NEW SCHEME
CHOICE BASED CREDIT SYSTEM

FOR

B.Sc. PHYSICS (Hons.)

JULY-2022

Department of Physics,
Sri Sai University
Palampur
Himachal Pradesh
176081

Course Code	Title of the Paper	L	P	Contact Hours / Week	Tutorial	Credits
	Semester-I					
PHY-CC-311	Mathematical Physics	4	0	4	0	4
PHY-CC-312	Mechanics	4	0	4	0	4
PHY-312(P)	Practical Lab-Mechanics	0	2	8	0	4
ENG-AE-011	Communication Skill	2	0	2	0	2
------------------	General elective Courses	4	0	4	0	4
------------------	General elective Courses Practical/Tutorial	0	2	4	0	2
						20
	Semester-II					
PHY-CC-321	Laser & Optical fiber	4	0	4	0	4
PHY-CC-322	Electronics-I	4	0	4	0	4
PHY-322(P)	Practical Lab-Electronics-I	0	2	8	0	4
ENV-AE-011	Environmental Sciences	2	0	2	0	2
------------------	General elective Courses	4	0	4	0	4
-------------------	General elective Courses Practical/Tutorial	0	2	4	0	2
						20
	Semester-III					
PHY-CC-331	Thermodynamics & Statistics	4	0	4	0	4
PHY-CC-332	Atomic & Molecular Physics	4	0	4	0	4
PHY-CC-333	Electronics –II	4	0	4	0	4
PHY-333(P)	Practical Lab-Electronic-II	0	2	8	0	4
PHY-SE-011	Electrical Circuit Network Skills	2	0	2	0	2
PHY-SE-011(P)	Electrical Circuit Network Skills	2	0	2	0	2
-----------------	General elective Courses	4	0	4	0	4

-----------------	General elective Courses Practical/Tutorial	0	2	4	0	2
						26
	Semester-IV					
PHY-CC-341	Oscillations & Waves	4	0	4	0	4
PHY-CC-342	High Energy Physics	4	0	4	0	4
PHY-CC-343	Electricity & Magnetism	4	0	4	0	4
PHY-343(P)	Practical Lab-Electricity & Magnetism	0	2	8	0	4
PHY-SE-012	Renewable Energy And Energy Harvesting	2	0	2	0	2
---------------------	General elective Courses	4	0	4	0	4
----------------------	General elective Courses Practical/Tutorial	2	0	2	0	2
						24
	Semester-V					
PHY-CC-351	Solid State Physics	4	0	4	0	4
PHY-CC-352	Optics	4	0	4	0	4
PHY-352(P)	Practical Lab-Optics	0	2	8	0	4
PHY-SE-013	Applied Optics	2	0	2	0	2
PHY-SE-013(P)	Practical Lab- Applied Optics	0	2	4	0	2
	Discipline specific elective courses(Any two)					
PHY-DSE-011	Nuclear & Particle Physics	4	0	4	1	5
PHY-DSE-012	Astronomy & Astrophysics	4	0	4	1	5
PHY-DSE-013	Photonics	4	0	4	1	5
PHY-DSE-014	Direct energy conversion	4	0	4	1	5
						26
	Semester-VI					
PHY-CC-361	Quantum mechanics	4	0	4	0	4
PHY-CC-362	Classical Mechanics	4	0	4	0	4

PHY-SE-014	Basic Instrumentation Skills	2	0	2	0	2
PHY-SE-014(P)	Practical Lab : Basic Instrumentation Skills	2	0	2	4	2
	Discipline specific elective courses(Any two)					
PHY-DSE-015	Electrodynamics	4	0	4	1	5
PHY-DSE-016	Nano Physics	4	0	4	1	5
PHY-DSE-017	Energy Storage and Fuel Cell Technology	4	0	4	1	5
PHY-DSE-018	Space Physics	4	0	4	1	5
PHY-363	Dissertation	0	4	8	0	4
						26
	Total Credits					**142**

Course Structure

Core Course (CC)	14
Ability Enhancement courses (AE)	02
Skill Enhancement Courses (SE)	04
Generic Elective Courses (GE) (Interdisciplinary)	04
Discipline Specific Elective Courses (DSE)	04

Generic Elective papers (GE) (Minor Physics) for other departments

Core	Course	L	P
PHY-GE-001	Physics-I	4	2
PHY-GE-002	Physics-II	4	2
PHY-GE-003	Physics-III	4	2
PHY-GE-004	Physics-IV	4	2

Other Discipline (Four papers of any one discipline)-GE 1 to GE 4

1. Mathematics (4)+ Tut (2)

2. Chemistry (4)+ Lab (4)

3. Computer Science (4) + Lab (4)

Important:

1. University can add/delete some experiments of similar nature in the Laboratory papers.

2. University can add to list of reference books given at the end of each paper.

SEMESTER – I

PHY-CC-311 : MATHEMATICAL PHYSICS

COURSE OBJECTIVES	• familiarizing students with orthogonal coordinate systems and their properties • teaching methods of solving differential equations that occur in various branches of theoretical physics like classical mechanics, quantum mechanics and electrodynamics
COURSE OUTCOMES	• solve mathematical problems in physics by a variety of mathematical techniques • solve ordinary and partial differential equations of first order and second order that are common in physics • use complex variable to solve definite integrals and differential equations

DETAILED CONTENT

Module I Introduction to Vector Algebra

Physical quantities: Scalars, Vectors, Null vectors, Equal vectors, Addable vectors, Graphical addition of vectors, Subtraction and Multiplication of vectors, Scalar and cross product of two vectors, Scalar triple Product and their physical interpretation.

Module II Calculus of Vectors

Vector Differentiation: Scalar and vector fields, Ordinary and partial derivative of a vector w.r.t. Coordinates, Directional derivative and normal derivative, Divergence and curl of a vector field, Gradient of a scalar field and its geometrical interpretation, Del and Laplacian operator, Vector identities. Vector Integration: Ordinary integral of vectors, Line, surface and volume integrals, Flux of a vector field, Gauss' Divergence Theorem, Stoke's and Green's Theorem.

Module III Orthogonal Curvilinear Coordinates

Orthogonal curvilinear co-ordinates, Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, spherical and cylindrical co-ordinates systems

Module IV Multiple Integrals

Double and triple integrals, Applications of Multiple integrals: Area enclosed by plane curves and volumes of solids.

Module V Complex Variable

Differentiation and integration of complex variable, Cauchy's theorem, Cauchy's integral formula, Power series of a complex variable, Taylor and Laurent's series, Residue and Residue theorem, Contour integration and its application to evaluation of integrals and series (simple exercises)

Text Books:

1. Integral Calculus, Shanti Narayan, Delhi, S. Chand.
2. Mathematical Hand Book, M. Vygodsky, Mir, Mascow.

***Reference Books*:**

1. Higher Engineering Mathematics, B.S. Grewal, Delhi, Khanna.
2. Introduction to Mathematical Physics, Charlie Harper, Prentice Hall of India.

PHY-CC-312: MECHANICS

COURSE OBJECTIVES	• Understand the basic concepts and ideas in mechanics- e.g. motion, force and torque, mass and moment of inertia, linear and angular momentum, kinetic energy and potential energy etc. by parallel studies of linear dynamics and rotational dynamics • Study planetary motions as a central force problem • Know about the peculiar phenomena of special relativity which are not seen in Newtonian relativity and to understand the concept of space-time
COURSE OUTCOMES	• Enable the students to understand simple harmonic oscillator as it is a unique mechanical problem and will help them to understand the advanced treatment in quantum mechanics and modern Physics. • Develop knowledge of special relativity to understand relativistic formulation of modern theories. • Develop knowledge of mechanics which will help students in their everyday life

DETAILED CONTENT

Module I Fundamentals of Dynamic

Dynamics of a System of Particles, Centre of Mass, Conservation of Momentum, Idea of Conservation of Momentum from Newton's Third Law, Impulse, Momentum of Variable, Mass System: Motion of Rocket.

Module II Work and Energy Theorem

Work and Kinetic Energy Theorem, Conservative and Non-Conservative Forces, Potential Energy, Energy Diagram, Stable and Unstable Equilibrium, Gravitational Potential Energy, Elastic Potential Energy, Force as Gradient of Potential Energy, Work and Potential energy, Work done by Non conservative Forces, Law of Conservation of Energy, Elastic and Inelastic Collisions between particles, Centre of Mass and Laboratory Frames.

Module III Rotational Dynamics

Angular Momentum of a Particle and System of Particles, Torque, Conservation of Angular Momentum, Rotation about a Fixed Axis, Moment of Inertia, Calculation of Moment of Inertia for Rectangular, Cylindrical and Spherical Bodies, Kinetic Energy of Rotation, Motion involving both Translation and Rotation.

Module IV Gravitation and Central Force Motion

Law of Gravitation, Inertial and Gravitational Mass, Potential and Field due to Spherical Shell and Solid Sphere, Motion of a Particle under Central Force Field, Two Body Problem and its Reduction to One Body Problem and its Solution, The Energy Equation and Energy Diagram, Kepler's Laws (Ideas Only), Orbits of Artificial Satellites.

Module V Special theory of Relativity

Frames of references, Postulates of Special Theory of Relativity, Galilean Transformation, Michelson Morley Experiment and its Outcome, Lorentz Transformations, Simultaneity of Events, Lorentz Contraction, Time Dilation, Relativistic Transformation of Velocity, Velocity addition, Variation of Mass with Velocity, Mass energy Equivalence, Relativistic Doppler effect, Relativistic Kinematics, Transformation of Energy and Momentum, Energy Momentum Four Vector.

Text Books:

1. Mechanics, D S Mathur, S. Chand & Company Limited.
2. An Introduction to Mechanics, Kleppner, Tata Macgraw Hill.
3. University Physics, Francis W Sears, Mark W. Zemanasky, Hugh D. Young, Indian Student Edition Available with Narosa Publishing House, N. Delhi.

Reference books:

1. Analytical Mechanics: Satish K. Gupta-Modern Publishers.
2. Fundamentals of Physics, D. Halliday, R. Resnick and J. Walker, Wiley India Pvt. Ltd., New Delhi.

PHY-312(P) : PRACTICAL LAB- MECHANICS

COURSE OBJECTIVES	• Understand the experimental knowledge of pendulums. • Understand the various circuits
COURSE OUTCOMES	• Able to know about the basic circuits in equipments • Able to understand the practical knowledge of pendulum

DETAILED CONTENT

Compound Pendulums

1. To determine g by Bar Pendulum.
2. To determine g by Kater's Pendulum.

Springs

1. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g, and (c) Modulus of Rigidity
2. To investigate the Motion of Coupled Oscillators.

Capacitance

1. To determine the Ratio of Two Capacitances by de Sauty's Bridge.
2. To determine the Dielectric Constant of a Dielectric placed inside a parallel plate capacitor using a B.G.

Self & Mutual Inductance

1. To determine Self Inductance of a Coil by Anderson's Bridge using AC
2. To determine Self Inductance of a Coil by Rayleigh's Method.
3. To determine the Mutual Inductance of Two Coils by Absolute method using a B.G.

A.C. Circuits

1. To study the response curve of a Series LCR circuit and determine its (a) Resonant Frequency, (b) Impedance at Resonance and (c) Quality Factor Q, and (d) Band Width.

2. To study the response curve of a Parallel LCR circuit and determine its (a) Anti-Resonant Frequency and (b) Quality Factor Q.

Text Books:

1. Geeta Sanon, B.Sc. Practical Physics, R. Chand & Co.
2. Advanced Practical Physics, B. L. Worsnop, Asia Publishing House, New Delhi.

Reference Books:

1. Practical Physics, C.L. Arora, S.Chand
2. A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, Vani
3. Publication House, New Delhi.

ENG-AE-011: COMMUNICATION SKILLS

COURSE OBJECTIVES	• To make students able to communicate effectively. • Reading and writing skills will also be sharpen.
COURSE OUTCOMES	Accurate grammer use is very important. The students will be well trained in reading, writing, listening skills.

DETAILED CONTENT

Module 1 Communication

Language and communication, differences between speech and writing, distinct features of speech, effective communication.

Module II Writing Skills

Effective writing skills, avoiding common errors, Basics of grammar and language.

Module III Technical Writing

Scientific and technical subjects; formal and informal writings; formal writings/reports, handbooks, manuals, letters, memorandum, notices, agenda, minutes; common errors to be avoided.

Module III Group discussion

Discussion on current topics and topics of national and national importance, Extempore, News paper reading, paper presentation.

Module V Essential Required Skills

Reading skills, listening skills, note-making, précis writing, audiovisual aids, oral communication

Text Books:

1. Writing as thinking: A guided process approach, M. Frank., Prentice Hall Reagents.
2. A course in written English for academic and professional purposes, L. Hamp-Lyons and B. Heasely, Study Writing; Cambridge Univ. Press.

Reference books:

1. A comprehensive grammar of the English language, R. Quirk, S. Greenbaum, G. Leech and J. Svartik, Longman, London.

SEMESTER II

PHY-CC-321: LASER AND OPTICAL FIBER

COURSE OBJECTIVE	• Give the basic knowledge of laser physics and its application • To make the students to understand optical fiber and its uses
COURSE OUTCOMES	• Students will be able to know about the laser physics and its application in various field • At last able to learn about the optical fiber and its uses

DETAILED CONTENT

Module I Basics Of Laser Physics

Introduction, population, thermal equilibrium, three processes, Characteristics and Principle, Einstein's coefficients, Laser Pumping , Resonators, modes of a resonator, quality factor, losses inside the cavity, threshold condition.

Module II Types of Lasers

Types of Lasers: solid, liquids and Gases with one example of each, condition for laser action.

Module III Application of Laser

Holography, non-linear optics: harmonic generation, second harmonic generation, phase matching and optical mixing, brief qualitative description of some experiments of fundamental importance.

Module IV Optical Fibres

Introduction, advantages of optical fibres, characteristics of optical fiber, principle, construction of optical fibre, numerical aperture, acceptance angle, Propagation of light in optical fiber

Module V Types and applications of optical fibre

Modes of propagation of an optical fibre, single mode, multi mode, step index optical fiber, graded index optical fibre, V number, Losses, dispersion, wave guides, application of optical fiber in communication.

Text Books :

1. Lasers and Non-linear Optics, B.B. Laud, Wiley Eastern
2. Principles of Lasers, O. Svelto, Plenum Press

Reference Books:

1. An Introduction to Lasers and their applications, Russell and Rhodes, Wesley.
2. Laser Theory and Applications, Thyagarajan and A. Ghatak, MacMillan
3. Optical Fiber Communication, Senior, Prentice Hall India.

PHY-CC-322 : ELECTRONICS-I

COURSE OBJECTIVES	• Understand the working of diodes, transistors, basic gates, flip flops, registers and counters • Understand the application of different electronic devices and be able to analyze the working as well as troubleshoot simple circuits. • Understand the BJT ,FET and MOSFET
COURSE OUTCOMES	• Understand the role of diodes in rectifier, wave shaping, voltage multiplier and voltage regulation circuits • Explain how the transistor works and describe how it can be used as an amplifier and switch • Develop a complete understanding of communication modulation and detection. • Understand the bipolar, uni junction field effect transistor.

DETAILED CONTENT

Module I Electronic Devices

PN junctions, characteristic of pn junction diode, pn junction as rectifier, characteristics and applications of Zener diode, Photodiode, LED and photocells.

Module II Power Supplies

Characteristics, Rectifiers, Filter circuits, efficiency, Ripple factor, voltage multiplying circuits, Regulation, Shunt and Series regulators, Monolithic regulators.

Module III Transistors

pnp and npn junction transistors, transistor current components, CB, CC and CE configurations, transfer characteristics, Transistor as switch and applications, Transistor biasing, fixed bias, emitter-stabilized biasing, Voltage-divider biasing, Junction FET, V-I Characteristics. Wave shaping Circuits: Clipping and Clamping circuits, Diode and transistor clippers, Clamping circuits, Clamping circuit theorem.

Module IV BJT, FET's AND MOSFET's

Structure and working, α and β of BJT, characteristics, common emitter amplifier, Field Effect transistor, JFET V-I curves, biasing JFET, ac operation of JFET, depletion and enhancement mode, MOSFET, Biasing a MOSFET, FET as a variable voltage resistor, FET amplifier.

Module V Communication

Modulation and detection, AM, FM, Radio wave propagation, Radio transmitter and receiver, TV receiver, Pulse Modulation, Modem.

Text Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, Tata McGraw Hill.
2. Electronic Devices & Circuits, J. Millman and C.C. Halkias, Tata McGraw Hill.

References Books:

1. Digital Principles & Applications, P. Malvine & Leach, Tata McGraw Hill.

PHY-322(P): PRCATICAL LAB-ELECTRONICS-I

COURSE OBJECTIVES	• To make knowledge of student for various electronics components. • To apply the theoretical knowledge for developing new devices
COURSE OUTCOMES	• Design and develop the instruments for advanced studies. • Evaluate theoretical calculations using experimental observations. • Will be capable of handling sophisticated instruments besides learning the Physics concepts behind these experiments

DETAILED CONTENT

1. To use a Multimeter for measuring (a) Resistances, (b) A/C and DC Voltages, (c) AC and DC Currents, (d) Capacitances, and (e) Frequencies.
2. To test a Diode and Transistor using (a) a Multimeter and (b) a CRO.
3. To measure (a) Voltage, (b) Frequency and (c) Phase Difference using a CRO.
4. To study Random Errors.
5. To determine the Height of a Building using a Sextant.
6. To study the Characteristics of a Series RC Circuit.
7. To determine the Acceleration due to Gravity and Velocity for a freely falling body, using Digital Timing Techniques.
8. To determine the Moment of Inertia of a Flywheel.
9. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
10. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
11. To determine the Elastic Constants of a Wire by Searle's method.

Text Books:

1. Geeta Sanon, B.Sc. Practical Physics, R. Chand & Co.
2. Advanced Practical Physics, B. L. Worsnop, Asia Publishing House, New Delhi.

Reference Books:

1. Practical Physics, C.L. Arora, S.Chand
2. A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, Vani Publication House, New Delhi.

ENV-AE-011 : ENVIRONMENTAL STUDIES

COURSE OBJECTIVES	• About various aspects of environments. • Ecosystem of environments • Energy and material flow in the environment
COURSE OUTCOMES	• Analyses Energy flow in Natural System • Evaluate Material flow in environment. • Understand the interdependence of different components of the environments

DETAILED CONTENT

Module I

Origin of earth, Earth's temperature and atmosphere, Sun as a source of energy, Solar spectrum, introduction to fossil fuel-petroleum, coal, natural gas and bio mass.

Module II

Introduction to ecology, concept of biosphere, community characteristics, ecological succession, Forest resources–Forest and environment, World forest resources, National forest Policy, Deforestation and forest management.

Module III

Energy flow in material cycle, Food chain, Food web, Photosynthesis, ecological pyramids, Autoecology, Biogeochemical cycles, Concept of sustainable development, Responses of Ecosystems (Land, Water, Marine) to deforestation, fire, pollution, ecological invasions; Rural vs Urban systems; Restoration of Degraded Ecosystems.

Module IV

Introduction–Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India, Conservation of biodiversity - In-situ and Ex-situ conservation of biodiversity.

Module V

Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards and solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution.

Text books:

1. Environment Biology, K C Agarwal, Nidi Publ. Ltd. Bikaner.
2. Environment Protection and Laws, Jadhav & Bhosale, Himalaya Pub House, Delhi.

Reference Books:

1. Waste Water Treatment, Rao & Datta, Oxford & IBH Publ. Co. Pvt. Ltd.

SEMESTER III

PHY-CC-331: THERMODYNAMICS AND STATISTICAL PHYSICS:

COURSE OBJECTIVES	• give the fundamentals of thermodynamic systems, the laws of thermodynamics and their application to thermodynamic problems • provide essential tools to analyze carnot engine, heat engines and refrigerators with the help of their thermodynamic cycles • highlight the use of mathematical methods to derive thermodynamic relationships
COURSE OUTCOMES	• represent thermodynamic processes on appropriate thermodynamic diagrams • appreciate the application of thermodynamic laws to liquefaction of gases for low temperature production • use kinetic theory of gases to derive expressions for pressure of an ideal gas, heat capacities of solids and gases and transport properties

DETAILED CONTENT

Module I Basics and Ist law of thermodynamics

Thermo dynamical analysis, thermodynamic systems, important definitions, thermodynamic variables, work and heat and their sign conventions, Joule's experiment and first law of thermodynamics, Corollaries of first law, sign conventions for heat and work, first law analysis of closed system, calculation of W, E& H under isothermal and adiabatic conditions for reversible and irreversible processes, standard state and standard enthalpies of formation, enthalpy of ionization and enthalpy of formation of ions.

Module II IInd law of thermodynamics

Carnot's cycle, Carnot's theorem, Thermodynamic temperature scale, Thermoelectric effect and its thermodynamical analysis, change of entropy along a reversible path in P-V diagram, entropy of a perfect gas, equation of state of an ideal gas, Heat death of Universe.

Module III IIIrd law of thermodynamics

Definition of entropy, change of entropy of a system, third law of thermodynamics, Additive nature of entropy, law of increase of entropy, reversible and irreversible processes and their examples, work done in a reversible process, Increase of entropy in some natural processes, entropy and disorder.

Module IV Maxwell's Thermodynamic Relations

Perfect differentials in Thermodynamics, Maxwell Relationships, cooling produced by adiabatic expansion, adiabatic compression, adiabatic stretching of wires and thin films, change of internal energy with volume, Cp-Cv, variation of Cv with volume, Clapeyron's equation, Second-order phase transitions, Thermodynamic equilibrium of a heterogeneous system, Application of phase rule to systems with one or more components.

Module V Statistical physics

Micro and macrostates, thermodynamic probability distribution of n particles in two compartments, deviation from the state of maximum probability; equilibrium state of dynamic system, distribution of distinguishable particles in compartments and cells, phase space and its division into cells, Boltzmann statistics for ideal gas, Bose-Einstein statistics and its application to black body radiation, Fermi-Dirac statistics and its application to electron gas, comparison of the three statistics.

***Text books*:**

1. A Textbook of Optics, Subrahmanyam and B. Lal, S. Chand & Co., New. Delhi.
2. Statistical Physics, Thermodynamics and Kinetic Theory, Bhatia, Vishal Publication, Jalandhar.

References Books:

1. Statistical and Termal Physics: F. Reif-Mc-Graw Hill, 1965
2. Statistical Mechanics: Kerson Huang-Wiley, 1963.

PHY-CC-332 : ATOMIC AND MOLECULAR PHYSICS

COURSE OBJECTIVES	• develop an understanding of the structure of matter through the study of atoms and molecules • give the basics of atomic and molecular spectroscopy and to gain a clear understanding of the principles and processes involved in spectroscopy • understand the fundamentals of lasers, to study their unique properties and learn the techniques used in different laser designs
COURSE OUTCOMES	• describe the atomic spectra of one and two valence electron systems/atoms • explain the change in behavior of atoms in external magnetic fields. • explain the details of rotational, vibrational and Raman spectra of molecules, evaluate the bond length and force constant of diatomic molecules • discuss the principles involved in lasing action, describe the requirements of a laser system and the properties of laser radiation

DETAILED CONTENT

Module I X rays

Determination of e/m of the Electron, Thermionic Emission, Isotopes and Isobars, Ionizing Power, X ray Diffraction, Bragg's Law, Bohr Atomic Model, Critical Potentials, X rays Spectra: Continuous and Characteristic X rays, Moseley Law.

Module II Atoms in Electric and Magnetic Fields

Electron Angular Momentum, Space , Quantization, Electron Spin and Spin Angular Momentum, Larmor's Theorem, Spin Magnetic Moment, Stern Gerlach Experiment, Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

Module III Atoms in External Magnetic Fields

Normal and Anomalous Zeeman Effect, Paschen Back and Stark Effect (Qualitative Discussion only).

Module IV Many electron atoms

Pauli's Exclusion Principle, Symmetric and Antisymmetric Wave Functions, Periodic table, Fine structure, Spin orbit coupling, Spectral Notations for Atomic States, Total Angular Momentum, Vector Model, L S and J J couplings, Hund's Rule, Term symbols, Spectra of Hydrogen and Alkali Atoms (Na etc.).

Module V Molecular Spectra

Rotational Energy levels, Selection Rules and Pure Rotational Spectra of a Molecule, Vibrational Energy Levels, Selection Rules and Vibration Spectra, Rotation Vibration Energy Levels, Selection Rules and Rotation Vibration Spectra, Determination of Internuclear Distance, Quantum Theory of Raman Effect, Characteristics of Raman Lines, Stoke's and Anti-Stoke's Lines, Complimentary Character of Raman and infrared Spectra.

***Text books*:**

1. Concepts of Modern Physics, Arthur Beiser, McGraw Hill Book Company.
2. Atomic physics, J.B.Rajam& Louis De Broglie, S. Chand & Company.

Reference books:

3. Atomic Physics, J. H. Fewkes& John Yarwood. Vol. II, Oxford University Press.
4. Molecular Spectroscopy, Banwell.

PHY-CC-333: ELECTRONICS-II

COURSE OBJECTIVES	• Study the performance of amplifiers, oscillators ,digital principles and flip flop circuts and converter circuits. • Establish the general methods for analyzing, modeling and predicting the performance of amplifiers and related linear integrated circuits. • Develop the students faculty in designing realistic circuits to perform specified operations using amplifiers.
COURSE OUTCOMES	• Describe the characteristic features of power amplifiers in class A, class B and class C operation and determine the efficiency of these amplifiers • Analyze and design various amplifier circuits using the ideal model assumptions • Analyze frequency dependent circuits like integrators and differentiators • Understand the working of a 555 timer and use it in astable and monostable modes of operation

DETAILED CONTENT

Module I Amplifiers

Small signal amplifiers: General principles of operation, classification, distortion, RC coupled amplifier, gain frequency response, input and output impedance, Multistage amplifiers, transformer coupled amplifiers, Equivalent circuits at low, medium and high frequencies; emitter follower, low frequency common-source and common-drain amplifier, Noise in electronic circuits. Feed back in amplifiers; Negative feedback and stability

Module II Oscillators

Sinusoidal oscillations; phase shift oscillators, LC oscillator, Hartley oscillator, RC oscillators, phase shift and Wein bridge oscillators, Crystal oscillator, Basic idea about AM modulation and demodulations, Oscilloscope.

Module III Digital Principles

Number system, Decimal, binary, Octal, hexadecimal, logic gates, AND, OR, NOT, NAND, NOR, XOR, XNOR, Karnnaugh map techniques.

Module IV Flip Flop circuits

Various kind of Flip Flops, clocked RS flip, Flop, Edge Triggered, D Flip Flop, Flip Flop, twitching time, JK Flip Flop, JK Master slave. Flip Flop, **Counters:** Clock waveforms, 555 timer as Astable Multivibrator; Shift registers: Serial out, parallel in, parallel out; synchronous counters, Asynchronous counters, Ring counters.

Module V Converter Circuits

D/A converters, A/D Counters, clipping and Clamping circuit, Clamping circuit theorem, Diode and transistor clippers, astable, Monostable and bistable multivibrators using transistors.

Text Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, Tata McGraw Hill.
2. Electronic Devices & Circuits, J. Millman and C.C. Halkias, Tata McGraw Hill.
3. Digital Principles & Applications, P. Malvine & Leach, Tata McGraw Hill.

***Reference Books*:**

1. Digital Computer Electronics - AP. Malvino.
2. Device Electronics for Integrated Circuits - Muller & Kamins

PHY-333(P): Physics lab III

COURSE OBJECTIVES	• To make knowledge of student for various electronics components. • To apply the theoretical knowledge for developing new devices
COURSE OUTCOMES	• Design and develop the instruments for advanced studies. • Evaluate theoretical calculations using experimental observations. • Will be capable of handling sophisticate instruments besides learning the Physics concepts behind these experiments

DETAILED CONTENT

Mechanical Equivalent of Heat

1. To determine J by Callender and Barne's constant flow method.

Thermal Conductivity

1. To determine the Coefficient of Thermal Conductivity of Copper by Searle's Apparatus.
2. To determine the Coefficient of Thermal Conductivity of Copper by Angstrom's Method.

Resistance Temperature Devices

1. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer.
2. To calibrate a Resistance Temperature Device (RTD) to measure temperature in a specified range using Null Method/ Off-Balance Bridge with Galvanometer based Measurement.

Thermocouples

1. To study the variation of Thermo-Emf of a Thermocouple with Difference of temperature of its Two Junctions.
2. To Calibrate a Thermocouple to measure Temperature in a Specified Range using Null Method (2) Direct Measurement using an Op-Amp Difference Amplifier and to determine Neutral Temperature.

Electronics

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To design a combinational logic system for a specified Truth Table.
3. To convert a Boolean Expression into Logic Gate Circuit and assemble it using logic gate ICs.

Text Books:

1. Geeta Sanon, B.Sc. Practical Physics, R. Chand & Co.
2. Advanced Practical Physics, B. L. Worsnop, Asia Publishing House, New Delhi.

Reference Books:

1. Practical Physics, C.L. Arora, S.Chand

PHY-SE-011: ELECTRICAL CIRCUIT NETWORK SKILLS

COURSE OBJECTIVES	The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode
COURSE OUTCOMES	• Able to understand electrical protection and various electrical circuits • Able to understand electrical drawing and symbols and their applications. • Familiar with generators and transformers, electric motors and electric wires

DETAILED CONTENT

Module I Basic Electricity Principles

Voltage, Current, Resistance, and Power, Ohm's law, Series, parallel, and series-parallel combinations, AC Electricity and DC Electricity, Familiarization with multimeter, voltmeter and ammeter. **Understanding Electrical Circuits:** Main electric circuit elements and their combination, Rules to analyze DC sourced electrical circuits, Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources, Rules to analyze AC sourced electrical circuits, real, imaginary and complex power components of AC source, Power factor, Saving energy and money.

Module II Generators and Transformers

DC Power sources, AC/DC generators, Inductance, capacitance and impedance, Operation of transformers, **Electric Motors**: Single-phase, three-phase & DC motors. Basic design, Interfacing DC or AC sources to control heaters & motors, Speed & power of ac motor. **Solid-State Devices**: Resistors, inductors and capacitors, Diode and rectifiers, Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources

Module III Electrical Protection

Relays, Fuses and disconnect switches, Circuit breakers, Overload devices, Ground-fault protection, Grounding and isolating, Phase reversal, Surge protection, Interfacing DC or AC sources to control elements (relay protection device). **Electrical Wiring**: Different types of conductors and cables, Basics of wiring-Star and delta connection, Voltage drop and losses across cables and conductors, Instruments to measure current, voltage, power in DC and AC circuits, Insulation. Solid and stranded cable, Conduit, Cable trays, Splices: wirenuts, crimps, terminal blocks, split bolts, and solder, Preparation of extension board.

Text Books:

1. A text book in Electrical Technology - B L Theraja - S Chand & Co..

Reference Books:

1. A text book of Electrical Technology - A K Theraja
2. Performance and design of AC machines - M G Say ELBS Edn

SEMESTER IV

PHY-CC-341: WAVES & OSCILLATIONS

COURSE OBJECTIVES	• provide a deeper understanding of electrostatics and magnetostatics leading to the fundamental laws of electrodynamics – Maxwell's equations in free space and their consequences • develop competence in using laboratory instruments to carry out experiments to study different electromagnetic phenomena, that will enhance students class room learning
COURSE OUTCOMES	• find expressions for the electric and magnetic fields produced by static and moving charges in a variety of configurations. • comprehend the dynamics of a charged particle in electric, magnetic and electromagnetic fields and its applications • formulate Maxwell's equations leading to electromagnetic wave equation and understand its propagation and energy transport

DETAILED CONTENT

MODULE I Damped Oscillations
Superposition of two SHM by vector addition, superposition of two perpendicular SHM, Polarization, Lissajous figures–superposition of many SHMs, complex number notation and use of exponential series, Damped motion of mechanical and electrical oscillator, heavy damping, critical damping, Damped single harmonic oscillator, amplitude decay, logarithmic decrement, relaxation time, energy decay, Q value, rate of energy decay equal to work rate of damping force, problems.

MODULE II Forced Oscillations
Transient and steady state behavior of a forced oscillator, Variation of displacement and velocity with frequency of driving force, frequency dependence of phase angle between force and (a) displacement, (b) velocity, Vibration Insulation – Power supplied to oscillator, Q-value as a measure of power absorption bandwidth, Q-value as amplification factor of low frequency response, modes of vibration, inductance coupling of electrical oscillators, wave motion as the limit of coupled oscillations.

MODULE III Wave Motion I(Transverse waves)
The wave equation, transverse waves on a string, the string as a forced oscillator, characteristic impedance of a string, reflection and transmission of transverse waves at a boundary, impedance matching, insertion of quarter wave element, standing waves on a string of fixed length, normal modes and Eigen frequencies, Energy in a normal mode of oscillation, wave groups, group velocity, dispersion, wave group of many components, bandwidth theorem, transverse waves in a periodic structure (crystal).

MODULE IV Wave Motion II(Longitudinal waves)
Sound waves, energy distribution in sound waves, intensity, specific acoustic impedance, longitudinal waves in a solid, Young's modulus, Poisson's ratio, longitudinal waves in a periodic structure, reflection and transmission of sound waves, Doppler effect.

MODULE V Acoustics
Harmonic analysis, modulation, pulses and wave groups, Fourier transform, An harmonic oscillations, free vibrations of finite amplitude pendulum, nonlinear restoring force, forced vibrations, Thermal expansion of a crystal, electrical 'relaxation' oscillator, nonlinear acoustic effects, Shock waves in a gas.

***Text Books*:**

1. The Physics of Vibrations and Waves, H.J. Pain, John Wiley.
2. Vibrations and Waves in Physics, I.G. Main, Cambridge University.

Reference Books:

1. Berkeley Physics Course Vol. III (Waves)-Frank S Crawford.

PHY-CC-342 : PHYSICS OF THIN FILMS

COURSE OBJECTIVES	• Define vacuum and compare various vacuum pumps and gauges. • Outline the thermodynamics of thin films. • Illustrate the mechanism of thin film formation. • Explain various techniques of thin film formation. • Summarize various properties of thin films.
COURSE OUTCOMES	• Demonstrate various types of pumps and gauges, inspect leak in vacuum and can design a vacuum system. • Define the thermodynamical parameters of thin films and can outline inter diffusion in thin films. • Demonstrate the stages of thin film formation and can outline the conditions for the formation of amorphous, crystalline and epitaxial films.

DETAILED CONTENT

Module I Vacuum Science & Technology
Classification of vacuum ranges, Kinetic theory of gases, gas transport and pumping, Conductance and Throughput, Classification of vacuum pumps, single stage and double stage rotary pump, diffusion pump, turbomolecular pump, cryopump and Classification of gauges, Mechanical gauges: McLeod gauge, Thermal conductivity gauges: Pirani gauge and thermocouple gauge, Ionization gauges: Bayard-Alpert gauge, Penning gauge, leak detection.

Module II Basic Thermodynamics of Thin Films
Solid surface, interphase surface, Surface energies: Binding energy and Interatomic Potential energy, latent heat, surface tension, Liquid surface energy measurement by capillary effect, by zero creep, magnitude of surface energy, General concept, jump frequency and diffusion flux, Fick's First law, Nonlinear diffusion, Fick's second law, calculation of diffusion coefficient, inter diffusion and diffusion in thin films.

Module III Mechanisms of Film Formation
Stages of thin film formation: Nucleation, Adsorption, Surface diffusion, capillarity theory of nucleation, statistical theory of nucleation, growth and coalescence of islands, grain structure and microstructure of thin films, diffusion during film growth, polycrystalline and amorphous films, Theories of epitaxy, role of interfacial layer, epitaxial film growth, super lattice structures.

Module IV Methods of Preparation of Thin Films

Physical vapour deposition: Vacuum evaporation-Hertz- Knudsen equation, evaporation from a source and film thickness uniformity, Glow discharge and plasmas-Plasma structure, DC, RF and microwave excitation; Sputtering processes-Mechanism and sputtering yield, Sputtering of alloys; magnetron sputtering, Reactive sputtering; vacuum arc: cathodic and anodic vacuum arc deposition. Chemical vapour deposition: Thermodynamics of CVD, gas transport, growth kinetics.

Module V Characterization of thin films

Deposition rate, Film thickness and uniformity, Structural properties: Crystallographic properties, defects, residual stresses, adhesion, hardness, ductility, electrical properties, magnetic properties; optical properties.

Text books:

1. The Material Science of Thin Films by Milton Ohring, Academic Press, Inc., 1992.
2. Handbook of Thin Films by Maissel and Glang.
3. Thin Film Phenomena by K. L. Chopra (McGraw Hill, 1969)

Reference books:

1. Thin Film Deposition: Principles & Practice by Donald L. Smith (McGraw Hill, 1995)
2. Coating Technology Handbook by D. Satas, A. A. Tracton, Marcel Dekkar Inc. USA.
3. Arc Plasma Technology in Material Science, P. A. Gerdeman and N. L. Hecht, Springer Verlag, 1972.

PHY-CC-343: ELECTRICITY& MAGNETISM

COURSE OBJECTIVES	• Provide a deeper understanding of electrostatics and magnetostatics leading to the fundamental laws of electrodynamics – Maxwell's equations in free space and their consequences • Develop competence in using laboratory instruments to carry out experiments to study different electromagnetic phenomena, that will enhance students class room learning
COURSE OUTCOMES	• Find expressions for the electric and magnetic fields produced by static and moving charges in a variety of configurations. • Comprehend the dynamics of a charged particle in electric, magnetic and electromagnetic fields and its applications • Set up and perform basic experiments to investigate the behavior of electric and magnetic fields for different configurations, to determine capacitance and inductance and study the effect of these components on the behavior of the circuits

DETAILED CONTENT

MODULE I Electric Field
Electric field: Electric field lines. Electric flux, Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry, Conservative nature of Electrostatic Field, Electrostatic Potential, Laplace's and Poisson equations, The Uniqueness Theorem.

MODULE II Electric Potential
Potential and Electric Field of a dipole, Force and Torque on a dipole, Electrostatic energy of system of charges, Electrostatic energy of a charged sphere, Conductors in an electrostatic Field, Surface charge and force on a conductor, Capacitance of a system of charged conductors, Parallel-plate capacitor, Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.

MODULE III Magnetic Properties of Matter
Magnetization vector (M), Magnetic Intensity(H), Magnetic Susceptibility and permeability, Relation between B, H& M, Ferromagnetism, B-H curve and hysteresis.

Module IV Electromagnetic Induction

Faraday's Law, Lenz's Law, Self Inductance and Mutual Inductance, Reciprocity Theorem, Energy stored in a Magnetic Field, Introduction to Maxwell's Equations, Charge Conservation and Displacement current. Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance, Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width, Parallel LCR Circuit.

Module V Network theorems

Ideal Constant-voltage and Constant-current Sources, Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem, Applications to dc circuits, Ballistic Galvanometer: Torque on a current Loop, Ballistic Galvanometer: Current and Charge Sensitivity, Electromagnetic damping, Logarithmic damping, CDR.

Text books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury,
2. 2012, Tata McGraw
3. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
4. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.

Reference Books:

1. Feynman Lectures Vol.2, R.P. Feynman, R.B. Leighton, M. Sands, 2008, Pearson Education
2. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
3. Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.

PHY-CC-343 (P): PRACTICAL LAB- ELECTRICITY& MAGNETISM

COURSE OBJECTIVES	• To make knowledge of student for various electronics components. • To apply the theoretical knowledge for developing new devices
COURSE OUTCOMES	• Design and develop the instruments for advanced studies. • Evaluate theoretical calculations using experimental observations. • Will be capable of handling sophisticated instruments besides learning the Physics concepts behind these experiments

DETAILED CONTENT

Polarization

Measurement of Magnetic Field and Related Parameters

1. Measurement of field strength B and its variation in a Solenoid (Determination of dB/dx).

2. To draw the BH curve of iron by using a Solenoid and to determine the energy loss due to Hysteresis.

Melde's Experiment

1. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment.

2. To verify $\lambda 2 - T$ Law by Melde's Experiment.

Resistance

1. To determine a Low Resistance by Carey Foster's Bridge.

2. To determine a Low Resistance by a Potentiometer.

3. To determine High Resistance by Leakage of a Capacitor.

Ballistic Galvanometer

1. To determine the (a) Charge Sensitivity and (b) Current Sensitivity of a B.G.
2. To determine the (a) Logarithmic Decrement and (b) CDR of a B.G.

Measurement in Solid State Physics

1. To measure the Resistivity of a Ge Crystal with Temperature by Four-Probe Method (from room temperature to 200 oC) and to determine the Band Gap Eg for it.
2. To determine the Hall Coefficient and the Hall angle of a Semiconductor.
3. To study the PE Hysteresis loop of a Ferroelectric Crystal.
4. To measure the Magnetic susceptibility of Solids and Liquids.

Text Books:

1. Geeta Sanon, B.Sc. Practical Physics, R. Chand & Co.
2. Advanced Practical Physics, B. L. Worsnop, Asia Publishing House, New Delhi.

Reference Books:

1. Practical Physics, C.L. Arora, S. Chand
2. A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, Vani Publication House, New Delhi.

PHY-SE-012: RENEWABLE ENERGY AND ENERGY HARVESTING

COURSE OBJECTIVES	The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible
COURSE OUTCOMES	• Able to understand fossil fuels and alternate sources of energy and solar energy • Able to understand wind energy harvesting and electromagnetic energy harvesting & electromagnetic energy harvesting • Familiar with ocean energy, Geothermal Energy and hydro energy

DETAILED CONTENT

Module I

Fossil fuels and Alternate Sources of energy: Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean thermal energy conversion, Solar energy, Biomass, Biochemical conversion, Biogas generation, Geothermal energy, Tidal energy, Hydroelectricity, Solar energy: Solar energy, Importance, Storage of solar energy, Solar pond, Non convective solar pond, Applications of solar pond and solar energy, Solar water heater, Flat plate collector, Solar distillation, Solar cooker, Solar green houses, Solar cell, Absorption air conditioning, Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, Sun tracking systems.

Module II

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces and grid inter connection topologies. Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices, Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean bio-mass. Geothermal Energy: Geothermal Resources, Geothermal Technologies.

Module III

Hydro Energy:Hydropower resources, Hydropower technologies, Environmental impact of hydro power sources. Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modelling, Piezoelectric generators, Piezoelectric energy harvesting applications, Human power. Electromagnetic Energy Harvesting: Linear generators, Physics mathematical models, Recent applications, Carbon captured technologies, cell, batteries, Power consumption, Environmental issues and Renewable sources of energy, Sustainability.

Text Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal – S. Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, Renewable Energy, Power for a sustainable future, 2004, Oxford University Press, in association with The Open University.

Reference Books:

1. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
2. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA). http://en.wikipedia.org/wiki/Renewable_energy

Demonstrations and Experiments

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into voltage using thermoelectric modules

SEMESTER V

PHY-CC-351: SOLID STATE PHYSICS

COURSE OBJECTIVES	• introduce solid state systems • give an in-depth knowledge of various crystalline structures and experimental techniques like X-ray diffraction • provide an understanding of thermal, electrical, optical and magnetic properties of solid state matter
COURSE OUTCOMES	• describe different types of crystal structures in terms of the crystal lattice and basis • formulate the theory of X-ray diffraction in reciprocal lattice formalism and explain the concepts like form factor, structure factor, scattering amplitude, etc. • understand the different physical mechanisms involved in crystal binding

DETAILED CONTENT

Module I Crystal Structure, Lattice Vibrations and Phonons

Amorphous and Crystalline Materials, Lattice Translation Vectors, Lattice with Basis. Unit Cell, Reciprocal Lattice, Types of Lattices, Brillouin Zones, Types of Bonds, Ionic Bond, Covalent Bond, Vander Waals Bond, Diffraction of X rays by Crystals, Bragg's Law, Linear Monoatomic and Diatomic Chains (Acoustical and Optical Phonons), Qualitative Description of the Phonon Spectrum in Solids, Einstein and Debye, Theories of Specific Heat of Solids, *T3* Law

Module II Magnetic Properties of Matter

Dia-, Para-, Ferri- and Ferromagnetic Materials, Classical Langevin Theory of dia and Paramagnetic Domains, Quantum Mechanical Treatment of Paramagnetism, Curie's law, Weiss's Theory of Ferromagnetism, Ferromagnetic Domains, Discussion of B-H Curve, Hysteresis and Energy Loss.

Module III Dielectric Properties of Materials

Polarization, Local Electric Field at an Atom, Depolarization Field, Dielectric Constant, Electric Susceptibility, Polarizability, Classical Theory of Electric Polarizability, Clausius Mosotti Equation (Statement only), Normal and Anomalous Dispersion, Complex Dielectric Constant (Only Quantitative Study).

Module IV Electrical Properties of Materials

Elementary Band Theory of Solids, Bloch Theorem, Kronig-Penney Model, Effective Mass of Electron, Concept of Holes, Band Gaps, Energy Band Diagram and Classification of Solids, Law of Mass Action, Insulators, and Semiconductors, Direct and Indirect Band Gap, Intrinsic and Extrinsic Semiconductors, p- and n- Type Semiconductors, Conductivity in Semiconductors, Hall Effect in Semiconductors (Qualitative Discussion Only).

Module V Superconductivity

Experimental Results, Critical Temperature, Critical magnetic field, Meissner effect, Type I and type II Superconductors, London's Equation and Penetration Depth, Isotope effect, Idea of BCS theory (No derivation): Cooper Pair and Coherence length, Variation of Superconducting Energy Gap with Temperature, Experimental Evidence of Phonons, Josephson Effect.

Text Books:

1. Introduction to Solid State Physics, Charles Kittel, John Wiley and Sons, Inc.
2. Solid State Physics, A J Dekkar, Macmillan India Limited.

Reference Books:

1. Solid State Physics, J. S. Blackmore, Cambridge University Press, Cambridge.
2. Solid State Physics, N. W. Ascroft and N. D. Mermin, Harcourt Asia, Singapore.

PHY-CC-352: OPTICS

COURSE OBJECTIVES	• The objectives of this lab-based course are to: • give students an in-depth look at geometrical and physical optics phenomena • expose them to the various historical theories of light and its propagation - rectilinear propagation, reflection, refraction, culminating in Fresnel's equations derived from the electromagnetic wave approach
COURSE OUTCOMES	• provide a deeper knowledge of basic concepts and applications of phenomena like interference, diffraction and polarization and their related optical techniques • give a hands-on experience to study different optical phenomena by performing experiments related to the concepts studied

DETAILED CONTENT

Module I Thick Lenses

Convex lens - Principal foci and principal points - Thick lens formula - Power of a thick lens Optic centre of a lens - Spherical aberration and lenses - Methods of minimizing spherical aberration - Condition for minimum spherical aberration in the case of two lenses separated by a distance - Chromatic aberration in lenses - Condition for achromatism of two thin lenses (in contact and out of contact) - coma - astigmatism - Curvature of the field - Huygen's and Ramsden's eye pieces.

Module II Dispersion

Dispersion produced by a thin prism - Angular dispersion - Dispersive power - Cauchy's formula - combination of prisms to produce - Dispersion without deviation - Deviation without dispersion - Achromatic prisms Direct vision spectroscope - Constant deviation spectroscope - Rainbows and haloes.

Module III Interference

Young's experiment, coherent sources, phase and path differences, Theory of interference fringes, Fresnel's biprism, sheet thickness determination, interference in thin films due to reflected and transmitted lights, Maxima and minima in intensities, Colors of thin films, Newton's rings and its various aspects, Non-reflecting films.

Module IV Diffraction

Introduction, rectilinear propagation, Fresnel and Fraunhofer diffraction, Diffraction at a circular aperture and straight edge and their discussion, Fraunhofer diffraction at a single slit and a double slit. Fraunhofer diffraction at N slits and its discussion, Plane diffraction grating and its theory, Dispersive power of grating, Resolving power of optical instruments, Rayleigh criterion, Resolving power telescope, microscope, prism and diffraction grating, Phase contrast microscope.

Module V Polarization

Introduction, Polarization by reflection, Brewster's law, Polarization by refraction, Malus's law, Double retraction, Nicol Prism and its use, elliptically and Circularly polarized light, quarter and half-wave plates, production and detection of plane, circularly and elliptically polarized light, optical activity, specific rotation, Half-shade polarimeter.

Text Books:

1. Text book of Optics, N. Subramanayam, B. Lal and M. N. Avadhamulu.
2. Fundamentals of Optics, Jenkins and White

Reference Books:

1. Optics, Ajay Ghatak

PHY-352 (P): PRACTICAL LAB - OPTICS

COURSE OBJECTIVES	• To make knowledge of student for various electronics components. • To apply the theoretical knowledge for developing new devices
COURSE OUTCOMES	• Design and develop the instruments for advanced studies. • Evaluate theoretical calculations using experimental observations. • Will be capable of handling sophisticated instruments besides learning the Physics concepts behind these experiments

DETAILED CONTENT

Reflection, Refraction and Dispersion

1. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
2. To determine the Refractive Index of a Liquid by Total Internal Reflection using Wollaston's Air-film.
3. To determine the Refractive Index of (1) Glass and (2) a Liquid by Total Internal Reflection using a Gaussian Eyepiece.
4. To determine the Dispersive Power of the Material of a given Prism using Mercury Light.
5. To determine the Resolving Power of a Prism.

Interference

1. To determine wavelength of sodium light using Fresnel Biprism.
2. To determine wavelength of sodium light using Newton's Rings.
3. To determine the Thickness of a Thin Paper by measuring the Width of the Interference Fringes produced by a Wedge-Shaped Film.
4. To determination Wavelength of Sodium Light using Michelson's Interferometer.

Diffraction

1. To determine the Diameter of a Thin Wire by studying the Diffraction Produced by it.
2. To determine the wavelength of Laser light using Diffraction of Single Slit.
3. To determine the wavelength of (1) Sodium and (2) Mercury Light using Plane Diffraction Grating.
4. To determine the Dispersive Power of a Plane Diffraction Grating.
5. To determine the Resloving Power of a Plane Diffraction Grating.

Polarization

1. To verify the Law of Malus for Plane Polarized Light.
2. To determine the Specific Rotation of cane sugar using Polarimeter.
3. To analyze Elliptically Polarized Light by using a Babinet's Compensator.
4. To measure the Numerical Aperture of an Optical Fibre

Text Books:

1. Geeta Sanon, B.Sc. Practical Physics, R. Chand & Co.
2. Advanced Practical Physics, B. L. Worsnop, Asia Publishing House, New Delhi.

Reference Books:

1. Practical Physics, C.L. Arora, S.Chand
2. A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, Vani Publication House, New Delhi.

PHY-SE-013: APPLIED OPTICS

COURSE OBJECTIVES	The quest to understand the 'nature of light' is a favourite inquiry of mankind since ancient times. By the advent of lasers, holography, and optical fibres in twentieth century the optics now-a-days finds application in several branches of science and engineering. This paper provides the conceptual understanding of these branches of modern optics to the students.
COURSE OUTCOMES	• Able to understand Holography and Photonics Fibre Optics and their applications. • Familiar with laser, photo detectors and optical fibre

DETAILED CONTENT

Module I Sources and Detectors

Lasers, Spontaneous and stimulated emissions, Theory of laser action, Population of energy levels, Einstein‟s coefficients and optical amplification, properties of laser beam, Ruby laser Einstein's coefficients, Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers. Light Emitting Diode (LED) and photo-detectors.

Module II Holography

Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition.

Module III Photonics Fibre Optics

Optical fibres and their properties, Principal of light propagation through a fibre, The numerical aperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating.

Skill Enhancement Compulsory Courses LAB

Minimum **three** experiments should be performed covering minimum two sections.

Experiments on Lasers:

1. To determine the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser.
2. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser.

3. To find the polarization angle of laser light using polarizer and analyzer
4. To determine the wavelength and angular spread of laser light by using plane diffraction grating.

Experiments on Semiconductor Sources and Detectors:
1. V-I characteristics of LED
2. Study the characteristics of solid state laser
3. Study the characteristics of LDR
4. Characteristics of Photovoltaic Cell/ Photodiode.
5. Characteristics of IR sensor

Experiments on Fibre Optics
1. To measure the numerical aperture of an optical fibre
2. To measure the near field intensity profile of a fibre and study its refractive index profile

Text Books:

1. LASERS: Fundamentals & applications, K.Thyagrajan & A. K. Ghatak, 2010, Tata McGraw Hill
2. Introduction to Fiber Optics, A. Ghatak & K. Thyagarajan, Cambridge University Press.
3. Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd.

Reference Books:

1. Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books
2. Optical Electronics, Ajoy Ghatak and K. Thyagarajan, 2011, Cambridge University, Press
3. Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt. Ltd.

PHY-DSE- 011: NUCLEAR & PARTICLE PHYSICS

CORE OBJECTIVES	• provide an understanding of radioactive phenomena • explore the nuclear properties and understand them through nuclear models • impart knowledge of the nuclear processes that yield nuclear energy • introduce the experimental tools used for studying nuclear physics.
COURSE OUTCOMES	• appreciate the importance of nuclear physics and its applications • understand radioactive decay modes and nuclear reactions • discuss nuclear properties ,nuclear reactions. • describe fission and fusion reactions and nuclear power production • have a basic idea of elementary particles and their conservation laws and properties.

DETAILED CONTENT

Module I Structure and Properties of the Nucleus
Discovery of the nucleus, composition, basic properties; charge, mass, size, spin, magnetic moment, electric quadruple moment, binding energy, binding energy per nucleon and its observed variation with mass number of the nucleus, coulomb energy, volume energy, surface energy, other corrections, explanation of the binding energy curve, semi-empirical mass formula.

Module II Radioactivity
The radioactive decay law, decay constant and half life; methods of measurement of half life, spectra of emitters. Alpha decay, Beta decay, Gamma decay: Basic decay processes, energy releases in decay processes Geiger-Nuttall law, Gamow's explanation, Mossbauer effect, energy levels.

Module III Nuclear reactions
Types of nuclear reactions, reactions cross section, conservation laws, Kinematics of nuclear reaction, Q-value and its physical significance, compound nucleus.

Module IV Nuclear Models
Introduction, Fermi gas model, Liquid drop model, condition of stability, evidence for nuclear magic numbers, Shell model, energy level scheme, angular moment of nuclear ground states.

Module V Elementary Particles and Their Properties
Historical survey of elementary particles and their classification, determination of mass, life time, decay mode, spin and parity of muons, pions, kaons and hyperons, Experimental evidence for two types of neutrinos, production and detection of some important resonances and antiparticles.

Text books:

1. Basic ideas and Concepts in Nuclear Physics, K. Hyde.
2. Introduction to Nuclear Physics, H.A. Enge.

Reference books:

1. Nuclear Physics, I. Kaplan, Addison Wesley.
2. Nuclei and Particles, E. Segre.

- The syllabus will be followed by Tutorial of credit 1.

PHY-DSE-012 : ASTRONOMY AND ASTROPHYSICS

COURSE OBJECTIVES	The quest to understand the 'nature of light' is a favourite inquiry of mankind since ancient times. By the advent of lasers, holography, and optical fibres in twentieth century the optics now-a-days finds application in several branches of science and engineering. This paper provides the conceptual understanding of these branches of modern optics to the students.
COURSE OUTCOMES	• Able to understand Holography and Photonics Fibre Optics and their applications. • Familiar with laser, photo detectors and optical fibre

DETAILED CONTENT

Module I

Contents of our Universe: basic introduction of stars, galaxies, clusters, interstellar medium, black holes, our own galaxy Milky Way, Mass, length, time and magnitude scales in astronomy, Interaction of light and matter fundamentals of radiative transfer, thermal radiation and thermodynamic equilibrium, Kirchhoff's law of thermal emission, Boltzmann and Saha equation, thermodynamics of black body radiation, concept of local thermodynamic equilibrium, Observational tools for multi-wavelength astronomy - telescope as a camera, optical telescopes, radio telescopes, astronomical instruments and detectors, observations at other wavelengths, all-sky surveys.

Module II

Properties of stars, Measurement of stellar parameters: distance parallax, Cepheid variables, nova and supernovae, red shift), stellar spectra, spectral lines, Hertzsprung-Russell diagram, luminosity and radius, binary system and mass determination, scaling relation on the Main Sequence, Basic equation of stellar structure hydrostatic equilibrium and the virial theorem, radiative and convective energy transport inside stars, nuclear energy production

Module III

Formation and evolution of stars star formation, pre-main-sequence collapse (gravitational instability and mass scales, collapse of spherical cloud, contraction onto the Main Sequence, Brown Dwarfs), evolution of high-mass and low-mass stars (core and shell hydrogen burning, helium ignition), late-stage evolution of stars, evolution of Sun-like stars and solar system, End stages of stars white dwarfs, neutron stars, black holes as end point of stellar evolution, supernovae.

Module IV

Milky Way galaxy: components, morphology and kinematics of the Milky way, the galactic center, spiral arms, Classification and morphology of galaxies -quiet and active galaxies, types of active galaxies, Active Galactic Nuclei (AGN) and Quasars, accretion by supermassive black holes.

Module V

Newtonian cosmology, Olber's paradox, Hubble's law and the expanding Universe, scale factor and commoving Coordinate, Standard cosmology, the Friedmann equations from Newtonian cosmology, fluid equation , equation of state for matter, dust etc. from basic thermodynamics, cosmological redshift, dark matter, dark energy and the accelerating universe, tests and probes of Big Bang cosmology

Text Books:

1. An Introduction to Modern Astrophysics, B.W. Carroll & D.A. Ostlie, Addison-Wesley Publishing Co.
2. Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, 4 th Edition, Saunders College Publishing
3. Astrophysics in a Nutshell (Basic Astrophysics), Dan Maoz, Princeton University Press
4. An Invitation to Astrophysics, T. Padmanabhan, World Scientic Publishing Co
5. Foundations of Astrophysics, Barbara Ryden and Bradley M. Peterson, Addison Wesley

Reference Books:

1. Astronomy and Astrophysics, A. B. Bhattacharya, S. Joardar, R. Bhattacharya, Overseas Press (India) Pvt. Ltd
2. Astrophysics for Physicists, Arnab Rai Choudhuri, Cambridge University Press
3. Introduction to Astronomy and Cosmology, Ian Morison, John Wiley & Sons Ltd
4. Theoretical Astrophysics, Volume III: Galaxies and Cosmology, T. Padmanabhan, Cambridge University Press

- The syllabus will be followed by Tutorial of credit 1.

PHY-DSE-013: PHOTONICS

COURSE OBJECTIVES	• To make the students familiar about the Photons in semiconductors and Semiconductor photon sources • To make the students learn about Semiconductor laser amplifiers, Semiconductor photon detectors and Photonic switching
COURSE OUTCOMES	• Able to understand Semiconductor photon detectors and Photonic switching and Semiconductor laser amplifiers • Familiar with Semiconductor photon sources and Photons in semiconductors

DETAILED CONTENT

Module I

Photons in semiconductors-semiconductors-energy band and charge carriers-semi conducting materials-electron and hole concentrations-generation, recombination and injection-junctions-hetero junctions-quantum wells and super lattices

Module II

Semiconductor photon sources -light emitting diodes-injection-electroluminescence- LED Characteristics - internal photon flux-output photon flux and efficiency- responsivity spectral distribution- materials-response time-device structures.

Module III

Semiconductor laser amplifiers-gain-amplifier band width-optical pumping-electrical current pumping-hetero structures-semiconductor injection lasers-amplification-feedback and oscillators resonator losses-gain condition-internal photon flux-output photon flux and efficiency-spectral distribution-spatial distribution-single frequency operation quantum well lasers (qualitative).

Module IV

Semiconductor photon detectors-The external photo effect-photo electron emission-The internal photo effect-semiconductor photo detection-quantum efficiency- responsivity devices with gain-response time-photoconductors-photo diodes-PIN photo diodes-hetero structure photo diode-Schotky barrier photodiodes-array detectors-avalanche photodiodes-gain and responsivity-response time.

Module V

Photonic switching and computing-opto mechanical, electro optic, acousto-optic and magneto optic switches-all optical switches- bistable systems-principle of optical bistability- bistable optical devices-optical inter connectors-optical computing-digital optical computing-analog optical processing.

Text Books:

1. Fundamentals of Photonics: BFA Saleh and M.C.Teich, John Wiley &Sons, Inc.

Reference Books:

1. Semiconductor optoelectronic devices: Pallab Bhattacharya, Printice Hall of India.
2. Optics and Photonics- An introduction: F. Graham Smith and Terry A.King, John Wiley & Sons, Inc.
3. Lasers and Non linear Optics: B.B.Laud, New Age International Pvt Ltd

PHY-DSE-014: DIRECT ENERGY CONVERSION

COURSE OBJECTIVES	• About various direct energy conversion technology. • Fabrication of solar cell • Knowledge of different materials for energy conversion.
COURSE OUTCOMES	• Able to Analyses the energy conversion process • Evaluate the applications of solar cell. • Understand the different fuel cells.

DETAILED CONTENT

Module I
Survey of energy conversion problem, Basic science of energy conversion, Physics of semiconductor junctions for photovoltaic.

Module II
Fabrication and evaluation of various solar cells, Application of solar cells in photo voltaic power generation systems.

Module III
Technology and physics of thermo-electric generators, Thermo-electric materials and optimization studies, Basic concepts and design consideration of MHD generators, Cycle analysis of MHD systems, Thermionic power conversion and basic concept of Fusion Energy.

Module IV
Thermodynamics and performance of fuel cells and their applications, recent developments and their applications.

Module V
Semiconductors for Solar Cell: Silicon: preparation of metallurgical, electronic and solar grade Silicon - Production of single crystal Silicon: Czokralski (CZ) and Float Zone (FZ) method–imperfections–carrier doping and lifetime -Germanium - compound semiconductors: growth & characterization.

Text Books:

1. Direct Energy Conversion :W.R.Corliss
2. Aspects of Energy Conversion : I.M.Blair and B.O.Jones
3. Principles of Energy Conversion : A.W.Culp (McGraw-Hill International)
4. Semiconductors for solar cells, H. J. Moller, Artech House Inc, MA, USA, 1993.

Reference Books:

1. Handbook: Batteries and Fuel cell – linden (Mc.Graw Hill)- 1984
2. Essentials of Solar Cells by R. K. Kotnala& N.P. Singh, Allied Publishers Pvt. Ltds, New Delhi, 1986.
3. Semiconductor Devices by NauroZamluto, Mc Graw Hill 1989 (Int. Ed.)
4. Solid State Electronic Devices, III ed. By B. G. Streetman, Prentice Hall India Pvt. Ltd., N.D, 1991.

SEMESTER VI

PHY-CC-361: QUANTUM PHYSICS

COURSE OBJECTIVES	• review the experiments that led development of quantum theory • understand the underlying foundations and basic principles of quantum mechanics • apply non- relativistic Schrödinger wave mechanics to a variety of potentials in one and three dimensions
COURSE OUTCOMES	• physics through experimental evidences and understand quantum theory of radiation and matter • understand the wave-particle duality, develop the concept of the wave function and give its interpretation, discuss Heisenberg's uncertainty principle and its applications • discuss the concept of probability conservation and probability current density, formulate the set of postulates to study quantum mechanics and apply the principles of quantum mechanics to calculate observables of a quantum system

DETAILED CONTENT

Module I Matter Waves and Uncertainty Principle
De Broglie's hypothesis – wavelength of matter waves, properties of matter waves. Phase and group velocities, Davisson and Germer experiment. Double slit experiment, Standing de Broglie waves of electron in Bohr orbits, Heisenberg's uncertainty principle for position and momentum (x and p_x), Energy and time (E and t), Gamma ray microscope. Diffraction by a single slit, Position of electron in a Bohr orbit, Particle in a box, Complementary principle of Bohr.

Module II Schrodinger Wave Equation
Schrödinger equation -time dependent and steady state forms, expectation value, Particle in a box, Schrodinger equation for hydrogen atom, separation of variables, quantum numbers.

Module III Quantum Kinematics
Stern- Gerlach experiment as a tool to introduce quantum ideas, analogy of two level quantum system with polarization states of light, Complex linear vector spaces, commutator and uncertainty relations, Change of basis and unitary transformations, Diagonalisation of

operators, Position, momentum and translation, momentum as a generator of translations, canonical commutation relations.

Module IV Quantum Dynamics
Time evolution operator and Schrödinger equation, special role of the
Hamiltonian operator, Ehrenfest's theorem. One Dimensional System: Potential Step, potential barrier, potential well, Scattering vs. Bound states.

Module V Harmonic oscillator and applications
Harmonic oscillator, energy Eigen states, wave functions and coherent states, Spherical Symmetric Systems and Angular Momentum: Schrödinger equation for a spherically symmetric potential, Orbital angular momentum commutation relations, Eigen value problem for spherical harmonics, Three dimensional harmonic oscillator, three dimensional potential well and the hydrogen atom.

Text Books:

1. Modern Quantum Mechanics, J. J. Sakurai (Principal text), Pearson Education Pvt. Ltd., New Delhi, 2002.
2. Quantum Mechanics, L I Schiff, Tokyo Mc Graw Hill.
3. Feynman lectures in Physics Vol. III, Addison Wesly.

Reference Books:

1. Quantum Physics of Atoms Molecules Solids, Nuclei & Particles: R. Eisberg and R. Resnick.
2. Concepts of modern physics, A. Beiser
3. Introduction to Atomic and Nuclear Physics: H. Semat and J.R. Albright.

PHY-CC-362: CLASSICAL MECHANICS

COURSE OBJECTIVES	• provide an in-depth understanding of the principles of Newtonian mechanics and apply them to solve problems involving the dynamic motion of classical mechanical systems • explain the limitations of Newtonian mechanics for motion at very high velocities, and thus introduce the special theory of relativity • provide hands-on experience to perform experiments to study some properties of matter and oscillations
COURSE OUTCOMES	• apply Newton's laws of motion to different force fields for a single particle and for a system of particles • set-up and solve differential equations to study the a) motion of a particle in a central force field, b) oscillatory motion and c) vibrations in a string and interpret the solutions obtained • apply the concept ofconservation of energy and linear momentum to solve problems involving collisions with respect to both laboratory frame of reference and center of mass frame • appreciate the study of special theory of relativity and understand its consequences- length contraction, time dilation, simultaneity of events, mass variation and equivalence of mass and energy

DETAILED CONTENT

Module I LagrangianMechanics

Newton's law of motion, mechanics of a system of particles, constraints, D'Alembert's principle and Lagrange's equations of motion, Velocity dependent potentials and dissipation function, Some applications of Lagrangian formulation, Hamilton's principle, derivation of Lagrange's equations from the Hamilton's principle, Conservation theorems and symmetry properties.

Module II Central Force Problem

Two body central force problem, reduction to equivalent one body problem, the equation of motion and first integrals, the equivalent one dimensional problem, and classification of orbits, The differential equation for the orbit and integral power-law potential, The Kepler problem, Scattering in a central force.

Module III Rigid Body Dynamics

The independent co-ordinates of a rigid body, orthogonal transformation, the Euler's angles, Euler's theorem on the motion of rigid body, finite and infinitesimal rotations, rate of change of a vector, angular momentum and kinetic energy about a point for a rigid body, the inertia tensor and moment of inertia, the Eigen values of the inertia tensor and the principal axis transformation, Euler's equations of motion, torque free motion of a rigid body.

Module IV Legendre and Hamiltonian Transformations

Legendre transformation and Hamilton's equations of motion, cyclic co-ordinates and conservation theorems, derivation of Hamilton's equations from a variational principle, the principle of least action.

Module V Canonical Transformations

The equation of canonical transformation, examples of canonical transformations, Poisson brackets, Equations of motion, infinitesimal canonical transformations and conservation theorems in the Poisson bracket formulation.

***Text Books*:**

1. Classical Mechanics: Herbert Goldstein, Narosa Pub. House.
2. Mechanics: Landau &Lifshitz, Pergamon Press Oxford.

Reference Books:

1. Classical Mechanics: Rana and Joag, Tata Mc Graw Hill, New Delhi.

PHY-SE-014: BASIC INSTRUMENTATION SKILLS

COURSE OBJECTIVES	The quest to understand the 'nature of light' is a favourite inquiry of mankind since ancient times. By the advent of lasers, holography, and optical fibres in twentieth century the optics now-a-days finds application in several branches of science and engineering. This paper provides the conceptual understanding of these branches of modern optics to the students.
COURSE OUTCOMES	• Able to understand Holography and Photonics Fibre Optics and their applications. • Familiar with laser, photo detectors and optical fibre

DETAILED CONTENT

Module I Basic of Measurement
Instruments accuracy, precision, sensitivity, resolution range etc, Errors in measurements and loading effects, Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance, Specifications of a multimeter and their significance.

Module II Electronic Voltmeter
Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity, Principles of voltage, measurement (block diagram only), Specifications of an electronic voltmeter/multimeter and their significance, AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.

Module III Digital Instruments & Digital Multimeter
Principle and working of digital meters, comparison of analog & digital instruments, characteristics of a digital meter, working principles of digital voltmeter, Block diagram and working of a digital multimeter, Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.

The test of lab skills will be of the following test items:
1. Use of an oscilloscope.

2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter/VTVM for measuring voltages
5. Circuit tracing of Laboratory electronic equipment,
6. Winding a coil / transformer.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges

PHY-SE-014(P): PRACTICAL LAB : BASIC INSTRUMENTATION SKILLS

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.
8. Measurement of R, L and C using a LCR bridge/ universal bridge.

Open Ended Experiments:
1. Using a Dual Trace Oscilloscope
2. Converting the range of a given measuring instrument (voltmeter, ammeter)

Text Books:
1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.
5. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.

Reference Books:
1. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012,Tata Mc-Graw Hill
2. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
3. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

PHY-DSE-015: ELECTRODYNAMICS

COURSE OBJECTIVES	• To make the students familiar about the concepts of Electrostatics & Magnetostatics and Electromagnetic waves • To make the students learn about Electrostatic Field, Circuit Theory and Electromagnetic waves
COURSE OUTCOMES	• Able to understand Electrostatic Field, Circuit Theory and Electromagnetic waves • Familiar with the concepts of Electrostatics & Magnetostatics and Electromagnetic waves

DETAILED CONTENT

Module I Electrostatic Field
Electric field: Introduction, Coulomb's Law, Electric field, continuous charge distribution, Divergence and curl of electrostatic fields; Field lines, flux and Gauss' law, the divergence of E, applications of gauss's law, the Curl of E Electric potential: Introduction to potential, Comments on potential, Poisson's and Laplace's equations, Potential of a localized charge distribution, electrostatic boundary, Work and energy in Electrostatics: The work done to move a charge, the energy of a point charge distribution, The energy of a continuous charge distribution.

Module II Electrostatics & Magnetostatics
Polarization: Dielectrics, induced dipoles, Polarization, The field of a polarized object: Bound charges, Physical interpretation of bound charges, and the field inside a dielectric Electric displacement: Gauss's law in the presence of dielectrics, Boundary conditions, The Biot-Savart law, Ampere's force law, Magnetic torque, Magnetic flux and gauss's law for magnetic fields, Magnetic vector potential, Magnetic intensity and Ampere's circuital law, Magnetic materials

Module III Electromagnetic Induction
Electromotive force: Ohm's law, Electromagnetic induction: Faraday's law, the induced electric field Maxwell's Equations: Electrodynamics before Maxwell, How Maxwell fixed Ampere's law, Maxwell's equations, Magnetic charge, Maxwell's equations in matter, Boundary conditions

Module IV Electromagnetic waves

Waves in one dimension: The wave equation Electromagnetic waves in vacuum: The wave equation for E and B, Monochromatic plane waves, Energy and momentum in electromagnetic waves.

Module V Circuit Theory

Ideal voltage and current sources- Thevenin's and Norton's theorems, Maximum power transfer theorem, h parameters applied to two port networks

Text Books:

1. Electrodynamics - David J Griffith (PHI 3rd edition)
2. Electricity and Magnetism- Murugesan (S.Chand & Co.)
3. Electricity and Magnetism - K. K. Tiwari (S.Chand & Co.)Addison Wesley

Reference Books:

1. Electricity and Magnetism - E.M. Purcell, Berkley Physics course, Vol.2 (MGH)
2. Electricity and Magnetism - J.H. Fewkes & John Yarwood (University tutorial press
3. Electricity and Magnetism- D.C. Tayal (Himalaya Publishing Co)
4. Electricity and Magnetism- Muneer H. Nayfeh & Norton K. Bressel (John Wiley & Sons)
5. Classical Electrodynamics- Walter Greiner (Springer International Edition)

PHY-DSE-016 : NANO PHYSICS

COURSE OBJECTIVES	• To foundational knowledge of the Nanoscience and related fields. • To make the students acquire an understanding the Nanoscience and Applications • To help them understand in broad outline of Nanoscience and Nanotechnology.
COURSE OUTCOMES	• determine the nanotechnology and actual working areas and applications. • can distinguish between nanomaterials depending on their technological applications. • knows which properties of materials mustpossess depending on application • can recognizes new nanomaterials.

DETAILED CONTENT

Module I Introduction of Nano Materials
Introduction, Basic idea of nanotechnology, nanoparticles, metal Nanoclusters, Semiconductor nanoparticles, Physical Techniques of Fabrication, inert gas condensation, Arc Discharge, RF plasma, Ball milling, Molecular Beam Epitaxy, Chemical Vapour deposition, Electrodeposition, Chemical Methods-Metal nanocrystals by reduction, Photochemical synthesis, Electrochemical synthesis, Sol-gel, micelles and microemulsions, Cluster compounds. Lithographic Techniques- AFM based nanolithography and nanomanipulation, E-beam lithography and SEM based nanolithography, X ray based lithography.

Module II Synthesis
Free electron theory and its features, Idea of band structure of metals, insulators and semiconductors. Density of state in one, two and three dimensional bands and its variation with energy, Effect of crystal size on density of states and band gap, Examples of nanomaterials, Topdown and bottom-up approaches, Physical and chemical methods for the synthesis of nanomaterials with examples.

Module III Characterization Techniques
X-ray diffraction, Scanning Probe microscopy, Scanning Electron microscopy, Transmission Electron Microscopy, Scanning Tunneling Microscopy, Optical microscopy, FTIR Spectroscopy, Raman Spectroscopy.

Module IV Carbon based materials

Important Carbon based materials; Preparation and Characterization of Fullerene and other associated carbon clusters/molecules, Graphene preparation, characterization and properties, DLC and nano diamonds, Quantum Dots, Carbon Nanotubes, Preparation of Carbon nano tubes, CVD and other methods of preparation of CNT, Properties of CNT; Electrical, Optical, Mechanical, Vibrational properties, Application of CNT.

Module V Nanosemiconductors and Nano sensors

Semiconductor nanoparticles - applications; optical luminescence and fluorescence from direct band gap semiconductor nanoparticles, carrier injection, polymers - nanoparticles, LED and solar cells, electroluminescence, Micro and nanosensors; fundamentals of sensors, biosensor, microfluids, MEMS and NEMS, packaging and characterization of sensors (Only Qualitative Analysis).

Text books:

1. Solid State Physics, J.P. Srivastva-Prentice Hall.
2. Introduction to nanoscience and Nanotechnology, K.K. Chattopadhyay and A.N. Banerjee-PHI Learning Pvt. Ltd.

Reference books:

1. Nanotechnology Fundamentals and Applications, Manasi Karkare, I.K.- International Publishing House.
2. Nanomaterials, B. Viswanathan- Narosa.
3. Encyclopedia of Nanotechnology, H.S. Nalwa-American Scientific Publishers.

- The syllabus will be followed by Tutorial of credit 1.

PHY-DSE -017: ENERGY STORAGE AND FUEL CELL TECHNOLOGY

COURSE OBJECTIVES	• Knowledge on use of hydrogen for achieving sustainable growth and facilitate analysis of the challenges. • In depth knowledge of fuel cell technology. • The underlying concepts, methods and application of fuel cell technology.
COURSE OUTCOMES	• To understand and demonstrate the hydrogen production technologies, storage methods. • To know the concepts and characteristics of various types of fuel cell • To consist and demonstrate the working of fuel cells. • To know the application of fuel cells with economic and environment analysis

DETAILED CONTENT

Module I Hydrogen Energy

Need and Relevance in relation to depletion of fossil fuels and environmental considerations, Hydrogen Production: Photo-electrolysis, Fossil, Biological Process & Bio Fuels, Benefits and barriers of different production methods.

Module II Hydrogen Storage technologies

Compressed gas storage, Liquid Storage, Underground storage, Line Packing, Solid State Storage, Advantages and disadvantage of different storage methods, Metal Hydrides: Benefits, PC isotherms, Hydrogen storage methods.

Module III Fuel cells

Introduction and overview, operating principle, polarization curves, components, types of fuel cell, low and high temperature fuel cells, fuel cell stacks. Fuel Cell systems and sub-systems, system and sub system integration; Power management, Thermal management; Pinch analysis

Module IV Hydrogen Fuel Cells

Principle and workings systems, Applications, Safety & Standards. Application of Hydrogen/Hydrides as fuel in Engines, Socio-Economic Aspects. Comparative future viability analysis, Policy implications and Current status.

Module V Fuel Cells and their applications

Fuel cell usage for domestic power systems, large scale power generation, automobile, space applications, economic and environmental analysis on usage of fuel cell, future trends of fuel cells.

Text Books:

1. Fuel cell and their applications, K. Kordesch, G. Simader, VCH, Weinheim, Germany, 1996.
2. Detlef Stolten, Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications, Wiley, 2010.

Reference Books:

1. Jiujun Zhang, Lei Zhang, Hansan Liu, Andy Sun, Ru-Shi Liu, Electrochemical Technologies for Energy Storage and Conversion, John Wiley and Sons, 2012.
2. Francois Beguin and ElzbietaFrackowiak ,Super capacitors, Wiley, 2013.
3. Doughty Liaw, Narayan and Srinivasan, Batteries for Renewable Energy Storage, The Electrochemical Society, New Jersy, 2010.

PHY-DSE -018: SPACE PHYSICS

COURSE OBJECTIVES	The aim of this course is to explore the physical processes, which occur in the space environment. The course will provide information on basic plasma phenomena, plasma waves, magnetohydrodynamics, Sun, solar wind, cosmic rays and solar energetic particles, neutral atmosphere, ionosphere, magnetosphere and experimental technique for radiation environment.
COURSE OUTCOMES	1. Able to explain Sun's interior structure, physics of solar wind and origin of cosmic rays. 2. Able to explain the main consequences of magnetic reconnection for Earth's magnetosphere. 3. To explain about space physics and space weather

DETAILED CONTENT

Module I
Maxwell's Equations and the Wave Equation: Basic Concepts , Phase Velocity, Wave Packet and Group Velocity , Refractive Index, The General Dispersion Relation, Plasma instabilities, Introduction to Dusty Plasma, Presence of plasma in nature, Generation of plasma, application and modelling

Module II
Sun the primary driver of solar system and life on earth, Basic solar properties, Source of Sun's energy, Nuclear reactions in the solar core, Black Body Radiation and the solar spectrum, Transport of Energy from core Convective instability, Convective energy transfer, The quiet photosphere, Sunspots, magnetic fields, Solar rotation and the solar cycle chromosphere and corona

Module III
Elements of dynamo theory & Solar kinematic dynamos, Concentrating and expelling the magnetic field, Basic physics of magnetic flux tubes, Surface magnetic field & Basic large-scale magnetic field, Parker's spiral & Basic heliospheric current sheet, Observed large-scale structure, Origin of solar wind, Magnetic field effects on the wind, Various sources of fast and slow winds, Observations of Sun and it's interior from ground, Satellite based observations of Sun, Challenges and Technology.

Module IV
Introduction to Earth's magnetic Field, Elements of earth's magnetic field, Difference between geographic and geomagnetic coordinates, Solar radiation and production of ionization, Ion Composition and Chemistry, The D Region, The E Region, The F Region, Equatorial

Electrojet, Atmospheric Composition and Chemistry, Mesosphere, Thermosphere and Ionosphere

Module V

Interaction of the Solar Wind with the Terrestrial Magnetic Field, the Bow Shock and the Magnetopause, the Magnetospheric Cavity, Magnetospheric Current Systems, the Ring Current, Magnetic Diffusion & Magnetic Reconnection, Aurorae, Space Weather, Magnetic Activity and Substorms, Magnetic Storms, Geomagnetic Activity Indices, Importance and applications of Space Weather.

Text Books:

1. Chen, F. F., Introduction of Plasma Physics and Controlled Fusion, Plenum Press, 1984
2. Gombosi, T. I., Physics of the Space Environment, Cambridge University Press, 1998
3. Kellenrode, M-B, Space Physics, An Introduction to Plasmas and Particles in the Heliosphere and Magnetospheres, Springer, 2000.
4. Walker, A. D. M., Magnetohydrodynamic Waves in Space, Institute of Physics Publishing, 2005.
5. Fundamentals of solar astronomy by Arvind Bhatnagar, William Livingston (World Scientific Series in Astronomy Astrophysics, Vol-6)
6) Solar and stellar magnetic activity by C. J. Schrijver and C. Zwaan, Cambridge University Press.

Reference Books:

1. Gombosi, T. I., Physics of the Space Environment, Cambridge University Press, 1998
2. Kellenrode, M-B, Space Physics, An Introduction to Plasmas and Particles in the Heliosphere and Magnetospheres, Springer, 2000.
3. M. G. Kivelson and C. T. Russle, Introduction to Space Physics, Cambridge University Press.
4. M. C. Kelley, The Earth's Ionosphere, Plasma Physics and Electrodynamics, Elsevier Press
5. Vladislav Yu. Khomich·Anatoly I. Semenov, Nikolay N. Shefov, Airglow as an Indicator of Upper Atmospheric Structure and Dynamics, Springer
6. Henry Rishbeth, Owen K. Garriott, Introduction to Ionospheric Physics (International Geophysics)
7. J. K. Hargreaves, Upper Atmosphere and Solar-terrestrial Relations: Introduction to the Aerospace Environment, Cambridge Press
8. J. K. Hargreaves, The Solar Terrestrial Environment, Cambridge Atmospheric and space science Series

- The syllabus will be followed by Tutorial of credit 1.

PHY- 363: DISSERTATION

The project will aim to introduce student to the basics of nanomaterial research in physics, which is done via theory, computation and experiments either all together or separately by one of these approaches. It is intended to give research exposure to students at B.Sc. level itself.

Format of Dissertation:

Title Page
B.Sc. PROJECT REPORT ON TITLE OF THE PROJECT
Supervised by:
Submitted by:
Name of the Group Name 1
Name 2
Name 3
Department of Applied Science
Sri Sai University, Palampur
Session
Month Year
Page 2
(Preferably on (Guide's) letter head)
CERTIFICATE
This is to certify that the project entitled "**Title of Project**" aimed at "Project purpose" was worked upon by the following students under my supervision at Physics Laboratory in Department of Applied Science, Sri Sai University, Palampur.
Name 1 with signatures
Name 2 with signatures
Name 3 with signatures
It is certified that this is a live project done by the team and has not been submitted for any degree.
Chairman Name of Guide
Page 3
ACKNOWLEDGEMENTS
Page 4
PREFACE
Page 5
CONTENTS
Page 6
M.Sc. Physics
ABBREVIATIONS USED
Page 7
LIST OF TABLES
Page 8

LIST OF GRAPH AND FIGURES
Page 9
INTRODUCTION
Chapter 1
Chapter 2
Chapter 3
…………..
Concluding remarks
END OF REPORT
Appendices
Source code and other relevant appendices
Bibliography /References.

INSTRUCTIONS FOR THE FORMATTING AND PRESENTATION OF PROJECT REPORT

The following instructions be strictly adhered to while formatting the Project Report.
Top margin = 2.54 cm
Bottom margin = 2.54 cm
Left margin = 3.17 cm
Header and Footer = 3.17 cm
Page Size = 1.25 cm (from edge)
Font = Times new Roman
- Body test size…………. 12pt
- Chapter headings ……… 18 pt Bold
- Section heading …………16 pt Bold
- Sub Section heading …….14 pt Bold

Header and footers
- Header ……………… Chapter Name
- Footer……………….. Page number

Spacing before and after body text paragraph 6 pt uniform
Spacing before section headings Zero
Spacing after section headings 12
Line spacing 1.5 lines
Tables………………………………Centered, captions must.
Diagrams……………Centered, captions must, No text around Diagrams
Page Numbering scheme for entailing chapters…. Roman Numbers
Page Numbering scheme for entailing pages of chapters ….. Arabic
The pages starting from Certificate to list of graph and figures must be enlisted in chronological sequence using Roman Numbers.
Final Project report must be - Hard Bound
- Rexene Covered
- Golden text to be used on cover
- Print details on side strip also in text book format.
- Paper to be used Bond paper

TOTAL NUMBER OF COPIES TO BE SUBMITTED ALONG WITH SOFT COPY ON A CD 4 COPIES

LAST DATE FOR SUBMISSION OF PROJECT REPORT

Last date for submission of project report shall be one month after the last theory paper examination of VI Semester for regular students.

GENERAL ELECTIVE COURSES FOR OTHER DEPARTMENTS OF APPLIED SCIENCES

Core	Course	L	P
PHY-GE-001	Physics-I	4	2
PHY-GE-002	Physics-II	4	2
PHY-GE-003	Physics-III	4	2
PHY-GE-004	Physics-IV	4	2

COURSE CONTENT

PHY-GE-001: PHYSICS – I

COURSE OBJECTIVES	The objective of this course is to equip students with the knowledge of Wave optics, mathematical calculus, vectors, oscillation and motion laws.
COURSE OUTCOMES	• At the end of course, student will able to • Understand integration of vectors calculus and mathematical physics. • Identify and illustrate the physical concepts and terminology used in optics. • Understand physical characteristics of SHM and obtaining solution of the oscillator. • Understand the concepts of mechanics, waves, interference and diffraction.

DETAILED CONTENT

Module I

Mathematical Physics:Scalar and vector products, polar and axial vectors, triple and quadruple products.

Module II

Vector calculus:Scalar and vector fields, differentiation of a vector, gradient, divergence, curl and Δ operations and their meaning, idea of line, surface and volume integrals, Gauss and Stokes' theorem.

Module III

Classical Mechanics: Particle dynamics: Newton's laws of motion, conservation of linear momentum, centre of mass, conservative forces, work energy theorem, particle collision, Rotational kinematics and dynamics: Rotational motion, forces and pseudo forces, torque and angular momentum, kinetic energy of rotation, rigid body rotation dynamics, moment of inertia, conservation of angular momentum, comparison of linear and angular momentum, motion of a top.

Module IV

Oscillations: Linearity and superposition principle, free oscillation with one and two degrees of freedom, simple pendulum, combination of two simple harmonic motions. Lissajous figures, free and damped vibrations, forced vibrations and resonance, Q factor, wave equation, travelling and standing waves, superposition of waves, phase and group velocity.

Module V

Wave optics:Interference, division of amplitudes, Young's double split, Fresnel's biprism, interference in thin films and wedged shaped films. Fresnel diffraction: Diffraction at a single slit and a circular aperture, diffraction at a double split, plane transmission grating, resolving power of a telescope and a microscope, resolving and dispersive power of a plane diffraction grating. Polarization: Polarization by reflection and refraction, Brewster's law, double refraction, nicol prism, quarter and half-wave plates, production and analysis of circularly and elliptically polarized light.

Text Books:

1. Spiegel, M. R. Vector Analysis Schaum's Outline Series. Mcgraw-Hill Book Co.:Singapore (1974)
2. Beiser, A. Concepts of Modern Physics mcgraw-Hill Education (2002).

Reference Books:

1. Resnick, R., Halliday, D. & Krane, K. S. Physics Vol. I and II 5th Ed. John Wiley & Sons (2004)
2. Serway, R. A. & Jewett, J. W. Physics for Scientists and Engineers 6th Ed.

PHY-GE-001(P): PRACTICAL LAB: PHYSICS – I

1. Determination of spring constant of a spring by (i) static, and (ii) dynamic methods.
2. Study of damped harmonic oscillator- Q factor.
3. Determination of temperature coefficient of resistance using platinum resistance thermometer.
4. Study of thermal couple calibration and inversion temperature.
5. Kator's pendulum- Bar pendulum.

6. Determination of wavelength of light by Fresnel's biprism.
7. Determination of wavelength of sodium light by Newton's arrangement.
8. Determination of refractive index of tint glass using a spectrometer.
9. Determination of dispersive power of a glass prism using Cauchy's constant. Also determine the resolving power of a prism.

Text Books:

1. Geeta Sanon, B.Sc. Practical Physics, R. Chand & Co.
2. Advanced Practical Physics, B. L. Worsnop, Asia Publishing House, New Delhi.

Reference Books:

1. Practical Physics, C.L. Arora, S.Chand
2. A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, Vani Publication House, New Delhi.

PHY-GE-002: PHYSICS-II

COURSE OBJECTIVES	• give the fundamentals of thermodynamic systems, the laws of thermodynamics and their application to thermodynamic problems • provide essential tools to analyze carnot engine, heat engines and refrigerators with the help of their thermodynamic cycles • highlight the use of mathematical methods to derive thermodynamic relationships • introduce the microscopic approach through kinetic theory of gases and basic statistical thermodynamics
COURSE OUTCOMES	• represent thermodynamic processes on appropriate thermodynamic diagrams • appreciate the application of thermodynamic laws to liquefaction of gases for low temperature production • use kinetic theory of gases to derive expressions for pressure of an ideal gas, heat capacities of solids and gases and transport properties • explain the properties of Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distributions and identify systems where they are applicable

DETAILED CONTENT

Module I Introduction to Thermodynamics
Zeroth and First law of Thermodynamics: Extensive and intensive Thermodynamics variables, Thermodynamics equilibrium, Zeroth law of Thermodynamics & Concept of temperature. Concept of work &Heat, state functions, first law of Thermodynamics and its differential form, Internal energy, first law & various processes, Applications of First law: General relation b/w C_p and C_v, Work done during Isothermal and Adiabatic processes, compressibility and expansion Co-efficient

Module II Second law of Thermodynamics
Reversible and irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engine. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd law of thermodynamics: Kelvin- Plank and Clausius statements and their Equivalence. Carnot's Theorem. Applications of second law of thermodynamics: Thermodynamic scale of temperature and its Equivalence to perfect gas scale.

Module III Entropy
Concept of Entropy, Clausius theorem, Clausius Inequality, Second law of Thermodynamics in terms of entropy, Entropy of a perfect gas, Principle of increase of Entropy changes in

Reversible and irreversible processes with example, Entropy of the universe. Entropy changes in reversible and irreversible processes, Principle of increase of entropy, Temperature- Entropy diagram for Carnot's Cycle, Third law of thermodynamics, Unattainability of absolute zero.

Module IV Thermodynamic potentials

Extensive and Intensive thermodynamic variable, Thermodynamic potentials: Internal energy, Enthalpy, Helmholtz free energy, Gibb's free energy, Their definition, Properties and applications, Surface films and variation of surface tension with temperature. Magnetic work, Cooling due to adiabatic demagnetization, First and second order phase transition with example, Clausius Clapeyron equation and Ehrenfest equations. Maxwell's thermodynamics relations: Derivation and applications of Maxwell's relations; Clausius Clapeyron equations

Module V Kinetic Theory of Gases

Distribution of velocities: Maxwell-Boltzmann law of Distribution of velocities in an ideal gas and its experimental verification. Doppler Broadening of special lines and Stern's Experiment, Mean, RMS and Most probable Speeds. Degree of Freedom, Law of Equipartitions of energy. Specific heats of Gases.

Text Books:

1. Heat and Thermodynamics, M,W.Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat MeghnadSaha, and B.N. Srivastava,1958, Indian Press.
3. Thermal Physics, S.Garg, R.Bansal and Ghosh, 2nd Edition,1993,Tata Mcgraw-Hill.

Reference Books:

1. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
2. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger.1988, Narosa.
3. Concept in Thermal Physics, S.J.Blundell and K.M. Blundell, 2nd Ed,2012, Oxford university Press.

PHY-GE-002 (P): PRACTICAL LAB: PHYSICS II

1. To determine Mechanical Equivalent of Heat, J, by callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Seale's Apparatus.
3. To determine the coefficient of thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the temperature coefficient of resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a thermocouple with Difference of temperature of its two junctions.
7. To calibrate a thermocouple to measure temperature in a specified range using (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral temperature.

Text Books:

1. Geeta Sanon, B.Sc. Practical Physics, R. Chand & Co.
2. Advanced Practical Physics, B. L. Worsnop, Asia Publishing House, New Delhi.

Reference Books:

1. Practical Physics, C.L. Arora, S.Chand
2. A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, Vani Publication House, New Delhi.

PHY-GE-003: PHYSICS-III

DETAILED CONTENT

Module I Electrostatics

COURSE OBJECTIVES	• provide a deeper understanding of electrostatics and magnetostatics • leading to the fundamental laws of electrodynamics – Maxwell's equations in free space and their consequences • develop competence in using laboratory instruments to carry out experiments to study different electromagnetic phenomena, that will enhance students class room learning
COURSE OUTCOMES	• find expressions for the electric and magnetic fields produced by static and moving charges in a variety of configurations. • comprehend the dynamics of a charged particle in electric, magnetic and electromagnetic fields and its applications • formulate Maxwell's equations leading to electromagnetic wave equation and understand its propagation and energy transport

Electric field, potential due to a charge distribution and due to a dipole, electrical potential energy, flux, Gauss's law, electric field in a dielectric, polarization, energy stored in an electric field.

Module II Magnetism

Magnetic field due to a current-carrying conductor, Biot Savart law, magnetic force on a current, Lorentz force, electromagnetic induction, Lenz's law, magnetic properties of matter, para- dia- and ferromagnetism, spinning of a magnetic dipole in an external magnetic field.

Module III Fundamental laws of electromagnetism

Modification of Ampere's law, equation of continuity and displacement current, Maxwell's equations, wave equation and its plane wave solution, nature of electromagnetic waves, tranversality and polarization, propaganation of electromagnetic plane waves in dielectric media.

Module IV Electronics

Half-wave, full-wave and bridge rectifiers, ripple factor, rectification efficiency, filters (series in inductor, shunt capacitator, LC and π sections), voltage regulations, load regulation, Zener diode as voltage regulator, Characteristic curves of bipolar transistors, static and dynamic load line, biasing (fixed and self) of transistor circuit.

Module V Digital electronics
Number systems (binary, BCD, octal and hexadecimal), 1's and 2's complements. Logic gates, AND, OR, NAND, NOR, XOR and NXOR, Boolean algebra (Boolean laws and simple expressions), binary adders, half adder, half subtractor, full adder and full subtractor.

Text Books:
1. Griffiths, D. J. Introduction to Electromagnetism 3rd Ed. Prentice-Hall (1999).
2. Malvino, A.P. & Leach, D. P. Digital Principles and Applications, Tata mcgraw-Hill (2008).

Reference Books:
1. Ryder, J. D. Electronic Fundamentals and Applications: Integrated and Discrete Systems, 5th Ed. Prentice-Hall, Inc. (2007).
2. Floyd, T. L. & Buchla, D. M. Electronics Fundamentals: Circuits, Devices and applications(8th Ed.), Prentice-Hall (2009).

PHY-GE-003 (P): PRACTICAL LAB- PHYSICS III

1. To use a Multimeter for measuring (a) Resistance, (b) AC and DC voltages,(c) DC current and (d) Checking electrical fuses.
2. Ballistic Galvanometer:
3. Measurement of charge and current sensitivity
4. Measurement of CDR

5. Determine a high resistance by Leakage Method.
6. To determine Self Inductance of a coil by Rayleigh's Method.
7. To compare capacitance using De'Sauty's bridge.
8. Measurement of field strength B and its variation in solenoid (Determine Db/dx)
9. To study the characteristics of a series RC circuit.
10. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency (b) Quality factor.
11. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor.
12. To determine a low resistance by Carey Foster's Bridge.
13. To verify the Thevenin and Norton theorem.
14. To verify the Superposition, and Maximum Power Transfer Theorem.

Text Books:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practical's, Michael Nelson and Jon M, Ogborn, 4th
3. Edition, required 1985, Heinemann Educational Publishers.

Reference Books:

1. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed.2011, Kitab Mahal.

PHY-GE-004: PHYSICS-IV

COURSE OBJECTIVES	• provide a deeper understanding of electrostatics and magnetostatics • leading to the fundamental laws of electrodynamics – Maxwell's equations in free space and their consequences • develop competence in using laboratory instruments to carry out experiments to study different electromagnetic phenomena, that will enhance students class room learning
COURSE OUTCOMES	• find expressions for the electric and magnetic fields produced by static and moving charges in a variety of configurations. • comprehend the dynamics of a charged particle in electric, magnetic and electromagnetic fields and its applications • formulate Maxwell's equations leading to electromagnetic wave equation and understand its propagation and energy transport

DETAILED CONTENT

Module I Wave nature of particles
Introduction to Quantum Mechanics, Wave nature of particles, time- dependent and time independent Schrondinger wave equation, Uncertainity Principle.

Module II Wave Optics
Huygen's principle, superposition of waves and interference of light by wave front splitting and amplitude spitting, Young's double slit experiment, Newton's ring, Diffraction grating and their resolving power.

Module III Laser
Einstein's theory of matter radiation interaction, and A & B coefficients, amplification of light by population inversion, different types of lasers : gas laser (He-Ne, CO_2), dye laser, solid state lasers, application of lasers in science.

Module IV Faraday's law
Farady's law in terms of EMF produced by changing magnetic flux, equivalence of Farday's law and motivational EMF, Lenz's Law, Electromagnetic breaking emf its applications, Differential form of Farady's Law expressing curl of electric field in terms of time-derivative of magnetic field.

Module V Electronic materials
Intrinsic and extrinsic semiconductor, dependence of Fermi level on carrier concentration and temperature, carrier generation and recombination, carrier transport: diffusion and drift, p-n junction.

Text Books:
1. Engineering Mechanics, 2nd Edition, MK Harbola
2. Introduction to Mechanics, MK Mehta

Reference Books:
1. Optics, A. Ghatak
2. Principles of laser, O.Svelto
3. Introduction of Electrodynamics, David Griffiths

PHY-GE-004 (P): PRACTICAL LAB- PHYSICS IV

1. Determination of wavelength of light by Fresnel's biprism.
2. Determination of wavelength of sodium light by Newton's arrangement.
3. Determination of refractive index of tint glass using a spectrometer.
4. Determination of dispersive power of a glass prism using Cauchy's constant. Also determine the resolving power of a prism.
5. Determination of wavelength of sodium light using a plane transmission grating and resolving power of a diffraction grating.
6. Determination of specific rotation of cane sugar solution using a polarimeter.
7. To verify experimentally OR, NAD, NOT, NOR, NAND gates.
8. Study of half-adder/ subtractor

Text Books:

1. Geeta Sanon, B.Sc. Practical Physics, R. Chand & Co.
2. Advanced Practical Physics, B. L. Worsnop, Asia Publishing House, New Delhi.

Reference Books:

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2. A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, Vani Publication House, New Delhi.