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

2017-2018 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 2017-18 & 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	17PHP01	Classical Mechanics	5	3	25	75	100	4
III	Core :II	17PHP02	Mathematical Physics	5	3	25	75	100	4
III	Core : III	17PHP03	Quantum Mechanics - I	5	3	25	75	100	4
III	Core : IV	17PHP04	Advanced Computational Physics	5	3	25	75	100	4
III	Core : V	17PHP05	Advanced Physics Practical-I	3	-	-	-	-	-
III	Core : VI	17PHP06	General Electronics Practical-I	3	-	-	-	-	-
III	Core : VII Elective: I	17PHP07A/ 17PHP07B	Elements of Nanoscience and Nanotechnology/ Physics of Non-conventional Energy Resources	4	3	25	75	100	4
			TOTAL	30				500	20
			SEMESTER – II						
III	Core: VIII	17PHP08	Quantum Mechanics - II	5	3	25	75	100	4
III	Core: IX	17PHP09	Advanced Electronics	5	3	25	75	100	4
III	Core: X	17PHP10	Solar Physics	3	3	25	75	100	4
III	Core : V	17PHP05	Advanced Physics Practical-I	5	4	40	60	100	4
III	Core : VI	17PHP06	General Electronics Practical-I	5	4	40	60	100	4
III	Core: XI Elective: II	17PHP11A/ 17PHP11B	Astronomy & Astrophysics/ Experimental Techniques	5	3	25	75	100	4
III	Core : XII	17PHP12	Comprehension in Physics –I (Online Exam)/ Self study	-	1½	-	100	100	2
IV	Skill Enhancement Course : I	17SEPPH1	Cyber Security	2	1½	-	100	100	2
			TOTAL	30				800	28
			SEMESTER – III						
III	Core : XIII	17PHP13	Atomic and Molecular Spectroscopy	5	3	25	75	100	4
III	Core :XIV	17PHP14	Nuclear Physics & Elementary Particles	5	3	25	75	100	4
III	Core :XV	17PHP15	Electromagnetic Field Theory	5	3	25	75	100	4
III	Core : XVI	17PHP16	Comprehension in Physics -II (Online Exam)/ Self study	-	1½	-	100	100	1
III	Core :XVII	17PHPCO1	Concepts of Electrical	3	3	-	-	100	3

			Appliances (Core Optional)						
III	Core: XVIII	17PHP17	Advanced Physics Practical-II	4	-	-	-	-	-
III	Core: XIX	17PHP18	General Electronics Practical-II	4	-	-	-	-	-
III	Core: XX Elective: III	17PHP19A/ 17PHP19B	Biomedical Instrumentation/ Thin Film Physics and Crystal Growth	4	3	25	75	100	4
IV	Skill Enhancement Course : II	17SEPPH2	Industrial Training	-	-	100	-	100	2
V	Proficiency Enhancement	17PEPPH1	Laser and its applications (self study)	-	3	-	100	100	2
			TOTAL	30				800	24
			SEMESTER – IV						
III	Core: XXI	17PHP20	Condensed Matter Physics	6	3	25	75	100	4
III	Core: XXII	17PHP21	Thermodynamics and Statistical Mechanics	6	3	25	75	100	4
III	Core: XXIII	17PHP22	Electronic Communication Systems	6	3	25	75	100	4
III	Core : XXIV	17PHP23	Comprehension in Physics - III (Online Exam)/ Self study	-	1½	-	100	100	1
III	Core: XVIII	17PHP17	Advanced Physics Practical-II	5	4	40	60	100	4
III	Core: XVIX	17PHP18	General Electronics Practical-II	5	4	40	60	100	4
III	Core: XXV Project	17PHP24	Major Project and viva voce	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				2900	100

(Signature with Seal)
Head,
Department of Physics,
P.K.R. Arts College for Women,
Gobichettipalayam - 638 476.

I SEMESTER

Course Code	Course Name	Category	L	T	P	Credit
17PHP01	Classical Mechanics	**CORE**	75	5	-	4

Preamble

- To gain deeper knowledge and understanding of classical mechanics.
- To advance skills and capability for formulating and solving problems.
- To increase mathematical and computational sophistication.

Course Outcome

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the Lagrangian formulation	K1, K2, K3
CO2	Understand the Hamiltonian Formulation	K1, K2, K3
CO3	Understand the Hamilton –Jacobi Method	K1, K2, K3
CO4	Understand the concepts of Two Body Problem	K1, K2
CO5	Understand Rigid body dynamics.	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 Problem: 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.

Text Books

1. Properties of Matter – Brijlal and N. Subramaniam - S Chand & Co
2. Text Book of Sound – Brijlal and N. Subramaniam - S Chand & Co

Reference Books

1. Mechanics, Properties of matter and sound, Thermal Physics – Murugesan, Edition 2002.
2. University Physics – Sears Semansky and Ground
3. Text books of Sound – Ghosh
4. Elements of Properties of Matter – D.S. Mathur
5. Mechanics - B.S. Mathur, S. Chand and Co.

Course Code	Course Name	Category	L	T	P	Credit
17PHP02	Mathematical Physics	**CORE**	75	5	-	4

Preamble

- To gain deeper knowledge and understanding of Mathematical Physics.
- To advance skills and capability for formulating and solving problems.
- Provide basic skills necessary for the application of Mathematical method in Physics

Course Outcome

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

CO Number	CO Statement	Knowledge Level
CO1	Identify different Special Functions of Legendre's, Bassel's and Hermite functions.	K1, K2, K3
CO2	Understand the Complex Variable and Cauchy-Reimann differential equation.	K1, K2, K3
CO3	Explain linear dependence and linear combination of vectors as quantities in Physics	K1, K2, K3
CO4	Differentiate between Fourier series and Laplace transforms	K1, K2, K3
CO5	Basic idea and concept of Group theory and application of elementary particle	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 Multivalued 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, ∞) - Uses of Fourier Series.-Laplace Transform-Definition-Properties-Translation Property-InverseLaplace Transform-Properties, example problems.

Unit V: **(15 Hrs)**

Group Theory

Definition of Groups-Groups of Transformation-Multiplication Table ($C\mathbf{4_V}$)-Subgroups and Conjugate Classes-Cyclic Groups-Symmetry Elements-Transformation & Matrix Representation-Point & Space Groups-Reducible & Irreducible Representation of a Group-Schur‟s Lemmas-Orthogonality Theorem- Character of a Representation & Character Table-$C\mathbf{2_V}$ & $C\mathbf{3_V}$ Groups in Molecular Physics-Application for Classification of Elementary Particles

Books for study:

1. Mathematical Physics- Sathya Prakash-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

References:

1. Mathematical Physics-B.D. Gupta-Vikas Publishing House, 3rd Edition, 2006
2. Mathematical Physics-B.S. Rajput- Pragati Prakashan- Meerut 17th Edition 2004
3. Mathematical physics by P.K. Chattopadhayay-New Age International-New Delhi.
4. Mathematical Physics-P.P. Gupta, Yadav & Malik-Kedarnath Ramnath-Meerut
5. Numerical Methods in Science & Engineering-M.K. Venkataraman-National Publishing-Chennai,1986
6. Numerical Methods-A. Singaravelu-Meenakshi Publishing.
7.

Course Code	Course Name	Category	L	T	P	Credit
17PHP03	Quantum Mechanics-I	**CORE**	75	5	-	4

Preamble

The aim is to provide the student

- To understand the concepts of Matrix formalism.
- To learn the approximation methods.
- To know 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.	Understand the idea of wave function and the uncertainty relations	K1, K2, K3
CO3.	Solve time-dependent and time-independent Schrodinger equation for simple potentials	K1, K2, K3
CO4.	Apply variational method, time-independent perturbation and time-dependent perturbation theory to solve problems	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 **(15Hrs)**

Introduction and Matrix formalism: Inadequacy of classical Physics-Spectral Distribution in Black-Body Radiation-Einstein's Derivation of Radiation law Through A and B Coefficients – Momentum Wave function –Free particle – particle in one dimension- Wave packets –Gaussian wave packet –spread of wave packet with time- the principle of casuality-Uncertainty relations-Schrodinger wave equation and probabilistic interpretation, Simple one dimensional problems.

UNIT II **(15 Hrs)**

Applications of Schrodinger wave equation: State Vectors-Hilbert Space-Dirac Notation-Dynamical Variables as Operators-Change of Basis-Unitary Transformation-Equation of Motion in Schroedinger Picture, Heisenberg Picture & Dirac Picture.

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 $j_1=1/2$, $j_2=1/2$.

Text Books

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
17PHP04	Advanced Computational Physics	**CORE**	75	5	-	4

Preamble

- To gain deeper knowledge and understanding of mathematical operations.
- To advance skills and capability for formulating and solving problems.
- Provide basic skills necessary for the application of mathematical method in Physics

Course Outcome

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

CO Number	CO Statement	Knowledge Level
CO1	Understanding about Numerical Differentiation	K1, K2, K3
CO2	Understand the Numerical integration	K1, K2, K3
CO3	Understanding the Matlab Fundamentals	K1, K2, K3
CO4	Observing the concepts of programming	K1, K2, K3
CO5	Basic idea and concept of plotting graphs using 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-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-Boole's 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-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

Unit V: **(15 Hrs)**

Matlab Graphics:

2D Plots-Planar Plots, Log Plots, Scatter Plots, Contour Plots-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-Illustrative Examples

Reference:

1. Engineering and Scientific Computations Using Matlab- Sergey E. Lyshevski-JohnWiley &Sons
2. A Guide to Matlab for Beginners & Experienced Users-Brian Hunt, Ronald Lipsman, Jonathan Rosenberg-Cambridge University Press
3. Matlab Primer-Timothy A. Davis & Kermit Sigmon-Chapman & Hall CRC Press-London
4. Matlab Programming-David Kuncicky-Prentice Hall
5. An Introduction to Programming and Numerical Methods in MATLAB- S.R. Otto and J.P.Denier- Springer-Verlag-London
6.Numerical Methods Using Matlab-John Mathews & Kurtis Fink-Prentice Hall-New Jersey,2006
7. Introductory Methods of Numerical Analysis- S.S. Sastry-Prentice Hall, 2005

Books for Study:

1.Numerical methods in Science and Engineering- M.K. Venkataraman-National Publishing Co. Madras, 1996
2.Getting Started With Matlab-Rudra Pratap-Oxford University Press-New Delhi

PRACTICAL I - GENERAL PHYSICS

(Examination at the end of Second Semester)

Course Code	Course Name	Category	L	T	P	Credit
17PHP05	Advanced Physics Practical - I	**CORE**	240	-	16	4

Preamble

- To gain better practical knowledge of general physics experiments
- To learn about handling of experiments
- 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
17PHP06	General Electronics Practical-I	**CORE**	240	-	16	4

Preamble

- To gain better practical knowledge of general physics experiments
- To learn about handling of experiments
- 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
17PHP07	Elements of Nanoscience and Nanotechnology	**ELECTIVE**	75	5	-	4

Preamble

- To gain deeper knowledge and understanding of nanoscience.
- To learn information about nanomaterials and methods of synthesis.
- To know about the applications of nanomaterials.

Course Outcome

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

CO Number	CO Statement	Knowledge Level
CO1	To know about the nanorevolution	K1, K2
CO2	To understand about the different types of nanomaterials	K1, K2
CO3	To suggest methods to minimize materials.	K1, K2
CO4	To use appropriate methods to characterize the nanomaterials.	K1, K2
CO5	To know applications about nano size materials.	K1, K2,K3

Unit I: (15 Hrs)

Overview of Nanoscience Nano revolution of the 20th century, Properties at Nanoscale (optical, electronic and magnetic). Theory, definitions and scaling.

Unit II: (15 Hrs)

Different Classes of Nanomaterials Metal and Semiconductor Nanomaterials, Quantum dots, Wells and Wires, Molecule to Bulk Transitions Bucky Balls and Carbon Nanotubes.

Unit III: (15 Hrs)

Synthesis of Nanomaterials Top-down (Nanolithography, CVD), bottom-up (sol-get processing, chemical synthesis). Wet Deposition Techniques, Self-assembly (Supramolecular approach), Molecular Design and Modeling.

Unit IV: (15 Hrs)

Characterization TEM, SEM and SPM Technique, Fluorescence Microscopy and Imaging.

Unit V: **(15 Hrs)**

Applications Solar Energy Conversion and Catalysis, Molecular Electronics and Printed Electronics Nanoelectronics, Polymers with a special architecture, Liquid Crystalline Systems, Linear and Nonlinear Optical and Electro Optical properties, Applications in Displays and other devices, Advanced Organic Materials for Data Storage, Photonics, Plasmonics, Chemical and Biosensors, Nanomedicine and Nano Biotechnology.

REFERENCES:

1. Nanostructured Materials and Nanotechnology -Hari Singh Nalwa, Academic Press, 2002

2. Organic and Inorganic Nanostructures, A. Nabok- Artech House, 2005

3. Nanoscience: “Nanotechnologies and Nanophysics”, C. Dupas, P. Houdy, M. Lahmani, Springer-

Verlag Berlin Heidelberg, 2007

4. Introduction to Nanotechnology, Charles P. Poole, Frank J Owens, Wiley- Interscience

5. Nanosystem Characterization Tools in the Life Sciences edited by Challa Kumar

6. Nanostructures and Nanomaterials (Synthesis, Properties and Applications), Guozhong Cao

Course Code	Course Name	Category	L	T	P	Credit
17PHP07	Physics of Non-conventional Energy Resources	**ELECTIVE**	75	5	-	4

Preamble

- To gain deeper knowledge and understanding of non-conventional energy resources
- To provide a detail about renewable energy sources.

Course Outcome

CO Number	CO Statement	Knowledge Level
CO1	Understanding the materials involve in Solar cells	K1, K2, K3
CO2	Discuss about performance and applications of solar thermal energy	K1, K2, K3
CO3	Understanding the resources of geothermal energy	K1, K2, K3
CO4	Gaining the knowledge about wind energy	K1, K2, K3
CO5	Illustrating the involvement of Bio mass in energy resources	K1, K2, K3

UNIT-I (15 Hrs)

Introduction-Various non-conventional energy resources-Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.

UNIT-II (15 Hrs)

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT-III (15 Hrs)

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto- hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.

UNIT-IV (15 Hrs)

Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, Concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.

UNIT-V **(15 Hrs)**

Bio-mass: Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations.

Text Books:

1. Introduction to Non-Conventional Energy Resources -Raja et al, SciTech Publications.

References:

1. Renewal Energy Resources -John Twideu and Tony Weir, BSP Publications, 2006.

2. Energy Resources: Conventional & Non-Conventional -M.V.R. Koteswara Rao, BSP Publications, 2006.

3. Non-conventional Energy Resources -D.S. Chauhan, New Age International.

4. Renewal Energy Technologies: A Practical Guide for Beginners C.S. Solanki-PHI Learning

SEMESTER II

Course Code	Course Name	Category	L	T	P	Credit
17PHP08	Quantum Mechanics – II	**CORE**	90	6	-	4

Preamble

The aim is to make the students understand

- the Scattering theory
- the applications to atomic and molecular structures
- 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
CO4.	Spot, identify and relate the eigen value problems for energy, momentum, angular momentum and central potentials explain the idea of spin	K1, K2, K3
CO5.	Appreciate the need for quantum field theory	K1, K2, K3

UNIT I **(15Hrs)**

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 **(15Hrs)**

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 **(15Hrs)**

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 **(15Hrs)**

Quantum Field Theory: Quantization of Wave Fields- Classical Lagrangian Equation-Classical Hamiltonian Equation-Field Quantization of the Non-Relativistic Schroedinger Equation-Creation, Destruction and Number Operators-Anti Commutation Relations-Quantization of Electromagnetic Field Energy and Momentum.

Text Books

1. Quantum Mechanics-Gupta, Kumar & Sharma, 23rd Edition, 2003-2004
2. Introduction to Quantum Mechanics-A.K. Chandra-Tata McGraw Hill
3. Quantum Mechanics-Aruldas, 2002

References

1. A Text Book of Quantum Mechanics-P.M. Mathews & K. Venkatesan-Tata McGraw Hill 29thReprint 2002
2. Quantum Mechanics-Satyaprakash
3. Quantum Mechanics-L.I. Schiff- McGraw Hill 3rd Edition, 1968
4. Quantum Mechanics-Devanathan-Narosa Publishing-New Delhi, 2005
5. Quantum Mechanics-A.K. Ghatak and S. Loganathan-McMillan India 4th Edition, 1999
6. Quantum Mechanics-Messiah (North Holland)1970
7. Quantum Mechanics-Merzbacher-John Wiley & Sons3rd Edition, 2004
8. Principles of Quantum Mechanics-R.Shankar, Springer, 2005
9. Introduction to Quantum Mechanics – David J Griffiths- Addison Wesley – 2 nd edition

Course Code	Course Name	Category	L	T	P	Credit
17PHP09	Advanced Electronics	**CORE**	90	6	-	4

Preamble

- To understand the concept of semiconductor devices.
- To gain knowledge about Fabrication and Characteristics of Integrated Circuits.
- 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 the different semi conductor devices	K1, K2
CO2.	Understand the Integrated circuit technology	K1, K2
CO3.	Understand the linear and non-linear analog systems	K1, K2
CO4.	Understand about flip-flops and Boolean algebra	K1, K2, K3
CO5.	Understand about the counters	K1, K2, K3

UNIT I **(15hrs)**

Semiconductor Devices : Field effect transistors – JFET bias line and load line – MOSFET construction and Symbols – MOSFET bias and load lines - 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 **(15hrs)**

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 **(15hrs)**

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 **(15hrs)**

Flip-flops, Logic Gates and Minimization Techniques:

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, Comperator, Decoder / Demultiplexer - Sum of products and Product –of-sums - Karnaugh map (up to four variables only) –Don't care

UNIT V **(15hrs)**

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
17PHP10	Solar Physics	**CORE**	45	3	-	4

Preamble

- To give an overview of the energy problem faced by the current generation
- To underline the importance of renewable energy sources
- To give 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	Understand about the Energy Source	K1, K2, K3
CO2	Understand concepts of renewable energy source	K1, K2, K3
CO3	Understand about Solar Energy	K1, K2, K3
CO4	Understand about Solar cells	K1, K2, K3
CO5	Understand about the applications of conventional sources - Solar energy	K1, K2, K3

Unit I: (9Hrs)

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: (9Hrs)

Renewable Energy

Prospects of renewable energy sources - solar energy. Usefulness and barriers in the implementation of renewable energy systems. Indian research and perspectives.

Unit II: (9Hrs)

Solar Energy

Solar radiation at the Earth's Surface - Solar Radiation Measurements - solar constant measurement of solar radiations.

Unit III: (9Hrs)

Solar Cells

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

Unit IV: (9Hrs)

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.

Text Books:

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
17PHP11	Astronomy & Astrophysics	**ELECTIVE**	75	5	-	4

Preamble

- To gain deeper knowledge and understanding of astronomy.
- To learn information about stars and galaxies.
- 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	Understanding of science is based upon observations of universe	K1, K2
CO2	Gain the knowledge about basic parameters of stars	K1, K2
CO3	Discuss about Sun.	K1, K2
CO4	Know about the galaxies based on observations	K1, K2
CO5	Know about the destruction of stars.	K1, K2

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

REFERENCES:

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
17PHP11	Experimental Techniques	**ELECTIVE**	75	5	-	4

Preamble

- To gain deeper knowledge and understand the techniques behind various measuring instruments.
- Ability to measure frequency with oscilloscope.
- Ability to handle the various electronic measuring instruments.

Course Outcome

CO Number	CO Statement	Knowledge Level
CO1	To know about the errors in measurements.	K1, K2
CO2	To suggest filters for signal conditioning.	K1, K2
CO3	To understand about the different types of transducers.	K1, K2
CO4	To know applications about various electronic measuring instruments.	K1, K2
CO5	To use appropriate methods for analyzing electronic waves	K1, K2

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)**

Amplifiers and Signal Conditioning:
Instrumentation amplifiers-Isolation amplifiers-Chopper amplifiers-Voltage to frequency and frequency to voltage converters-Frequency multipliers-logarithmic amplifiers, S/H Circuits Active filters-Low pass, High pass, Band pass and Band stop filters -Butterworth filters.
Electrical Transducer Classification: Active and Passive transducers-resistive, inductive, capacitive, thermocouple and Piezoelectric transducer-Digital transducers.

Unit III **(15 Hrs)**

Amplifiers and Signal Conditioning:
Instrumentation amplifiers-Isolation amplifiers-Chopper amplifiers-Voltage to frequency and frequency to voltage converters-Frequency multipliers-logarithmic amplifiers, S/H Circuits Active filters-Low pass, High pass, Band pass and Band stop filters -Butterworth 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-t, X-Y Recorders-Magnetic Tape recorders-Storage 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.

Recommended Text Books:

1. Modern Electronic Instrumentation and Measurement Techniques -A.O. Hefnick and W.D. Cooper., Prentice Hall India Publications.
2. 2.Introduction to Instrumentation and Control -A.K. Ghosh-Prentice Hall India
3. Publications
4. References:
5. Electrical & Electronics Measurement &Instrumentation -A.K. Sawhney
6. Modern Electronic Instrumentation

Course Code	Course Name	Category	L	T	P	Credit
17SEP01	Cyber Security	**Skill Enhancement Course**	30	2	-	2

Preamble

To understand 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	Deals 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: **5 Hours**

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: **5 Hours**

Introduction to Cyber Security

Cyber Security: Objectives- Roles- Differences between Information Security and Cyber Security. **Cyber Security Principles:** Confidentiality- Integrity – Availability.

Unit III: **5 Hours**

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: **5 Hours**

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: **4 Hours**

Case study

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

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
17PHP13	**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
17PHP14	**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's Hypothesis-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 Matter Measurement 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
17PHP15	**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
17PHPCO1	**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
17PHP17	**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
17PHP18	**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
17PHP19A	**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
17PHP19B	**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
17PEPPH1	**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
17PHP20	**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 how different kinds of crystal are described based on microscopic structure	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
17PHP21	**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	Basic knowledge of thermal and statistical equilibrium	K1, K2, K3
CO3	Understand the concept behind equi-partition of energy and distributions	K1, K2, K3
CO4	Deep knowledge about quantum statistics of Bose Einstein and Fermi Dirac.	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, Pragati Prakashan 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
17PHP22	**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 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.