Dr. B. R. AMBEDKAR UNIVERSITY-SRIKAKULAM

B.Sc. PHYSICS SYLLABUS
STRUCTURE UNDER CHOICE BASED CREDITS SYSTEM
REVIEWED SYLLUBUS w.e.f. 2016-17

First Semester
Paper I: Mechanics& Properties of Matter
Practical I (Lab-1)

Second Semester
Paper II: Waves & Oscillations
Practical 2 (Lab2)

B.Sc. (Physics) (Mathematics Combinations)

Scheme of instruction and examination to be followed w.e.f. 2016-2017

S. No	Semester	Title of the paper	Instruc-tion hrs/week	Duration of exam(hrs)	Max Marks (external)
Thoery					
1	First	Paper I: Mechanics & Properties of Matter	4	3	75
2	Second	Paper II: Waves & Oscillations	4	3	75
Practicals					
1	First	Practical 1	2	3	50
2	Second	Practical II	2	3	50

B.Sc. PHYSICS SYLLABUS UNDER CHOICE BASED CREDIT SYSTEM

B.Sc. I Semester Physics

Paper I: Mechanics & Properties of Matter

(For Mathematics Combinations)

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

UNIT-I (10 hrs)

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 (10 hrs)

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 (16 hrs)

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 y, n, k. Classification of beams, types of bending, point load, distributed load, shearing force and bending moment, sign conventions.

UNIT-IV (12Hrs)

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, equatglobal ion of motion under a central force. Derivation of Kepler’s laws. Motion of satellites, idea of Global Positioning System (GPS).

UNIT-V (12 hrs)

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.

REFERENCE BOOKS:

1. B. Sc. Physics, Vol.1, Telugu Academy, Hyderabad
2. Fundamentals of Physics Vol. I - Resnick, Halliday, Krane ,Wiley India 2007
3. Unified Physics, Vol. 1, S.L. Gupata & S. Guptha, Jai Prakash Nath & Co, Meerut.
4. College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
5. University Physics-FW Sears, MW Zemansky & HD Young,Narosa Publications, Delhi
6. Mechanics, S.G.Venkatachalapathy, Margham Publication, 2003.

Practical paper 1: Mechanics & Properties of Matter

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

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 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)

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

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Examples

Seminars	- A topic from any of the Units is given to the student and asked to give a brief seminar presentation.
Group discussion to	- A topic from one of the units is given to a group of students and asked to discuss and debate on it.
Assignment	- Few problems may be given to the students from the different units and asked them to solve.
Field trip	- Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.
Study project	- Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

B.Sc. PHYSICS SYLLABUS UNDER CHOICE BASED CREDIT SYSTEM

B.Sc. II Semester Physics

Paper II: Waves & Oscillations

(For Mathematics Combinations)

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

UNIT-I (12 hrs)

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 (12 hrs)

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 (10 hrs)

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 evolution of Fourier coefficients.

UNIT-IV (17hrs)

4. Vibrating strings: 8 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 and harmonics. Energy transport and transverse impedance.

5. Vibrations of bars: 9 hrs

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 (9 hrs)

6. Ultrasonics: 9hrs

Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezoelectric and magnetostriction methods, detection of ultrasonics, determination of wavelength of ultrasonic waves. Applications of ultrasonic waves.

REFERENCE BOOKS:

1. BSc Physics Vol.1, Telugu Academy, Hyderabad.
2. Waves and Oscillations. N. Subramanyam and Brijlal, Vikas Pulications.
3. Unified Physics Vol., Mechanics, Waves and Oscillations, Jai Prakash Nath & Co. Ltd.
4. Fundamentals of Physics. Halliday/Resnick/Walker ,Wiley India Edition 2007.
5. Waves & Oscillations. S.Badami, V. Balasubramanian and K.R. Reddy, Orient Longman.
6. College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
7. Science and Technology of Ultrasonics - Baldevraj, Narosa, New Delhi,2004
8. Introduction to Physics for Scientists and Engineers. F.J. Buche. McGraw Hill.

Practical Paper II: Waves & Oscillations

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

Minimum of 6 experiments to be done and recorded

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.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

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Examples

Seminars	- A topic from any of the Units is given to the student and asked to give a brief seminar presentation.
Group discussion to	- A topic from one of the units is given to a group of students and asked to discuss and debate on it.
Assignment	- Few problems may be given to the students from the different units and asked them to solve.
Field trip	- Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.
Study project	- Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

B.Sc. Physics (Non-Mathematics Combinations)
Scheme of Syllabus and Examination to be followed w.e.f. 2015-16

S.No	Semester	Title of the paper	Instruction Hrs/week	Duration o f exam (hrs)	Max Marks (external)
Theory					
1	First	Paper I: Mechanics & Properties of Matter	4	3	75
2	Second	Paper II: Waves & Oscillations	4	3	75
Practical					
1	First	Practical 1	2	3	50
2	Second	Practical II	2	3	50

B.Sc. PHYSICS SYLLABUS UNDER CHOICE BASED CREDIT SYSTEM

B.Sc. I Semester Physics

Paper I: Mechanics & Properties of Matter

(For Non-Mathematics Combinations)

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

UNIT-I (16 hrs)

1. Mathematical Background

Scalars and vectors –vector addition-scalar and vector products of vector and their physical significance-vector calculus-gradient of a scalar point function-divergence and curl of vector-statements of Stokes and Gauss theorems -examples (no derivations).

2. Motion of system

Collisions- Elastic and inelastic collisions-Collisions in one and two dimension-Rocket propulsion-Center of mass-Motion of the centre of mass-Impact parameter-Scattering cross-section, Rutherford scattering (No derivation-Qualitative ideas only)

UNIT-II (12 hrs)

3. Mechanics of Rigid body

Rigid body, rotational kinematic relations Rotational kinetic energy and moment of inertia - moment of inertia in simple cases (Rod, disc, sphere and cylinder)- No derivations. Parallel& Perpendicular axes theorems-Torque-relation between torque and angular momentum.

Angular momentum of a particle-Torque and angular momentum for a system of particles-conservation of angular momentum-Translation and rotational motion of system-Elementary ideas about gyroscopic motion (No derivation – Qualitative ideas only)- Precession of the equinoxes.

UNIT-III (10 hrs)

4. Central forces

Central force- Definition& examples- General Characteristics of central forces-Conservative nature of central forces, Planetary motion-Kepler's laws (Statements & Explanation), Newton's law of gravitation from Kepler's law, Geostationary Satellite Motion.Uses of communication satellites.

UNIT-IV (10 hrs)

5. Fluid Flow

The flow of ideal fluids Stream line motion -Equation of continuity –Bernoulli's equation-Simple applications - Torricelli's theorem-The Venturimeter-Pitot's tube-Viscosity and the flow of real fluids- Poiseuille's equation.

UNIT-V (12 hrs)

6. Relativistic effects

Moving reference frames-Inertial and Non-inertial reference frames-Galilean relativity – Special theory of relativity-Statements of the two basic postulates- (Elementary treatment and application only) Lorentz transformation equations-length contraction-time dilation-addition of velocities-Momentum and relativistic mass- Mass –Energy equation, rest mass & momentum of a particle.

REFERENCE BOOKS:

1. BSc Physics, Vol.1 -Telugu Academy, Hyderabad
2. Physics for Biology and Premedical Students –D.N. Burns & SGG Mac Donald
3. Unified Physics Vol. I Mechanics,Waves and Oscillations – Jai Prakash Nath&Co.Ltd., Meerut.

4. Properties of Matter - D.S. Mathur, S.Chand& Co, New Delhi ,11th Edn., 2000
5. Properties of Matter - Brijlal & Subrmanyam ,S.Chand&Co. 1982

Practical paper 1: Mechanics & Properties of Matter

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

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 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)

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

Seminars	- A topic from any of the Units is given to the student and asked to give a brief seminar presentation.
Group discussion to	- A topic from one of the units is given to a group of students and asked to discuss and debate on it.
Assignment	- Few problems may be given to the students from the different units and asked them to solve.
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Study project	- Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

B.Sc. PHYSICS SYLLABUS UNDER CHOICE BASED CREDIT SYSTEM
Paper II: Waves & Oscillations
(For Non-Mathematics Combinations)
II SEMESTER

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

UNIT-I (15 hrs)

1. Oscillatory Motion

Simple harmonic motion-Equation of motion and solution-Simple harmonic motion from the standpoint of energy-The rotor diagram representation of simple harmonic motion-Compound pendulum-determination of g and k, torsional pendulum-determination of n, Combination of Simple harmonic motions along a line and perpendicular to each other-Lissajous figures-

UNIT-II (14 hrs)

2. Damped Oscillators

Damped vibrations - Explanation and examples - Forced vibrations – Explanation and examples, Resonance, examples -Sharpness of resonance Q-factor, Volume Resonator, Determination of frequency of a given tuning fork.

UNIT-III (11 hrs)

3. Wave Motion

Progressive waves-Equation of a progressive wave-sinusoidal waves-Velocity of waves in elastic media-Standing waves-Transverse vibrations of stretched strings, overtones and harmonics. Sonometer verification of laws of transverse vibrations in a stretched string, beats (qualitative analysis Only).

UNIT-IV (10 hrs)

4. Acoustics

Classification of sound, Characteristics of musical sound, Acoustics of Buildings, Reverberation, Sabine's formula (without derivation) Absorption coefficient, Factors affecting acoustics of buildings, Intensity of sound, Sound distribution in an auditorium.

UNIT-V (10 hrs)

5. Ultrasonics

Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezoelectric and magnetostriction methods, detection of ultrasonics, Applications of ultrasonic waves.

REFERENCE BOOKS

1. BSc Physics, Vol.1 -Telugu Academy, Hyderabad
2. Physics for Biology and Premedical Students –D.N. Burns & SGG Mac Donald
3. Unified Physics Vol.I, Mechanics,Waves and Oscillations – Jai Prakash Nath&Co.Ltd., Meerut.
4. Waves and Oscillations. S. Badami, V. Balasubramanian and K. Rama Reddy Orient Longman.
5. Waves and Oscillations. N. Subramaniyam and BrijlalVikas Publishing House Private Limited.
6. Acoustics – Waves and Oscillations, S.N.Sen, Wiley Estern Ltd.

Practical Paper II: Waves & Oscillations

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

Minimum of 6 experiments to be done and recorded

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.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

Seminars	- A topic from any of the Units is given to the student and asked to give a brief seminar presentation.
Group discussion to	- A topic from one of the units is given to a group of students and asked to discuss and debate on it.
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Study project	- Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

Revised Common Framework of CBCS for Colleges in Andhra Pradesh

w.e.f. 2015-16, Revised in April, 2016

Table-1: B.Sc., SEMESTER – I

Sno	Course	Total Marks	Mid Sem Exam*	Sem End Exam	Teaching Hours	Credits
1	First Language (Tel/Hin/Urdu/Sans…)	100	25	75	4	3
2	Second Language English	100	25	75	4	3
3	*Foundation Course - 1* Human Values & Professional Ethics	50	0	50	2	2
4	*Foundation course -2* Environmental Studies	50	0	50	2	2
5	DSC-1 Paper-1 (Core)	100	25	75	4	3
6	DSC 1 Lab Practical	50	0	50	2	2
7	DSC 2 Paper-1 (Core)	100	25	75	4	3
8	DSC 2 Lab Practical	50	0	50	2	2
9	DSC 3 Paper-1 (Core)	100	25	75	4	3
10	DSC 3 A Lab Practical	50	0	50	2	2
	Total	750	-	-	30	25

#DSC: Domain (Subject) Specific Course (Paper)

Foundation Course: value or skill based

Note: For Science Domain Subjects which had no lab practical component earlier (eg. Mathematics) the following format is applicable. They, however, will have co-curricular activities (eg. Problem solving sessions etc.). The total marks will change accordingly for such combinations. For example for Maths, Physics and Chemistry the total marks will be 700.

	DSC (without Lab Practical)	100	25	75	6	5

*Mid sem exam at the college (The marks split between Formal Test and Co-curricular activities may be decided by the University concerned). End Sem Exam by the Univ.

*Practical component will not be applicable to those science subjects which had no such component earlier (ex. Mathematics)

**Syllabus size shall be in accordance with the number of teaching hours

Table-2: B.Sc., SEMESTER – II

Sno	Course	Total Marks	Mid Sem Exam	Sem End Exam	Teaching Hours	Credits
1	First Language (Tel/Hin/Urdu/Sans…)	100	25	75	4	3
2	Second Language English	100	25	75	4	3
3	*Foundation course – 3* ICT – I	50	0	50	2	2
4	*Foundation course – 4* CSS – I	50	0	50	2	2
5	DSC 1 Paper-2 (Core)	100	25	75	4	3
6	DSC 1 Lab Practical	50	0	50	2	2
7	DSC 2 Paper-2 (Core)	100	25	75	4	3
8	DSC 2 Lab Practical	50	0	50	2	2
9	DSC 3 Paper-2 (Core)	100	25	75	4	3
10	DSC 3 Lab Practical	50	0	50	2	2
	Total	750	-	-	30	25

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B.Sc. PHYSICS SYLLABUS
STRUCTURE UNDER CHOICE BASED CREDITS SYSTEM
REVIEWED SYLLUBUS w.e.f. 2016-17

Third Semester

Paper III: Wave Optics
Practical 3. (Lab 3)

Fourth Semester

Paper IV: Thermodynamics & Radiation Physics
Practical 4. (Lab 4)

B.Sc. (Physics) (Mathematics Combinations)
Scheme of instruction and examination to be followed w.e.f. 2015-16

S. No	Semester	Title of the paper	Instruc-tion hrs/week	Duration of exam(hrs)	Max Marks (external)
Thoery					
3	Third	Paper III: Wave Optics	4	3	75
4	Fourth	Paper IV: Thermodynamics & Radiation Physics	4	3	75
Practicals					
3	Third	Practical III	2	3	50
4	Fourth	Practical IV	2	3	50

B.Sc. PHYSICS SYLLABUS UNDER CHOICE BASED CREDIT SYSTEM
Paper III: Wave Optics
(For Mathematics Combinations)
III SEMESTER

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

UNIT-I (8 hrs)

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 (14 hrs)

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 (14 hrs)

3. Diffraction

Introduction, distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction –Diffraction due to single slit - Fraunhoffer diffraction due to double slit - Fraunhoffer 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(10 hrs)

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 (14 hrs)

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.

REFERENCE BOOKS:

1. BSc Physics, Vol.2, Telugu Akademy, Hyderabad
2. A Text Book of Optics - N Subramanyam, L Brijlal, S.Chand& Co.
3. Unified Physics Vol. II Optics & Thermodynamics – Jai Prakash Nath&Co.Ltd., Meerut
4. Optics,F..A. Jenkins and H.G. White, Mc Graw-Hill
5. Optics, Ajoy Ghatak, Tata Mc Graw-Hill.
6. Introduction of Lasers – Avadhanulu, S.Chand& Co.
7. Principles of Optics- BK Mathur, Gopala Printing Press, 1995

Practical Paper III: Wave Optics

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

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.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

Seminars	- A topic from any of the Units is given to the student and asked to give a brief seminar presentation.
Group discussion to	- A topic from one of the units is given to a group of students and asked to discuss and debate on it.
Assignment	- Few problems may be given to the students from the different units and asked them to solve.
Field trip	- Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.
Study project	- Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

B.Sc. PHYSICS SYLLABUS UNDER CHOICE BASED CREDIT SYSTEM
Paper IV: Thermodynamics & Radiation Physics
(For Mathematics Combinations)
IV SEMESTER

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

UNIT-I (10 hrs)

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 (12 hrs)

2. Thermodynamics

Introduction - Isothermal and adiabatic process - Reversible and irreversible processes- Carnnot's engine and its efficiency - Carnot's theorem - Second law of thermodynamics. Kelvin's and Claussius 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 (12 hrs)

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 van der Waal's gas.

UNIT-IV (12 hrs)

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 lowtemperature - effects of chloro and fluoro carbons on ozone layer.

UNIT-V (14 hrs)

5. Quantum theory of radiation

Blackbody - Ferry's black body - distribution of energy in the spectrum of black body - Wein'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 – Angstrom pyrheliometer - determination of solar constant, Temperature of Sun.

REFERENCE BOOKS:

1. BSc Physics, Vol.2, Telugu Akademy, Hyderabad
2. Thermodynamics, R.C.Srivastava, S.K.Saha & Abhay K.Jain, Eastern Economy Edition.
3. Unified Physics Vol.2, Optics & Thermodynamics, Jai Prakash Nath & Co.Ltd., Meerut
4. Fundamentals of Physics. Halliday/Resnick/Walker.C. Wiley India Edition 2007

5. Heat, Thermodynamics and Statistical Physics-N Brij Lal, P Subrahmanyam, PS Hemne, S.Chand & Co., 2012
6. Heat and Thermodynamics- MS Yadav, Anmol Publications Pvt. Ltd, 2000
7. University Physics, HD Young, MW Zemansky,FW Sears, Narosa Publishers, New Delhi

Practical Paper IV: Thermodynamics & Radiation Physics

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

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.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

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Domain skills:

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B.Sc. PHYSICS SYLLABUS UNDER CHOICE BASED CREDIT SYSTEM

B.Sc. III Semester Physics

Paper III: Optics

(For Non- Mathematics Combinations)

III SEMESTER

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

UNIT –I (10 hrs)

1. Geometric optics

Aberrations in lenses-Chromatic Aberration-Achromatic Combination of lenses-Monochromatic defects-Spherical aberration-Astigmatism-Coma-Curvature and Distortion-Minimizing aberration.

UNIT-II (13 hrs)

2. Interference

The superstition principle, Condition for Interference, Classification of Interferences methods-Young's double slit experiment-Theory. Interference with white light and appearance of Young's interference fringes-Intensity in interference pattern - Optical Path length, Lloyd's single mirror-Phase change on reflection, Interference due to plane parallel wedge shaped films, Colours in thin films-Newton rings, Determination of wavelength of light. Michelson's interferometer.

UNIT-III (12 hrs)

3. Diffraction

The Fresnel and Fraunhoffer diffraction phenomena-Fraunhoffer diffraction of single Slit normal incidence and oblique incidence – Resolving power –limits of resolution for telescopes and microscope- Fraunhoffer diffraction by double slit-Intensity-pattern- Diffraction grating-Wavelength determination (Normal incidence and Minimum deviation).

UNIT-IV (13hrs)

4. Polarization

Types of Polarized light-Polarization by reflection, Brewster's law-Dichroism the Polaroid-double refraction- the calcite crystal-the principal plane-O and E rays-the Nicol Prism, Polariserand Analyser, Law of Malus –the quarter wave plate and halfwave plate Plane, Circularly, elliptically polarized light-Production and analysis -Optical activity-Specific rotatory power –Polarimeter.

UNIT V: (12 hrs)

5. Holography & Fiber Optics

Holography: Basic principle of holography-Gabor hologram and its limitations, applications of holography. Introduction- different types of fibres, rays and modes in an optical fibre, fibre material, principles of fiber communication (qualitative treatment only), applications.

REFERENCE BOOKS

1. BSc Physics, Vol.2, Telugu Academy, Hyderabad
2. Physics for Biology and Premedical Students –D.N. Burns & SGG Mac Donald
3. Unified Physics Vol.II, Optics and Thermodynamics,*Jai Prakash Nath&Co.Ltd., Meerut*.
4. Optics, Ajoy Ghatak, Tata Mc Graw-Hill.
5. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication
6. Introduction of Lasers – Avadhanulu, S.Chand& Co.
7. Principles of Optics- BK Mathur, Gopala Printing Press, 1995

Practical Paper III: Optics

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

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 fiber by wedge method
10. Determination of refractive index of liquid-Boy's method.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

Seminars	- A topic from any of the Units is given to the student and asked to give a brief seminar presentation.
Group discussion	- A topic from one of the units is given to a group of students and asked to discuss and debate on it.
Assignment	- Few problems may be given to the students from the different units and asked them to solve.
Field trip	- Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.
Study project	- Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

B.Sc. PHYSICS SYLLABUS UNDER CHOICE BASED CREDIT SYSTEM
Paper IV: Thermodynamics & Radiation Physics
(For Non- Mathematics Combinations)
IV SEMESTER

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

UNIT-I (12 hrs)

1. Kinetic theory of Gases

Zeroth law of thermodynamics, Measurment of temperature- resistance thermometry, thermoelectric theromometers - kinetic theory of gases- assumptions-pressure of an ideal gas-molecular interpretation of temperature- Maxwell's law of distribution of molecular speeds (no derivation)-experimental verification.

UNIT-II (12 hrs)

2. Thermodynamics

The first law of thermodynamics- work done in isothermal and adiabatic changes -Reversible and irreversible process-Carnot's cycle-Carnot's theorem - Second law of thermodynamics, Kelvin's and Claussius statements - Entropy, physical significance-Change in entropy in reversible and irreversible processes-Entropy and disorder-Entropy of universe.

UNIT-III (12 hrs)

3. Low temperature Physics

Introduction-Joule Kelvin effect - porous plug experiment. Joule's expansion-Distinction between adiabatic and Joule Thomson expansion - Liquefaction of helium Kapitza's method-Adiabatic demagnetization - Production of low temperatures-Principle of refrigeration. applications of substances at low-temperature.

UNIT-IV (12 hrs)

4. Measurement, laws and theories of radiation

Black body - Ferry's black body-distribution of energy in the spectrum of Black body - Wein's law - Planck's radiation formula (no derivation) - Measurement of radiation - Types of pyrometers - Disappearing filament optical pyrometer - experimental determination - Angstrom Pyroheliometer - determination of solar constant, effective temperature of Sun.

UNIT-V (12 hrs)

5. Thermoelectricity

Seebeck effect variation of thermo – emf with temperature. Thermo electric series - Measurement of thermo emf using potentiometer, Law of intermediate metals and intermediate temperatures - Peltier effect, Demonstration Peltier coefficient. Thomson effect demonstration Thomson coefficient, Thermoelectric diagrams and their uses, Thermoelectric power. Application of Thermoelectric effects.

REFERENCE BOOKS

1. BSc Physics, Vol.2, Telugu Academy, Hyderabad
2. Physics for Biology and Premedical Students –D.N. Burns & SGG Mac Donald
3. Unified Physics Vol. II, Optics and Thermodynamics, Jai Prakash Nath & Co.Ltd., Meerut.
4. Heat and Thermodynamics, N. Subramanyam and L. Brijlal, S.Chand & Co.
5. Electricity and Magnetism, N.Subramanyam and L.Brijlal, S.Chand & Co.
6. University Physics, HD Young, MW Zemansky,FW Sears, Narosa Publishers, New Delhi

Practical Paper IV: Thermodynamics & Radiation Physics

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

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.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

Seminars	- A topic from any of the Units is given to the student and asked to give a brief seminar presentation.
Group discussion	- A topic from one of the units is given to a group of students and asked to discuss and debate on it.
Assignment	- Few problems may be given to the students from the different units and asked them to solve.
Field trip	- Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.
Study project	- Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

B.Sc. Table-III: B.Sc., SEMESTER – III

SEMESTER – III

Sno	Course	Total Marks	Mid Sem Exam	Sem End Exam	Teaching Hours	Credits
1	First Language (Tel/Hin/Urdu/Sans…)	100	25	75	4	3
2	Second Language English	100	25	75	4	3
3	*Foundation Course - 5* ICT – II	50	0	50	2	2
4	*Foundation course – 6* CSS – II	50	0	50	2	2
5	DSC 1 Paper-3 (Core)	100	25	75	4	3
6	DSC 1 Practical	50	0	50	2	2
7	DSC 2 Paper-3 (Core)	100	25	75	4	3
8	DSC 2 Practical	50	0	50	2	2
9	DSC 3 Paper-3 (Core)	100	25	75	4	3
10	DSC 3 Practical	50	0	50	2	2
	Total	750	-	-	30	25

Table-IV: B.Sc., SEMESTER – IV

SEMESTER – IV

Sno	Course	Total Marks	Mid Sem Exam*	Sem End Exam	Teaching Hours**	Credits
1	*Foundation Course – 7* CSS – 2	50	0	50	2	2
2	*Foundation Course – 8* Analytical Skills	50	0	50	2	2
3	*Foundation Course - 9* Entrepreneurship	50	0	50	2	2
4	*Foundation course – 10* Leadership Education	50	0	50	2	2
5	DSC 1 Paper-4 (Core)	100	25	75	4	3
6	DSC 1 Lab Practical	50	0	50	2	2
7	DSC 2 Paper-4 (Core)	100	25	75	4	3
8	DSC 2 Lab Practical	50	0	50	2	2

9	DSC 3 Paper-4 (Core)	100	25	75	4	3
10	DSC 3 Lab Practical	50	0	50	2	2
	Total	750	-	-	30	23

*Analytical Skills: To be taught by Maths/Stat Teachers (may be partly by English Teachers)
Entrepreneurship: To be taught by Commerce Teachers
Leadership Education: To be taught by Telugu Teachers

Dr. B. R. AMBEDKAR UNIVERSITY-SRIKAKULAM

III B.Sc. (PHYSICS) SYLLABUS

STRUCTURE UNDER CHOICE BASED CREDITS SYSTEM

REVIEWED SYLLUBUS w.e.f. 2016-17

Semester V

- **Paper V: Electricity, Magnetism& Electronics**
- **Paper VI: Modern Physics**
- **Practical 5.(Lab 5)**
- **Practical 6.(Lab 6)**

Paper V: Electricity, Magnetism& Electronics
(For Mathematics Combinations)

V Semester

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

UNIT-I (12 hrs)

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 dipolemoment 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 (12 hrs)

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 (12 hrs)

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 (12 hrs)

7. **Basic electronics:**
   PN juction diode, Zener diode, Tunnel diode, I-V characteristics, PNP and NPN transistors, CB, CE and CC configurations – Relation betweenα, β and γ - transistor (CE) characteristics -Determination of hybrid parameters, Transistor as an amplifier.

UNIT-V: (12 hrs)

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.

REFERENCE BOOKS

1. BSc Physics, Vol.3, Telugu Akademy, Hyderabad.
2. Electricity and Magnetism, D.N. Vasudeva. S. Chand & Co.
3. Electricity, Magnetism with Electronics, K.K.Tewari, R.Chand& Co.,
4. Principles of Electronics, V.K. Mehta, S.Chand& Co.,
5. Digital Principles and Applications, A.P. Malvino and D.P.Leach, Mc GrawHill Edition.

Practical Paper V: Electricity, Magnetism & Electronics

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

Minimum of 6 experiments to be done and recorded

1. Figure of merit of a moving coil galvonometer.
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.

Suggested student activities
Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples
Seminars - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.
Group discussion - A topic from one of the units is given to a group of students and asked to discuss and debate on it.
Assignment - Few problems may be given to the students from the different units and asked them to solve.
Field trip - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.
Study project - Web based study of different satellites and applications.

Domain skills:
Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

***** Documental evidence is to be maintained for the above activities.**

Paper VI: Modern Physics
(For Mathematic Combinations)

V Semester

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

UNIT-I (12 hrs)

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 (12 hrs)

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 (12 hrs)

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(12 hrs)

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 (12 hrs)

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.

REFERENCE BOOKS

1. BSc Physics, Vol.4, Telugu Akademy, Hyderabad
2. Molecular Structure and Spectroscopy by G. Aruldhas. Prentice Hall of India, New Delhi.
3. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath. S. Chand & Co.
4. Modern Physics by G. Aruldhas & P. Rajagopal. Eastern Economy Edition.
5. Concepts of Modern Physics by Arthur Beiser. Tata McGraw-Hill Edition.
6. Quantum Mechanics, Mahesh C Jain, Eastern Economy Edition.
7. Nuclear Physics, Irving Kaplan, Narosa publishing House.
8. Nuclear Physics, D.C.Tayal, Himalaya Publishing House.
9. Elements of Solid State Physics, J.P.Srivastava, Prentice Hall of India Pvt., Ltd.
10. Solid State Physics, A.J. Dekker, McMillan India.

Practical Paper VI: Modern Physics

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

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.

Note: For all the above 8 practical papers the book "B.Sc Practical Physics" by C.L. Arora Published by S.Chand & Co, New – Delhi may be followed.

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

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

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Field trip - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.

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Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

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III B.Sc. (PHYSICS) SYLLABUS

STRUCTURE UNDER CHOICE BASED CREDITS SYSTEM

REVIEWED SYLLUBUS w.e.f. 2016-17

Sixth Semester

PaperVII: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 following0

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 VIis 4 hours per paper for theory and2 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 as30 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

***NOTE: Practical syllabus is same for both Mathematics and Non Mathematics combinations**

B.Sc. (Physics) (Maths Combinations)

Scheme of instruction and examination to be followed w.e.f. 2015-2016

S. No	Semester	Title of the paper	Instruc-tion hrs/week	Duration of exam(hrs)	Max Marks (external)
Thoery					
1	First	Paper I: Mechanics& Properties of Matter	4	3	75
2	Second	Paper II: Waves & Oscillations	4	3	75
3	Third	Paper III: Wave Optics	4	3	75
4	Fourth	Paper IV: Thermodynamics & Radiation Physics	4	3	75
5	Fifth	Paper V:Electricity, Magnetism& Electronics Paper VI: Modern Physics	4 4	3 3	75 75
6	Sixth	PaperVII :Elective (One) Paper VIII: Cluster Electives (Three)	4 4	3 3	75 75
Practicals					
1	First	Practical 1	2	3	50
2	Second	Practical II	2	3	50
3	Third	Practical III	2	3	50
4	Fourth	Practical IV	2	3	50
5	Fifth	Practical V	2	3	50
6		Practical VI	2	3	50
7	Sixth	Practical VII	2	3	50
8		Practical VIII	2	3	50

Model question Paper for all theory papers

Time : 3 hrs **Max marks : 75**

Section-A (Essay type)

Answer All questions with internal choice from all units Marks :10x5 = 50

(Two questions are to be set from each unit with either or type)

Section-B (Short answer type)

Answer any three out of 5 questions from all units (I to V) Marks: 5 x3 = 15

At least one question should be set from each unit.

Section-C

Answer any two out of 5 questions set from all units Marks: 5x2 = 10

Paper–VII-(A) Elective (Electronics)

Semester –VI

Elective Paper –VII-(A): Analog and Digital Electronics

No. of Hours per week: 04 **Total Lectures: 60**

Unit-I (14 Hours)

1. FET-Construction, Working, characteristics and uses; MOSFET-enhancement MOSFET, depletion MOSFET, construction and working , drain characteristics of MOSFET, applications of MOSFET
2. Photo electric devices: Structure and operation, characteristics, spectral response and application of LDR, LEDand LCD

Unit-II (10Hours)

3. Operational Amplifiers: Characteristics of ideal and practical Op-Amp (IC 741), Basic differential amplifiers, Op-Amp supply voltage, IC identification, Internal blocks of Op-Amp, its parameter off set voltages and currents, CMRR, slew rate, concept of virtualground.

Unit-III (10 Hours)

4. Applications of Op-Amp: Op-Amp as voltage amplifier, Inverting amplifier, Non-inverting amplifier, voltage follower, summing amplifier, difference amplifier, comparator, integrator, differentiator.

Unit-IV(14 Hours)

5. Data processing circuits: Multiplexers, De-multiplexers, encoders, decoders, Characteristics for Digital ICs -RTL, DTL, TTL, ECL CMOS (NAND & NOR Gates).
6. IC 555 Timer -Its pin diagram,internal architecture, Application as astablemultivibrator and mono stable multivibrator.

Unit-V (12 Hours)

7. Sequential digital circuits:Flip-flops, RS, Clocked SR, JK, D, T, Master-Slave, Flip- flop, Conversion of Flip flops.
8. Code Converters: Design of code converter, BCD to 7 segment, binary/BCD to gray, gray to binary/BCD ,design of counters using state machine.

Reference Books

1. Digital Electronics by G.K.Kharate Oxford University Press
2. Unified Electronics by Agarwal and Agarwal.
3. Op- Amp and Linear ICs by Ramakanth A Gayekwad, 4th edition PHI
4. Digital Principles and Applications by Malvino and Leach, TMH, 1996, 4th edition.
5. Digital Circuit design by Morris Mano,PHI
6. Switching Theory and Logic design by A.AnandKumar ,PHI
7. operations amplifier by SV Subramanyam.

Elective Paper-VII Practical: Analog and Digital Electronics
2hrs/Week

Minimum of 6 experiments to be done and recorded

1) Characteristics of FET
2) Characteristics of MOSFET
3) Characteristics of LDR
4) Characteristics of Op-amp.(IC741)
5)Op-Amp as amplifier/inverting amplifier
6) Op-Amp as integrator/differentiator
7) Op-Amp as summing amplifier/difference amplifier
8) IC 555 as astable multivibrator
9) IC 555 as monostable amplifier
10) Master slave flip-flop
11) JK flip-flop

Semester –VI
Cluster Electives VIII-A
Paper – VIII-A-1: Introduction to Microprocessors and Microcontrollers

No. of Hours per week: 04 **Total Lectures: 60**

Unit – I (10Hours)
1. Introduction to microcontrollers:General purpose of computer systems,architecture of embedded system, classification, applications and purposes, challenges and designs, operational and non operational quality attributes, elemental description of embedded processors and micro controllers

Unit –II (10Hours)
2. Microprocessors:Organisation of microprocessorbased system, 8085 microprocessor,its pin diagram and architecture, concept of data bus, and address bus, 8085 programming, instruction classification, stacks and its implementation, hardware and software interrupts.

Unit– III (15Hours)
3. 8051 microcontroller:Introduction , block diagram, assembly language programming, programme counter, ROM memory, data types and directives, flag bits PSW register, jump, loop and call constructions
4. 8051 I/O Programming: Introduction to I/O port programming, pin out diagram, I/O port pin programming, bit manipulation, addressing modes, accessing memory, arithmetic and logic instructions.

Unit – IV (13 Hours)
5. Timers:Programming of 8051 timers, counter programming, interrupts, externalhardware interrupts**,** serial communication interrupts, interrupt priority.
6. Embedded system programming:Structure of programming, infinite loop, compiling, linking locating, down loading and debugging.

Unit –V (12Hours)
7. Embedded system design and development:Embedded system development environment, file type generated after cross compilation, dissembler, decompiler, simulator, emulator and debugging.
8. Embedded product life cycle:Embedded product development life cycle, trends in embedded industry.

Reference Books
1)Embedded Systems.. Architecture,programming and design, R Kamal, 2008, TMH
2) The 8051 micro controller and embedded systems using Assembly and C, M.A.Mazidi, J.G.Mazidi and R.D.McKinlay, second Ed., 2007 pearson Education India
3) Introduction to embedded systems K.V. Shibu, 1st edition, 2009 McGraw Hill
4) Micro Controllers in practice, I Susnea and Mitescu,2005,springer

Elective Paper-VIII-A-1 Practical: Introduction to Microprocessors and Microcontrollers 2hrs/Week

Minimum of 6 experiments to be done and recorded

1. To find that the given numbers is prime or not.
2. To find the factorial of a number.
3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
4. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's.
5. Program to glow first four LED then next four using TIMER application.
6. Program to rotate the contents of the accumulator first right and then left.
7. Program to run a countdown from 9-0 in the seven segment LED display.
8. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.
9. To toggle '1234' as '1324' in the seven segment LED.
10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction.
11. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing a keyboard.

Semester –VI

Cluster Elective Paper VIII-A-2: Computational Methods and Programming

No. of Hours per week: 04 **Total Lectures: 60**

UNIT-I (12hrs)

1. Fundamentals of C language: C character set-Identifiers and Keywords-Constants -Variables-Data types-Declarations of variables-Declaration of storage class-Defining symbolic constants-Assignment statement.
2. Operators: Arithmetic operators-Relational operators-Logic operators-Assignment operators-Increment and decrement operators-Conditional operators.

UNIT-II (12hrs)

3. Expressions and I/O Statements: Arithmetic expressions-Precedence of arithmetic operators-Type converters in expressions-Mathematical (Library) functions - Data input and output-The getchar and putchar functions-Scanf-Printf simple programs.
4. Control statements:If -Else statements -Switch statements - The operators - GO TO - While, Do - While, FOR statements - BREAK and CONTINUE statements.

UNIT-III (12hrs)

5. Arrays: One dimensional and two dimensional arrays - Initialization - Type declaration - Inputting and outputting of data for arrays - Programs of matrices addition, subtraction and multiplication
6. User defined functions: The form of C functions - Return values and their types - Calling a function - Category of functions. Nesting of functions.Recursion.ANSI C functions- Function declaration. Scope and life time of variables in functions.

UNIT-IV (12hrs)

7. Linear and Non - Linear equations: Solution of Algebra and transcendental equations-Bisection, Falsi position and Newton-Rhapson methods-Basic principles-Formulae-algorithms
8. Simultaneous equations: Solutions of simultaneous linear equations-Guass elimination and Gauss Seidel iterative methods-Basic principles-Formulae – Algorithms.

UNIT-V (12hrs)

9. Interpolations: Concept of linear interpolation-Finite differences-Newton's and Lagrange's interpolation formulae-principles and Algorithms
10. Numerical differentiation and integration: Numerical differentiation-algorithm for evaluation of first order derivatives using formulae based on Taylor's series-Numerical integration-Trapezoidal and Simpson's 1/3 rule- Formulae-Algorithms.

Reference books:

1. Introductory methods of Numerical Analysis: Sastry
2. Numerical Methods: Balaguruswamy
3. Programming in ANSI C (TMH) : Balaguruswamy
4. Programming with 'C'- Byron Gottafried, Tata Mc Graw Hill

Elective PaperVIII-A-2: Practical: Computational Methods and Programming
2hrs/Week

Minimum of 6 experiments to be done and recorded

1. Write a program that reads an alphabet from keyboard and display in the reverse order.
2. Write a program to read and display multiplication of tables.
3. Write a program for converting centigrade to Fahrenheit temperature and Fahrenheit temperature centigrade.
4. Write a program to find the largest element in an array.
5. Write a program based on percentage calculation, the grade by entering the subject marks. (If percentage > 60 I class, if percentage between 50&60 II class, if percentage between 35&50 III class, if percentage below 35 fail).
6. Write a program for generation of even and odd numbers up to 100 using while, do-while and for loop.
7. Write a program to solve the quadratic equation using Bisection method.
8. Write a program for integration of function using Trapezoidal rule.
9. Write a program for solving the differential equation using Simpson's $1/3^{rd}$ rule.

Semester –VI

Cluster Elective Paper –VIII-A-3: Electronic Instrumentation

No. of Hours per week: 04 **Total Lectures: 60**

Unit – I (12Hours)

1. Basic of measurements:Instruments accuracy , precision , sensitivity , resolution range, errors in measurement, Multimeter , principles of measurement of dc voltage and dc currents, ac current and resistance, specifications of multimeter and their significance.

Unit -11 (10 Hours)

2. Electronic Voltmeter:Advantage over conventional multimeter for voltage measurement with respect to input impedence and sensitivity, principles of voltage measurement (block diagram only), specification of an electronic voltmeter/multimeter and their significance.

Unit– III (14 Hours)

3. CRO :Block diagram of basic CRO, construction of CRT, electron gun, electrostatic focusing and acceleration(only explanation) , time base operation, synchronization, front panel controls, specifications of CRO and their significance.

Applications CRO: Measurement of voltage ,dc and ac frequency , time period, special features of dual trace, digital storage oscilloscope, block diagram and principle of working.

Unit – IV (12 Hours)

4. Digital Multimeter:Block diagram,working, frequency and period measurement using universal counter, frequency counter ,accuracy and resolution.
5. Digital instruments:Principle and working of digitalinstruments, characteristics of a digital meter, working principle of digital voltmeter.

Unit – V (12 Hours)

6. Signal generators:Block diagram explanation, specifications of low frequency signal generators, pulse generator, function generator-working, Brief idea for testing, specifications. Distortion factor meter, wave analysis.
7. Bridges:Block diagram, working of basic LCR bridge – specifications – block diagram and working.

Reference Books

1. A text book in electrical technology by B.L.Thereja (S.Chand&Co)
2. Digital circuits and systems by Venugopal 2011 (Tata Mcgraw Hill)
3. Digital Electronics by SubrathaGhoshal 2012 (Cengage Learning)

Elective Paper-VIII-A-3: Practical: Electronic Instrumentation
2hrs/Week

Minimum of 6 experiments to be done and recorded

1. Study the loading effect of a multimeter by measuring voltage across alow and high resistance.
2. Study the limitations of a multimeter for measuring high frequency voltageand currents.
3. Measurement of voltage, frequency, time period and phase angle using CRO.
4. Measurement of time period and frequency using universal counter/frequency counter.
5. Measurement of rise, fall and delay times using a CRO.
6. Measurement of distortion of a RF signal generator using distortion factor meter.
7. Measurement of R, L and C using a LCR bridge/ universal bridge.

Paper VII-(B) Elective (Materials Science)

Semester –VI
Elective Paper –VII-(B): Materials Science

No. of Hours per week: 04 **Total Lectures: 60**

UNIT-I (12 hrs)
1.Materials and Crystal Bonding: Materials, Classification, Crystalline, Amorphous, Glasses; Metals, Alloys, Semiconductors, Polymers, Ceramics, Plastics, Bio-materials, Composites, Bulk and nanomaterials. Review of atomic structure – Interatomic forces – Different types of chemical bonds – Ioniccovalent bond or homopolar bond – Metallic bond – Dispersion bond – Dipole bond – Hydrogenbond – Binding energy of a crystal.

UNIT-II (12 hrs)
2. Defects and Diffusion in Materials: Introduction – Types of defects - Point defects- Line defects- Surface defects- Volume defects- Production and removal ofdefects- Deformation- irradiation- quenching- annealing- recovery - recrystallization andgrain growth. Diffusion in solids- Fick's laws of diffusion.

UNIT-III(12 hrs)
3. Mechanical Behavior of Materials: Different mechanical properties of engineering materials – Creep – Fracture – Technologicalproperties – Factors affecting mechanical properties of a material – Heat treatment - Cold andhot working – Types of mechanical tests – Metal forming process – Powder – Misaligning – Deformation of metals.

UNIT-IV (12 hrs)
4. Magnetic Materials:Dia-, Para-, Ferri- and Ferromagnetic materials, Classical Langevin theory of dia magnetism, Quantum mechanical treatment of paramagnetism. Curie's law, Weiss's theory of ferromagnetism, Ferromagnetic domains.Discussion of B-H Curve.Hysteresis and energy Loss.

UNIT-V (12 hrs)
5. Dielectric Materials:Dielectric constant, dielectric strength and dielectric loss, polarizability, mechanism of polarization,factors affecting polarization, polarization curve and hysteresis loop, types of dielectric materials, applications; ferroelectric, piezoelectric and pyroelectric materials, Clausius -Mosotti equation.

Reference books
1. Materials Science by M.Arumugam, Anuradha Publishers. 1990, Kumbakonam.
2.Materials Science and Engineering V.Raghavan, Printice Hall India Ed. V 2004. New Delhi.
3. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
4. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

Elective Paper-VII-B Practical: Materials Science
2hrs/Week

Minimum of 6 experiments to be done and recorded
1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)

2. Measurement of magnetic susceptibility of solids.
3. Determination of coupling coefficient of a piezoelectric crystal.
4. Measurement of the dielectric constant of a dielectric Materials
5. Study the complex dielectric constant and plasma frequency of metal using surface plasmon resonance (SPR)
7. Study the hysteresis loop of a Ferroelectric Crystal.
8. Study the B-H curve of 'Fe' using solenoid and determine energy loss from hysteresis.

Semester –VI: Cluster Electives – VIII-B
Cluster Elective Paper VIII-B-1: Fundamentals of Nano science

No. of Hours per week: 04 **Total Lectures: 60**

UNIT-I (12hrs)
1. Background and history: Emergence of Nanoscience with special reference to Feynman and Drexler; Role of particle size; Spatial and temporal scale; Concept of confinement, strong and weak confinement with suitable example; Development of quantum structures, Basic concept of quantum well, quantum wire and quantum dot.
Finite size Zero, One and Two Dimensional Nanostructures, Concept of Surface and Interfacial Energies. Physics of the solid state – size dependence of properties, crystal structures, Lattice vibrations, Energy bands:- Insulators Semiconductors and conductors.

UNIT-II (12hrs)
2. Classification of Nanomaterials: Inorganic nanomaterials: carbon nanotubes and cones, Organic nanomaterials: dendrimers, micelles, liposomes, block copolymers; Bionanomaterials: Biomimtric, bioceramic and nanotherapeutics; Nanomaterials for molecular electronics and optoelectronics.

UNITS-III (12hrs)
3. Macromolecules: Classification of polymers, chemistry of polymerization, chain polymerization, step polymerization, coordination polymerization. Molecular weight of polymers-number average and weight average molecular weight, degree of polymerization, determination of molecular weight of polymers by viscometry, Osmometry and light scattering methods.Kinetics of free radical polymerization, derivation of rate law.Preparation and application of polyethylene, PVC, Teflon.

UNIT-IV (12hrs)
4. Molecular & Nanoelectronics: Semiconductors, Transition from crystal technology to nanotechnology. Tiny motors, Gyroscopes and accelerometers. Nano particle embedded wrinkle resistant cloth, Transparent Zinc Oxide sun screens.Bio-systems, Nanoscale processes in environment. Nanoscale structures, Novel phenomena and Quantum control and quantum computing. Single electron transistors, Quantum dots, Quantum wires.

UNIT-V (12hrs)
5. Biomaterials: Implant materials: Stainless steels and its alloys, Ti and Ti based alloys, Ceramic implant materials; Hydroxyapatite glass ceramics, Carbon Implant materials, Polymeric Implant materials, Soft tissue replacement implants, Sutures, Surgical tapes and adhesives, heart valve implants, Artificial organs, Hard Tissue replacement Implants, Internal Fracture Fixation Devices, Wires, Pins, and Screws, Fracture Plates.

Reference Books

1. T. Pradeep: Textbook of Nanoscience and Nanotechnology Chapter (McGraw-Hill Professional, 2012), Access Engineering.
2. C. N. R. Rao, A. Mu¨ller, A. K. Cheetham, "The Chemistry of Nanomaterials :Synthesis, Properties and Applications", Wiley-VCH, 2006.
3. C. Breachignac P. Houdy M. Lahmani, "Nanomaterials and Nanochemistry", Springer, 2006.
4. Guozhong Cao, "Nanostructures and Nanomaterials: Synthesis, Properties, and Applications", World Scientific Publishing Private, Ltd., 2011.

5. Zhong Lin Wang, “Characterization of Nanophase Materials”, Wiley-VCH, 2004.
6. Carl C. Koch, “Nanostructured Materials: Processing, Properties and Potential Applications”, William Andrew Publishing Norwich, 2006.

Elective Paper- VIII-B-1: Practical: Fundamentals of Nanoscience
2hrs/Week

Minimum of 6 experiments to be done and recorded
1. Determination of the Band Gap of Semiconductor Nanoparticles.
2. Surface Enhanced Raman Scattering Activity of Silver Nanoparticles
3. Conversion of Gold Nanorods into Gold Nanoparticles
4. Bimetallic Nanoparticles
5. Processing and Development of Nanoparticle gas sensor
6. Magnetic separation/identification studies of nanoparticles
7. Harvesting light using nano-solar cells
8. Nano-Forensic analysis to identify, individualize and evaluate evidence using nanophase materials
9. Comparison of the performance of nanoparticles based conductive adhesives and conventional non conductive adhesives.
10. Electrodeposition and corrosion behavior of nanostructured composite film
11. Photocatalytic activity of nanomaterials

Semester –VI

Cluster Elective Paper –VIII-B-2: Synthesis and Characterization of Nanomaterial's

No. of Hours per week: 04 **Total Lectures: 60**

Unit-I (12 hrs)

1. Nanomaterials synthesis: Synthesis and nanofabrication, Bottom-Up and Top-Down approach with examples. Chemical precipitation methods, sol-gel method, chemical reduction, hydrothermal, process. Physical Mehtods- ball milling, Physical Vapour deposition (PVD), Sputtering, ChemicalVapor deposition (CVD), pray pyrolysis, Biological methods- Synthesis using micro organisms and bacteria, Synthesis using plant extract, use of proteins and DNA templates.

Unit-II (12 hrs)

2. Classification of materials: Types of materials, Metals, Ceramics (Sand glasses) polymers, composites, semiconductors.Metals and alloys- Phase diagrams of single component, binary and ternary systems, diffusion, nucleation and growth. Diffusional and diffusionless transformations.Mechanical properties.Metallic glasses. Preparation, structure and properties like electrical, magnetic, thermal and mechanical, applications.

UNITS-III (12 hrs)

3. Glasses: The glass transition - theories for the glass transition, Factors that determine the glass-transition temperature. Glass forming systems and ease of glass formation, preparation of glass materials.Applications of Glasses: Introduction: Electronic applications, Electrochemical applications, optical applications, Magnetic applications.

UNITS-IV (12 hrs)

4. Liquid Crystals: Mesomorphism of anisotropic systems, Different liquid crystalline phase and phase transitions, Thermal and electrical properties of liquid crystals, Types Liquid Crystals displays, few applications of liquid crystals.

UNITS-V (12 hrs)

5. Characterization Methods: XRD, SEM, TEM, AFM, XPS and PL characterization techniques for nano materials.Electrical and mechanical properties, Optical properties by IR and Raman Spectroscopy.

References books

1. Encyclopedia of Nanotechnology by M.Balakrishna Rao and K.Krishna Reddy, Vol.I to X, Campus books.
2. Nano: The Essentials-Understanding Nanoscinece & Nanotechnology by T.Pradeep; Tata Mc. Graw Hill
3. Nanotechnology in Microelectronics & Optoelectronics, J.M Martine Duart, R.J Martin Palma, F. Agullo Rueda, Elsevier
4. Nanoelectronic Circuit Design, N.K Jha, D Chen, Springer
5. Handbook of Nanophysics- Nanoelectronics & Nanophotonics, K.D Sattler, CRC Press
6. Organic Electronics-Sensors & Biotechnology- R. Shinar & J. Shinar, McGraw-Hill

Cluster Elective Paper- VIII-B-2: Practical: Synthesis and Characterization of Nanomaterials 2hrs/Week

Minimum of 6 experiments to be done and recorded

1. Synthesis of nanocrystalline films of II-VI compounds doped with rare earths by chemical process.
2. Synthesis of Alkaline earth aluminates in nanocrystalline form by combustion synthesis.
3. Preparation of surface conducting glass plate by spray pyrolysis method
4. Preparation of surface conducting glass plate by chemical route
5. Fabrication of micro fluidic nanofilter by polymerisation reaction
6. Absorption studies on the nanocrystalline films and determination of absorption coefficient.
7. Determination of band gap from the absorption spectra using Tauc's plots.
8. Study of Hall effect in semiconductors and its application in nanotechnology.
9. Measurement of electrical conductivity of semiconductor film by Four Probe method and study of temperature variation of electrical conductivity.

Semester –VI

Cluster Elective Paper –VIII-B-3: Applications of Nanomaterial's and Devices

No. of Hours per week: 04 **Total Lectures: 60**

UNIT-I (12 hrs)

1. Optical properties: Coulomb interaction in nanostructures. Concept of dielectric constant for nanostructures and charging of nanostructure.Quasi-particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals. Quantitative treatment of quasi-particles and excitons, charging effects. Radiative processes: General formalization-absorption, emission and luminescence. Optical properties of heterostrctures and nanostructures.

UNIT-II (12 hrs)

2. Electrical transport:

Carrier transport in nanostrcutures.Hall effect, etermination of carrier mobility and carrier concentration; Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity. Defects and impurities: Deep level and surface defects.

UNIT-III (12 hrs)

3. Applications: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron transfer devices (no derivation). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructures lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots - magnetic data storage.Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

UNIT-IV(12 hrs)

4. Nanoelectronics: Introduction, Electronic structure of Nanocrystals,Tuning the Band gap of Nanoscale semiconductors, Excitons, Quantumdot, Single electron devices, Nanostructured ferromagnetism,Effect of bulk nanostructuring of magnetic properties, Dynamics of nanomagnets, Nanocarbon ferromagnets, Giant and colossal magneto-resistance, Introduction of spintronics, Spintronics devices and applications.

UNIT-V (12 hrs)

5. Nanobiotechnology and Medical application: Introduction, Biological building blocks- size of building blocks and nanostructures, Peptide nanowires and protein nanoparticles, DNA double nanowires, Nanomaterials in drug delivery and therapy, Nanomedicine, Targeted gold nanoparticles for imaging and therapy.

Reference books:

1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
2. S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company).
3. K.K. Chattopadhyay and A.N. Banerjee, Introduction to Nanoscience & Technology (PHI Learning Private Limited).
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

Cluster Elective Paper-VIII-B-3: Practical: Applications of Nanomaterials and Devices 2hrs/Week

Minimum of 6 experiments to be done and recorded

1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on color of nanomaterials.
6. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.
7. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.
8. Fabricate a pn-diode by diffusing Al over the surface of n-type Si and study its I-V characteristics.

Paper-VII-(C) Elective (Renewable Energy)

Semester –VI
Elective Paper –VII-C: Renewable Energy

No. of Hours per week: 04 **Total Lectures: 60**

UNIT-I (12 hrs)
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 (12 hrs)
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 (12 hrs)
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 (12 hrs)
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 (12 hrs)
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.

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.

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.

Semester –VI
Cluster Electives –VIII-C
Elective Paper –VIII-C-1: Solar Thermal and Photovoltaic Aspects

No. of Hours per week: 04 **Total Lectures: 60**

UNIT-I (12 hrs)
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 throughsingle and multi covers; Kirchoff's law – Relation between absorptance, emittance and reflectance; Selective Surfaces - preparation and characterization, Types and applications; Anti-reflective coating.

UNIT-II (14 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.
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 (14 hrs)
5. 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.
6. Solar cell fabrication: Production of single crystal Silicon: Czokralski (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 (8 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 – use of Bypass and Blocking diodes, Solar PV system and its components, PV array, inverter, battery and load.

UNIT-V (12 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.
Solar PV applications: SPV systems; Stand alone, hybrid and grid connected systems, System installation, operation and maintenances; Field experience; PV market analysis and economics of SPV systems.

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, Tata Mc-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, 2004.

Cluster Elective Paper- VIII-C-1: Practical: Solar Thermal and Photovoltaic Aspects
2hrs/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.

Semester - VI
Cluster Elective Paper –VIII-C-2: Wind, Hydro and Ocean Energies

No. of Hours per week: 04 **Total Lectures: 60**

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 withballoons.

UNIT-II

3. Wind Energy Conversion System:Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element andcombine theory; Rotor characteristics; Maximum power coefficient; Prandlt's tip losscorrection.

4. Design of Wind Turbine: Wind turbine design considerations; Methodology; Theoretical simulation of wind turbinecharacteristics; 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 energyutilization; 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 andturbine; 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 anddisadvantages, 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.

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

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

No. of Hours per week: 04 **Total Lectures: 60**

UNIT-I (12 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, bio-chemical,electro-chemical, fossil fuels and synthetic fuels. Hydrogen for energy storage.

UNIT-II (12 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 (12 hrs)

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 (12 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, fuel cell stack, fuel cell power plant: fuel processor, fuel cell powersection, power conditioner, Advantages and disadvantages.

UNIT-V (12 hrs)

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.

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.

Cluster Elective Paper –VIII-C-3: Practical: Energy Storage Devices
2hrs/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.

B.Sc. (Physics) (Non-Mathematics Combinations)
Scheme of instruction and examination to be followed w.e.f. 201-2017

S.No	Semester	Title of the paper	Instruction Hrs/week	Duration o f exam (hrs)	Max Marks (external)
Theory					
1	First	Paper I: Mechanics & Properties of Matter	4	3	75
2	Second	Paper II: Waves & Oscillations	4	3	75
3	Third	Paper III: Optics	4	3	75
4	Fourth	Paper IV: Thermodynamics & Radiation Physics	4	3	75
5	Fifth	Paper V: Electricity, Magnetism & electronics Paper VI: Modern Physics & Medical Physics	4 4	3 3	75 75
6	Sixth	PaperVII : Elective Paper VIII: Cluster Electives	4 4	3 3	75 75
Practical					
1	First	Practical 1	2	3	50
2	Second	Practical II	2	3	50
3	Third	Practical III	2	3	50
4	Fourth	Practical IV	2	3	50
5	Fifth	Practical V	2	3	50
6		Practical VI	2	3	50
7	Sixth	Practical VII	2	3	50
8		Practical VIII	2	3	50

B.Sc. Physics under CBCS for Non-Mathematics Combinations

w.e.f. 2015-16(Revised in April, 2016)

B.Sc. 1st Semester Physics

Paper I: Mechanics & Properties of Matter

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

UNIT-I(16 hrs)

1. Mathematical Background

Scalars and vectors –vector addition-scalar and vector products of vector and their physical significance-vector calculus-gradient of a scalar point function-divergence and curl of vector-statements of Stokes and Gauss theorems -examples (no derivations).

2. Motion of system

Collisions- Elastic and inelastic collisions-Collisions in one and two dimension-Rocket propulsion-Center of mass-Motion of the centre of mass-Impact parameter-Scattering cross-section, Rutherford scattering (No derivation-Qualitative ideas only)

UNIT-II(12 hrs)

3. Mechanics of Rigid body

Rigid body, rotational kinematic relations Rotational kinetic energy and moment of inertia - moment of inertia in simple cases (Rod, disc, sphere and cylinder)- No derivations. Parallel& Perpendicular axes theorems-Torque-relation between torque and angular momentum.

Angular momentum of a particle-Torque and angular momentum for a system of particles-conservation of angular momentum-Translation and rotational motion of system-Elementary ideas about gyroscopic motion (No derivation – Qualitative ideas only)-Precession of the equinoxes.

UNIT-III(10 hrs)

4. Central forces

Central force- Definition& examples- General Characteristics of central forces-Conservative nature of central forces, Planetary motion-Kepler's laws (Statements & Explanation), Newton's law of gravitation from Kepler's law, Geostationary Satellite Motion.Uses of communication satellites.

UNIT-IV(10 hrs)

5. Fluid Flow

The flow of ideal fluids Stream line motion -Equation of continuity –Bernoulli's equation-Simple applications - Torricelli's theorem-The Venturimeter-Pitot's tube-Viscosity and the flow of real fluids- Poiseuille's equation.

UNIT-V (12 hrs)

6. Relativistic effects

Moving reference frames-Inertial and Non-inertial reference frames-Galilean relativity – Special theory of relativity-Statements of the two basic postulates- (Elementary treatment and application only) Lorentz transformation equations-length contraction-time dilation-

addition of velocities-Momentum and relativistic mass- Mass –Energy equation, rest mass & momentum of a particle.

REFERENCE BOOKS:

1. BSc Physics, Vol.1 -Telugu Academy, Hyderabad
2. Physics for Biology and Premedical Students –D.N. Burns & SGG Mac Donald
3. Unified Physics Vol.I Mechanics,Waves and Oscillations – Jai Prakash Nath&Co.Ltd., Meerut.
4. Properties of Matter - D.S. Mathur, S.Chand& Co, New Delhi ,11thEdn., 2000
5. Properties of Matter - Brijlal&Subrmanyam ,S.Chand&Co. 1982

Practical paper 1: Mechanics & Properties of Matter

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

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 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'sviscometer 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)

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

Seminars - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.

Group discussion - A topic from one of the units is given to a group of students and asked to discuss and debate on it.

Assignment - Few problems may be given to the students from the different units and asked them to solve.

Field trip - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.

Study project - Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

***** Documental evidence is to be maintained for the above activities.**

Paper II: Waves & Oscillations
(For Non-Maths Combinations)
II SEMESTER

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

UNIT-I(15 hrs)

1. Oscillatory Motion

Simple harmonic motion-Equation of motion and solution-Simple harmonic motion from the standpoint of energy-The rotor diagram representation of simple harmonic motion-Compound pendulum-determination of g and k, torsional pendulum-determination of n, Combination of Simple harmonic motions along a line and perpendicular to each other-Lissajous figures-

UNIT-II(14 hrs)

2. Damped Oscillators

Damped vibrations - Explanation and examples - Forced vibrations – Explanation and examples, Resonance, examples -Sharpness of resonance Q-factor, Volume Resonator, Determination of frequency of a given tuning fork.

UNIT-III(11 hrs)

3. Wave Motion

Progressive waves-Equation of a progressive wave-sinusoidal waves-Velocity of waves in elastic media-Standing waves-Transverse vibrations of stretched strings, overtones and harmonics. Sonometer verification of laws of transverse vibrations in a stretched string, beats (qualitative analysis Only).

UNIT-IV(10 hrs)

4. Acoustics

Classification of sound, Characteristics of musical sound, Acoustics of Buildings, Reverberation, Sabine's formula (without derivation) Absorption coefficient, Factors affecting acoustics of buildings, Intensity of sound, Sound distribution in an auditorium.

UNIT-V(10 hrs)

5. Ultrasonics

Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezoelectric and magnetostriction methods, detection of ultrasonics, Applications of ultrasonic waves.

REFERENCE BOOKS

1. BSc Physics, Vol.1 -Telugu Academy, Hyderabad
2. Physics for Biology and Premedical Students –D.N. Burns & SGG Mac Donald
3. Unified Physics Vol.I, Mechanics,Waves and Oscillations – Jai Prakash Nath&Co.Ltd., Meerut.
4. Waves and Oscillations. S. Badami, V. Balasubramanian and K. Rama Reddy Orient Longman.
5. Waves and Oscillations. N. Subramaniyam and BrijlalVikas Publishing House Private Limited.

6. Acoustics – Waves and Oscillations, S.N.Sen, Wiley Estern Ltd.

Practical Paper II: Waves & Oscillations

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

Minimum of 6 experiments to be done and recorded

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.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

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Study project - Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

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Paper III: Optics
(For Non- Maths Combinations)
III SEMESTER

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

UNIT –I(10 hrs)

1. Geometric optics

Aberrations in lenses-Chromatic Aberration-Achromatic Combination of lenses-Monochromatic defects-Spherical aberration-Astigmatism-Coma-Curvature and Distortion-Minimizing aberration.

UNIT-II(13 hrs)

2. Interference

The superstition principle, Condition for Interference, Classification of Interferences methods-Young's double slit experiment-Theory. Interference with white light and appearance of Young's interference fringes-Intensity in interference pattern-Optical Path length, Lloyd's single mirror-Phase change on reflection, Interference due to plane parallel wedge shaped films, Colours in thin films-Newton rings, Determination of wavelength of light. Michelson's interferometer.

UNIT-III(12 hrs)

3. Diffraction

The Fresnel and Fraunhoffer diffraction phenomena-Fraunhoffer diffraction of single Slit normal incidence and oblique incidence – Resolving power –limits of resolution for telescopes and microscope- Fraunhoffer diffraction by double slit-Intensity-pattern-Diffraction grating- Wavelength determination (Normal incidence and Minimum deviation).

UNIT-IV(13hrs)

4. Polarization

Types of Polarized light-Polarization by reflection, Brewster's law-Dichroism the Polaroid-double refraction- the calcite crystal-the principal plane-O and E rays-the Nicol Prism, Polariserand Analyser, Law of Malus –the quarter wave plate and halfwave plate Plane, Circularly, elliptically polarized light-Production and analysis -Optical activity-Specific rotatory power –Polarimeter.

UNIT V: (12 hrs)

5. Holography & Fiber Optics

Holography: Basic principle of holography-Gabor hologram and its limitations, applications of holography. Introduction- different types of fibres, rays and modes in an optical fibre, fibre material, principles of fiber communication (qualitative treatment only), applications.

REFERENCE BOOKS

1. BSc Physics, Vol.2, Telugu Academy, Hyderabad
2. Physics for Biology and Premedical Students –D.N. Burns & SGG Mac Donald
3. Unified Physics Vol.II, Optics and Thermodynamics,*Jai Prakash Nath&Co.Ltd., Meerut*.
4. Optics, Ajoy Ghatak, Tata Mc Graw-Hill.
5. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication

6. Introduction of Lasers – Avadhanulu, S.Chand& Co.
7. Principles of Optics- BK Mathur, Gopala Printing Press, 1995

Practical Paper III: Optics

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

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 fiber by wedge method
10. Determination of refractive index of liquid-Boy's method.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

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Assignment - Few problems may be given to the students from the different units and asked them to solve.

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Study project - Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

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Paper IV: Thermodynamics &Radiation Physics
(For Non- Mathematics Combinations)
IV SEMESTER

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

UNIT-I(12 hrs)

1. Kinetic theory of Gases

Zeroth law of thermodynamics,Measurment of temperature- resistance thermometry, thermoelectric theromometers-kinetic theory of gases- assumptions-pressure of an ideal gas-molecular interpretation of temperature- Maxwell's law of distribution of molecular speeds (no derivation)-experimental verification.

UNIT-II(12 hrs)

2. Thermodynamics

The first law of thermodynamics- work done in isothermal and adiabatic changes -Reversible and irreversible process-Carnot's cycle-Carnot's theorem - Second law of thermodynamics, Kelvin's and Claussius statements -Entropy, physical significance-Change in entropy in reversible and irreversible processes-Entropy and disorder-Entropy of universe.

UNIT-III(12 hrs)

3. Low temperature Physics

Introduction-Joule Kelvin effect-porous plug experiment. Joule's expansion-Distinction between adiabatic and Joule Thomson expansion-Liquefaction of helium Kapitza's method-Adiabatic demagnetization-Production of low temperatures-Principle of refrigeration. applications of substances at low-temperature.

UNIT-IV(12 hrs)

4. Measurement, laws and theories of radiation

Black body-Ferry's black body-distribution of energy in the spectrum of Black body- Wein's law- Planck's radiation formula (no derivation)-Measurement of radiation-Types of pyrometers-Disappearing filament optical pyrometer-experimental determination-Angstrom Pyroheliometer-determination of solar constant, effective temperature of Sun.

UNIT-V(12 hrs)

5. Thermoelectricity

Seebeck effect variation of thermo – emf with temperature.Thermo electric series - Measurement of thermoemf using potentiometer,Law of intermediate metals and intermediate temperatures - Peltier effect, Demonstration Peltier coefficient. Thomson effect demonstration Thomson coefficient, Thermoelectric diagrams and their uses, Thermoelectric power. Application of Thermoelectric effects.

REFERENCE BOOKS

1. BSc Physics, Vol.2, Telugu Academy, Hyderabad
2. Physics for Biology and Premedical Students –D.N. Burns & SGG Mac Donald
3. Unified Physics Vol.II, Optics and Thermodynamics,Jai Prakash Nath&Co.Ltd., Meerut.
4. Heat and Thermodynamics, N.Subramanyam and L.Brijlal, S.Chand& Co.
5. Electricity and Magnetism, N.Subramanyam and L.Brijlal, S.Chand& Co.

6. University Physics, HD Young, MW Zemansky,FW Sears, Narosa Publishers, New Delhi

Practical Paper IV: Thermodynamics& Radiation Physics

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

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. 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.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

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Field trip - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.

Study project - Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

***** Documental evidence is to be maintained for the above activities.**

Paper V : Electricity, Magnetism& Electronics
(For Non-Maths Combinations)
V Semester

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

UNIT-1(15 hrs)

1. Electric field and potential

Coulomb's law – electric field and intensity of electric field –intensity of electric field due to i) a point charge–electric dipole and dipole moment. Electric lines of force, Electric flux.Gauss's law statement and its proof- applications of Gauss Law to (1) Uniformly charged sphere (2) an infinite conducting sheet of charge (No Derivation- qualitative ideas only). Electrical potential – equi-potential surfaces- potential due to i) a point charge, ii)charged spherical shell.Equi-potential surfaces with examples.

UNIT-II(10 hrs)

2. Capacitance and dielectrics

Derivation of expression for capacity due to i) a parallel plate capacitor with and without dielectric, ii) a spherical capacitor. Energy stored in a capacitor, electric capacitance. Electric dipole moment Di-electrics with examples, effect of electric field-electric displacement D, electric polarization P, permeability &susceptibility (Definitions only) – relation between D,E and P.Dipolemoment of heart.

UNIT-III (10 hrs)

3. Current electricity

Current and current density, drift velocity expression, Kirchhoff's laws –statement and explanation and application to Wheatstone bridge, sensitivity of Wheatstone bridge, Carey-Foster's bridge- experimentalmeasurement of temperature coefficient of resistance- strain gauge-piezoelectric transducers (applications only)

UNIT-IV (15 hrs)

5. Electromagnetism

Magnetic induction B, magnetic flux – Biot –Savart's law, magnetic induction due to (i) a long straight conductor carrying current (ii) on the axis of a circular coil carrying current (iii) solenoid, (No derivation-qualitative treatment only) Ampere's law – derivation of expression for the force on (i) charged particles and (ii) current carrying conductor in the magnetic field, Hall effect and its importance-electromagnetic pumping.

Faraday's law of electromagnetic induction, Lenz's law - Construction, theory and working of a Moving Coil Ballistic Galvanometer,application of B.G. damping correction, Self induction, Mutual induction and their units- Electromagnetic measurement of blood flow.

UNIT-V(12 hrs)

6. Basic Electronics

PN junction diode, Zener diode and its V-I characteristics, half and full wave rectifiers(semiconductor type) (working qualitative ideas only).Bridge type full wave rectifier.Action of filters- Land π type.PNP and NPN transistors and charactrestics,Configurations Transistor configurations – CE transistor characteristics – h-parameters – Transistor as an amplifier.

Number system, conversion of binary to decimal and vice versa, De Morgans's theorems statements - logic gates – verification of truth tables, NAND and NOR gates as universal gates, Half and Full adders.

REFERENCE BOOKS

1. B.Sc., Physics, Vol.3, Telugu Academy, Hyderabad
2. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath – S. Chand & Co.
3. Electricity and Magnetism, Brijlal and Subramanyam. RatanPrakashanMandir.
4. Physics for Biology & Premedical Students –DN Burns & SG MacDonald, Addison Wiley.
5. Principles of Electronics, V.K. Mehta, S.Chand & Co.,
6. Digital Principles and Applications, A.P. Malvino and D.P.Leach, Mc GrawHill Edition.

Practical Paper V: Electricity, Magnetism& Electronics

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

Minimum of 6 experiments to be done and recorded

1. Figure of merit of a moving coil galvonometer.
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.

Suggested student activities

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Study project - Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

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Paper VI: Modern Physics& Medical Physics
(For Non-Maths Combinations)
V Semester

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

UNIT-1(10 hrs)

1. Spectroscopy

Introduction - Zeeman effect - Experimental verification – Paschen Back effect – Stark effect – Explanations (elementary ideas only) - Raman effect, hypothesis, classical and quantum theory of Raman effect. Experimental arrangement for Raman effect and its application.

UNIT-II (12 hrs)

2. Fundamentals of quantum mechanics

Photoelectric effect – Explanation through demonstration, Einstein's Photoelectric equation – its verification by Millikan's experiment –theory of Compton effect (no derivation) and its experimental verification –Bohr's theory of Hydrogen atom – Derivation of expression for energy levels and spectral series of Hydrogen atom, atomic excitation, Frank Hertz experiment.

UNIT-III (10 hrs)

3. Matter Waves and uncertainty principle

Dual nature of radiation- de Broglie's theory of matter waves, expression for wavelength, properties of matter waves, Davisson and Germer experiment on electron diffraction – Discussion of results, Wave velocity and group velocity.

Heisenberg's uncertainty principle for position and momentum (x and p), energy and time (E and t).Experimental illustrations of uncertainty principal, Complementary principle of Bohr.

UNIT-IV: (12 hrs)

4. Radioactivity and radiation protection

The nature of radioactive emissions, the law of Radioactive decay, derivation, decay constant, Half life and mean life periods - derivations, units of radio activity, Carbon and Uranium dating (explanation) - Age of earth and rocks, Radioactive isotopes as tracers, radio cardiography. Principles of radiation protection– protective materials-radiation effects – somatic, genetic stochastic & deterministic effect, Natural radioactivity, Biological effects of radiation, Radiation monitors**.**

UNIT-V (16 hrs)

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.

REFERENCE BOOKS

1. B.Sc Physics, Vol.4, Telugu Academy, Hyderabad.
2. Molecular Structure and Spectroscopy by G. Aruldhas. Prentice Hall of India, New Delhi.
3. Physics for Biology & Premedical Students –D.N. Burns & SG Mac Donald, Addison Wiley.
4. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath. S. Chand & Co.
5. Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley (1978)
6. Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
7. Physics of Radiation Therapy : F M Khan - Williams and Wilkins, Third edition (2003)
8. Physics of the human body, Irving P. Herman, Springer (2007).
9. The Physics of Radiology-H E Johns and Cunningham.

Practical Paper VI: Modern Physics& Medical Physics

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

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.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab

Examples

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Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

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Note: For all the above 8 practical papers the book "B.Sc Practical Physics" by C.L.Arora Published by S.Chand& Co, New – Delhi may be followed.

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

Elective VII (A): (Electronics)

Semester –VI

Elective Paper –VII-(A) :Analog and Digital Electronics

No. of Hours per week: 04 **Total Lectures:60**

Unit-I (14 Hours)

9. FET-Construction, Working, characteristics and uses; MOSFET-enhancement MOSFET, depletion MOSFET, construction and working , drain characteristics of MOSFET, applications of MOSFET

10. Photo electric devices: Structure and operation, characteristics, spectral response and application of LDR, LEDand LCD

Unit-II (10Hours)

11. Operational Amplifiers: Characteristics of ideal and practical Op-Amp (IC 741), Basic differential amplifiers, Op-Amp supply voltage, IC identification, Internal blocks of Op-Amp, its parameter off set voltages and currents, CMRR, slew rate, concept of virtualground.

Unit-III (10 Hours)

12. Applications of Op-Amp: Op-Amp as voltage amplifier, Inverting amplifier, Non-inverting amplifier, voltage follower, summing amplifier, difference amplifier, comparator, integrator, differentiator.

Unit-IV(14 Hours)

13. Data processing circuits: Multiplexers, De-multiplexers, encoders, decoders, Characteristics for Digital ICs -RTL, DTL, TTL, ECL CMOS (NAND & NOR Gates).

14. IC 555 Timer -Its pin diagram,internal architecture, Application as astablemultivibrator and mono stable multivibrator.

Unit-V (12 Hours)

15. Sequential digital circuits:Flip-flops, RS, Clocked SR, JK, D, T, Master-Slave, Flip- flop, Conversion of Flip flops.

16. Code Converters: Design of code converter, BCD to 7 segment, binary/BCD to gray, gray to binary/BCD,design of counters using state machine.

Reference Books

1. Digital Electronics by G.K.Kharate Oxford University Press
2. Unified Electronics by Agarwal and Agarwal.
3. Op- Amp and Linear ICs by Ramakanth A Gayekwad, 4th edition PHI
4. Digital Principles and Applications by Malvino and Leach, TMH, 1996, 4th edition.
5. Digital Circuit design by Morris Mano,PHI
6. Switching Theory and Logic design by A.AnandKumar ,PHI
7. operations amplifier by SV Subramanyam.

Elective Paper-VII-A : Practical: Analog and Digital Electronics
2hrs/Week

Minimum of 6 experiments to be done and recorded

1) Characteristics of FET
2) Characteristics of MOSFET
3) Characteristics of LDR
4) Characteristics of Op-amp.(IC741)
5)Op-Amp as amplifier/inverting amplifier
6) Op-Amp as integrator/differentiator
7) Op-Amp as summing amplifier/difference amplifier
8) IC 555 as astable multivibrator
9) IC 555 as monostable amplifier
10) Master slave flip-flop
11) JK flip-flop

Semester –VI
Cluster Electives VIII-A
Cluster Elective Paper –VIII-A-1: Introduction to Microprocessors and Microcontrollers

No. of Hours per week: 04 **Total Lectures:60**

Unit – I (10Hours)
1. Introduction to microcontrollers:General purpose of computer systems,architecture of embedded system, classification, applications and purposes, challenges and designs, operational and non operational quality attributes, elemental description of embedded processors and micro controllers

Unit –II (10Hours)
2. Microprocessors:Organisation of microprocessorbased system, 8085 microprocessor,its pin diagram and architecture, concept of data bus, and address bus, 8085 programming, instruction classification, stacks and its implementation, hardware and software interrupts.

Unit– III (15Hours)
3. 8051 microcontroller:Introduction , block diagram, assembly language programming, programme counter, ROM memory, data types and directives, flag bits PSW register, jump, loop and call constructions
4. 8051 I/O Programming: Introduction to I/O port programming, pin out diagram, I/O port pin programming, bit manipulation, addressing modes, accessing memory, arithmetic and logic instructions.

Unit – IV (13 Hours)
5. Timers:Programming of 8051 timers, counter programming, interrupts, externalhardware interrupts**,** serial communication interrupts, interrupt priority.
6. Embedded system programming:Structure of programming, infinite loop, compiling, linking locating, down loading and debugging.

Unit –V (12Hours)
7. Embedded system design and development:Embedded system development environment, file type generated after cross compilation, dissembler, decompiler, simulator, emulator and debugging.
8. Embedded product life cycle:Embedded product development life cycle, trends in embedded industry.

Reference Books
1)Embedded Systems.. Architecture,programming and design, R Kamal, 2008, TMH
2) The 8051 micro controller and embedded systems using Assembly and C, M.A.Mazidi, J.G.Mazidi and R.D.McKinlay, second Ed., 2007 pearson Education India
3) Introduction to embedded systems K.V. Shibu, 1st edition, 2009 McGraw Hill
4) Micro Controllers in practice, I Susnea and Mitescu,2005,springer

Cluster Elective Paper-VIII-A-1: Practical: Introduction to Microprocessors and Microcontrollers 2hrs/Week

Minimum of 6 experiments to be done and recorded

1. To find that the given numbers is prime or not.
2. To find the factorial of a number.
3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
4. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's.
5. Program to glow first four LED then next four using TIMER application.
6. Program to rotate the contents of the accumulator first right and then left.
7. Program to run a countdown from 9-0 in the seven segment LED display.
8. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.
9. To toggle '1234' as '1324' in the seven segment LED.
10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction.
11. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing a keyboard.

Semester –VI

Cluster Elective Paper –VIII-A-2: Computational Methods and Programming

No. of Hours per week: 04 **Total Lectures:60**

UNIT-I (12hrs)

1. Fundamentals of C language: C character set-Identifiers and Keywords-Constants -Variables-Data types-Declarations of variables-Declaration of storage class-Defining symbolic constants-Assignment statement.
2. Operators: Arithmetic operators-Relational operators-Logic operators-Assignment operators-Increment and decrement operators-Conditional operators.

UNIT-II (12hrs)

3. Expressions and I/O Statements: Arithmetic expressions-Precedence of arithmetic operators-Type converters in expressions-Mathematical (Library) functions - Data input and output-The getchar and putchar functions-Scanf-Printf simple programs.
4. Control statements:If -Else statements -Switch statements - The operators - GO TO - While, Do - While, FOR statements - BREAK and CONTINUE statements.

UNIT-III (12hrs)

5. Arrays: One dimensional and two dimensional arrays - Initialization - Type declaration - Inputting and outputting of data for arrays - Programs of matrices addition, subtraction and multiplication
6. User defined functions: The form of C functions - Return values and their types - Calling a function - Category of functions. Nesting of functions.Recursion.ANSI C functions- Function declaration. Scope and life time of variables in functions.

UNIT-IV (12hrs)

7. Linear and Non - Linear equations: Solution of Algebra and transcendental equations-Bisection, Falsi position and Newton-Rhapson methods-Basic principles-Formulae-algorithms
8. Simultaneous equations: Solutions of simultaneous linear equations-Guass elimination and Gauss Seidel iterative methods-Basic principles-Formulae – Algorithms.

UNIT-V (12hrs)

9. Interpolations: Concept of linear interpolation-Finite differences-Newton's and Lagrange's interpolation formulae-principles and Algorithms
10. Numerical differentiation and integration: Numerical differentiation-algorithm for evaluation of first order derivatives using formulae based on Taylor's series-Numerical integration-Trapezoidal and Simpson's 1/3 rule- Formulae-Algorithms.

Reference books:

1. Introductory methods of Numerical Analysis: Sastry
2. Numerical Methods: Balaguruswamy
3. Programming in ANSI C (TMH) : Balaguruswamy
4. Programming with 'C'- Byron Gottafried, Tata Mc Graw Hill

Cluster Elective Paper-VIII-A-2: Practical: Computational Methods and Programming 2hrs/Week

Minimum of 6 experiments to be done and recorded

10. Write a program that reads an alphabet from keyboard and display in the reverse order.
11. Write a program to read and display multiplication of tables.
12. Write a program for converting centigrade to Fahrenheit temperature and Fahrenheit temperature centigrade.
13. Write a program to find the largest element in an array.
14. Write a program based on percentage calculation, the grade by entering the subject marks. (If percentage > 60 I class, if percentage between 50&60 II class, if percentage between 35&50 III class, if percentage below 35 fail).
15. Write a program for generation of even and odd numbers up to 100 using while, do-while and for loop.
16. Write a program to solve the quadratic equation using Bisection method.
17. Write a program for integration of function using Trapezoidal rule.
18. Write a program for solving the differential equation using Simpson's $1/3^{rd}$ rule.

Semester –VI

Cluster Elective Paper –VIII-A-3: Electronic Instrumentation

No. of Hours per week: 04 **Total Lectures: 60**

Unit – I (12Hours)

1. Basic of measurements:Instruments accuracy , precision , sensitivity , resolution range, errors in measurement, Multimeter , principles of measurement of dc voltage and dc currents, ac current and resistance, specifications of multimeter and their significance.

Unit -11 (10 Hours)

2. Electronic Voltmeter:Advantage over conventional multimeter for voltage measurement with respect to input impedence and sensitivity, principles of voltage measurement (block diagram only), specification of an electronic voltmeter/multimeter and their significance.

Unit– III (14 Hours)

3. CRO :Block diagram of basic CRO, construction of CRT, electron gun, electrostatic focusing and acceleration(only explanation) , time base operation, synchronization, front panel controls, specifications of CRO and their significance.

Applications CRO: Measurement of voltage ,dc and ac frequency , time period, special features of dual trace, digital storage oscilloscope, block diagram and principle of working.

Unit – IV (12 Hours)

4. Digital Multimeter:Block diagram,working, frequency and period measurement using universal counter, frequency counter ,accuracy and resolution.
5. Digital instruments:Principle and working of digitalinstruments, characteristics of a digital meter, working principle of digital voltmeter.

Unit – V (12 Hours)

6. Signal generators:Block diagram explanation, specifications of low frequency signal generators, pulse generator, function generator-working, Brief idea for testing, specifications. Distortion factor meter, wave analysis.
7. Bridges:Block diagram, working of basic LCR bridge – specifications – block diagram and working.

Reference Books

4. A text book in electrical technology by B.L.Thereja (S.Chand&Co)
5. Digital circuits and systems by Venugopal 2011 (Tata Mcgraw Hill)
6. Digital Electronics by SubrathaGhoshal 2012 (Cengage Learning)

Cluster Elective Paper-VIII-A-3: Practical: Electronic Instrumentation
2hrs/Week

Minimum of 6 experiments to be done and recorded

1. Study the loading effect of a multimeter by measuring voltage across alow and high resistance.
2. Study the limitations of a multimeter for measuring high frequency voltageand currents.
3. Measurement of voltage, frequency, time period and phase angle using CRO.

4. Measurement of time period and frequency using universal counter/frequency counter.
5. Measurement of rise, fall and delay times using a CRO.
6. Measurement of distortion of a RF signal generator using distortion factor meter.
7. Measurement of R, L and C using a LCR bridge/ universal bridge.

Elective VII-(B): (Materials Science)

Semester –VI
Elective Paper – VII-(B): Materials Science

No. of Hours per week: 04 **Total Lectures:60**

UNIT-I (12 hrs)
1.Materials and Crystal Bonding: Materials, Classification, Crystalline, Amorphous, Glasses; Metals, Alloys, Semiconductors, Polymers, Ceramics, Plastics, Bio-materials, Composites, Bulk and nanomaterials. Review of atomic structure – Interatomic forces – Different types of chemical bonds – Ioniccovalent bond or homopolar bond – Metallic bond – Dispersion bond – Dipole bond – Hydrogenbond – Binding energy of a crystal.

UNIT-II (12 hrs)
2. Defects and Diffusion in Materials: Introduction – Types of defects - Point defects- Line defects- Surface defects- Volume defects- Production and removal ofdefects- Deformation- irradiation- quenching- annealing- recovery - recrystallization andgrain growth. Diffusion in solids- Fick's laws of diffusion.

UNIT-III(12 hrs)
3. Mechanical Behavior of Materials: Different mechanical properties of engineering materials – Creep – Fracture – Technologicalproperties – Factors affecting mechanical properties of a material – Heat treatment - Cold andhot working – Types of mechanical tests – Metal forming process – Powder – Misaligning – Deformation of metals.

UNIT-IV (12 hrs)
4. Magnetic Materials:Dia-, Para-, Ferri- and Ferromagnetic materials, Classical Langevin theory of dia magnetism, Quantum mechanical treatment of paramagnetism. Curie's law, Weiss's theory of ferromagnetism, Ferromagnetic domains.Discussion of B-H Curve.Hysteresis and energy Loss.

UNIT-V (12 hrs)
5. Dielectric Materials:Dielectric constant, dielectric strength and dielectric loss, polarizability, mechanism of polarization,factors affecting polarization, polarization curve and hysteresis loop, types of dielectric materials, applications; ferroelectric, piezoelectric and pyroelectric materials, Clausius -Mosotti equation.

Reference books
1. Materials Science by M.Arumugam, Anuradha Publishers. 1990, Kumbakonam.
2.Materials Science and Engineering V.Raghavan, Printice Hall India Ed. V 2004. New Delhi.
3. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
4. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

Elective Paper-VII-B: Practical: Materials Science
2hrs/Week

Minimum of 6 experiments to be done and recorded

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. Measurement of magnetic susceptibility of solids.
3. Determination of coupling coefficient of a piezoelectric crystal.
4. Measurement of the dielectric constant of a dielectric Materials
5. Study the complex dielectric constant and plasma frequency of metal using surface plasmon resonance (SPR)
7. Study the hysteresis loop of a Ferroelectric Crystal.
8. Study the B-H curve of 'Fe' using solenoid and determine energy loss from hysteresis.

Semester –VI
Cluster Electives VIII-B
Cluster Elective Paper –VIII-B-1: Fundamentals of Nanoscience

No. of Hours per week: 04 **Total Lectures:60**

UNIT-I (12hrs)
1. Background and history: Emergence of Nanoscience with special reference to Feynman and Drexler; Role of particle size; Spatial and temporal scale; Concept of confinement, strong and weak confinement with suitable example; Development of quantum structures, Basic concept of quantum well, quantum wire and quantum dot.
Finite size Zero, One and Two Dimensional Nanostructures, Concept of Surface and Interfacial Energies. Physics of the solid state – size dependence of properties, crystal structures, Lattice vibrations, Energy bands:- Insulators Semiconductors and conductors.

UNIT-II (12hrs)
2. Classification of Nanomaterials: Inorganic nanomaterials: carbon nanotubes and cones, Organic nanomaterials: dendrimers, micelles, liposomes, block copolymers; Bionanomaterials: Biomimtric, bioceramic and nanotherapeutics; Nanomaterials for molecular electronics and optoelectronics.

UNITS-III (12hrs)
3. Macromolecules: Classification of polymers, chemistry of polymerization, chain polymerization, step polymerization, coordination polymerization. Molecular weight of polymers-number average and weight average molecular weight, degree of polymerization, determination of molecular weight of polymers by viscometry, Osmometry and light scattering methods.Kinetics of free radical polymerization, derivation of rate law.Preparation and application of polyethylene, PVC, Teflon.

UNIT-IV (12hrs)
4. Molecular & Nanoelectronics: Semiconductors, Transition from crystal technology to nanotechnology. Tiny motors, Gyroscopes and accelerometers. Nano particle embedded wrinkle resistant cloth, Transparent Zinc Oxide sun screens.Bio-systems, Nanoscale processes in environment. Nanoscale structures, Novel phenomena and Quantum control and quantum computing. Single electron transistors, Quantum dots, Quantum wires.

UNIT-V (12hrs)
5. Biomaterials: Implant materials: Stainless steels and its alloys, Ti and Ti based alloys, Ceramic implant materials; Hydroxyapatite glass ceramics, Carbon Implant materials, Polymeric Implant materials, Soft tissue replacement implants, Sutures, Surgical tapes and adhesives, heart valve implants, Artificial organs, Hard Tissue replacement Implants, Internal Fracture Fixation Devices, Wires, Pins, and Screws, Fracture Plates.

Reference Books

1. T. Pradeep: Textbook of Nanoscience and Nanotechnology Chapter (McGraw-Hill Professional, 2012), Access Engineering.
2. C. N. R. Rao, A. Mu¨ller, A. K. Cheetham, "The Chemistry of Nanomaterials :Synthesis, Properties and Applications", Wiley-VCH, 2006.
3. C. Breachignac P. Houdy M. Lahmani, "Nanomaterials and Nanochemistry", Springer, 2006.
4. Guozhong Cao, "Nanostructures and Nanomaterials: Synthesis, Properties, and Applications", World Scientific Publishing Private, Ltd., 2011.

5. Zhong Lin Wang, “Characterization of Nanophase Materials”, Wiley-VCH, 2004.
6. Carl C. Koch, “Nanostructured Materials: Processing, Properties and Potential Applications”, William Andrew Publishing Norwich, 2006.

Elective Paper- VIII-B-1: Practical: Fundamentals of Nanoscience 2hrs/Week

Minimum of 6 experiments to be done and recorded

1. Determination of the Band Gap of Semiconductor Nanoparticles.
2. Surface Enhanced Raman Scattering Activity of Silver Nanoparticles
3. Conversion of Gold Nanorods into Gold Nanoparticles
4. Bimetallic Nanoparticles
5. Processing and Development of Nanoparticle gas sensor
6. Magnetic separation/identification studies of nanoparticles
7. Harvesting light using nano-solar cells
8. Nano-Forensic analysis to identify, individualize and evaluate evidence using nanophase materials
9. Comparison of the performance of nanoparticles based conductive adhesives and conventional non conductive adhesives.
10. Electrodeposition and corrosion behavior of nanostructured composite film
11. Photocatalytic activity of nanomaterials

Semester –VI

Cluster Elective Paper –VIII-B-2: Synthesis and Characterization of Nanomaterials

No. of Hours per week: 04 **Total Lectures: 60**

Unit-I (12 hrs)

1. Nanomaterials synthesis: Synthesis and nanofabrication, Bottom-Up and Top-Down approach with examples. Chemical precipitation methods, sol-gel method, chemical reduction, hydrothermal, process. Physical Mehtods- ball milling, Physical Vapour deposition (PVD), Sputtering, ChemicalVapor deposition (CVD), pray pyrolysis, Biological methods- Synthesis using micro organisms and bacteria, Synthesis using plant extract, use of proteins and DNA templates.

Unit-II (12 hrs)

2. Classification of materials: Types of materials, Metals, Ceramics (Sand glasses) polymers, composites, semiconductors.Metals and alloys- Phase diagrams of single component, binary and ternary systems, diffusion, nucleation and growth. Diffusional and diffusionless transformations.Mechanical properties.Metallic glasses. Preparation, structure and properties like electrical, magnetic, thermal and mechanical, applications.

UNITS-III (12 hrs)

3. Glasses: The glass transition - theories for the glass transition, Factors that determine the glass-transition temperature. Glass forming systems and ease of glass formation, preparation of glass materials.Applications of Glasses: Introduction: Electronic applications, Electrochemical applications, optical applications, Magnetic applications.

UNITS-IV (12 hrs)

4. Liquid Crystals: Mesomorphism of anisotropic systems, Different liquid crystalline phase and phase transitions, Thermal and electrical properties of liquid crystals, Types Liquid Crystals displays, few applications of liquid crystals.

UNITS-V (12 hrs)

5. Characterization Methods: XRD, SEM, TEM, AFM, XPS and PL characterization techniques for nano materials.Electrical and mechanical properties, Optical properties by IR and Raman Spectroscopy.

References books

1. Encyclopedia of Nanotechnology by M.Balakrishna Rao and K.Krishna Reddy, Vol.I to X, Campus books.
2. Nano: The Essentials-Understanding Nanoscinece & Nanotechnology by T.Pradeep; Tata Mc. Graw Hill
3. Nanotechnology in Microelectronics & Optoelectronics, J.M Martine Duart, R.J Martin Palma, F. Agullo Rueda, Elsevier
4. Nanoelectronic Circuit Design, N.K Jha, D Chen, Springer
5. Handbook of Nanophysics- Nanoelectronics & Nanophotonics, K.D Sattler, CRC Press
6. Organic Electronics-Sensors & Biotechnology- R. Shinar & J. Shinar, McGraw-Hill

Cluster Elective Paper-VIII-B-2: Practical: Synthesis and Characterization of Nanomaterials 2hrs/Week

Minimum of 6 experiments to be done and recorded

1. Synthesis of nanocrystalline films of II-VI compounds doped with rare earths by chemical process.
2. Synthesis of Alkaline earth aluminates in nanocrystalline form by combustion synthesis.
3. Preparation of surface conducting glass plate by spray pyrolysis method
4. Preparation of surface conducting glass plate by chemical route
5. Fabrication of micro fluidic nanofilter by polymerisation reaction
6. Absorption studies on the nanocrystalline films and determination of absorption coefficient.
7. Determination of band gap from the absorption spectra using Tauc's plots.
8. Study of Hall effect in semiconductors and its application in nanotechnology.
9. Measurement of electrical conductivity of semiconductor film by Four Probe method and study of temperature variation of electrical conductivity.

Semester –VI

Cluster Elective Paper –VIII-B-3: Applications of Nanomaterial's and Devices

No. of Hours per week: 04 **Total Lectures: 60**

UNIT-I (12 hrs)

1. Optical properties: Coulomb interaction in nanostructures. Concept of dielectric constant for nanostructures and charging of nanostructure.Quasi-particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals. Quantitative treatment of quasi-particles and excitons, charging effects. Radiative processes: General formalization-absorption, emission and luminescence. Optical properties of heterostrctures and nanostructures.

UNIT-II (12 hrs)

2. Electrical transport:

Carrier transport in nanostrcutures.Hall effect, etermination of carrier mobility and carrier concentration; Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity. Defects and impurities: Deep level and surface defects.

UNIT-III (12 hrs)

3. Applications: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron transfer devices (no derivation). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructures lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots - magnetic data storage.Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

UNIT-IV(12 hrs)

4. Nanoelectronics: Introduction, Electronic structure of Nanocrystals,Tuning the Band gap of Nanoscale semiconductors, Excitons, Quantumdot, Single electron devices, Nanostructured ferromagnetism,Effect of bulk nanostructuring of magnetic properties, Dynamics of nanomagnets, Nanocarbon ferromagnets, Giant and colossal magneto-resistance, Introduction of spintronics, Spintronics devices and applications.

UNIT-V (12 hrs)

5. Nanobiotechnology and Medical application: Introduction, Biological building blocks- size of building blocks and nanostructures, Peptide nanowires and protein nanoparticles, DNA double nanowires, Nanomaterials in drug delivery and therapy, Nanomedicine, Targeted gold nanoparticles for imaging and therapy.

Reference books:

1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
2. S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company).
3. K.K. Chattopadhyay and A.N. Banerjee, Introduction to Nanoscience & Technology (PHI Learning Private Limited).
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

Elective Paper- VIII-B-3: Practical: Applications of Nanomaterials and Devices
2hrs/Week

Minimum of 6 experiments to be done and recorded

1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on color of nanomaterials.
6. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.
7. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.
8. Fabricate a pn-diode by diffusing Al over the surface of n-type Si and study its I-V characteristics.

Elective VII-(C) :(Renewable Energy)

Semester –VI
Elective Paper –VII-(C): Renewable Energy

No. of Hours per week: 04 **Total Lectures:60**

UNIT-I (12 hrs)

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 (12 hrs)

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 (12 hrs)

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 (12 hrs)

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 (12 hrs)

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.

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.

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.

Semester –VI
Cluster Electives VIII-C
Cluster Elective Paper –VIII-C-1: Solar Thermal and Photovoltaic Aspects

No. of Hours per week: 04 **Total Lectures: 60**

UNIT-I (12 hrs)
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 throughsingle and multi covers; Kirchoff's law – Relation between absorptance, emittance and reflectance; Selective Surfaces - preparation and characterization, Types and applications; Anti-reflective coating.

UNIT-II (14 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.
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 (14 hrs)
5. 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.
6. Solar cell fabrication: Production of single crystal Silicon: Czokralski (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 (8 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 – use of Bypass and Blocking diodes, Solar PV system and its components, PV array, inverter, battery and load.

UNIT-V (12 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.
Solar PV applications: SPV systems; Stand alone, hybrid and grid connected systems, System installation, operation and maintenances; Field experience; PV market analysis and economics of SPV systems.

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, Tata Mc-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, 2004.

Cluster Elective Paper- VIII-C-1: Practical: Solar Thermal and Photovoltaic Aspects
2hrs/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.

Semester - VI
Cluster Elective Paper –VIII-C-2: Wind, Hydro and Ocean Energies

No. of Hours per week: 04 **Total Lectures: 60**

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 withballoons.

UNIT-II

3. Wind Energy Conversion System:Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element andcombine theory; Rotor characteristics; Maximum power coefficient; Prandlt's tip losscorrection.

4. Design of Wind Turbine: Wind turbine design considerations; Methodology; Theoretical simulation of wind turbinecharacteristics; 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 energyutilization; 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 andturbine; 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 anddisadvantages, 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.

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

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

No. of Hours per week: 04 **Total Lectures: 60**

UNIT-I (12 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, bio-chemical,electro-chemical, fossil fuels and synthetic fuels. Hydrogen for energy storage.

UNIT-II (12 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 (12 hrs)
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 (12 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, fuel cell stack, fuel cell power plant: fuel processor, fuel cell powersection, power conditioner, Advantages and disadvantages.

UNIT-V (12 hrs)
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.

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.

Cluster Elective Paper –VIII-C-3: Practical: Energy Storage Devices 2hrs/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.