

Andhra Pradesh State Council of Higher Education
B.Sc. PHYSICSSYLLUBUS UNDER CBCS
W.e.f. 2015-16 (Revised in April 2016)

First Semester

Paper I : Mechanics & Properties of Matter

Practical I (Lab-1)

Second Semester

Paper II: Waves & Oscillations

Practical 2 (Lab2)

Third Semester

Paper III: Wave Optics

Practical 3. (Lab 3)

Fourth Semester

Paper IV: Thermodynamics & Radiation Physics

Practical 4. (Lab 4)

Fifth Semester

Paper V: Electricity, Magnetism & Electronics

Paper VI: Modern Physics

Practical 5.(Lab 5)

Practical 6.(Lab 6)

Sixth Semester

Paper VII: Elective (One)

Paper VIII: Cluster Electives (Three)

Practical 7 (Lab 7)

Practical 8 (Lab 8)

Proposed Electives in Semester - VI

Paper – VII (one elective is to be chosen from the following)

Paper VII-(A): Analog and Digital Electronics

Paper VII-(B): Materials Science

Paper VII-(C): Renewable Energy

Paper – VIII (one cluster of electives (A-1,2,3 or B-1,2,3 or C-1,2,3) to be chosen *preferably* relating to the elective chosen under paper – VII (A or B or C))

Cluster 1.

Paper VIII-A-1. Introduction to Microprocessors and Microcontrollers

Paper VIII-A-2. Computational Physics and Programming

Paper VIII-A-3. Electronic Instrumentation

Cluster 2

Paper VIII-B-1.Fundamentals of Nanoscience

Paper VIII-B-2.Synthesis and Characterization of Nanomaterials

Paper VIII-B-3.Applications of Nanomaterials and Devices

Cluster 3

Paper VIII-C-1.Solar Thermal and Photovoltaic Aspects

Paper VIII-C-2.Wind, Hydro and Ocean Energies

Paper VIII-C-3.Energy Storage Devices

NOTE: Problems should be solved at the end of every chapter of all Units.

1. Each theory paper is of 100 marks and practical paper is also of 50 marks.
Each theory paper is 75 marks University Exam (external) + 25 marks mid Semester Exam
(Internal). Each practical paper is 50 marks external
2. The teaching work load per week for semesters I to VI is 4 hours per paper for theory And 2 hours for all laboratory (practical) work.
3. The duration of the examination for each theory paper is 3.00 hrs.
4. The duration of each practical examination is 3 hrs with 50 marks, which are to be Distributed as
30 marks for experiment
10 marks for viva
10 marks for record

Practicals

50 marks

Formula & Explanation

6

Tabular form +graph +circuit diagram

6

Observations

12

Calculation, graph, precautions & Result

6

Viva-Voce

10

Record

10

SRI VANI DEGREE & PG COLLEGE, ANANTHAPURAMU
DEPARTMENT OF PHYSICS
SEMESTER-I (MECHANICS & PROPERTIES OF MATTER)
UNIT-I

1. Vector Analysis

Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and curl of a vector field with derivations and physical interpretation. Vector integration (line, surface and volume), Statement and proof of Gauss and Stokes theorems.

UNIT-II

2. Mechanics of particles

Laws of motion, motion of variable mass system, Equation of motion of a rocket. Conservation of energy and momentum, Collisions in two and three dimensions, Concept of impact parameter, scattering cross-section, Rutherford scattering-derivation.

UNIT-III

3. Mechanics of Rigid bodies

Definition of rigid body, rotational kinematic relations, equation of motion for a rotating body, angular momentum, Euler equations and its applications, precession of a top, Gyroscope, precession of the equinoxes.

4. Mechanics of continuous media

Elastic constants of isotropic solids and their relations, Poisson's ratio and expression for Poisson's ratio in terms of γ , n , k . Classification of beams, types of bending, point load, distributed load, shearing force and bending moment, sign conventions.

UNIT-IV

5. Central forces

Central forces, definition and examples, characteristics of central forces, conservative nature of central forces, conservative force as a negative gradient of potential energy, equation of motion under a central force. Derivation of Kepler's laws. Motion of satellites, idea of Global Positioning System (GPS).

UNIT-V

6. Special theory of relativity

Galilean relativity, absolute frames. Michelson-Morley experiment, negative result. Postulates of special theory of relativity. Lorentz transformation, time dilation, length contraction, addition of velocities, mass-energy relation. Concept of four-vector formalism.

Practical paper 1: Mechanics & Properties of Matter

Minimum of 6 experiments to be done and recorded

1. Viscosity of liquid by the flow method (Poiseuille's method)
2. Young's modulus of the material of a bar (scale) by uniform bending
3. Young's modulus of the material of a bar (scale) by non-uniform bending
4. Surface tension of a liquid by capillary rise method
5. Determination of radius of capillary tube by Hg thread method
6. Viscosity of liquid by Searle's viscometer method
7. Bifilar suspension –moment of inertia of a regular rectangular body.
8. Determination of moment of inertia using Fly-wheel
9. Determination of the height of a building using a sextant.
10. Rigidity modulus of material of a wire-dynamic method (torsional pendulum)

SRI VANI DEGREE & PG COLLEGE, ANATAPURAMU.
DEPARTMENT OF PHYSICS
Paper II: Waves & Oscillations (For Maths Combinations)
II SEMESTER

UNIT-I

1. Simple Harmonic oscillations

Simple harmonic oscillator and solution of the differential equation-Physical characteristics of SHM, torsion pendulum-measurements of rigidity modulus, compound pendulum- measurement of 'g', Principle of superposition, beats, combination of two mutually perpendicular simple harmonic vibrations of same frequency and different frequencies. Lissajous figures.

UNIT-II

2. Damped and forced oscillations

Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy considerations, comparison with un-damped harmonic oscillator, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance and velocity resonance.

UNIT-III

3. Complex vibrations

Fourier theorem and evaluation of the Fourier coefficients, analysis of periodic wave functions-square wave, triangular wave, saw tooth wave, simple problems on evaluation of Fourier coefficients.

UNIT-IV

4. Vibrating strings:

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 and harmonics. Energy transport and transverse impedance.

5. Vibrations of bars:

Longitudinal vibrations in bars-wave equation and its general solution. Special cases (i) bar fixed at both ends (ii) bar fixed at the midpoint (iii) bar fixed at one end. Tuning fork.

UNIT-V

6. Ultrasonic's:

Ultrasonic's, properties of ultrasonic waves, production of ultrasonic's by piezoelectric and magnetostriction methods, detection of ultrasonic's, determination of wavelength of ultrasonic waves. Applications of ultrasonic waves.

Practical Paper II: Waves & Oscillations

1. Volume resonator experiment
2. Determination of 'g' by compound/bar pendulum
3. Simple pendulum normal distribution of errors-estimation of time period and the error of the mean by statistical analysis
4. Determination of the force constant of a spring by static and dynamic method.
5. Determination of the elastic constants of the material of a flat spiral spring.
6. Coupled oscillators
7. Verification of laws of vibrations of stretched string –sonometer
8. Determination of frequency of a bar –Melde's experiment.
9. Study of a damped oscillation using the torsional pendulum immersed in liquid-decay constant and damping correction of the amplitude.
10. Formation of Lissajous figures using CRO.

SRI VANI DEGREE & PG COLLEGE, ANANTHAPURAMU

DEPARTMENT OF PHYSICS
SEMESTER-III (WAVE OPTICS)

UNIT-I

1. Aberrations:

Introduction – 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.

UNIT-II

2. Interference

Principle of superposition – coherence-temporal coherence and spatial coherence-conditions for interference of light. Fresnel's biprism-determination of wavelength of light –change of phase on reflection. Oblique incidence of a plane wave on a thin film due to reflected and transmitted light (cosine law) –colors of thin films-

Interference by a film with two non-parallel reflecting surfaces (Wedge shaped film). Determination of diameter of wire, Newton's rings in reflected light. Michelson interferometer, Determination of wavelength of monochromatic light using Newton's rings and Michelson Interferometer.

UNIT-III

3. Diffraction

Introduction, distinction between Fresnel and Fraunhofer diffraction, Fraunhofer diffraction – Diffraction due to single slit-Fraunhofer diffraction due to double slit-Fraunhofer diffraction pattern with N slits (diffraction grating). Resolving power of grating, Determination of wavelength of light in normal incidence and minimum deviation methods using diffraction grating,

Fresnel's half period zones-area of the half period zones-zone plate-comparison of zone plate with convex lens-difference between interference and diffraction.

UNIT-IV

4. Polarisation:

Polarized light: methods of polarization polarization by reflection, refraction, double refraction, scattering of light-Brewster's law-Mauls law-Nicol prism polarizer and analyzer-Quarter wave plate, Half wave plate-optical activity, determination of specific rotation by Laurent's half shade polarimeter-Babinet's compensator - idea of elliptical and circular polarization

UNIT-V

5. Lasers and Holography

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-Gabor hologram and its limitations, Applications of holography.

6. Fiber Optics

Introduction- different types of fibers, rays and modes in an optical fiber, fiber material, principles of fiber communication (qualitative treatment only), advantages of fiber optic communication.

Practical Paper III: Wave Optics

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.

SRI VANI DEGREE & PG COLLEGE, ANATAPURAMU.
DEPARTMENT OF PHYSICS
Paper IV: Thermodynamics & Radiation Physics (For Maths Combinations)
IV SEMESTER
UNIT-I

1. Kinetic theory of gases

Introduction –Deduction of Maxwell’s law of distribution of molecular speeds, experimental verification. Transport phenomena – Mean free path - Viscosity of gases-thermal conductivity-diffusion of gases.

UNIT-II

2. Thermodynamics

Introduction- Isothermal and adiabatic process- Reversible and irreversible processes- Carnot’s engine and its efficiency-Carnot’s theorem-Second law of thermodynamics. Kelvin’s and Clausius statements-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 of a perfect gas-change of entropy when ice changes into steam.

UNIT-III

3. Thermodynamic potentials and Maxwell’s equations

Thermodynamic potentials-Derivation of Maxwell’s thermodynamic relations-Clausius-Clayperon’s equation-Derivation for ratio of specific heats-Derivation for difference of two specific heats for perfect gas. Joule Kelvin effect-expression for Joule Kelvin coefficient for perfect and vander Waal’s gas.

UNIT-IV

4. Low temperature Physics

Introduction-Joule Kelvin effect-Porous plug experiment - Joule expansion-Distinction between adiabatic and Joule Thomson expansion-Expression for Joule Thomson cooling-Liquefaction of helium, Kapitza’s method-Adiabatic demagnetization, Production of low temperatures -applications of substances at low temperature-effects of chloro and fluoro carbons on ozone layer.

UNIT-V

5. Quantum theory of radiation

Blackbody-Ferry’s black body-distribution of energy in the spectrum of black body-Wien’s displacement law, Wein’s law, Rayleigh-Jean’s law-Quantum theory of radiation-Planck’s law-Measurement of radiation-Types of pyrometers-Disappearing filament optical pyrometer-experimental determination – Angstrompyrheliometer-determination of solar constant, Temperature of Sun.

Practical Paper IV: Thermodynamics & Radiation Physics

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. Thermoemf- 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.

SRI VANI DEGREE & PG COLLEGE, ANANTHAPURAMU
DEPARTMENT OF PHYSICS
SEMESTER-V (PAPER V: Electricity, Magnetism & Electronics)

UNIT-I

1. Electric field intensity and potential:

Gauss's law statement and its proof- Electric field intensity due to (1) Uniformly charged sphere and (2) an infinite conducting sheet of charge. Electrical potential – equipotential surfaces- potential due to i) a point charge, ii) charged spherical shell and uniformly charged sphere.

2. Dielectrics:

Electric dipole moment and molecular polarizability- Electric displacement D , electric polarization P – relation between D , E and P - Dielectric constant and susceptibility. Boundary conditions at the dielectric surface.

UNIT-II

3. Electric and magnetic fields

Biot-Savart's law, explanation and calculation of B due to long straight wire, a circular current loop and solenoid – Lorentz force – Hall effect – determination of Hall coefficient and applications.

4. Electromagnetic induction

Faraday's law-Lenz's law- Self and mutual inductance, coefficient of coupling, calculation of self inductance of a long solenoid, energy stored in magnetic field. Transformer - energy losses - efficiency.

UNIT-III

5. Alternating currents and electromagnetic waves

Alternating current - Relation between current and voltage in LR and CR circuits, vector diagrams, LCR series and parallel resonant circuit, Q -factor, power in ac circuits.

6. Maxwell's equations

Idea of displacement current - Maxwell's equations (integral and differential forms) (no derivation), Maxwell's wave equation (with derivation), Transverse nature of electromagnetic waves. Poynting theorem (statement and proof), production of electromagnetic waves (Hertz experiment).

UNIT-IV

7. Basic electronics:

PN junction diode, Zener diode, Tunnel diode, I-V characteristics, PNP and NPN transistors, CB, CE and CC configurations – Relation between α , β and γ - transistor (CE) characteristics - Determination of hybrid parameters, Transistor as an amplifier.

UNIT-V

8. Digital electronics

Number systems - Conversion of binary to decimal system and vice versa. Binary addition and subtraction (1's and 2's complement methods). Laws of Boolean algebra - De Morgan's laws- statement and proof, Basic logic gates, NAND and NOR as universal gates, exclusive-OR gate, Half adder and Full adder, Parallel adder circuits

Practical Paper V: Electricity, Magnetism & Electronics

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.
6. PN Junction Diode Characteristics
7. Zener Diode Characteristics
8. Transistor CE Characteristics- Determination of hybrid parameters
9. Logic Gates- OR, AND, NOT and NAND gates. Verification of Truth Tables.
10. Verification of De Morgan's Theorems.

SRI VANI DEGREE & PG COLLEGE, ANANTHAPURAMU

DEPARTMENT OF PHYSICS

SEMESTER-V (PAPER VI: MODERN PHYSICS)

UNIT-I

1. Atomic and molecular physics

Introduction –Drawbacks of Bohr’s atomic model- Sommerfeld’s elliptical orbits-relativistic correction (no derivation). Vector atom model and Stern-Gerlach experiment - quantum numbers associated with it. L-S and j- j coupling schemes. Zeeman effect and its experimental arrangement.

Raman effect, hypothesis, Stokes and Anti Stokes lines. Quantum theory of Raman effect. Experimental arrangement – Applications of Raman effect.

UNIT-II

2. Matter waves & Uncertainty Principle

Matter waves, de Broglie’s hypothesis - wavelength of matter waves, Properties of matter waves - Davisson and Germer experiment – Phase and group velocities.

Heisenberg’s uncertainty principle for position and momentum (x and p), & energy and time (E and t). Experimental verification - Complementarity principle of Bohr.

UNIT-III

3. Quantum (wave) mechanics

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 particle in one dimensional infinite box.

UNIT-IV

4. General Properties of Nuclei

Basic ideas of nucleus -size, mass, charge density (matter energy), binding energy, angular momentum, parity, magnetic moment, electric moments. Liquid drop model and Shell model (qualitative aspects only) - Magic numbers.

5. Radioactivity decay:

Alpha decay: basics of α -decay processes. Theory of α -decay, Gamow’s theory, Geiger Nuttal law. β -decay, Energy kinematics for β -decay, positron emission, electron capture, neutrino hypothesis.

UNIT-V

6. Crystal Structure

Amorphous and crystalline materials, unit cell, Miller indices, reciprocal lattice, types of lattices, diffraction of X-rays by crystals, Bragg’s law, experimental techniques, Laue’s method and powder diffraction method.

7. Superconductivity:

Introduction - experimental facts, critical temperature - critical field - Meissner effect – Isotope effect - Type I and type II superconductors - BCS theory (elementary ideas only) - applications of superconductors.

Practical Paper VI: Modern Physics

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. Study of absorption of α -rays.
5. Study of absorption of β -rays.
6. Determination of Range of β -particles.
7. Determination of M & H.
8. Analysis of powder X-ray diffraction pattern to determine properties of crystals.
9. Energy gap of a semiconductor using junction diode.
10. Energy gap of a semiconductor using thermister.

SRI VANI DEGREE & PG COLLEGE, ANANTHAPURAMU
DEPARTMENT OF PHYSICS
SEMESTER-VI (ELECTIVE PAPER VII: RENEWABLE ENERGY)

UNIT-I

1. 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. Origin and time scale of fossil fuels, Conventional energy sources, Role of energy in economic development and social transformation.

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. Effect of pollution due to thermal power station, nuclear power generation, hydroelectric power stations on ecology and environment.

UNIT-II

3. Global Energy Scenario: Energy consumption in various sectors, projected energy consumption for the next century, exponential increase in energy consumption, energy resources, coal, oil, natural gas, nuclear and hydroelectric power, impact of exponential rise in energy usage on global economy.

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

UNIT-III

5. Solar energy: Solar energy, Spectral distribution of radiation, Flat plate collector, solar water heating system, Applications, Solar cooker. Solar cell, Types of solar cells, Solar module and array, Components of PV system, Applications of solar PV systems.

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

UNIT-IV

7. Ocean Energy: Introduction, Principle of ocean thermal energy conversion, Tidal power generation, Tidal energy technologies, Energy from waves, Wave energy conversion, Wave energy technologies, advantages and disadvantages.

8. Hydrogen Energy: History of hydrogen energy - Hydrogen production methods - Electrolysis of water, Hydrogen storage options - Compressed and liquefied gas tanks, Metal hydrides; Hydrogen safety - Problems of hydrogen transport and distribution - Uses of hydrogen as fuel.

UNIT-V

9. Bio-Energy

Energy from biomass - Sources of biomass - Different species - Conversion of biomass into fuels - Energy through fermentation - Pyrolysis, gasification and combustion - Aerobic and anaerobic bio-conversion - Properties of biomass - Biogas plants - Types of plants - Design and operation - Properties and characteristics of biogas.

Elective Paper-VII-C: Practical: Renewable Energy

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.

SRI VANI DEGREE & PG COLLEGE, ANANTHAPURAMU
DEPARTMENT OF PHYSICS
SEMESTER-VI (CLUSTER ELECTIVE-1)
PAPER VIII-C-1: SOLAR THERMAL & PHOTOVOLTAIC ASPECTS

UNIT-I

1. Basics of Solar Radiation: Structure of Sun, Spectral distribution of extra terrestrial radiation, 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 – Thermoelectric pyranometer and pyrheliometer.

2. Radiative Properties and Characteristics of Materials: Reflection, absorption and transmission of solar radiation through single and multi covers; Kirchhoff's law – Relation between absorptance, emittance and reflectance; Selective Surfaces - preparation and characterization, Types and applications; Anti-reflective coating.

UNIT-II

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.

4. Concentrating Collectors: Classification, design and performance parameters; Definitions of aperture, rim-angle, concentration ratio and acceptance angle; Tracking systems; Parabolic trough concentrators; Concentrators with point focus.

Unit-III

5. Solar photovoltaic (PV) cell: Physics of solar cell – Type of interfaces, homo, hetero and Schottky 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.

6. Solar cell fabrication: Production of single crystal Silicon: Czochralski (CZ) and Float Zone (FZ) methods, Silicon wafer fabrication, Wafer to cell formation, Thin film solar cells, Advantages, CdTe/CdS cell formation, Multi-junction solar cell; Basic concept of Dye-sensitized solar cell, Quantum dot solar cell.

UNIT-IV

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 – use of Bypass and Blocking diodes, Solar PV system and its components, PV array, inverter, battery and load.

UNIT-V

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.

Solar PV applications: SPV systems; Stand alone, hybrid and grid connected systems, System installation, operation and maintenance; Field experience; PV market analysis and economics of SPV systems.

Cluster Elective Paper- VIII-C-1: Practical: Solar Thermal and Photovoltaic Aspects

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 transmissivity.
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.

SRI VANI DEGREE & PG COLLEGE, ANANTHAPURAMU
DEPARTMENT OF PHYSICS
SEMESTER-VI (CLUSTER ELECTIVE-2)
PAPER VIII-C-2: WIND, HYDRO & OCEAN ENERGIES

UNIT-I

- 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.
- 2. Wind Measurements:** Eolian features, biological indicators, rotational anemometers, other anemometers, wind measurements with balloons.

UNIT-II

- 3. Wind Energy Conversion System:** Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element and combine theory; Rotor characteristics; Maximum power coefficient; Prandtl's tip loss correction.
- 4. Design of Wind Turbine:** Wind turbine design considerations; Methodology; Theoretical simulation of wind turbine characteristics; Test methods.

UNIT-III

- 5. Wind Energy Application:** Wind pumps: Performance analysis, design concept and testing; Principle of wind energy generation; Standalone, grid connected and hybrid applications of wind energy conversion systems, Economics of wind energy utilization; Wind energy in India; Environmental Impacts of Wind farms.

UNIT-IV

- 6. 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; Investment issues load management and tariff collection; potential of small hydro power in India. Wind and hydro based stand-alone hybrid power systems.

UNIT-V

- 7. Ocean Thermal, Tidal and Wave Energy Systems:** Ocean Thermal - Introduction, Technology process, Working principle, Resource and site requirements, Location of OCET system, Electricity generation methods from OCET, Advantages and disadvantages, Applications of OTEC,
- 8. Tidal Energy** - Introduction, Origin and nature of tidal energy, Merits and limitations, Tidal energy technology, Tidal range power, Basic modes of operation of tidal systems. Wave Energy – Introduction, Basics of wave motion, Power in waves, Wave energy conversion devices, Advantages and disadvantages, Applications of wave energy.

Cluster Elective Paper- VIII-C-2: Practical: Wind, Hydro and Ocean Energies

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.

SRI VANI DEGREE & PG COLLEGE, ANANTHAPURAMU
DEPARTMENT OF PHYSICS
SEMESTER-VI (CLUSTER ELECTIVE-3)
PAPER VIII-C-3: ENERGY STORAGE DEVICES

UNIT-I

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, bio-chemical, electro-chemical, fossil fuels and synthetic fuels. Hydrogen for energy storage.

UNIT-II

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

UNIT-III

3. Magnetic and Electric Energy Storage Systems: Superconducting Magnet Energy Storage (SMES) systems; Capacitor and battery: Comparison and application; Super capacitor: Electrochemical Double Layer Capacitor (EDLC), principle of working, structure, performance and application.

UNIT-IV

4. Fuel Cell: Fuel cell definition, difference between batteries and fuel cells, fuel cell components, principle and working of fuel cell, performance characteristics, efficiency, fuel cell stack, fuel cell power plant: fuel processor, fuel cell power section, power conditioner, Advantages and disadvantages.

UNIT-V

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

Cluster Elective Paper –VIII-C-3: Practical: Energy Storage Devices

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.