Department of Physics

PROGRAMME M.Sc. (Physics)

(Session: 2024-2025 Onwards)

- **Programme Structure**
- **Programme Outcomes (POs)**
- **Course Outcomes (COs)**
- **Detailed Syllabus (Course Contents)**

COURSE STRUCTURE WITH CREDITS DISTRIBUTION
(Subject: M.Sc. PHYSICS)
(2024-2025 onwards)
UG SEMESTER-VII/PG SEMESTER-I

Course Code		Course Name	Maximum Credits (20)	CIE	ETE
B010701T	Core	**ELECTRONICS**	3 Credits	25	75
B010702P	Core	**ELECTRONICS LAB-1**	1 Credits	25	75
B010703T	Core	**CLASSICAL MECHANICS**	3 Credits	25	75
B010704P	Core	**GENERAL LAB-1**	1 Credits	25	75
B010705T	Core	**RESEARCH METHODOLOGY**	4 Credits	25	75
B010706T	Discipline Centric Elective (Select any one)	**QUANTUM MECHANICS-I**	4 Credits	25	75
B010707T		**COMPUTATIONAL METHOD & PROGRAMMING**			
B010708T	Discipline Centric Elective (Select any one)	**MATHEMATICAL PHYSICS**	**4 Credits**	25	75
B010709T		**THERMODYNAMICS AND STSTISTICAL PHYSICS**			

UG SEMESTER-VIII (for Four Year Undergraduate Programme)
PG SEMESTER- II

Course Code		Course Name	Maximum Credit (20)	CIE	ETE
B010801T	Core	**ELECTROMAGNETIC THEORY & PLASMA PHYSICS**	3 Credits	25	75
B010802P	Core	**GENERAL LAB-2**	1 Credits	25	75
B010803T	Core	**ADVANCED ELECTRONICS -I**	3 Credits	25	75
B010804P	Core	**ELECTRONICS LAB-2**	1Credits	25	75
B010805R	Research Project	**Research Project**	12 Credits	-	100

or

PG SEMESTER-II
(for Two Year Post Graduate Programme- lateral entry)

Course Code		Course Name	Maximum Credits (20)	CIE	ETE
B010801T	Core	**ELECTROMAGNETIC THEORY & PLASMA PHYSICS**	3 Credits	25	75
B010802P	Core	**GENERAL LAB-2**	1 Credits	25	75
B010803T	Core	**ADVANCED ELECTRONICS -I**	3 Credits	25	75
B010804P	Core	**ELECTRONICS LAB-2**	1Credits	25	75
B010805T	Discipline Centric Elective (select any one)	**NANO SCIENCE AND SENSOR RECHNOLOGY**	4 Credits	25	75
B010806T		**SATELLITE COMMUNICATION & REMOTE SENSING**			
B010807T	Discipline Centric Elective (select any one)	**ATOMIC & MOLECULAR PHYSICS**	4 Credits	25	75
B010808T		**ELCTRODYNAMICS**			
B010809T	Ability Enhancement Course (select any one)	**SPACE PHYSICS**	4 Credits	25	75
B010810T		**ELECTRICAL WIRING**			

PG SEMESTER-III/PG SEMESTER-I (One Year PG Programme-Lateral Entry)

Course Code		Course Name	Maximum Credits (20)	CIE	ETE
B010901T	Core	**ADVANCED ELECTRONICS-II**	3 Credits	25	75
B010902P	Core	**ELECTRONICS LAB-3**	1 Credits	25	75
B010903T	Core	**NUCLEAR & PARTICLE PHYSICS**	3 Credits	25	75
B010904P	Core	**GENERAL LAB-3**	1 Credits	25	75
B010905T	Discipline Centric Elective (select any one)	**MODERN OPTICS**	4 Credits	25	75
B010906T		**QUANTUM MECHANICS-II**			
B010907T	Discipline Centric Elective (select any one)	**SOLID STATE PHYSICS**	4 Credits	25	75
B010908T		**CONDENSED MATTER PHYSICS**			
B010909T	Ability Enhancement Course (select any one)	**PHYSICS OF RENEWABLE ENERGIES**	4 Credits	25	75
B010910T		**LASER AND HOLOGRAPHY**			

PG SEMESTER-IV/PG SEMESTER-II (One Year PG Programme)

Course Code		Course Name	Maximum Credits (20)	CIE	ETE
B011001R	MRP	**MASTER DISSERTATION**	**20 Credits**	**-**	**100**

Structure of Syllabus Developed by			
Name of BOS Convener/ BOS Member	**Designation**	**Department**	**College/ University**
Prof. Padam Singh	Convener	Physics	Mahamaya G.D.C. Dhanupur, Handia. Prayagraj
Dr. Vishalakshi Singh	Member	Physics	D.D.U. G.D.C. Saidabad, Prayagraj
Dr Aashit Kumar Jaiswal	Member	Physics	H.N.B. G.P.G.C. Naini Prayagraj
Prof. Pratima	Expert Member	Physics	Allahabad University, Allahabad
Prof. Sudesh Singh	Expert Member	Physics	T.D.P.G. College, Jaunpur

UG SEMESTER-VII/PG SEMESTER-I

Paper-I: (CORE PAPER)

PHY : Electronics

UNIT-I

Power Electronics: Rectifier with LC Filter, Electronic regulators, SCR: Basic structure, I-V characteristics and two- transistor model of SCR, SCR controlled half and full wave rectifier circuit and their analysis, UJT, equivalent circuit, I-V characteristics, Saw tooth wave generation, Elements of SMPS.

UNIT - II

Operational Amplifier: IC-741-Block diagram, operation, Characteristics of Op-Amp; inverting and non-inverting inputs: Input offset current and Input offset voltage, differential amplifier, CMRR, Slew rate and power band width, op-amp as an amplifier, Application of Op-amp: summer, integrator and differentiator, Timer: IC-555 -Block diagram, A stable and Monostable operations, application of IC-555 - VCO.

UNIT - III

Boolean Algebra and Gates: Boolean algebra, composite function and their algebraic simplification, De-Morgan's theorem, duality in Boolean algebra, Universality of NAND and NOR gates, SOP and POS forms, Karnaugh map, design of logic circuits, X-OR gate and its applications, half adder and full adder, parallel adder, look ahead carry:

UNIT – IV

Elements of Logic Families: Transistor as a switch, FAN IN, FAN OUT, Noise Immunity, propagation delay, RTL, DTL, TTL logic, Sourcing and Sinking logic, TTL loading and Fan out, ECL logic.

Reference Books:

1. Switch Mode Power Conversion by K. Kit Sum (Marcel Dekker).
2. Power Electronics by P.C. Sen (Tata Mc Graw-Hill)
3. Pulse. Digital and Switching Wave Forms by J. Milman and 11. Taub (McGraw-Hill)
4. Op-amp and Linear Integrated Circuits by R.A. Gayakwad (Prentice-Hall India)
5. Integrated Circuits by J. Millman and C.C. Halkias (Tata-McGraw-Hill)
6. Digital Principle and Application by A.P. Malvino and D.P. Leach (McGraw-Hill)
7. Modern Digital Electronics by R.P. Jain (Tata McGraw-Hill)

Paper-II: ((CORE PRACTICAL)

PHY : ELECTRONICS LAB -1

Students will be required to perform at least four experiments from each semester, They will have to maintain record books of experiments done for each course separately.

LIST OF EXPERIMENTS

1. Study of multivibrator: Use of 555
2. Study of saw tooth wave generation by UJT
3. Study of characteristics of operational amplifier
4. Study of TTL gates
5. Study of combinational logic circuits
6. Study of super heterodyne receiver
7. Study of linear and square wave detector

Paper III: (CORE PAPER)

PHY : Classical Mechanics

UNIT-I

Vectors: Curvilinear Coordinates, Gradient, Divergence and Curl, Laplace equation in spherical polar and cylindrical polar coordinates and their solution, Green's theorem, Gauss and Stokes Theorems.

Tensors: Covariant and Contra-variant vectors, Tensors-Addition, Multiplication, Contraction, Symmetry properties; Tensor density, Pseudo-tensors.

UNIT-II

Mechanics of a system of particles: System of particles and Constraints, Generalized coordinates, D'Alembert's principle, Lagrange's Equation, Hamilton's principle, Least action principle, Langrange's equations, symmetry properties and Noether's theorem, Lagrangian formulation for elementary mechanical systems-free particle, and simple pendulum.

UNIT-III

Two Body Problem: Reduction to one-body problem, reduced mass, Virial Theorem, planetary orbits.
Scattering: Collision between particles, disintegration of particles, elastic collisions, scattering, Rutherford's formula.

UNIT-IV

Hamiltonian Formulation: Hamilton equations, canonical transformations, Poisson's bracket, Symplectic approach to canonical transformations; Hamilton Principle function, Hamilton-Jacobi equation, Harmonic Oscillator Problem, Hamilton characteristic Function, Separation of variables, Central Force problem.

Reference Books:

1. Vector Analysis and Introductory Tensor Analysis by M.R. Spiegel (Schaum Series)
2. Matrices and Tensors in Physics by A.W. Joshi (New Age)
3. Classical Mechanics by H. Goldstein (Narosa, New Delhi)
4. Classical Mechanics by K.C. Gupta (Wiley Eastern)
5. Classical Mechanics by LD, Landau (Elsevier)
6. Classical Mechanics by N.C. Rana and P.S. Joag (Tata-McGraw-Hill)

Paper-IV: (CORE PRACTICAL)

PHY : GENERAL LAB -1

Students will be required to perform at least four experiments from each semester, They will have to maintain record books of experiments done for each course separately.

LIST OF EXPERIMENTS

1. He-Ne Laser.
2. e/m by Zeeman effect.
3. Programming on PC
4. Velocity of ultrasonic wave.
5. Measurement of dipole moment
6. Determination of Dielectric Constant.
7. Study of RC coupled amplifier
8. Study of regulator circuits.
9. Study of switch mode power supply (SMPS)
10. Flip -Flop

PAPER V: (CORE PAPER)

PHY: Research Methodology

Unit-1

Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method - Understanding the language of Research - Concept, Construct, Definition, Variable. Research Process.
Problem Identification & Formulation - Research Question, Investigation Question, Measurement Issues, Hypothesis - Null Hypothesis & Alternative Hypothesis, Hypothesis Testing - Logic & Importance.

Unit-2

Research Design: Concept and Importance in Research - Features of a good research design - Exploratory Research Design - concept, types and uses, Descriptive Research Designs - concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.
Qualitative and Quantitative Research: Qualitative research, Quantitative research, causality, generalization, replication. Merging the two approaches.
Measurement: Concept of measurement- what is measured? Problems in measurement in research- Validity and Reliability, Levels of measurement-Nominal, Ordinal, Interval, Ratio.

Unit-3

Sampling: Probability and Non-Probability sampling- types and criteria for selection. Developing sampling Frames. Sampling Distribution, Testing the Significance of difference between means(z and 't' test) Analysis of Variance (ANOVA) and covariance (ANCOVA) concept and applications only.
Data Analysis: Data Preparation, Univariate analysis (frequency tables, bar charts, pie charts, percentages).
Interpretation of Data and Paper Writing- Layout of a Research Paper, Journals in Physical Sciences, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Unit-4

Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Physical Sciences Discipline.
Use of tools & techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/ Mendeley, Software for paper formatting like LaTeX/ MS Office, Software for detection of Plagiarism – Turnitin, iAuthentcate, Urkund, UGC-infonet, cyber security.

Reference Books

1. C. R. Kothari, *Research methodology methods and Techniques, 4th Edition, New Age International (P) Ltd. Publisher, 2014*.
2. W. Creswell, *Research Design, Qualitative, Quantitative and Mixed method approaches, 3rd Edition, Sage Publications, Inc*.
3. Reema Thareja *(2019) Fundamentals of computers (2nd Edition), Oxford University Press.*
4. Indian National Science Academy (INSA), *Ethics in Science Education, Research and Governance (2019)*, ISBN: 978-81-939482-1-7. https://www.insaindia.res.in/pdf/Ethics_Book.pdf
5. D.B. Resnik (2011), *What ethics in research & Why is it important. National institute of Environmental Health Science*, Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm
6. Latex tutorials https:// www.tug.org/twg/mactex/tutorials/itxprimer-1.0.pdf

Paper VI: Discipline Centric Elective
(Select any one)

PHY : Quantum Mechanics - I

UNIT-I

Wave Mechanical formulation: Schrodinger wave equation: stationary states, boundary & continuity conditions, degeneracy, orthogonality of eigen functions and parity, Hermitian operators and observables, Dirac delta function, commuting observables and related algebra, Simple one-dimensional applications: potential well, barrier potential, and tunnel effect.

UNIT-II

Identical Particles and spin: Distinguishability of identical particles, exchange degeneracy and operator, construction of symmetric and antisymmetric wave functions, Pauli's exclusion principle and Slater's determinant, Electron spin hypothesis, spin matrices and eigen value equations, symmetric and antisymmetric wave functions for hydrogen molecule.

UNIT-III

Matrix formulation: Concept of Hilbert Space, Dirac's bra and ket notations, Orthonormality and completeness relations (discrete and continuous), linear and real operators, eigenvalue equations and related theorems, projection operators and measurement of Pure and mixed states, application to Harmonic Oscillator, Equivalence of wave and matrix mechanics.

UNIT-IV

Theory of Angular momentum: Orbital, spin and total angular momentum operators: eigen value equations and matrix representations, Ladder operators, commutation relations, Addition of angular momenta, Clebsch-Gordon coefficients.

Reference Books:

1. Quantum Mechanics, Vol. I & II by Albert Messiah (Dover Publication)
2. The Principles of Quantum Mechanics by P.A.M. Dirac (Oxford University Press)
3. Quantum Mechanics by L.I. Schiff (Tata-McGraw-Hill)
4. Modern Quantum Mechanics by J.J. Sakurai (Addison Wesley)
5. Introduction to Quantum Mechanics by D.J. Griffiths (Pearson Education)
6. Quantum Mechanics by C. Cohen-Tannoudji, B. Diu and F. Laloe (Wiley VCH)
7. Quantum Mechanics by B. K. Agarwal and Hari Prakash (Prentice-Hall, India)
8. Introduction to Quantum Mechanics by C. J. Joachain and B. H. Bransden.

Paper VI: Discipline Centric Elective
(Select any one)

PHY : Computational Methods and Programming

UNIT-I

Numerical Analysis I: Interpolation: methods of interpolation, least square curve fitting, Methods of equal intervals, unequal intervals, Central Differences, Inverse interpolation: Iteration of successive approximation, exchange of dependent and independent variables and **reversi**on of series, Numerical differentiation: method based on interpolation, finite differences, operator and undetermined coefficients.

UNIT - II

Numerical Analysis II: Numerical integration: Simpson's one-third and one-eighth rule, Euler-Maclaurin formula, Quadrature formulae, Numerical Solution to ordinary differential equation by Euler's method and Runge-Kutta (second and fourth order) method, Newton Raphson method, Iterative methods.

UNIT-III

C++ keyword: Various data types, implicit conversions, for loop, while and do- while loop, break and continue statements, switch statements, if else, conditional operator, functions with default arguments, function overloading.
++ and -operators. Arrays, Structures, pointers, compound assignment.
Basic concept of OOP: definition of class and object, declaration of classes and objects and simple applications.

UNIT - IV

Programming in C++ for the following: Newton-Raphson Method, Matrix manipulation, Euler's method, Runge-Kutta (second and fourth order) method.

Reference Books:

1. Introductory Methods of Numerical Analysis by S.S. Sastry (Prentice-Hall India)
2. Numerical Methods by E. Balguruswamy (Tata McGraw-Hill)
3. Numerical Recipes: The art of Scientific Computing by W.H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery (Cambridge University Press)
4. Object Oriented Programming with C++ by E. Balguruswamy (McGraw Hill Education).
5. The C++ Programming Language by Bjarne Stroustrup (Pearson Education India).
6. Computational Method in Physics and Engineering by Wong.

Paper VII: Discipline Centric Elective
(Select any one)

PHY: Mathematical Physics

UNIT-I

Special Functions: Second order linear differential equations; Solution by series expansion; Legendre, Bessel, Hermite and Laguerre differential equations, their solutions and properties, Spherical Harmonics.

UNIT-II

Fourier and Laplace Transform: Dirac Delta function, Fourier Transform, Sine and Cosine transform, Laplace transform, Inverse Laplace transform, Linearity, Change of Scale, Translation, Modulation, simple applications.

UNIT- III

Complex Variables I: General function of complex variable, Cauchy-Riemann differential equation and analyticity, Cauchy's integral formula, Taylor's and Laurent's series, singularity poles.
Complex Variables II: Residue theorem, Evaluation of definite integrals, around (i) unit circle and (ii) infinite semi-circle using Jordan's lemma with poles lying on real axis.

UNIT- IV

Green Function: Green's function as a technique to solve linear ordinary differential equations, Homogeneous and Inhomogeneous boundary conditions, Solution of Poisson equation using Green's function technique, Symmetry property.

Reference Books:

1. Mathematical Methods for Physicists by G. Arfken, H. Weber and F.E. Harris (Elsevier)
2. Mathematics for Physicist by P. Dennery and A. Krzynicki (Dover Publication)
3. Special Functions and their Applications by N. N. Lebedev (Dover Publication)
4. Mathematical Methods for Physics and Engineering by K. F. Riley, M.P. Hobson and S. J. Bence (Cambridge University Press)
5. Mathematical Physics by B. S. Rajput (Pragati Prakashan)
6. Complex Variables and Applications by J.W. Brown and R. V. Churchill (McGraw-Hill)

Paper VII: Discipline Centric Elective
(Select any one)

PHY: Thermodynamics and statistical physics

UNIT- I

Thermodynamics

Thermodynamics of first and second order phase transition, Thermodynamic properties of liquid Helium II, The Lambda transition, Tisza two fluid model, second sound.

UNIT- II

Statistical Mechanics

Ensembles, Canonical, microcanonical and grand canonical ensembles and their partition function, Partition function for monoatomic and diatomic gases, Gibb's paradox, Maxwell-Boltzman, Bose-Einstein and Fermi-Dirac statistics, Degenerate bosons and Bose-Einstein condensation, Black body radiation, electron gas and its thermodynamic properties, White dwarfs and their limiting mass.

UNIT- III

Fluctuations

Mean square deviation, Fluctuation in ensembles; Concentration fluctuation in quantum statistics, one-dimensional random walk and Brownian motion, Wiener-Khintchine theorem, The Nyquist theorem.

UNIT- IV

Cooperative Phenomena

Phase transition of second kind, Ising model, Bragg-Williams approximations, Kirkwood Method, Order-disorder in alloys, structural phase change.

References:

1. A treatise on Heat by M. N. Saha and B. N. Srivastava (Indian Press Limited, Allahabad).
2. Thermal Physics by C. Kittel (John Wiley, New York).
3. Statistical Mechanics by B. K. Agrawal and Melvin Eisner (Wiley Eastern Ltd., Delhi).
4. Statistical Mechanics by R. K. Pathria (Pergmon Press).
5. Statistical Mechanics by Kerson Huang (Wiley Student Edition).
6. Fundamentals of Statistical & Thermal Physics by Reif (Mc Graw Hill, London).
7. Statistical Physics Part I and Part II by Landau and Lifshitz (Pergmon Press, Oxford).

UG SEMESTER-VIII (for Four Year Undergraduate Programme)

PG SEMESTER- II

Paper I: (CORE PAPER)

PHY: Electromagnetic Theory and Plasma Physics

UNIT -I

Maxwell Equations: Microscopic and Macroscopic fields, Macroscopic Maxwell equations, Fields D and H, Dielectric tensor, Principal dielectric axes.

Potential and Gauges: Scalar and vector potentials, Gauge transformation, Lorentz guage and Transverse gauge, Maxwell equations in terms of electromagnetic potentials.

UNIT-II

Propagation of Electromagnetic Waves: Propagation of electromagnetic waves in free space, conducting and non-conducting medium, skin depth, Boundary conditions on EM Fields, Reflection and refraction at a plane interface between dielectrics.

Polarisation of EM Waves: Fresnel's Formula; Normal- and anomalous- Dispersion, metallic reflection, EM Wave in bound media: rectangular and circular wave guides, TE, TM and TEM Modes, Cut-off frequency and Wavelength.

UNIT –III

Plasma State: Plasma state of matter, Motion of charge particles in uniform E & B fields, non-uniform fields, drifting motion, electrostatic and magneto static drift; Time varying E& B fields, Adiabatic invariants, Plasma confinements (Pinch effect, Mirror confinement, Van Allen Belts), Elementary idea of fusion technology, Sun Spots.

UNIT - IV

Hydrodynamics of Plasma: Hydrodynamical description, Equation of magneto hydrodynamics, High frequency plasma oscillations, Short wavelength limit and Debye- screening distance.

Reference Books:

1. Introduction to Electrodynamics by D. J. Griffiths (Prentice - Hall, New Delhi)
2. The Classical theory of Fields by L. D. Landau and E.M. Lifshitz. (Elsevier)
3. Classical Electrodynamics by J. D. Jackson (Wiley Eastern)
4. Introduction to Plasma Physics by F.F. Chen (Plenum Press, New York)
5. Plasma Physics by S.N. Sen (Pragati Prakashan)
6. Plasma Physics by A. Birien Court.

Paper-II (CORE PAPER)

PHY : Atomic and Molecular Physics

UNIT-I

Quantum states of an electron in an atom, Spectrum of Hydrogen and Helium atom, fine structure, Spectra of Alkali atoms; energy level diagrams, Sharp, Principal, Diffuse and fundamental series.

UNIT-II

Hyperfine structure, Width of spectral lines, Spectroscopic terms; LS & JJ couplings, Zeeman, Paschen Back & Stark effect, X-ray spectroscopy, Electron spin resonance, Nuclear magnetic resonance, chemical shift, Spectra of Diatomic Molecules.

UNIT-III

Rotational Spectra (rigid rotator and non-rigid rotator model), Vibrational Spectra (harmonic and anharmonic model), Molecular Symmetric Top, Vibrating rotator, Isotopic shift.

UNIT-IV

Chandrasekhara Venkata Raman Biography, Raman Spectra (Quantum mechanical and classical approach), Electronic Spectra-vibrational structure of band system, fine structure of the band systems, Intensity distribution in band systems: Frank Condon principle.

Reference Books:

1. Molecular Spectra and Molecular Structure by G. Herzberg (Dover Publication).
2. Fundamentals of Spectroscopy by C.N. Banwell and E.M. McCash (Tata-McGraw-Hill)
3. Introduction to Molecular Spectroscopy by G. M. Barrow (McGraw-Hill)
4. Modern Spectroscopy by M.J. Hollas (Wiley Inter Science)

Paper:

PHY: Research Project

It will be a Major Research Project or equivalently a research-oriented Dissertation on the allotted topic. The student will have to complete his/her research project under any supervisor. The supervisor and the topic for research project shall be allotted in second semester. The student straight away will be awarded 05 credits if he publishes a research paper on the topic of Research Project or Dissertation. The dissertation will be evaluated by internal examiner and external examiner appointed by university,

PG SEMESTER-II
(for Two Year Post Graduate Programme- lateral entry)

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UNIT -I

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UNIT-II

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Polarisation of EM Waves: Fresnel's Formula; Normal- and anomalous- Dispersion, metallic reflection, EM Wave in bound media: rectangular and circular wave guides, TE, TM and TEM Modes, Cut-off frequency and Wavelength.

UNIT –III

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UNIT - IV

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2. The Classical theory of Fields by L. D. Landau and E.M. Lifshitz. (Elsevier)
3. Classical Electrodynamics by J. D. Jackson (Wiley Eastern)
4. Introduction to Plasma Physics by F.F. Chen (Plenum Press, New York)
5. Plasma Physics by S.N. Sen (Pragati Prakashan)
6. Plasma Physics by A. Birien Court.

Paper-II: (CORE PRACTICAL)

PHY : GENERAL LAB-2

Students will be required to perform at least four experiments from each semester, They will have to maintain record books of experiments done for each course separately.

LIST OF EXPERIMENTS

1. Use of scintillation counter .
2. G M Counter characteristics.
3. Magnetic Susceptibility.
4. Energy band gap by four probe technique
5. EPR of free radicals
6. Hall effect
7. Study of characteristic of SCR and controlled rectification by SCR.
8. B. H Curve (Hysteresis loss) by C.R.O.
9. ESR

Paper – III:

PHY : Advanced Electronics-I

UNIT-I

Analog and Combinational Logic Circuits: Analog computation, time and amplitude scaling, Analog to digital and digital to analog converter, Comparator, parity generator and checking, code conversion, Binary to gray and gray to binary, Logic design with MSI coder and decoder, multiplexer and demultiplexer circuits.

UNIT-II

Sequential Circuits: Basic definition, finite state model SR, JK, T, D, Edge triggered flip flop, race condition and master slave flip flop, characteristic table and characteristic equation, sequential logic design state table, state diagram, state equation.

UNIT-III

Registers and Counters: Register, shift register, universal shift register, Ring counter, twisted or Johnson counter, synchronous and asynchronours counters, UP/DOWN and scale of 2n counter.

UNIT-IV

Microprocessor: Basic idea of magnetic memory, Ferrite core memory, semiconductor memory viz. RAM, ROM, PROM, EPROM, EEPROM. Introduction to intel 8085 microprocessor architecture, instruction and timings assembly language programming, stack and subroutine, code conversion.

Reference Books:

1. Digital Systems by J. Ronald Tocci
2. Digital Principles and applications by Malvino and Leach
3. Microprocessor by Goenkar

Paper-IV: (CORE PRACTICAL)

PHY: ELECTRONICS LAB-2

Students will be required to perform at least four experiments from each semester, They will have to maintain record books of experiments done for each course separately.

LIST OF EXPERIMENTS

1. Study of emitter follower
2. Study of phase shift oscillator
3. Microwave measurement: Mode analysis and standing wave ratio
4. Linear characteristics of Operational amplifier
5. Non-linear characteristics of Operational amplifier
6. Active filters using Operational amplifier
7. D/A and A/D converters
8. Negative Feed Back amplifier

Paper-V: Discipline Centric Elective
(Select any one)

PHY: Nano Science and Sensor Technology

UNIT-I

Nano materials Science: Nano materials- Definition, Properties of Nano materials, Nano materials Scale, Nano scale in One Dimension: Thin Films, Layer and Surfaces, Nano scale in Two Dimension: Carbon Nano tubes, Inorganic Nano tubes, Nano wires, Biopolymers, Nano scale in Three Dimensions: Nano particles, Fullerenes (C-60), Quantum Dots, Application of Nano materials

UNIT-II

Graphene: Discovery, Synthesis and Structural Characterization through TEM, Elementary Concept of its applications.

Quantum Wells, Wires and Dots: Preparation of Quantum Nanostructures, Size Effects, Conduction Electrons and Dimensionality. Properties dependent on Density of States

UNIT-III

Nanoparticles-Synthesis and Properties: Method of Synthesis: RF Plasma Chemical Methods, RF spurting method, Sol-gel Method, Physical Vapor Deposition, Chemical Vapor Deposition and Pulsed Laser Method.

UNIT-IV

Physics of Sensor-Technology: Physical sensor, Chemical sensor, MOS gas sensor, MOS capacitor; C-V characteristics, Thin/thick films Sensor; sensing mechanism of gas sensors, Fabrication of MOS, Thick /Thin film gas sensors.

Reference Books:

1. Introduction to Nanotechnology: Poole and Owners
2. Quantum Dots: Jacak, Hawry lak and Wojs
3. Handbook of Nanostructured Materials and Nanotechnology: Nalva (editor)
4. Nano Technology/ Principles and Practices: S.K. Kulkarni
5. Carbon Nanotubes: Silvana Fiorito
6. Nanotechlongy: Richard Booker and Earl Boysen.
7. Functional Thin Films and Nanostructures for Sensors by Anis, Zribi, Jeffrey.
8. Gas Sensors by Xiao, Tun. Qiu.

Paper-V: Discipline Centric Elective
(Select any one)

PHY : Satellite Communication and Remote Sensing

UNIT-I

Principle of Satellite Communication: General and Technical characteristics, Active and Passive satellites, Modem and Codec.
Communication Satellite Link Design: General link design equation, Atmospheric and Ionospheric effect on link, design, Earth station parameters.

UNIT-II

Satellite Analog Communication: Baseband analog signal, FDM techniques, S/N and C/N ratio in FM in satellite link.

Digital Satellite Transmission; Advantages, Elements of digital satellite communication, Digital base band signal, Digital modulation Techniques, Digital link Design, TDM, TDMA, some applications of satellite communications,

UNIT-III

Concept and Foundations of Remote Sensing: Electromagnetic Radiation (EMR), interaction of EMR with atmosphere and earth surface, Application area of Remote Sensing.

Characteristics of Remote Sensing Platform & Sensors: Ground, Air & Space platforms, Return Beam Vidicon, Multi-spectral Scanner, Brief idea of Digital Image Processing.

UNIT-IV

Microwave Remote Sensing Tools: Radar Remote Sensing, Microwave Sensing, LIDAR (Single and double ended system), (Radar & Lidar): Data Characteristics.

Earth Resource Satellites: Brief description of Landsat and Indian remote sensing satellites (IRS) Satellites.

Reference Books:

1. Satellite Communication: D.C. Agrawal and A. K. Maini.
2. Satellite Communication: T. Pratt and C. W. Bostiern.
3. Satellite Communication System: M. Richharia.
4. Introduction of Remote Sensing: J.B. Campbell.
5. Manual of Remote Sensing Vol I and II : (Ed. R.N. Colwell).

Paper-VI: Discipline Centric Elective
(Select any one)

PHY : Atomic and Molecular Physics

UNIT-I

Quantum states of an electron in an atom, Spectrum of Hydrogen and Helium atom, fine structure, Spectra of Alkali atoms; energy level diagrams, Sharp, Principal, Diffuse and fundamental series.

UNIT-II

Hyperfine structure, Width of spectral lines, Spectroscopic terms; LS & JJ couplings, Zeeman, Paschen Back & Stark effect, X-ray spectroscopy, Electron spin resonance, Nuclear magnetic resonance, chemical shift, Spectra of Diatomic Molecules.

UNIT-III

Rotational Spectra (rigid rotator and non-rigid rotator model), Vibrational Spectra (harmonic and anharmonic model), Molecular Symmetric Top, Vibrating rotator, Isotopic shift.

UNIT-IV

Chandrasekhara Venkata Raman Biography, Raman Spectra (Quantum mechanical and classical approach), Electronic Spectra-vibrational structure of band system, fine structure of the band systems, Intensity distribution in band systems: Frank Condon principle.

Reference Books:

1. Molecular Spectra and Molecular Structure by G. Herzberg (Dover Publication).
2. Fundamentals of Spectroscopy by C.N. Banwell and E.M. McCash (Tata-McGraw-Hill)
3. Introduction to Molecular Spectroscopy by G. M. Barrow (McGraw-Hill)
4. Modern Spectroscopy by M.J. Hollas (Wiley Inter Science)

Paper-VI: Discipline Centric Elective
(Select any one)

PHY: Electrodynamics

UNIT-I

Four Dimensional Formulation: Postulates of special theory of relativity, Minkowski Space, Lorentz transformation, Intervals, Light cone, Proper time, Four Vectors, Doppler Effect (Transverse and Longitudinal) and Aberration.

UNIT- II

Relativistic Mechanics: Langrangian formulation, Principle of least action, Four-momentum vector of a free particle, Hamiltonian, Equation of motion.

Electromagnetic Field Equations: Four Potential Four dimensional formulation: Action of a charged particle, Generalized Momentum and Hamiltonian, Equation of motion, Electromagnetic field tensor, Transformation properties of electric and magnetic fields.

UNIT-III

Invariants of Electromagnetic field, Four dimensional formulation of first and second pair of Maxwell equations, Equation of continuity.

The Field of Moving Charges: Retarded potentials, Lienard-Wiechert potentials, Field due to system of charges at large distances,

UNIT-IV

Dipole radiation, Quadrupole and magnetic dipole radiation; Field at near distances, Radiation from a rapidly moving charge, Synchrotron radiation (magnetic bremsstrahlung), Radiation damping,

Reference Books:

1. *The Classical theory of Field*s by L.D. Landau and E.M. Lifshitz (Elsevier)
2. *Classical Electrodynamic*s by J.D. Jackson (Wiley Eastern)
3. *Classical Electricity and Magnetism* by W. Panofsky and M. Phillips (Dover Publication) 4. *Quantum Electrodynamic*s by F. Mandl & G, Shaw (John Wiley and Sons)
5. *A First Book of Quantum Field Theory* by A. Lahiri & P. B. Pal (Narosa, New Delhi)

Paper VII: Ability Enhancement Course
(Select any one)

PHY: Space Physics

UNIT- I

Lower atmosphere

Its composition, constituents, dynamics; Ozone: temporal & spatial variation of ozone, Ozone hole and its impact on climate; Aerosols: Aerosol Optical Depth; Diurnal and seasonal variations of Temperature, Pressure and Humidity.

UNIT- II

Upper Atmosphere

Ionosphere: Its structure & formation; Storm-substorm phenomena, Ionospheric irregularities- Sporadic E and Spread-F irregularities and their distribution,
Magnetosphere: Its structure, Bow shock, Magnetopause, Magnetopause current, Stand-off distance of stagnation point, Microstructure of magnetopause.

UNIT- III

Structure of the sun

Solar interior, solar atmosphere, photosphere, chromosphere, corona, Sunspots and their properties, solar rotation and Babcock model of sunspot formation.

UNIT- IV

Solar cycle and solar activity

Solar wind, Solar flares, Coronal mass ejections (CMEs), Heliosphere and solar magnetic field, Space weather- causes and consequences, Solar- Terrestrial interaction.

Text and Reference Books:

1. An introduction to Meteorology: S. Petterssen, (McGraw-Hill Book Company, USA).
2. The Physics of Atmosphere: John Houghton, (Cambridge University Press, U.K.)
3. The Earth's Ionosphere: Plasma Physics & Electrodynamics: M.C. Kelley (Academic Press, Elsevier, USA).
4. Elements of Space Physics: R. P. Singhal, (Prentice Hall of India, New Delhi).
5. Guide to the Sun: Kenneth J. H. Philips, (Cambridge University Press P.
6. Astrophysics of the Sun: Harold Zirin, (Cambridge University Press, U. K.)

Paper VII: Ability Enhancement Course
(Select any one)

PHY: Electrical wiring

UNIT- I

Basic Concepts

Ohm`s Law, Kirchhoff's Law, Biot-Savart Law, Electromafnetic induction, Faraday's Law, Lenz's Law, Superposition theorm, Thevnin theorem, Norton's theorem, Reciprocity theorem,

UNIT- II

Design Consideration of Electrical Installations

Electrical supply system, Three phase four wire distribution system, Protection of electric installation against overload, short circuit, Earth fault and electric shock, Single phase supply, Three phase four wire supply, Neutral and Earth wire.

UNIT- III

Electrical Wiring

List of symbols, Supply voltages, Service connection, Interior wiring, Guideline for sub circuits and fittings, Single wiring Schemes, Two way control of lamps, Three way control of lamps.

UNIT- IIV

Design of Simple Electrical Circuits

Electrical diagram, Methods of Representation for wiring diagram, Introduction to simple light and Fan circuits, System of connection of appliances and accessories, Solved examples of light and Fan circuits, Alarm circuits and Relays, Fuses, Miniature circuit breaker (MCB), Earth Leackage Circuit Breaker(ECB), Earthing, Computation of Energy consumed.

Text and Reference Books:

1. "Basic Electrical Engineering" by K. Uma Rao and A. Jayalakshmi, Sanguine Technical Publishers, Banglore 2014.
2. "Electrical Design Estimating and costing" by K. B. Rains and S. K. Bhattacharya, New Age International(P) Ltd. New Delhi 2007.
3. V. K. Mehta, " Principles of Electrical Engineering and Electronics" S. Chand & Company Ltd. 2012.
4. Uppal S. L.,"Electrical wiring, Estimating and Costing", Khanna Publishers, Sixth edition 2011.

PG SEMESTER-III/PG SEMESTER-I (One Year PG Programme-Lateral Entry)

Paper – I: (CORE PAPER)

PHY : Advanced Electronics-II

UNIT-I

Communication Theory: Types of Noise and its Spectrum, S/N ratio in analog communication systems, information content of message, rate of information-transmission in discrete communication channels, channel capacity, Shanon- Hartly Theorem and its applications.

UNIT-II

Analog Modulation: Sampling of analog signals, sampling theorem, Types of modulation and generation: PAM, PPM, and PWM; Quantization of Analog signals: Uniform and Non uniform.

UNIT-III

Digital Modulation: Pule code modulation, Binary coding and PCM bandwidth DPCM, DM and ADM, Base Band data transmission, inter-symbol interference, RRC filters, Passband data transmission. ASK, PSK and FSK system, transmission and detection of binary system.

UNIT-IV

Microwaves and Antenna: Microwave generation, Reflex Klystron Oscillator, Transfer Electron Effect, Gun Diode, Tunnel diode, IMPATT, Current and voltage distribution in antenna, Short electric dipole, linear and ground antenna, field -distribution around vertical antenna, antenna arrays.

Reference Books:

1. Communication Systems by B.P. Lathi (Oxford University Press)
2. Principles of Communication System by Taub & Schilling (Mc Graw Hill)
3. Microwave by K.C. Gupta (Hiley Tristem Limited)
4. Antennas and Wave Propagation by J.D. Kraus (Tata Mc Graw Hill Publishing Company Limited - 2010
5. Communication System by Haykin.

Paper-II: (CORE PRACTICAL)

PHY : ELECTRONICS LAB -3

Students will be required to perform at least four experiments from each semester, They will have to maintain record books of experiments done for each course separately.

LIST OF EXPERIMENTS

1. Combinational circuits
2. Sequential circuits
3. Characteristics of TTL logic
4. Multiplexer and Demultiplexer circuits
5. Semiconductor memory using IC 7489 RAM
6. Encoder and Decoder
7. Microprocessor 8085 – I
8. Microprocessor 8085 – II
9. Multivibrator
10. Generation and detection of Amplitude Shift Keying (ASK)
11. Generation and detection of Phase shift Keying (PSK)
12. Generation and detection of Frequency shift Keying (FSK)
13. V-I and P-I Characteristics of LED
14. V-I and P-I Characteristics of Photodiode
15. D/A and A/D converters
16. Superconducting transition and critical current density measurement.

Paper III: (CORE PAPER)

PHY : Nuclear and Particle Physics

UNIT-I

Nuclear Models: Evidence of Nuclear shell Structure; Nuclear Potential and sequence of energy levels of nucleons, spin orbit potential and explanation of magic numbers, Collective model.

UNIT-II

Nuclear Reactions: Cross section; partial wave analysis, optical theorem and shadow scattering, Compound nucleus hypothesis, Breit-Wigner one level formula, Direct Reactions; pickup and stripping reactions.

UNIT-III

Beta Decay: Pauli's neutrino hypothesis. Fermi theory of (β)-decay, Fermi-Kurie Plot and comparative half-lives, selection rules and classification of transitions, Parity non conservation and Wu's experiment.
Nuclear forces: Deuteron problem, low energy (n-p) and (p-p) scattering, scattering length, effective range theory, Spin-dependence of (n-p) interaction

UNIT-IV

Elementary Particles: Homi Jehangir Bhabha Biography, Fundamental interactions, Classification of elementary particles, symmetry and conservation laws, Elementary idea of CP and CPT invariance, Classification of Hadrons, Quantum numbers in strong interaction, Gell-Mann Nishijima formula, Lie algebra, SU(2)-SU(3) multiplets, Quark model of Hadrons.

Reference Books:

1. Nuclear Physics by Irvin Kaplan (Addison-Wesley)
2. Concepts of Nuclear Physics hy B.L. Choen (Tata McGraw Hill)
3. Atomic and Nuclear Plysics Vol-II by S. V.Ghoshal (S. Chand and Co. Ltd.)
4. Nuclear Physics (Theory and Experiment) by R.R. Roy and B.P. Nigam (Wiley Eastern)
5. Nuclear Physics Vol. I by Y M Shirikoy and N P Yudin, (Mir Publisher, Moscow 1982).
6. Nuclear and Particle Physics by E.B. Paul (North Holland Publishing)
7. Facts and Mysteries in Elementary Particle Physics by M. Veltman (World Scientific).

Paper-IV: (CORE PRACTICAL)

PHY: GENERAL LAB-3

Students will be required to perform at least four experiments from each semester, They will have to maintain record books of experiments done for each course separately.

LIST OF EXPERIMENTS

1. Use of constant deviation spectrograph
2. Use of Fabry-Perot interferometer
3. Use of concave grating
4. Power distribution within the laser beam
5. Spatial coherence with Young's double slits
6. Spot size and divergence of a laser beam
7. IC 555 Timer in different modes
8. Phase Locked Loops using IC 565 PLL
9. Sample and Hold circuit,
10. Pulse amplitude modulation and demodulation
11. PAM, PPM,PWM modulation and demodulation
12. Determination of wavelength of laser by grating (transmission/reflection)

Paper-V: Discipline Centric Elective
(Select any one)

PHY: Modern Optics

UNIT-I

Nonlinear Optics: Non-linear polarizability tensors, Coupled amplitude equation; Manely- Rowe relationship; Parametric amplification and oscillation, Phase matching, Second harmonic generation.

UNIT-II

Quantum Optics: Spatial and temporal coherence, classical and quantum coherence function; Glauber's theory of optical coherence, Over completeness of coherent states and its properties; Quasi phase distribution function.

UNIT-III

Fibre Optics: Types of fibres, Single mode and multi-mode fibres: dispersion and loss in fibre; Principles of optical communication, Optical elements.

UNIT-IV

Holography: Basic principle of holography, Method of hologram Recording and Reconstruction; Basic theory of plane hologram; practical consideration of holography and its application.

Reference Books:

1. *Optical Coherence and Quantum Optic*s by L. Mandel and E. Wolf (Cambridge University Press, Cambridge)
2. *Quantum Optic*s by M. O. Scully and M. Suhail Zubairy (Cambridge University Press, Cambridge)
3. *Physics of Non-Linear Optics* by Guang S. He and Song H. Liu (World Scientific Press, Singapore)
4. *Laser and holographic Data processing* by N. G. Bosov (Mir Publisher, Moscow)
5. *Nonlinear Optics* by R. W. Boyd.
6. *Nonlinear Fiber Optic*s by Govind P. Agarwal (Elesevier)
7. *Quantum Optic*s by Girish S. Agarwal

Paper-V: Discipline Centric Elective
(Select any one)

PHY: Quantum Mechanics-II

UNIT-I

Application of three-dimensional Schrodinger equations: Particle in box, spherically symmetric systems: hydrogen atom, harmonic oscillator, Their solutions for quantum numbers, energy levels & degeneracy, and eigen functions

UNIT-II

Approximate methods: Time independent perturbation theory and anharmonic oscillator, Variational method and Helium atom, Time dependent perturbation theory and transition probability (Fermi-Golden Rule), WKB method and alpha decay.

UNIT-III

Relativistic quantum mechanics: Klein-Gordon equation, Plane wave solution and Physical interpretation, Inadequacy of Klein-Gordon equation; Dirac equation, α and β matrices and related algebra, Representation and arbitrariness of α and β, Probabilistic interpretation.

UNIT- IV

Covariance of Dirac equation: Covariant form of Dirac equation, Dirac(γ) matrices, Representation and algebra, Linearly independent set of composite γ matrices; Infinitesimal and Finite proper Lorentz transformation, Proof of covariance, Plane wave solution and negative energy states: Two component Pauli spin theory, Non relativistic correspondence,

Reference Books;

1. Quantum Mechanics by L.I. Schiff (Tata-McGraw-Hill)
2. Introduction to Quantum Mechanics by D. J. Griffith (Pearson Education)
3. Quantum Mechanics by C. Cohen-Tannoudji, B. Diu and F, Laloe (Wiley VCH)
4. Quantum Chemistry by Ira N. Levine (Pearson Education)
5. Relativistic Quantum Mechanics by James D. Bjorken and Sidney D. Drell (McGraw-Hill)
6. An Introduction to Relativistic Quantum Field Theory by S.S. Schweber (Harper & Row)

Paper-VI: Discipline Centric Elective
(Select any one)

PHY: Solid State Physics

UNIT-I

Crystal Structure: Ionic, covalent, metallic and hydrogen bonding, space lattice and basis; Types of lattice, Miller indices, crystal structures of NaCl, CsCl, ZnS, graphite and diamond; Reciprocal lattice and Brillouin Zones; Basic idea of crystal defects and dislocations.

UNIT-II

Band Theory of Solids: Sommerfield model, Density of states, Fermi and mean energies at zero and finite temperatures; Origin of energy bands: Bloch Theorem; Kronig Penny model, Electron dynamics in crystalline lattice: light binding approximation.

UNIT- III

Thermal Properties: Lattice vibrations of mono and diatomic chains, Quantization of lattice vibration, Phonon; Infrared absorption: Einstein and Debye theories of specific heat; Thermal conductivity; Anharmonicity and Thermal expansion.

UNIT- IV

Optical Properties: Optical reflectance, Kramers-Kronig relations; Basic theory of luminescence, phosphorescence, thermoluminescence, etectroluminescence and photo-conductivity; Excitons in ionic and molecular crystals, Electron-hole drops (EHD) and colour centres.

Reference Books:

1. Solid state Physics by A. J. Dekkar (McMillan Publishers)
2. Introduction to Solid State Physics by C. Kittel (Wiley Eastern)
3. Elementary Solid State Physics by M. Ali Omar (Pearson Education)
4. Solid State Physics. N. W. Ashcroft and N. D. Mermin, (Harcourt Asia Limited)
5. Principles of the Theory of Solids by J. M. Ziman (Cambridge University Press)
6. Solid State Physics by S. O. Pillai (New Age Publishers)

Paper-VI: Discipline Centric Elective
(Select any one)

PHY: Condensed Matter Physics

UNIT- I

Dielectric Properties of Solids

Macroscopic concept of Polarization, Dielectrics, Claussius Mossotti relation, Dipolar, Ionic & Electronic Polarizability, Dielectric constant, Ferroelectricity- Curie temperature, dielectric behaviour above curie temperature, spontaneous polarization below curie temperature, Ferroelectric hysteresis, Antiferroelectricity, Piezoelectricity, Pyroelectric effect, Applications of Piezoelectricity and Pyroelectric crystals.

UNIT- II

Optical properties of Solids

Optical reflectance, Kramers-Kronig relations, Conductivity and dielectric function of electron gas, Basic theory of luminescence, phosphorescence, thermoluminescence, electroluminescence and photo-conductivity, Excitons in ionic and molecular crystals, Electron-hole drops (EHD) and colour centres.

UNIT- III

Magnetic Properties of Solids

Magnetic ions and magnetic excited states, Types of magnetic materials, Paramagnetism of non-interacting magnetic ions and its application to rare earth and transition metal ions in solids, Ferromagnetism, Magnetic domains, Heisenberg explanation of internal magnetic field, Basic features of Neel`s two sublattice models for antiferromagnetism and ferrimagnetic materials.

UNIT- IV

Superconductivity

Phenomenological theories of superconductivity, Meisner effect, Types of superconductors- Type-I and Type-II superconductors, Entropy and Heat capacity, Isotope effect, Thermodynamics of Superconducting transition- Rutger`s formula, Electrodynamics of superconducting transition - London equations, Superconducting tunnelling- AC and DC Josephson effect. Cooper pairs, coherence length, BCS theory, BCS ground state and energy gap, a brief introduction to high-temperature superconductors.

References:

1. Introduction to Solid State Physics by C. Kittel (Wiley Eastern, New Delhi).
2. Elementary Solid State Physics: Principle and Application by Omar Ali (Addison Wesley, London).
3. Solid State Physics by S. O. Pillai (Wiley Eastern Ltd).
4. Solid State Physics by R. Kubo and T. Nagamiya (McGraw Hill, New York).
5. Solid State Theory by W.A. Harrison (McGraw Hill, New York).
6. Solid states Physics by A-J. Dekkar (McMillan and Co., London).
7. Introduction to Magnetic Materials by B. D. Cullity , C. D. Graham (Wiley-IEEE Press).
8. Introduction to Superconductivity by Michael Tinkham (Dover Publications Inc.).

Paper-VII: Ability Enhancement Course
(Select any one)
PHY: Physics of Renewable Energies

UNIT – I

An Overview

Introduction to Energy- definition and units of energy, power, Forms of energy, Conservation of energy, second law of thermodynamics, Energy flow diagram to the earth, Causes of energy scarcity, Solution to energy scarcity, Factors affecting energy resource development, Energy resources and classification, Renewable-nonrenewable, Green energy and clean energy, Conventional-nonconventional, Fossil fuels-origin and their limitations and need for use of new and renewable energy sources.

UNIT – II

Solar Energy

Fundamentals of photovoltaic energy conversion, Physics and material properties, Basic to photovoltaic energy conversion, Optical properties of solids, Direct and indirect transition semiconductors, interrelationship between absorption coefficients and band gap recombination of carriers, p-n junction solar cell and elementary idea about advanced solar cells.

UNIT – III

Hydrogen Energy

Benefits of hydrogen energy, Hydrogen production technologies, Hydrogen energy storage, Uses of hydrogen energy, Advantages and disadvantages of Hydrogen Energy, Problems associated with Hydrogen energy.

UNIT – IV

Wind, Tidal, Geothermal and Biogas Energies

Fundamentals of Wind energy, Wind resources, Windmills, Wind turbines; Tidal energy resource, Tidal energy availability, Energy availability in tides, Advantages and disadvantages of Tidal power, Problems faced in exploiting Tidal energy, Geothermal systems, Classifications, Geothermal resource Utilization, Resource exploration. Biogas and its composition, Anaerobic digestion, Biogas production, Benefits of biogas,

Text and Reference Books:

1. Solar Cell Devices - Physics : Fonash.
2. Fundamentals of Solar Cells Photovoltaic Solar Energy : Fahrenbruch & Bube.
3. Phoptoelectrochemical Solar Cells: Chandra .
4. Hydrogen as an Energy Carrier Technologies Systems Economy : Winter & Nitch (Eds.) .
5. Hydrogen as a Future Engery Carrier : Andreas Zuttel, Andreas Borgschulte and Louis Schlapbach.
6. Nonconventional Energy Resources Shobh Nath Singh Pearson 1st Edition, 2015.
7. Nonconventional Energy Resources B.H. Khan (McGraw Hill 3rd Edition.
8. Renewable Energy; Power for a sustainable Future Godfrey Boyle Oxford 3rd Edition, 2012.
9. Renewable Energy Sources: Their Impact on global Warming and Pollution Tasneem Abbasi, S.A. Abbasi, PHI 1st Edition, 2011.

Paper-VII: Ability Enhancement Course
(Select any one)

PHY: Laser and Holography

UNIT- I

Laser theory, Light Amplification, threshold condition, Optical pumping, population inversion and coherence length, Laser Rate Equations-two, three and four level systems,

UNIT- II

Laser power around threshold, optimum output coupling, Line Broadening Mechanisms–Natural, Collision and Doppler, Optical Resonators – Modes of a rectangular cavity and open planar resonator,

UNIT- III

Principles of He-Ne, Co_2, Dye, Nd: YAG and Semi-conductor Lasers, Basic principle of holography, methods of hologram recording, reconstruction of object waveform by hologram,

UNIT- IV

Basic theory of plane hologram; Typical arrangement for hologram reconstruction, practical consideration of holography and its application.

References:

1. Lasers and Non-Linear Optics by B.B. Laud (Wiley Est. Ltd., New Delhi).
2. Quantum Optics by S.H. Kay and A. Maitland (Academic Press, London).
3. Non-Linear Optics by P.G. Harper and B.S. Wherret (Academic Press, London).
4. Laser and holographic Data processing by N.G. Bosov (Mir Publisher, Moscow).

PG SEMESTER-IV/PG SEMESTER-II (One Year PG Programme)

PHY: Master Dissertation

The dissertation topic will be based on special papers or elective papers and topics of current interest. A departmental committee will distribute the topics.

Student must carry out review of a selected topic and make a presentation to an evaluation committee. These projects will involve literature survey and collection of material, detailed study of the material, verification of results and writing of the review. Review projects will include exposure and conduct of experiments as require. The dissertation will be evaluated by the internal examiner and external examiner appointed by the University.