IV **(9 hrs)**

Principles and Applications of Transformers: Principle of operation - Constructional details - Core type- Shell type - Classification of transformers - EMF equation - Voltage Ratio - Current

ratio - Transformer on no-load - Auto transformer - Principle - Applications. Three phase Transformer – Connections.

Unit V **(9 hrs)**

Domestic Electric Appliances: Electrical bulbs - Fluorescent lamps - Street lighting - Electrical fans -wet grinder - Mixer - Water heater - Storage and instant types - Electric iron box -induction heater- Stabilizer.

Books for Study:

1. Fitzgerald A. E., David E Higginbothom and Arvin Gabrel, Basic Electrical Engineering, Tata McGraw-Hill Education, 2009.
2. Roman Malaric, Instrumentation and Measurement in Electrical Engineering,Brown Walker Press, 2011.

Books for Reference:

1. Clive Maxfield, John Bird, Tim Williams, Walt Kester and Dan Bensky, Electrical Engineering: Know It All, Elsevier Inc, 2008.
2. Despande, M.V, Electrical Machines, PHI Learning, 2011.
3. Bhattacharya K, Electrical Machines, Tata Mc Graw Hill, 1998.
4. Teraja B.L., A Text book in Electrical Technology, S. Chand and Co., 2005
5. Taylor E.O., Utilisation of Electrical Energy, Orient Longman Private Ltd.,2006

Course Code	Course Name	Category	L	T	P	Credit
18PHP18	**Advanced Physics Practical - II**	**Core: Practical**	135	-	9	4

(Examination at the end of Second Semester)

Preamble

The aim is to provide the students better practical knowledge of general Physics experiments, learn about handling of experiments and to know about different equipments used.

Any Tweleve Experiments:

1. e/m-Magnetron Method
2. Compressibility of a Liquid-Ultrasonic Method
3. Arc Spectra-Constant Deviation Spectrograph-Copper, Iron & Brass
4. Michelson Interferometer- λ, dλ and Thickness of Mica Sheet
5. Susceptibility-Guoy and Quincke‟s Method
6. Hall Effect and its application
7. e/m-Zeeman Effect
8. B-H Curve-Solenoid
9. B-H Curve-Anchor ring
10. Double Slit-Wavelength Determination
11. G.M Counter-Characteristics
12. Kelvin‟s Double Bridge-Determination of Very Low Resistance & Temperature Coefficient of Resistance
13. He-Ne Laser determination
14. Matlab Programming-Radioactive Decay
15. Matlab Programming-Numerical Integration
16. Matlab Programming-Double Integration

17. Matlab Programming-Solution of Ordinary Differential Equations

18. Matlab Programming-Computer Simulation of Equations of Motion for a System of Particles

19. Matlab Programming-Computer Simulation of 1-D and 2-D Lattice Vibrations

20. Matlab Programming-Computer Simulation of Kronig-Penney Model

21. Matlab Programming-Numerical simulation of Wave-Functions of Simple Harmonic Oscillator

22. Matlab Programming-Simulation of Wave Functions for a Particle in Critical Box

23. Matlab Programming-Solution of Diffusion Equation

Course Code	Course Name	Category	L	T	P	Credit
18PHP19	**General Electronics Practical-II**	**Core: Practical**	135	-	9	4

(Examination at the end of Second Semester)

Preamble

The aim is to provide the students better practical knowledge of general Physics experiments, learn about handling of experiments and to know about different equipments used.

Any Ten Experiments:

1. Op-Amp: Simultaneous Addition & Subtraction
2. Op-Amp: V to I & I to V Converter
3. Op-Amp: Circuits Using Diodes-Half Wave, Full Wave, Peak Value, Clipper, Clamper
4. Op-Amp: Log and Antilog Amplifier
5. Op-Amp Comparator-Zero Crossing Detector, Window Detector, Time Marker
6. Op-Amp: Instrumentation Amplifier-Temperature Measurement
7. Op-Amp: Instrumentation Amplifier-Light Intensity-Inverse Square Law
8. IC 555 Timer Application-Monostable, Linear & Astable
9. A/D Converters-Any One Method
10. D/A Converters-Binary Weighted Methods
11. Microprocessor: LED Interfacing
12. Microprocessor: Stepper Motor Interfacing
13. Microprocessor: Traffic Control Simulation
14. Microprocessor: ADC Interface-Wave Form Generation
15. Microprocessor: Hex Keyboard Interfacing
16. Microprocessor: Musical Tone Generator Interface

Course Code	Course Name	Category	L	T	P	Credit
18PHP20A	**Bio Medical Instrumentation**	**Core: Elective**	60	4	-	4

Preamble

The aim is to provide the students, the working principles of medical instruments and Physics behind the instruments.

Course Outcome

On successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Understand and gain knowledge about human nerve systems.	K1, K2, K3
CO2.	Understand the idea about the working of ECG machine.	K1, K2, K3
CO3.	Gain the knowledge about ultrasound technology.	K1, K2, K3
CO4.	Understand the techniques behind ultrasonography.	K1, K2, K3
CO5.	Gain idea about MRI parameters.	K1, K2, K3

Unit I **(12 Hrs)**

Electrophysiological measurements: Cell potential genesis – Nernst relation – cell in resting state – action potential from a cell – the resultant externally recorded action potential.

Electrocardiography(ECG): Electrocardiographic planes – Einthoven triangle – bi polar and uni-polar limb lead frontal plane ECG measurements – ECG leads – precordial leads – relationship between various leads – recording of ECG waves and measurements (block diagram)

Unit II **(12 Hrs)**

Electroencephalogram: The brain and the central nervous system – the brain and its parts – cell potential and action – the characteristics of the normal ECG – the input electrodes – electrode construction and connections – EEG recording instruments (explanation with block diagram) – EEG wave analysis – a typical EEG machine specifications and requirements.

Unit III **(12 Hrs)**

ENT and ophthalmic instruments: Audiometry – Bekesy audiometer system – instruments used in opthamology - opthalmoscope – retinoscopy – Keratometer – intra ocular pressure – ultra sound in ophthalmology – components of a typical laser system in ophthalmology.

Unit IV **(12 Hrs)**

Ultrasonography – advantages – B scan – ultrasound scanning – ultrasonic system – probes for ultrasound – Doppler ultrasound (basic aspects) – transducer design – demodulation methods.

Unit V **(12 Hrs)**

Magnetic Resonance and Imaging (MRI): Magnetic intensity – magnetic resonance phenomena – the magnets – magnetic relaxation and MRI parameters – pulse sequences.

Books for Study:

1. A Text book of Medical Instruments – S.Anandhi – New Age International (P) Ltd., Publishers

Books for Reference:

1. Encyclopedia of medical devices and instrumentation – second edition – John G. Webster et.al, - wiley-Interscience.
2. Medical Physics and Bio medical Engineering – B.H.Brown et,al.-Institute of Physics Publishing Bristol and Philadelphia.
3. Design and Development of Medical Electronic Instrumentation – David Prutchi, Michael Norris – wiley-Interscience.

Course Code	Course Name	Category	L	T	P	Credit
18PHP20B	**Thin Film Physics and Crystal Growth**	**Core: Elective**	60	4	-	4

Preamble

The aim is to provide the students deeper knowledge and understanding of thin film technique, its application and understanding the purpose of characterization studies.

Course Outcomes

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Gain the knowledge about thin film deposition	K1, K2, K3
CO2	Understand the concepts of different techniques	K1, K2, K3
CO3	Analyze the growth and structure of a crystal	K1, K2, K3
CO4	Deep knowledge about preparation of thin films	K1, K2, K3
CO5	Knowledge about characterization techniques	K1, K2, K3

Unit I **(12 Hrs)**

Preparation of Thin Film: Nature of Thin Film-Deposition Technology-Distribution of Deposit-Resistance Heating- Thermal Evaporation-Flash Evaporation

Unit II **(12 Hrs)**

Deposition techniques: Electron Beam Method-Cathodic Sputtering-Glow Discharge Sputtering-Low Pressure Sputtering-Reactive Sputtering-RF Sputtering-Chemical Vapour Deposition-Chemical Deposition

Unit III **(12 Hrs)**

Thin Film Growth Process: Epitaxy-Thin Film Structure-Substrate Effect-Epitaxial Deposit - Film growth-five stages- Nucleation theories-Incorporation of defects and impurities in films Deposition parameters and grain size-structure of thin films.

Film Thickness: Mass Methods-Optical Method-Photometry-Ellipsometry-Interferometry-Other Methods- Substrate Cleaning.

Unit IV **(12 Hrs)**

Crystallization Principles and Growth Techniques: Solution growth-Low and high temperatures solution growth-Slow cooling and solvent evaporation methods-Constant temperature bath as a crystallizer. Principle of gel technique-Various types of gel -Structure and importance of gel-Methods of gel growth and advantages-Melt technique- Czochralski growth-Vapor-phase growth-Physical vapor deposition-Chemical vapor deposition.

Unit V **(12 Hrs)**

Characterization Technique: X-ray Diffraction (XRD)-power and single crystal-Fourier transform infrared analysis-FT-Raman analysis-Elemental dispersive x-ray analysis (EDA–X)-scanning electron microscopy (SEM)-UV-VIS Spectrometer-Photo luminance (PL)

Books for Study:

1. K. Sangawal, Elementary Crystal Growth, Shan Publisher, UK (1994).
2. P. Santhana Ragavan, P.Ramasamy, Crystal Growth and Processes, KRU Publications, Kumbakonam (2000).
3. J.C.Brice, Crystal Growth Process, John Wiley Publications, New York (1996).
4. A. Goswami, *Thin Film Fundamentals* (New Age, New Delhi, 2008).

Books for Reference:

1. L.I. Maissel and R. Clang, Hand book of Thin Films Technology, McGraw Hill (1970).
2. J. L. Vossen and W. Kern, Thin Films Process, Academic Press (1978).
3. M. Ohring, The Materials Science of Thin Films, Academic Press (1992).
4. M. William and D. Steve, Instrumental Methods of Analysis, CBS publishers, New Delhi (1986).
5. H.H. Williard, L.L. Merritt, M.J. Dean, and F.A. Settle, Instrumental Methods of Analysis, Sixth Edition, CBS Publishers and distributors, New Delhi (1986).

Course Code	Course Name	Category	L	T	P	Credit
18PEPPH1	**Laser and its Applications (Self Study)**	**Proficiency Enhancement**	-	-	-	2

Preamble

The aim is to provide the student the principles and applications of laser light and the Physics behind it.

Course Outcome

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Study the energy levels and interactions of radiation and matter	K1, K2, K3
CO2.	Understand the concepts of excitation	K1, K2, K3
CO3.	Study about the laser beam properties	K1, K2, K3
CO4.	Study the different types of gas lasers	K1, K2, K3
CO5.	Know the applications of laser light	K1, K2, K3

Unit I

Fundamentals of Lasers: Electromagnetic radiation – energy levels – Interaction of radiation and matter – fluorescence, absorption, stimulated emission.

Laser materials: population inversion – optical pumping- excitation by electron collisions – resonant transfer of energy – resonant cavity.

Unit II

Properties of laser light: Line width – collimation – spatial profiles of laser beams – temporal behavior of Laser output – Q switched operation – mode locked operation – cavity dumping – coherence – radiance – focusing properties of Laser radiation – power.

Unit III

Gas Laser: He-Ne Laser – ionized gas laser – Molecular Laser (CO2) — Solid state lasers: Neodymium YAG Lasers- glass Lasers- Ruby Lasers.

Unit IV

Semi conductor Laser: semiconductor laser properties – Diode structures – diode doped solid state laser – Organic dye lasers – chemical lasers – X ray lasers – Tunable lasers

Unit V

Applications: – Interferometric distance measurement – velocity measurements – measurement of wire diameter – measurement of surface finish – particle diameter measurement – laser applications in material processing – laser welding – surface treatment – drilling, cutting and marking – laser deposition of thin film – integrated circuit fabrication.

Book for study:

1. Industrial application of Lasers – 2nd edition- John F.Reddy – Academic Press.

Books for reference:

1. Semiconductor Lasers – Fundamentals – Edited by Eli Kapon – Academic press
2. Solid state Lasers: A graduate text – Walter Koechner Michael Bass – Springer.
3. Semiconductor Laser Fundamentals – Weng W.chow etal. - Springer

SEMESTER-IV

Course Code	Course Name	Category	L	T	P	Credit
18PHP21	**Condensed Matter Physics**	**Core**	90	6	-	4

Preamble

The aim is to provide students knowledge and understanding of the Crystal structure and crystal defects and to advance skills for analyzing Heat capacity of the electron ga**s** and Magnetism

Course Outcomes

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1.	Understand the fundamentals of reciprocal lattice	K1, K2, K3
CO2.	Describe and understand the concepts of crystal defects	K1, K2, K3
CO3.	Demonstrate knowledge in electron theory of metals.	K1, K2, K3
CO4.	Study the lattice vibration, the conductivity of superconductor and the importance of different materials in a variety of applications.	K1, K2, K3
CO5.	Demonstrate knowledge in theories of magnetism	K1, K2, K3

Unit I **(18 Hrs)**

Reciprocal lattices: Vector development of reciprocal lattice – Properties of the reciprocal lattice – Reciprocal lattice to bcc lattice and fcc lattice.

Unit II **(18 Hrs)**

Crystal Defects: Classification of defects - Points defect - The Schottky defect - The Frenkel defect -colour centers - F center - other colour centers - Production of colour centers by X rays and practice irradiation – Defect and energy state.Dislocations - Slip and plastic deformation - Shear strength of single crystals - Edge dislocation - Screw dislocation - Stress field around an edge dislocation

Unit III **(18 Hrs)**

Lattice Vibrations, Semiconductors & Free Electron Theory: Vibrations of One Dimensional Diatomic Linear Lattice -Acoustic and Optical Branches Phonon State- Energy levels and density of orbitals – Motion in magnetic fields – Hall effect – Thermal conductivity of metals –

Nearly free electron model –Electron in a periodic potential – Semiconductors – Band gap – Effective mass – Intrinsic carrier concentration

Unit IV **(18 Hrs)**

Dielectrics, Ferroelectrics and Superconductivity: Macroscopic electric field – Local electrical field at an atom –Polarizability – Clausius- Mossotti equation – Ferroelectric crystals – Polarization Catastrophe – Ferroelectric domains.Occurrence of Superconductivity – Meissner effect – Thermodynamics of Superconducting transition – London equation – Coherence length – BCS theory – Flux Quantization – Type-I and Type-II Superconductors –Josephson tunneling effect- DC and AC Josephson effect – SQUID – Recent developments in high Temperature Superconductivity – Application of superconductors.

Unit V **(18 Hrs)**

Diamagnetism, Paramagnetism, Ferromagnetism And Antiferromagnetism: Langevin classical theory of Diamagnetism and Paramagnetism – Weiss theory – Quantum theory of Paramagnetism – Paramagnetic susceptibility of conduction electrons – Hund's rules- Kondo effect. Ferroelectric order – Curie point and the exchange integral – Temperature dependence of saturation magnetization – Magnons – Thermal excitation – Ferromagnetic order – Antiferromagnetic order – Antiferromagnetic Magnons – Ferromagnetic domains – Origin of domains – Coercive force and hysteresis.

Books for study:

1. Kittel. C. 2005, Introduction to Solid State Physics, 8th Edition, Willey Eastern Ltd., New Delhi.
2. Saxena. B.S., R.C.Gupta and P.N.Saxena, 2012, Fundamentals of Solid State Physics, 15th edition, Pragati Prakashan, Meeru.

Books for Reference:

1. A.J., revised edition, 2000, Solid State Physics, Macmillan India Ltd., New Delhi.
2. Keer. H.V. 1st edition, 2002, Principles of Solid State, New age international, New Delhi.
3. Pillai S.O., 2005, Solid State Physics, 4th Edition, New Age International Publishers Ltd.

Course Code	Course Name	Category	L	T	P	Credit
18PHP22	**Thermodynamics and Statistical Mechanics**	**Core**	90	6	-	4

Preamble

The aim is to provide students a deeper knowledge and understanding of Thermodynamics, particle distribution and statistics

Course Outcomes

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Gain the knowledge about energy and radiation	K1, K2, K3
CO2	Understand the concept of canonical ensemble, statistical and thermal equilibrium	K1, K2, K3
CO3	Analyze the micro and macrostate distribution	K1, K2, K3
CO4	Deep knowledge about quantum statistics of Bose Einstein and Fermi Dirac statistics	K1, K2, K3
CO5	Knowledge about application of quantum statistics in Bose Einstein condensation and Ising model	K1, K2, K3

Unit I **(18 Hrs)**

Thermodynamics and Radiation: Second law of thermodynamics- Entropy and Second law of thermodynamics- Entropy and Disorder- Thermodynamic Potential and Reciprocity relation- Thermodynamic Equilibria- Chemical Potential- Blackbody radiation- Planck's Radiation law.

Unit II **(18 Hrs)**

Basic Concepts of Statistical Physics: Phase space- Concept of ensemble- Micro canonical ensemble-Canonical ensemble- Grand Canonical ensemble- Density distribution in phase space- Liouvilles theorem- Postulate of equal apriori probability- Statistical equilibrium- Thermal equilibrium- Mechanical equilibrium-Particle equilibrium-Connection between Statistical and thermodynamic quantities.

Unit III **(18 Hrs)**

Classical Distribution Law: Microstates and Macro states-Classical Maxwell-Boltzmann distribution law- Evaluation of constants, α and β- Maxwell's law of Distribution of velocities- Principle of equi-partition of energy- Gibbs paradox- Partition function and its correlation with thermodynamics quantities

Unit IV **(18 Hrs)**

Quantum Statistics: Indistinguishability and quantum statistics- Statistical weight and apriori probability- Identical particle's and symmetry requirements- Bose Einstein's Statistics- Fermi Dirac Statistics- Results of three statistics- Thermodynamic interpretation of parameter's α and β- Blackbody radiation and Planck radiation- Specific heat of solids: Dulong and Petit's law- Einstein's Theory- Debye theory.

Unit V **(18 Hrs)**

Application of Quantum Statistics: Energy and pressure of ideal Bose Einstein gas- Bose Einstein condensation- Liquid helium- Energy and pressure of ideal Fermi Dirac gas- Free electron model and electronic emission- Onsager relations- Fluctuation in Energy, Pressure, Volume & Enthalpy- The Ising model-Bragg William Approximation- One dimensional Ising model .

Books for study:

1. Statistical Mechanics, Gupta & Kumar, 20th edition, PragatiPrakashan Meerut, 2003.
2. Fundamentals Of Statistical Mechanics, Keiser Huang, Revised edition

Book for Reference:

1. Fundamentals of statistical & thermal physics - F.Reif- wareland press - 2010

Course Code	Course Name	Category	L	T	P	Credit
18PHP23	**Electronic Communication Systems**	**Core**	90	6	-	4

Preamble

The aim is to provide the students good understanding of radar systems and types of modulation used in electronic communication systems and the operation of different types of microwave devices

Course outcome

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Explain antenna systems and wave propagation	K1, K2, K3
CO2	Understand the microwave generators and how to generate microwaves.	K1, K2, K3
CO3	Gain knowledge about Radar performance	K1, K2, K3
CO4	Understand about frequency and phase modulation	K1, K2, K3
CO5	Acquire knowledge in fiber optics and its applications	K1, K2, K3

Unit I **(18 Hrs)**

Antennas & Wave Propagation : Terms and Definition -Effect of Ground on Antenna-Grounded λ/4 Antenna Ungrounded λ/2 Antenna Antenna Arrays-Broadside and End SideArrays-Antenna Gain-Directional High Frequency Antennas-Sky Wave Propagation-Ionosphere-Ground Wave Propagation.

Unit II **(18 Hrs)**

Microwaves: Microwave Generation-Multicavity Klystron -Reflex Klystron-Magnetron-Travelling Wave Tubes (TWT) -MASER.

Unit III **(18 Hrs)**

Radar System: Elements of a Radar System-Radar Equation-Radar Performance Factors-Radar Transmitting Systems-Radar Antennas-Duplexers-Radar Receivers and Indicators-Pulsed Systems-Other Radar Systems

Unit IV **(18 Hrs)**

Communication Electronics: Analog and Digital Signals –Modulation –Types of Modulation-Amplitude modulation theory –Frequency spectrum of the AM wave –Representation of AM –Power relations in the AM wave –Generation of AM –Basic requirements-Description of

frequency and phase modulation –Mathematical representation of FM –Frequency spectrum of the FM wave -Effects of noise on carrier.

Unit V **(18 Hrs)**

Optical Fibres: Propagation of Light in an Optical Fibre-Acceptance Angle-Numerical Aperture-Step and Graded Index Fibres-Optical Fibre as a Cylindrical Wave Guide-Wave Guide Equations-Wave Equations in Step Index Fibres-Fibre Losses and Dispersion-Applications.

Books for study:

1. Electronic Communication System-George Kennedy & Davis -Tata McGraw Hill 4^{th} edition 1989
2. Optical fibre and fibre optic communication systems –S K Sarkar –S.ChandPub– 2007 edition

Books for Reference:

1. Principles of Communication Systems-Taub Schilling-TMH 1986
2. Communication Systems-Simon Haykin-John Wiley & Sons 2005
3. Electronics & Radio Engineering-F.E.Terman-McGraw Hill
4. Communication Systems-Carlson-McGraw Hill 3rd Edition1986
5. Fibre Optics technology & Applications-Stewart D. Personick-Khanna Publishers-Delhi.