Department of Physics
SYLLABUS-AY 2021-22

S. No	Semester	Paper	Title of the Paper
1	I	I	Mechanics, Waves & Oscillations
2	2	II	Wave Optics
3	3	III	Heat and Thermodynamics
4	4	IV	Electricity, Magnetism & Electronics
5	4	V	Modern Physics
6	5	V	Electricity, Magnetism & Electronics
7	5	VI	Modern Physics
7	6	VI	Elective- Renewable Energy
8	6	VIIA	Cluster-1-Solar, Thermal & Photo voltaic Aspects
9	6	VIIB	Cluster-2-Wind, Hydro & Ocean Energies
10	6	VIIC	Cluster-3-Energy Storage Devices

B.Sc. PHYSICS SYLLABUS UNDER CBCS

For Mathematics Combinations

[2020-21 Batch onwards]

I Year B.Sc.- Physics: I Semester

Course I: MECHANICS, WAVES AND OSCILLATIONS

Work load:60 hrs per semester **4 hrs/week**

Course outcomes:

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

- *Understand Newton's laws of motion and motion of variable mass system and its application to rocket motion and the concepts of impact parameter, scattering cross section.*
- *Apply the rotational kinematic relations, the principle and working of gyroscope and it applications and the precessional motion of a freely rotating symmetric top.*
- *Comprehend the general characteristics of central forces and the application of Kepler's laws to describe the motion of planets and satellite in circular orbit through the study of law of Gravitation.*
- *Understand postulates of Special theory of relativity and its consequences such as length contraction, time dilation, relativistic mass and mass-energy equivalence.*
- *Examine phenomena of simple harmonic motion and the distinction between undamped, damped and forced oscillations and the concepts of resonance and quality factor with reference to damped harmonic oscillator.*
- *Appreciate the formulation of the problem of coupled oscillations and solve them to obtain normal modes of oscillation and their frequencies in simple mechanical systems.*
- *Figure out the formation of harmonics and overtones in a stretched string and acquire the knowledge on Ultrasonic waves, their production and detection and their applications in different fields.*

UNIT-I:

1. Mechanics of Particles (5 hrs)

Review of Newton's Laws of Motion, Motion of variable mass system, Motion of a rocket, Multistage rocket, Concept of impact parameter, scattering cross-section, Rutherford scattering-Derivation.

2. Mechanics of Rigid bodies (7 hrs)

Rigid body, rotational kinematic relations, Equation of motion for a rotating body, Angular momentum and Moment of inertia tensor, Euler equations, Precession of a spinning top, Gyroscope, Precession of atom and nucleus in magnetic field, Precession of the equinoxes

Unit-II:

3. Motion in a Central Force Field (12hrs)

Central forces, definition and examples, characteristics of central forces, conservative natureof central forces, Equation of motion under a central force, Kepler's laws of planetary motion-Proofs, Motion of satellites, Basic idea of Global Positioning System (GPS), weightlessness, Physiological effects of astronauts

UNIT-III:

4. Relativistic Mechanics (12hrs)

Introduction to relativity, Frames of reference, Galilean transformations, absolute frames, Michelson-Morley experiment, negative result, Postulates of Special theory of relativity,Lorentz transformation, time dilation, length contraction, variation of mass with velocity, Einstein's mass-energy relation

Unit-IV:

5. Undamped, Damped and Forced oscillations: (07 hrs)

Simple harmonic oscillator and solution of the differential equation, Damped harmonic oscillator, Forced harmonic oscillator – Their differential equations and solutions, Resonance, Logarithmic decrement, Relaxation time and Quality factor.

6. Coupled oscillations: (05 hrs)

Coupled oscillators-Introduction, Two coupled oscillators, Normal coordinates and Normal modes- N-coupled oscillators and wave equation

Unit-V:

7. Vibrating Strings: (07 hrs)

Transverse wave propagation along a stretched string, General solution of wave equation and its significance, Modes of vibration of stretched string clamped at ends, Overtones andHarmonics, Melde's strings.

8. Ultrasonics: (05 hrs)

Ultrasonics, General Properties of ultrasonic waves, Production of ultrasonics by piezoelectricand magnetostriction methods, Detection of ultrasonics, Applications of ultrasonic waves, SONAR

REFERENCE BOOKS:

- B. Sc. Physics, Vol.1, Telugu Academy, Hyderabad
- Fundamentals of Physics Vol. I - Resnick, Halliday, Krane ,Wiley India 2007
- College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
- University Physics-FW Sears, MW Zemansky& HD Young,Narosa Publications, Delhi
- Mechanics, S.G.Venkatachalapathy, Margham Publication, 2003.
- Waves and Oscillations. N. Subramanyam and Brijlal, VikasPulications.
- Unified Physics - Waves and Oscillations, Jai PrakashNath&Co.Ltd.
- Waves & Oscillations. S.Badami, V. Balasubramanian and K.R. Reddy, Orient Longman.
- The Physics of Waves and Oscillations, N.K.Bajaj, Tata McGraw Hill
- Science and Technology of Ultrasonics- Baldevraj, Narosa, New Delhi,2004

Practical Course 1: Mechanics, Waves and Oscillations

Work load: 30 hrs per semester **2 hrs/week**

Course outcomes (Practicals):

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

- Perform experiments on Properties of matter such as the determination of moduli of elasticity *viz.*, Young's modulus, Rigidity modulus of certain materials; Surface tension of water , Coefficient of viscosity of a liquid , Moment of inertia of some regular bodies by different methods and compare the experimental values with the standard values.
- Know how to determine the acceleration due to gravity at a place using Compound pendulum and Simple pendulum.
- Notice the difference between flat resonance and sharp resonance in case of volume resonator and sonometer experiments respectively.
- Verify the laws of transverse vibrations in a stretched string using sonometer and comment on the relation between frequency, length and tension of a stretched string under vibration.
- Demonstrate the formation of stationary waves on a string in Melde's string experiment.
- Observe the motion of coupled oscillators and normal modes.

Minimum of 6 experiments to be done and recorded:

1. Young's modulus of the material of a bar (scale) by uniform bending
2. Young's modulus of the material a bar (scale) by non- uniform bending
3. Surface tension of a liquid by capillary rise method
4. Viscosity of liquid by the flow method (Poiseuille's method)
5. Bifilar suspension –Moment of inertia of a regular rectangular body.
6. Fly-wheel -Determination of moment of inertia
7. Rigidity modulus of material of a wire-Dynamic method (Torsional pendulum)
8. Volume resonator experiment
9. Determination of 'g' by compound/bar pendulum
10. Simple pendulum- normal distribution of errors-estimation of time period and the error of the mean by statistical analysis
11. Determination of the force constant of a spring by static and dynamic method.
12. Coupled oscillators
13. Verification of laws of vibrations of stretched string –Sonometer
14. Determination of frequency of a bar –Melde's experiment.
15. Study of a damped oscillation using the torsional pendulum immersed in liquid-decay constant and damping correction of the amplitude.

B.Sc. PHYSICS SYLLABUS UNDER CBCS

For Mathematics Combinations

[2020-21 Batch onwards]

I Year B.Sc.-Physics: II Semester

Course-II: WAVE OPTICS

Work load:60 hrs per semester **4 hrs/week**

Course outcomes:

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

- *Understand the phenomenon of interference of light and its formation in (i) Lloyd's single mirror due to division of wave front and (ii) Thin films, Newton's rings and Michelson interferometer due to division of amplitude*.
- *Distinguish between Fresnel's diffraction and Fraunhoffer diffraction and observe the diffraction patterns in the case of single slit and the diffraction grating.*
- *Describe the construction and working of zone plate and make the comparison of zone plate with convex lens.*
- *Explain the various methods of production of plane, circularly and polarized light and their detection and the concept of optical activity..*
- *Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their applications in different fields.*
- *Explain about the different aberrations in lenses and discuss the methods of minimizing them.*
- *Understand the basic principles of fibreoptic communication and explore the field of Holography and Nonlinear optics and their applications.*

UNIT-I Interference of light: (12hrs)

Introduction, Conditions for interference of light, Interference of light by division of wave front and amplitude, Phase change on reflection- Stokes' treatment, Lloyd's single mirror, Interference in thin films: Plane parallel and wedge- shaped films, colours in thin films, Newton's rings in reflected light-Theory and experiment,

Determination of wavelength of monochromatic light, Michelson interferometer andDetermination of wavelength.

UNIT-II Diffraction of light:(12hrs)

Introduction, Types of diffraction: Fresnel and Fraunhoffer diffractions, Distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction at a single slit, Plane diffraction grating, Determination of wavelength of light using diffraction grating, Resolving power of grating, Fresnel's half period zones, Explanation of rectilinear propagation of light, Zone plate, comparison of zone plate with convex lens.

UNIT-III Polarisation of light:(12hrs)

Polarized light: Methods of production of plane polarized light, Double refraction, Brewster's law, Malus law, Nicol prism, Nicol prism as polarizer and analyzer, Quarter wave plate, Half wave plate, Plane, Circularly and Elliptically polarized light-Production and detection, Opticalactivity, Laurent's half shade polarimeter: determination of specific rotation, Basic principleof LCDs

UNIT-IV Aberrations and Fibre Optics: (12hrs)

Monochromatic aberrations, Spherical aberration, Methods of minimizing spherical aberration, Coma, Astigmatism and Curvature of field, Distortion; Chromatic aberration-the achromatic doublet; Achromatism for two lenses (i) in contact and (ii) separated by a distance.

Fibre optics: Introduction to Fibers, different types of fibers, rays and modes in an optical fiber, Principles of fiber communication (qualitative treatment only), Advantages of fiber optic communication.

UNIT-V Lasers and Holography:(12hrs)

Lasers: Introduction, Spontaneous emission, stimulated emission, Population Inversion, Laser principle, Einstein coefficients, Types of lasers-He-Ne laser, Ruby laser, Applications of lasers; Holography: Basic principle of holography, Applications of holography

REFERENCE BOOKS:

- BSc Physics, Vol.2, Telugu Akademy, Hyderabad
- A Text Book of Optics-N Subramanyam, L Brijlal, S.Chand& Co.
- Optics-Murugeshan, S.Chand& Co.
- Unified Physics Vol.IIOptics, Jai PrakashNath&Co.Ltd., Meerut
- Optics,F.A. Jenkins and H.G.White, McGraw-Hill
- Optics, AjoyGhatak,TataMcGraw-Hill.
- Introduction of Lasers – Avadhanulu, S.Chand& Co.
- Principles of Optics- BK Mathur, Gopala Printing Press, 1995

Practical Course II: Wave Optics

Work load:30hrs **2 hrs/week**

Course outcomes (Practicals):

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

1. *Gain hands-on experience of using various optical instruments like spectrometer, polarimeter and making finer measurements of wavelength of light using Newton Rings experiment, diffraction grating etc.*
2. *Understand the principle of working of polarimeter and the measurement of specific rotatory power of sugar solution*
3. *Know the techniques involved in measuring the resolving power of telescope and dispersive power of the material of the prism.*
4. *Be familiar with the determination of refractive index of liquid by Boy's method andthe determination of thickness of a thin wire by wedge method.*

Minimum of 6 experiments to be done and recorded

1) Determination of radius of curvature of a given convex lens-Newton's rings.
2) Resolving power of grating.
3) Study of optical rotation –polarimeter.
4) Dispersive power of a prism.
5) Determination of wavelength of light using diffraction grating-minimum deviation method.
6) Determination of wavelength of light using diffraction grating-normal incidence method.
7) Resolving power of a telescope.
8) Refractive index of a liquid-hallow prism
9) Determination of thickness of a thin wire by wedge method
10) Determination of refractive index of liquid-Boy's method.

B.Sc. PHYSICS SYLLABUS UNDER CBCS

For Mathematics Combinations

[2020-21 Batch onwards]

II Year B.Sc.-Physics: III Semester

PAPER-3: HEAT AND THERMODYNAMICS

Work load:60 hrs per semester **4 hrs/week**

Course outcomes:

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

- *Understand the basic aspects of kinetic theory of gases, Maxwell-Boltzman distribution law, equipartition of energies, mean free path of molecular collisions and the transport phenomenon in ideal gases*
- *Gain knowledge on the basic concepts of thermodynamics, the first and the second law of thermodynamics, the basic principles of refrigeration, the concept of entropy, the thermodynamic potentials and their physical interpretations.*
- *Understand the working of Carnot's ideal heat engine, Carnot cycle and its efficiency*
- *Develop critical understanding of concept of Thermodynamic potentials, the formulation of Maxwell's equations and its applications.*
- *Differentiate between principles and methods to produce low temperature and liquefy air and also understand the practical applications of substances at low temperatures.*
- *Examine the nature of black body radiations and the basic theories.*

UNIT-I: Kinetic Theory of gases: **(12 hrs)**

Kinetic Theory of gases-Introduction, Maxwell's law of distribution of molecular velocities (qualitative treatment only) and its experimental verification, Mean free path, Degrees of freedom, Principle of equipartition of energy (Qualitative ideas only), Transport phenomenon in ideal gases: viscosity, Thermal conductivity and diffusion of gases.

UNIT-II: Thermodynamics: **(12hrs)**

Introduction- Isothermal and Adiabatic processes, Reversible and irreversible processes, Carnot's engine and its efficiency, Carnot's theorem, Thermodynamic scale of temperature

and its identity with perfect gas scale, Second law of thermodynamics: Kelvin's and Clausius statements, Principle of refrigeration, Entropy, Physical significance, Change in entropy in reversible and irreversible processes; Entropy and disorder-Entropy of Universe; Temperature-Entropy (T-S) diagram and its uses ; change of entropy when ice changes into steam.

UNIT-III: Thermodynamic Potentials and Maxwell's equations: (12hrs)

Thermodynamic potentials-Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy and their significance, Derivation of Maxwell's thermodynamic relations from thermodynamic potentials, Applications to (i) Clausius-Clayperon's equation (ii) Value of C_P-C_V (iii) Value of C_P/C_V (iv) Joule-Kelvin coefficient for ideal gases.

UNIT-IV: Low temperature Physics: (12hrs)

Methods for producing very low temperatures, Joule Kelvin effect, Porous plug experiment , Joule expansion, Distinction between adiabatic and Joule Thomson expansion, Expression for Joule Thomson cooling, Liquefaction of air by Linde's method, Production of low temperatures by adiabatic demagnetization (qualitative), Practical applications of substances at low temperatures.

UNIT-V: Quantum theory of radiation: (12 hrs)

Black body and its spectral energy distribution of black body radiation, Kirchoff's law, Wein'sdisplacement law, Stefan-Boltzmann's law and Rayleigh-Jean's law (No derivations),Planck's law of black body radiation-Derivation, Deduction of Wein's law and Rayleigh-Jean's law from Planck's law, Solar constant and its determination using Angstrom pyrohelio meter, Estimation of surface temperature of Sun.

REFERENCE BOOKS:

- BSc Physics, Vol.2, Telugu Akademy, Hyderabad
- Thermodynamics, R.C.Srivastava, S.K.Saha&AbhayK.Jain, Eastern Economy Edition.
- Unified Physics Vol.2, Optics & Thermodynamics, Jai PrakashNath&Co.Ltd., Meerut
- Fundamentals of Physics. Halliday/Resnick/Walker.C. Wiley India Edition 2007
- Heat and Thermodynamics -N BrijLal, P Subrahmanyam, S.Chand& Co.,2012
- Heat and Thermodynamics- MS Yadav, Anmol Publications Pvt. Ltd, 2000
- University Physics, HD Young, MW Zemansky,FW Sears, Narosa Publishers, New Delhi

practical Course-III: Heat and Thermodynamics

Work load: 30 hrs **2 hrs/week**

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

- *Perform some basic experiments in thermal Physics, viz., determinations of Stefan's constant, coefficient of thermal conductivity, variation of thermo-emf of athermocouple with temperature difference at its two junctions, calibration of a thermocouple and Specific heat of a liquid.*

Minimum of 6 experiments to be done and recorded

1. Specific heat of a liquid –Joule's calorimeter –Barton's radiation correction
2. Thermal conductivity of bad conductor-Lee's method
3. Thermal conductivity of rubber.
4. Measurement of Stefan's constant.
5. Specific heat of a liquid by applying Newton's law of cooling correction.
6. Heating efficiency of electrical kettle with varying voltages.
7. Thermo emf- thermo couple - Potentiometer
8. Thermal behavior of an electric bulb (filament/torch light bulb)
9. Measurement of Stefan's constant- emissive method
10. Study of variation of resistance with temperature - Thermistor.

For Mathematics Combinations

[2020-21 Batch onwards]

II Year B.Sc.-Physics: IV Semester

Course-IV: ELECTRICITY, MAGNETISM AND ELECTRONICS

Work load:60 hrs per semester **4 hrs/week**

Course outcomes:

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

- *Understand the Gauss law and its application to obtain electric field in different cases and formulate the relationship between electric displacement vector, electric polarization, Susceptibility, Permittivity and Dielectric constant.*
- *Distinguish between the magnetic effect of electric current and electromagnetic induction and apply the related laws in appropriate circumstances.*
- *Understand Biot and Savart's law and Ampere's circuital law to describe and explain the generation of magnetic fields by electrical currents.*
- *Develop an understanding on the unification of electric and magnetic fields andMaxwell's equations governing electromagnetic waves.*
- *Phenomenon of resonance in LCR AC-circuits, sharpness of resonance,Q- factor,Power factor and the comparative study of series and parallel resonant circuits.*
- *Describe the operation of p-n junction diodes, zener diodes, light emitting diodes and transistors*
- *Understand the operation of basic logic gates and universal gates and their truth tables.*

UNIT-I

1.Electrostatics: (6hrs)

Gauss's law-Statement and its proof, Electric field intensity due to (i) uniformly charged solid sphere and (ii) an infinite conducting sheet of charge, Deduction of Coulomb's law from Gauss law, Electrical potential–Equipotential surfaces, Potential due to a (i)uniformly charged sphere

2. Dielectrics: (6 hrs)

Dielectrics-Polar and Non-polar dielectrics- Effect of electric field on dielectrics, Dielectric strength, Capacitance of a parallel plate condenser with dielectric slab between the plates, Electric displacement D, electric polarization P, Relation between D, E and P, Dielectricconstant and electric susceptibility.

UNIT-II

3. Magnetostatics: (6 hrs)

Biot-Savart's law and its applications: (i) circular loop and (ii) solenoid, Ampere's Circuital Law and its application to Solenoid, Hall effect, determination of Hall coefficient and applications.

4. Electromagnetic Induction: (6 hrs)

Faraday's laws of electromagnetic induction, Lenz's law, Self induction and Mutual induction, Self inductance of a long solenoid, Mutual inductance of two coils, Energy stored in magnetic field, Eddy currents.

UNIT-III

5.Alternating currents: (6 hrs)

Alternating current - Relation between current and voltage in LR and CR circuits, Phasor and Vector diagrams, LCR series and parallel resonant circuit, Q –factor, Power in ac circuits, Power factor.

6.Electromagnetic waves-Maxwell's equations: (6 hrs)

Idea of displacement current, Maxwell's equations-Derivation, Maxwell's wave equation (with derivation), Transverse nature of electromagnetic waves, Poynting theorem (Statement and proof),velocity wave equation using Maxwells relations in vaccum.

UNIT-IV

7.Basic Electronic devices: (12 hrs)

PN junction diode, Zener diode and Light Emitting Diode (LED) and their I-V characteristics, Zener diode as a regulator- Transistors and its operation, CB, CE and CC configurations, Input and output characteristics, transistor in CE mode, Relation between alpha bête gamma Transistor as an amplifier.

UNIT-V:

8.Digital Electronics: (12 hrs)

Number systems, Conversion of binary to decimal system and vice versa, Binary addition & Binary subtraction (1's and 2's complement methods), Laws of Boolean algebra, DeMorgan's laws-Statements and Proofs, Basic logic gates, NAND and NOR as universal gates, Exclusive-OR gate, Half adder and Full adder circuits.

REFERENCE BOOKS

- BSc Physics, Vol.3, Telugu Akademy, Hyderabad.
- Electricity and Magnetism, D.N. Vasudeva. S. Chand & Co.
- Electricity and Magnetism, B.D.Duggal and C.L.Chhabra. Shobanlal& Co.
- Electricity, Magnetism with Electronics, K.K.Tewari, R.Chand& Co.,
- Electricity and Magnetism, R.Murugeshan, S. Chand & Co.
- Principles of Electronics, V.K. Mehta, S.Chand& Co.,
- Digital Principles and Applications, A.P. Malvino and D.P.Leach, McGrawHill Edition.

Practical Course IV: Electricity, Magnetism and Electronics

Work load: 30 hrs 2 hrs/week

Course outcomes (Practicals):

On successful completion of this practical course the student will be able to;

- *Measure the current sensitivity and figure of merit of a moving coil galvanometer.*
- *Observe the resonance condition in LCR series and parallel circuit*
- *Learn how a sonometer can be used to determine the frequency of AC-supply.*
- *Observe the variation of magnetic field along the axis of a circular coil carrying current using Stewart and Gee's apparatus.*
- *Understand the operation of PN junction diode, Zener diode and a transistor and their V-I characteristics.*
- *Construct the basic logic gates, half adder and full adder and verify their truth tables. Further, the student will understand how NAND and NOR gates can be used as universal building blocks.*

Minimum of 6 experiments to be done and recorded

1. Figure of merit of a moving coil galvanometer.
2. LCR circuit series/parallel resonance, Q factor.
3. Determination of ac-frequency –Sonometer.
4. Verification of Kirchoff's laws and Maximum Power Transfer theorem.
5. Field along the axis of a circular coil carrying current-Stewart & Gee's apparatus.
6. PN Junction Diode Characteristics
7. Zener Diode –V-I Characteristics
8. Zener Diode as a voltage regulator
9. Transistor CE Characteristics- Determination of hybrid parameters
10. Logic Gates- OR,AND,NOT and NAND gates. Verification of Truth Tables.
11. Verification of De Morgan's Theorems.
12. Construction of Half adder and Full adders-Verification of truth tables

B.Sc. PHYSICS SYLLABUS UNDER CBCS

For Mathematics Combinations

[2020-21 Batch onwards]

II Year B.Sc.-Physics: IV Semester

Course V: MODERN PHYSICS

Work load:60hrs per semester **4 hrs/week**

Course outcomes:

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

- *Develop an understanding on the concepts of Atomic and Modern Physics, basic elementary quantum mechanics and nuclear physics.*
- *Develop critical understanding of concept of Matter waves and Uncertainty principle.*
- *Get familiarized with the principles of quantum mechanics and the formulation of Schrodinger wave equation and its applications.*
- *Examine the basic properties of nuclei, characteristics of Nuclear forces, salient features of Nuclear models and different nuclear radiation detectors.*
- *Classify Elementary particles based on their mass, charge, spin, half life and interaction.*
- *Get familiarized with the nano materials, their unique properties and applications.*
- *Increase the awareness and appreciation of superconductors and their practical applications.*

UNIT-I :

1. Atomic and Molecular Physics:(12 hrs)

Vector atom model and Stern-Gerlach experiment, Quantum numbers associated with it, Angular momentum of the atom, Coupling schemes, Spectral terms and spectral notations, Selection rules, Intensity rules, Fine structure of Sodium D-lines, Zeeman effect, Experimental arrangement to study Zeeman effect; Raman effect, Characteristics of Raman effect,

Experimental arrangement to study Raman effect, Quantum theory of Raman effect, Applications of Raman effect.

UNIT-II:

2. Matter waves & Uncertainty Principle: (12 hrs)

Matter waves, de Broglie's hypothesis, Wave length of matter waves, Properties of matter waves, Davisson and Germer's experiment, Phase and group velocities, Heisenberg's uncertainty principle for position and momentum& energy and time, Illustration of uncertainty principle using diffraction of beam of electrons (Diffraction by a single slit)and photons(Gamma ray microscope),Bohr's principle of complementarity.

UNIT-III:

3. Quantum (Wave) Mechanics:(12 hrs)

Basic postulates of quantum mechanics, Schrodinger time independent and time dependent wave equations-Derivations, Physical interpretation of wave function, Eigen functions, Eigen values, Application of Schrodinger wave equation to (i) one dimensional potential box of infinite height (Infinite Potential Well).

UNIT-IV:

4. Nuclear Physics:(12 hrs)

Nuclear Structure: General Properties of Nuclei, Mass defect, Binding energy; *Nuclear forces*: Characteristics of nuclear forces- Yukawa's meson theory; *Nuclear Models*: Liquid drop model, The Shell model, Magic numbers; *Nuclear Radiation detectors*: G.M. Counter, Cloud chamber, Solid State detector; *Elementary Particles*: Elementary Particles and their classification.

UNIT-V:

5. Nano materials:(7hrs)

Nanomaterials – Introduction, Electron confinement, Size effect, Surface to volume ratio, Classification of nano materials– (0D, 1D, 2D); Quantum dots, Nano wires, Fullerene, CNT, Graphene(Mention of structures and properties),Distinct properties of nano materials (Mention-*mechanical, optical, electrical, and magnetic properties*); Mention of applications of nano materials: (*Fuel cells, Phosphors for HD TV),*

UNIT-5

6.Superconductivity: (5 hrs)

Introduction to Superconductivity, Experimental results-critical temperature, critical magnetic field, Meissner effect, Isotope effect, Type I and Type II superconductors, BCS theory (elementary ideas only), Applications of superconductors

REFERENCE BOOKS

- BSc Physics, Vol.4, Telugu Akademy, Hyderabad
- Atomic Physics by J.B. Rajam; S.Chand& Co.,
- Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath. S. Chand & Co.
- Concepts of Modern Physics by Arthur Beiser. Tata McGraw-Hill Edition.
- Nuclear Physics, D.C.Tayal, Himalaya Publishing House.
- S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publ.Co.)
- K.K.Chattopadhyay&A.N.Banerjee, Introd.to Nanoscience and Technology(PHILearningPriv.Limited).
- Nano materials, A K Bandopadhyay. New Age International Pvt Ltd (2007)
- Textbook of Nanoscience and Nanotechnology, BS Murthy, P Shankar, BaldevRaj,BB Rath and J Murday-Universities Press-IIM

Practical Course V: Modern Physics

Work load: 30 hrs **2 hrs/week**

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

- *Measure charge of an electron ande/m value of an electron by Thomson method.*
- *Understand how the Planck's constant can be determined using Photocell and LEDs.*
- *Study the absorption of α-rays and β-rays, Range of β-particles and the characteristicsof GM counter*
- *Determine the Energy gap of a semiconductor using thermistor and junction diode.*

Minimum of 6 experiments to be done and recorded

1. e/m of an electron by Thomson method.
2. Determination of Planck's Constant (photocell).
3. Verification of inverse square law of light using photovoltaic cell.
4. Determination of the Planck's constant using LEDs of at least 4 different colours.
5. Determination of work function of material of filament of directly heated vacuumdiode.
6. Study of absorption of α-rays.
7. Study of absorption of β-rays.
8. Determination of Range of β-particles.
9. Determination of M & H.
10. Analysis of powder X-ray diffraction pattern to determine properties of crystals.
11. Energy gap of a semiconductor using junction diode.
12. Energy gap of a semiconductor using thermistor
13. GM counter characteristics

III B. Sc. Physics: Semester-VI

Elective Paper-VII (C) - Renewable Energy

No. of Credits: 03 **3 Hour/Week**
Total Hours: 45

UNIT-I (9 hrs)
1. Introduction to Energy: Definition and units of energy, power, Forms of energy, Energy flow diagram to the earth. Role of energy in economic and social development.

2. Environmental Effects: Environmental degradation due to energy production and utilization, air and water pollution, depletion of ozone layer, global warming, biological damage due to environmental degradation.

UNIT-II (9hrs)
3. Global Energy Scenario: Energy consumption in various sectors, energy resources, coal, oil, natural gas, nuclear and hydroelectric power.

4. Indian Energy Scene: Energy resources available in India, urban and rural energy consumption, nuclear energy - promise and future, energy as a factor limiting growth, need for use of new and renewable energy sources.

UNIT-III (9hrs)
5. Solar energy: Solar energy, Spectral distribution of radiation, solar water heating system, Applications, Solar cooker. Solar cell, Types of solar cells.

6. Wind Energy: Introduction, Principle of wind energy conversion, Components of wind turbines, Operation and characteristics of a wind turbine, Applications of wind energy.

UNIT-IV (9hrs)
7. Ocean Energy: Introduction, Principle of ocean thermal energy conversion, Tidal power generation, Tidal energy technologies, Energy from waves.

8. Hydrogen Energy: History of hydrogen energy - Hydrogen production methods - Electrolysis of water, Uses of hydrogen as fuel.

UNIT-V (9 hrs)
9. Bio-Energy

Energy from biomass – Sources of biomass – Conversion of biomass into fuels – Energy through fermentation – Pyrolysis, gasification and combustion – Aerobic and anaerobic bio-conversion – Properties of biomass – Properties and characteristics of biogas.

References:

1. Solar Energy Principles, Thermal Collection &Storage, S.P.Sukhatme: Tata McGraw Hill Pub., New Delhi.
2. Non-Conventional Energy Sources, G.D.Rai, New Delhi.
3. Renewable Energy, power for a sustainable future, Godfrey Boyle, 2004,
4. The Generation of electricity by wind, E.W. Golding.
5. Hydrogen and Fuel Cells: A comprehensive guide, Rebecca Busby, Pennwell corporation (2005)
6. Hydrogen and Fuel Cells: Emerging Technologies and Applications, B.Sorensen, Academic

Press (2012).
7. Non-Conventional Energy Resources by B.H. Khan, Tata McGraw Hill Pub., 2009.
8. Fundamentals of Renewable Energy Resources byG.N.Tiwari, M.K.Ghosal, Narosa Pub., 2007.

III B. Sc. Physics : Semester-VI
Elective Paper-VII C-Practical
Renewable Energy

2hrs/Week

Minimum of 6 experiments to be done and recorded

1. Preparation of copper oxide selective surface by chemical conversion method.

2. Performance testing of solar cooker.

3. Determination of solar constant using pyrheliometer.

4. Measurement of I-V characteristics of solar cell.

5. Study the effect of input light intensity on the performance of solar cell.

6. Study the characteristics of wind.

7. Study the characteristics of photocell

III B. Sc. Physics : Semester-VI

Cluster Paper-VIII C1 Solar Thermal and Photovoltaic Aspects

No. of Credits: 03 **3 Hour/Week**

Total Hours: 45

UNIT-I (9 hrs)

1. Basics of Solar Radiation: Structure of Sun, Solar constant, Concept of Zenith angle and air mass, Definition of declination, hour angle, solar and surface azimuth angles; Direct, diffuse and total solar radiation, Solar intensity measurement –pyrheliometer.

2. Radiative Properties and Characteristics of Materials: Kirchoff's law – Relation between absorptance, emittance and reflectance; Selective Surfaces - preparation and characterization, Types and applications; Anti-reflective coating.

UNIT-II (9 hrs)

3. Flat Plate Collectors (FPC) : Description of flat plate collector, Liquid heating type FPC, Energy balance equation,Efficiency, Temperature distribution in FPC, Definitions of fin efficiency and collector efficiency, Evacuated tubular collectors.

Unit-III (9 hrs)

4. Solar photovoltaic (PV) cell: Physics of solar cell –Type of interfaces, homo, hetero andschottky interfaces, Photovoltaic Effect, Equivalent circuit of solar cell, Solar cell output parameters, Series and shunt resistances and its effect on cell efficiency; Variation of efficiency with band-gap and temperature.

UNIT-IV (9 hrs)

Solar PV systems: Solar cell module assembly – Steps involved in the fabrication of solar module, Module performance, I-V characteristics, Modules in series and parallel, Module protection –Solar PV system and its components, PV array, inverter, battery and load.

UNIT-V (9 hrs)

Solar thermal applications: Solar hot water system (SHWS), Types of SHWS, Standard method of testing the efficiency of SHWS; Passive space heating and cooling concepts, Solar desalinator and drier, Solar thermal power generation.

Reference books:

1. Solar Energy Utilization, G. D. Rai, Khanna Publishers
2. Solar Energy- Fundamentals, design, modeling and applications, G.N. Tiwari, Narosa Pub., 2005.
3. Solar Energy-Principles of thermal energy collection & storage, S.P. Sukhatme,TataMc-Graw Hill Publishers, 1999.
4. Solar Photovoltaics- Fundamentals, technologies and applications, Chetan Singh Solanki, PHI Learning Pvt. Ltd.,
5. Science and Technology of Photovoltaics, P. Jayarama Reddy, BS Publications, 20

III B. Sc. Physics : Semester-VI

Cluster Paper-VIII (C1) Practical

Solar Thermal and Photovoltaic Aspects

Credits: 02
3hrs/Week

Minimum of 6 experiments to be done and recorded.

1. Measurement of direct solar radiation using pyrheliometer.

2. Measurement of global and diffuse solar radiation using pyranometer.

3. Measurement of emissivity, reflectivity and transsivity.

4. Measurement of efficiency of solar flat plate collector.

5. Performance testing of solar air dryer unit.

6. Effect of tilt angle on the efficiency of solar photovoltaic panel.

7. Study on solar photovoltaic panel in series and parallel combination.

III B. Sc. Physics : Semester-VI

Cluster Paper-VIII C2 - Wind, Hydro and Ocean Energies

No. of Credits: 03 **3 Hour/Week**
Total Hours: 45

UNIT-I(9hrs)
1. Introduction: Wind generation, meteorology of wind, world distribution of wind, wind speed variation with height, wind speed statistics, Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics.

UNIT-II(9hrs)
2. Wind Energy Conversion System: Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element; Rotor characteristics; Maximum power coefficient.

UNIT-III(9hrs)
3. Wind Energy Application: Wind pumps: Performance analysis, design concept and testing; Principle of wind energy generation; Wind energy in India; Environmental Impacts of Wind farms.

UNIT-IV(9hrs)
4. Small Hydropower Systems: Overview of micro, mini and small hydro systems; Hydrology; Elements of pumps and turbine; Selection and design criteria of pumps and turbines; Site selection; Speed and voltage regulation.

UNIT-V(9hrs)
5. Ocean Thermal, Tidal and Wave Energy Systems:Ocean Thermal - Introduction, Technology process, Working principle, Electricity generation methods from OCET, Advantages and disadvantages, Applications of OTEC.

6. Tidal Energy - Introduction, Origin and nature of tidal energy, Wave Energy – Introduction, Basics of wave motion, Power in waves, Wave energy conversion devices, Advantages and disadvantages, Applications of wave energy.

Reference Books:

1. Dan Charis, Mick Sagrillo, LanWoofenden, “Power from the Wind”, New Society Pub., 2009.
2. Erich Hau, “Wind Turbines-Fundaments, Technologies, Applications, Economics”, 2ndEdition, Springer Verlag, BerlinHeidelberg, NY, 2006.
3. Joshue Earnest, Tore Wizelius, Wind Power and Project Developmen”, PHI Pub., 2011.
4. T. Burton, D. Sharpe, N. Jenkins, E. Bossanyi, Wind Energy Handbook, John Wiley Pub., 2001.
5. Paul Gipe, “Wind Energy Basics”, Chelsea Green Publications, 1999.
6. Khan, B.H., “Non-Conventional Energy Resources”, TMH, 2nd Edition, New Delhi, 2009.
7. Tiwari, G.N., and Ghosal, M.K, Renewable Energy Resources – Basic Principles and applications, Narosa Publishing House,2007.

III B. Sc. Physics: Semester-VI

Cluster Practical Paper-VIII C2 - Wind, Hydro and Ocean Energies

Credits : 02
3hrs/Week

Minimum of 6 experiments to be done and recorded

1. Estimation of wind speed using anemometer.

2. Determination of characteristics of a wind generator

3. Study the effect of number and size of blades of a wind turbine on electric power output.

4. Performance evaluation of vertical and horizontal axes wind turbine rotors.

5. Study the effect of density of water on the output power of hydroelectric generator.

6. Study the effect of wave amplitude and frequency on the wave energy generated.

III B. Sc. Physics : Semester-VI

Cluster Paper-VIII C3 - Energy storage devices

No. of Credits : 03

3 Hour/Week
Total Hours: 45

UNIT-I (9 hr)

1. Energy Storage: Need of energy storage; Different modes of energy storage, Flywheel storage, Electrical and magnetic energy storage: Capacitors,electromagnets; Chemical Energy storage: Thermo-chemical, photo-chemical, electro-chemical, Hydrogen for energy storage.

UNIT-II (9 hrs)

2. Electrochemical Energy Storage Systems: Batteries: Primary, Secondary, Lithium, Solid-state and molten solvent batteries; Leadacid batteries; Nickel Cadmium Batteries; Advanced Batteries. Role of carbon nano-tubes inelectrodes.

UNIT-III (9 hrs)

3. Magnetic and Electric Energy Storage Systems: Superconducting Magnet Energy Storage(SMES) systems; Capacitor and battery: Comparison and application; Super capacitor.

UNIT-IV (9 hrs)

4. Fuel Cell: Fuel cell definition, difference between batteries and fuel cells, fuel cell components, principle and working of fuel cell, performance characteristics, efficiency, Advantages and disadvantages of fuel cell.

UNIT-V (9 hrs)

5. Types of Fuel Cells: Classification, Alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell; solid oxide fuel cell, proton exchange membrane fuel cell, applications of fuel cells.

REFERENCE BOOKS

1. J. Jensen and B. Squrensen, Fundamentals of Energy Storage, John Wiley, NY, 1984.
2. M. Barak, Electrochemical Power Sources: Primary and Secondary Batteries by, P. Peregrinus,IEE,1980.

3.P.D.Dunn, Renewable Energies, Peter Peregrinus Ltd, London, 1986.
4. B.Viswanathan and M. A. Scibioh, Fuel Cells-Principles and Applications, University Press, 2006.
5. Hart, A.B and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, NewYork, 1989.

III B. Sc. Physics : Semester-VI Cluster Practical Paper-VIII C3
Energy storage devices

Credits : 02 **3hrs/Week**

Minimum of 6 experiments to be done and recorded

1. Study of charge and discharge characteristics of storage battery.

2. Study of charging and discharging behavior of a capacitor.

3. Determination of efficiency of DC-AC inverter and DC-DC converters

4. Study of charging characteristics of a Ni-Cd battery using solar photovoltaic panel.

5. Performance estimation of a fuel cell.

6. Study of effect of temperature on the performance of fuel cell.

OR
PROJECT