Department Of Physics

OsmaniaUniversity

Scheme of Instruction and Syllabus

B.Sc Physics (I – VI Semesters)

Under CBCS scheme

(from the academic year 2016-2017)

B.Sc. PHYSICS SYLLABUS UNDER CBCS SCHEME
SCHEME OF INSTRUCTION

Semester	Paper [Theory and Practical]	Instructions Hrs/week	Marks	Credits
I sem	Paper – I : Mechanics	4	100	4
	Practicals – I : Mechanics	3	50	1
II sem	Paper – II: Waves and Oscillations	4	100	4
	Practicals – II : Waves and Oscillations	3	50	1
III sem	Paper – III : Thermodynamics	4	100	4
	Practicals – III : Thermodynamics	3	50	1
IV sem	Paper – IV : Optics	4	100	4
	Practicals – IV :Optics	3	50	1
V sem	Paper –V : Electromagnetism	3	100	3
	Practicals – V: Electromagnetism	3	50	1
	Paper – VI : Elective – I Solid state physics/ Quantum Mechanics and Applications	3	100	3
	Practicals – VI : Elective – I Practical Solid state physics/ Quantum Mechanics and Applications	3	50	1
VI sem	Paper – VII : Modern Physics	3	100	3
	Practical – VII : Modern Physics Lab	3	50	1
	Paper – VIII : Elective – II Basic Electronics/ Physics of Semiconductor Devices	3	100	3
	Practicals – VIII : Elective – II Practical Basic Electronics/ Physics of Semiconductor Devices	3	50	1

Total Credits 36

B.Sc. (Physics)Semester I-Theory Syllabus 56hrs
Paper – I:Mechanics

(W.E.F the academic year 2016-2017)
(CBCS)

Unit – I

1. Vector Analysis (14)

Scalar and vector fields, gradient of a scalar field and its physical significance.Divergence and curl of a vector field and related problems.Vector integration, line, surface and volume integrals.Stokes, Gauss and Greens theorems-simple applications.

Unit – II

2. Mechanics of Particles (07)

Laws of motion, motion of variable mass system, motion of a rocket, multi-stage rocket, conservation of energy and momentum. Collisions in two and three dimensions, concept of impact parameter, scattering cross-section,

3. Mechanics of rigid bodies (07)

Definition of Rigid body, rotational kinematic relations, equation of motion for a rotating body, angular momentum and inertial tensor.Euler's equation, precession of a top, Gyroscope,

Unit – III

4. Centralforces (14)

Central forces – definition and examples, conservative nature of central forces, conservative force as a negative gradient of potential energy, equation of motion under a central force, gravitational potential and gravitational field, motion under inverse square law, derivation of Kepler's laws, Coriolis force and its expressions.

Unit – IV

5. Special theory of relativity (14)

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

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

Textbooks

1. Berkeley Physics Course. Vol.1, **Mechanics** by C. Kittel, W. Knight, M.A. Ruderman - *Tata-McGraw hill Company Edition 2008*.
2. **Fundamentals of Physics**. Halliday/Resnick/Walker *Wiley India Edition 2007*.
3. **First Year Physics** - *Telugu Academy*.
4. **Introduction to Physics for Scientists and Engineers**. F.J. Ruche. *McGraw Hill*.

Reference Books

1. **Fundamentals of Physics** by Alan Giambattista et al *Tata-McGraw Hill Company* Edition, 2008.
2. **University Physics** by Young and Freeman, *Pearson Education, Edition 2005*.
3. **Sears and Zemansky's University Physics** by Hugh D. Young, Roger A. Freedman *Pearson Education Eleventh Edition*.
4. **An introduction to Mechanics** by Daniel Kleppner& Robert Kolenkow. *The McGraw Hill Companies*.
5. **Mechanics**. Hans &Puri. *TMH Publications*.
6. **Engineering Physics**. R.K. Gaur & S.L. Gupta. *DhanpatRai Publications*.
7. R P Feymman, RB Lighton and M Sands - The Feymman Lectures in Physics, Vol.-1, BI Publications,
8. J.C. Upadhyay - Mechanics.
9. P.K. Srivastava - Mechanics, New Age International.

42hrs
(3 hrs / week)

FIRST SEMISTER PRACTICALS

Practical Paper – I : Mechanics

1. Study of a compound pendulum determination of ‘g’ and ‘k’.
2. Y’ by uniform Bending
3. Y by Non-uniform Bending.
4. Moment of Inertia of a fly wheel.
5. Measurement of errors –simple Pendulum.
6. ‘Rigidity moduli by torsion Pendulum.
7. Determine surface tension of a liquid through capillary rise method.
8. Determination of Surface Tension of a liquid by different methods.
9. Determine of Viscosity of a fluid.

Note: Minimum of eight experiments should be performed. Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.

Text and reference books

1. D.P. Khandelwal, “A laboratory manual for undergraduate classes” (Vani Publishing House, New Delhi).
2. S.P. Singh, “Advanced Practical Physics” (PragatiPrakashan, Meerut).
3. Worsnop and Flint- Advanced Practical physics for students.
4. “Practical Physics” R.K Shukla, AnchalSrivastava

B.Sc. (Physics)Semester II-Theory Syllabus 56 hrs
Paper – II :Waves and Oscillations

(W.E.F the academic year 2016-2017)
(CBCS)

Unit – I

1. Fundamentals of vibrations (14)

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

Unit – II

2. Damped and forced oscillations (14)

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

Unit – III

3. Vibrating Strings (14)

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, energy transport, transverse impedance

Unit – IV

4. Vibrations of bars (14)

Longitudinal vibrations in bars- wave equation and its general solution. Special cases (i) bar fixed at both ends ii) bar fixed at the mid point iii) bar free at both ends iv) bar fixed at one end. Transverse vibrations in a bar- wave equation and its general solution. Boundary conditions, clamped free bar, free-free bar, bar supported at both ends, Tuning fork.

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

Textbooks

1. **Fundamentals of Physics**. Halliday/Resnick/Walker *Wiley India Edition 2007*.
2. **First Year Physics** - *Telugu Academy*.
3. **Introduction to Physics for Scientists and Engineers**. F.J. Ruche. *McGraw Hill*.
4. **Fundamentals of Acoustics by Kinsler and Fray, Meer publishers**.

Reference Books

1. **Fundamentals of Physics** by Alan Giambattista et al *TMH Company* Edition, 2008.
2. **University Physics** by Young and Freeman, *Pearson Education, Edition 2005*.
3. **An introduction to Mechanics** by Daniel Kleppner& Robert Kolenkow. *The McGraw Hill Companies*.
4. **Engineering Physics**. R.K. Gaur & S.L. Gupta. *DhanpatRai Publications*.

.

42hrs

SECOND SEMISTER PRACTICALS

Practical Paper – II : Waves and Oscillations

1. Study of damping of an oscillating disc in Air and Water logarithmic decrement.
2. Study of Oscillations under Bifilar suspension.
3. Study of oscillations of a mass under different combination of springs.
4. Verification of Laws of a stretched string (Three Laws).
5. Determination of frequency of a Bar-Melde's experiment.
6. Observation of Lissajous figures from CRO.
7. Volume Resonator –determination of frequency of a tuning fork.
8. Velocity of Transverse wave along a stretched string.
9. Study of damping of a bar pendulum
10. Study of coupled oscillator.

Note: Minimum of eight experiments should be performed. .
Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.

Text and reference books

1. D.P. Khandelwal, "A laboratory manual for undergraduate classes" (Vani Publishing House, New Delhi).
2. S.P. Singh, "Advanced Practical Physics" (PragatiPrakashan, Meerut).
3. Worsnop and Flint- Advanced Practical physics for students.
4. "Practical Physics" R.K Shukla, AnchalSrivastava

B.Sc. Semester III-Theory Syllabus 56hrs

Subject: Physics Paper – III :Thermodynamics

(W.E.F the academic year 2017-2018)

Unit – I

1. **Kinetic theory of gases: (6)**

   Introduction – Deduction of Maxwell's law of distribution of molecular speeds, Transport Phenomena – Viscosity of gases – thermal conductivity – diffusion of gases.

2. **Thermodynamics: (8)**

   Basics of thermodynamics-Kelvin's and Claussius statements – Thermodynamic scale of temperature – Entropy, physical significance – Change in entropy in reversible and irreversible processes – Entropy and disorder – Entropy of universe – Temperature-Entropy (T-S) diagram – Change of entropy of a perfect gas-change of entropy when ice changes into steam.

Unit – II

3. **Thermodynamic potentials and Maxwell's equations: (7)**

   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 Vanderwaal's gas.

4. **Low temperature Physics: (7)**

   Joule Kelvin effect – liquefaction of gas using 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 – Principle of refrigeration, vapour compression type.

Unit – III

5. **Quantum theory of radiation: (14)**

   Black body-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 – deduction of Wein'sdistribution law, Rayleigh-Jeans law, Stefan's law from Planck's law.

Measurement of radiation using pyrometers – Disappearing filament optical pyrometer – experimental determination – Angstrom pyroheliometer - determination of solar constant, effective temperature of sun.

Unit – IV

6. Statistical Mechanics: (14)

Introduction, postulates of statistical mechanics.Phase space, concept of ensembles and some known ensembles ,classical and quantum statistics and their differences, concept of probability, Maxwell-Boltzmann's distribution law -Molecular energies in an ideal gas-Maxwell-Boltzmann's velocity distribution law, Bose-Einstein Distribution law, Fermi-Dirac Distribution law, comparison of three distribution laws, Application of B-E distribution to Photons-planks radiation formula, Application of Fermi-Dirac statistics to white dwarfs and Neutron stars.

Textbooks

1. **Fundamentals of Physics**. Halliday/Resnick/Walker.*C. Wiley India Edition 2007.*
2. **Second Year Physics** – *Telugu Academy.*
3. **Modern Physics** by R. Murugeshan and Kiruthiga Siva Prasath (for statistical Mechanics) *S. Chand & Co*.
4. **Heat and Thermodynamics** by Mark W.Zemansky 5th edition McGraw - Hill
5. **Heat and Thermodynamics** by D.S. Mathur.

Reference Books

1. **Modern Physics** by G. Aruldhas and P. Rajagopal, *Eastern Economy Education*.
2. Berkeley Physics Course. Volume-5. **Statistical Physics** by F. Reif. *The McGraw-Hill Companies*.
3. **An Introduction to Thermal Physics** by Daniel V. Schroeder.*Pearson Education Low Price Edition*.
4. **Thermodynamics** by R.C. Srivastava, Subit K. Saha&Abhay K. *Jain Eastern Economy Edition*.
5. **Modern Engineering Physics** by A.S. Vasudeva. *S.Chand& Co. Publications*.
6. **Feyman's Lectures on Physics** Vol. 1,2,3& 4. *Narosa Publications*.
7. **Fundamentals of Optics** by Jenkins A. Francis and White E. Harvey, *McGraw Hill Inc.*

8 .B.B. Laud **"Introduction to statistics Mechanics"**(Macmillan 1981)

9. F.Reif**: "Statistical Physics "**(Mcgraw-Hill,1998)

10.K.Haung: "**Statistical Physics "**(Wiley Eastern 1988)

42hrs
(3 hrs / week)

III SEMESTERPracticals Paper – III : Thermodynamics

1. Co-efficient of thermal conductivity of a bad conductor by Lee's method.
2. Measurement of Stefan's constant.
3. Specific heat of a liquid by applying Newton's law of cooling correction.
4. Heating efficiency of electrical kettle with varying voltages.
5. Determination of Thermo emf
6. Cooling Curve of a metallic body (Null method)
7. Resistance thermometer. To Determine temp coeff resistance
8. Thermal expansion of solids
9. Study of mechanical energy to heat.
10. Determine the Specific of a solid (graphite rod)
11. Thermistor Characteristics. Calculation of A and B

Note: Minimum of eight experiments should be performed. Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.

Text and reference books

1. D.P. Khandelwal, "A laboratory manual for undergraduate classes" (Vani Publishing House, New Delhi).
2. S.P. Singh, "Advanced Practical Physics" (PragatiPrakashan, Meerut).
3. Worsnop and Flint- Advanced Practical physics for students.
4. "Practical Physics" R.K Shukla, AnchalSrivastava

B.Sc. Semester IV-Theory Syllabus 56hrs

Subject :(Physics)Paper – IV :Optics

(W.E.F the academic year 2017-2018)

Unit I

1 Interference: (14)

Principle of superposition – coherence – temporal coherence and spatial coherence – conditions for Interference of light

Interference by division of wave front: Fresnel's biprism – determination of wave length of light. Determination of thickness of a transparent material using Biprism – change of phase on reflection – Lloyd's mirror experiment.

Interference by division of amplitude: Oblique incidence of a plane wave on a thin film due to reflected and transmitted light (Cosine law) – Colours of thin films – Non reflecting films – interference by a plane parallel film illuminated by a point source – Interference by a film with two non-parallel reflecting surfaces (Wedge shaped film) – Determination of diameter of wire-Newton's rings in reflected light with and without contact between lens and glass plate, Newton's rings in transmitted light (Haidinger Fringes) – Determination of wave length of monochromatic light – Michelson Interferometer – types of fringes – Determination of wavelength of monochromatic light, Difference in wavelength of sodium D_1,D_2 lines and thickness of a thin transparent plate.

Unit I1:

2 Diffraction: (14)

Introduction – Distinction between Fresnel and Fraunhoffer diffraction Fraunhoffer diffraction:- Diffraction due to single slit and circular aperture – Limit of resolution – Fraunhoffer diffraction due to double slit – Fraunhoffer diffraction pattern with N slits (diffraction grating)

Resolving Power of grating – Determination of wave length of light in normal and oblique incidence methods using diffraction grating.

Fresnel diffraction-Fresnel's half period zones – area of the half period zones –zone plate – Comparison of zone plate with convex lens – Phase reversal zone plate – diffraction at a straight edge – difference between interference and diffraction.

Unit I1I:

3 Polarization (14)

Polarized light : Methods of Polarization, Polarization by reflection, refraction, Double refraction, selective absorption , scattering of light – Brewsters law – Malus law – Nicol prism polarizer and analyzer – Refraction of plane wave incident on negative and positive crystals (Huygen's explanation) – Quarter wave plate, Half wave plate – Babinet's compensator – Optical activity, analysis of light by Laurent's half shade polarimeter.

Unit IV:

4 Aberrations and Fiber Optics : (14)

Introduction – Monochromatic aberrations, spherical aberration, methods of minimizing spherical aberration, coma, astigmatism and curvature of field, distortion. Chromatic aberration – the achromatic doublet – Removal of chromatic aberration of a separated doublet.

Fiber Optics : Introduction – Optical fibers –Principles of fiber communication – Step and graded index fibers – Rays and modes in an optical fiber – Fiber material – Types of optical fibers and advantages of fiber communication.

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

Textbooks

1. **Optics** by AjoyGhatak. *The McGraw-Hill companies*.
2. **Optics** by Subramaniyam and Brijlal. *S. Chand & Co*.
3. **Fundamentals of Physics**. Halliday/Resnick/Walker.*C. Wiley India Edition 2007*.
4. **Optics and Spectroscopy**. R. Murugeshan and Kiruthiga Siva Prasath. *S. Chand & Co*.
5. **Second Year Physics** – *Telugu Academy.*

Reference Books

1. **Modern Engineering Physics** by A.S. Vasudeva. *S.Chand& Co. Publications*.
2. **Feyman's Lectures on Physics** Vol. 1,2,3& 4. *Narosa Publications*.
3. **Fundamentals of Optics** by Jenkins A. Francis and White E. Harvey, *McGraw Hill Inc.*
4. K. Ghatak, **Physical Optics'**
5. D.P. Khandelwal, Optical and Atomic Physics' (Himalaya Publishing House, Bombay,1988)
6. Jenkins and White: 'Fundamental of Optics' (McGraw-Hill)
7. Smith and Thomson: 'Optics' (John Wiley and sons)

42hrs

IV SEMESTERPracticals Paper – IV : Optics

1. Thickness of a wire using wedge method.
2. Determination of wavelength of light using Biprism.
3. Determination of Radius of curvature of a given convex lens by forming Newton's rings.
4. Resolving power of grating.
5. Study of optical rotation-polarimeter.
6. Dispersive power of a prism
7. Determination of wavelength of light using diffraction grating minimum deviation method.
8. Wavelength of light using diffraction grating – normal incidence method.
9. Resolving power of a telescope.
10. Refractive index of a liquid and glass (Boys Method).
11. Pulfrichrefractometer – determination of refractive index of liquid.
12. Wavelength of Laser light using diffraction grating.

Note: Minimum of eight experiments should be performed.
Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.

Text and reference books

1. D.P. Khandelwal, "A laboratory manual for undergraduate classes" (Vani Publishing House, New Delhi).
2. S.P. Singh, "Advanced Practical Physics" (PragatiPrakashan, Meerut).
3. Worsnop and Flint- Advanced Practical physics for students.
4. "Practical Physics" R.K Shukla, AnchalSrivastava

B.Sc. Semester V-Theory Syllabus 42 hrs

Subject :(Physics) Paper – V :Electromagnetism

(DSE- Compulsory)

(W.E.F the academic year 2018-2019)

Unit I :

Electrostatics (11hrs)

Electric Field:- Concept of electric field lines and electric flux, Gauss's law (Integral and differential forms), application to linear, plane and spherical charge distributions. Conservative nature of electric field E, irrotational field. Electric Potential:- Concept of electric potential, relation between electric potential and electric field, potential energy of a system of charges. Energy density in an electric field.Calculation of potential from electric field for a spherical charge distribution.

Unit II :

Magnetostatics(12hrs)

Concept of magnetic field B and magnetic flux, Biot-Savart's law, B due to a straight current carrying conductor. Force on a point charge in a magnetic field. Properties of B, curl and divergence of B, solenoidal field. Integral form of Ampere's law, applications of Ampere's law: field due to straight, circular and solenoidal currents. Energy stored in magnetic field. Magnetic energy in terms of current and inductance.Magnetic force between two current carrying conductors.Magnetic field intensity. Ballistic Galvanometer:- Torque on a current loop in a uniform magnetic field, working principle of B.G., current and charge sensitivity, electromagnetic damping, critical damping resistance.

Unit III:

Electromagnetic Induction (9hrs)

Faraday's laws of induction (differential and integral form), Lenz's law, self and mutual Induction. Continuity equation, modification of Ampere's law, displacement current, Maxwell equations

Unit IV :

Electromagnetic waves (10hrs)

Maxwell's equations in vacuum and dielectric medium, boundary conditions, plane wave equation: transverse nature of EM waves, velocity of light in vacuum and in medium, polarization, reflection and transmission. Polarization of EM waves, Brewster's angle, description of linear, circular and elliptical polarization.

Text Books

1. Fundamentals of electricity and magnetism By Arthur F. Kip (McGraw-Hill, 1968)
2. Electricity and magnetism by J.H.Fewkes& John Yarwood. Vol.I (Oxford Univ. Press, 1991).
3. Introduction to Electrodynamics, 3rd edition, by David J. Griffiths, (Benjamin Cummings,1998).

Reference Books

4. Electricity and magnetism By Edward M. Purcell (McGraw-Hill Education, 1986)
5. Electricity and magnetism. By D C Tayal (Himalaya Publishing House,1988)
6. Electromagnetics by Joseph A.Edminister 2nd ed.(New Delhi: Tata McGraw Hill, 2006).

36hrs

V SEMISTERPracticals Paper – V : Electromagnetism

PHYSICS LABORATORY Marks: 50

1. To verify the Thevenin Theorem
2. To verify Norton Theorem
3. To verify Superposition Theorem
4. To verify maximum power transfer theorem.
5. To determine a small resistance by Carey Foster's bridge.
6. To determine the (a) current sensitivity, (b) charge sensitivity, and (c) CDR of a B.G.
7. To determine high resistance by leakage method.
8. To determine the ratio of two capacitances by De Sauty's bridge.
9. To determine self-inductance of a coil by Anderson's bridge using AC.
10. To determine self-inductance of a coil by Rayleigh's method.
11. To determine coefficient of Mutual inductance by absolute method.

Note: Minimum of eight experiments should be performed.
Maximum of 15 students per batch and maximum of three students per experiment should be allotted in the regular practical class of three hours per week.

Suggested Books for Reference

1. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.
2. InduPrakash and Ramakrishna, A Text Book of Practical Physics, KitabMahal

B.Sc. Semester V-Theory Syllabus

Subject :(Physics) **(DSE- Elective-I)** **42hrs**

Paper-VI-A – Solid State Physics

Unit-I(11hrs)
Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors.Lattice with a Basis – Central and Non-Central Elements.Unit Cell.Miller Indices.Types of Lattices, Reciprocal Lattice.Brillouin Zones.Diffraction of X-rays by Crystals.Bragg's Law.Atomic and Geometrical Factor.

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons.Qualitative Description of the Phonon Spectrum in Solids.Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T3 law

Unit-II(11hrs)
Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia–and Paramagnetic Domains.Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains.Discussion of B-H Curve.Hysteresis and Energy Loss.
Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom.Depolarization Field.Electric Susceptibility.Polarizability.ClausiusMosotti Equation.Classical Theory of Electric Polarizability.

Unit-III(10 hrs)
Elementary band theory: Kronig Penny model. Band Gap.Brillouin zones, effective mass of electron. Conductor, Semiconductor (P and N type) and insulator.Conductivity of Semiconductor, mobility, Hall Effect,Electric Conductivity by four probe method& Hall coefficient.

UNIT IV(10hrs)
Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion.Three-Level and Four-Level Lasers.Ruby Laser and He-Ne Laser.
Superconductivity: Experimental Results. Critical Temperature.Critical magnetic field.Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect.Idea of BCS theory.D.C and A.C Josepson effects.

Text Books:
1. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
2. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
3. Solid State Physics, M.A. Wahab, 2011, Narosa Publications
4. Solid State Physics – S. O. Pillai (New Age Publication)
5. Modern Physics by R.Murugesham

Reference Books:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
5. Solid State Physics- R.K.Puri&V.K. Babbar (S.Chand Publication)2013
6. Lasers and Non linear Optics –B.B.Laud-Wiley Eastern.
7. LASERS: Fundamentals and Applications – Thyagarajan and Ghatak (McMillanIndia)

36hrs

V SEMISTERPracticals Paper – VI A
Solid State Physics

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To study the PE Hysteresis loop of a Ferroelectric Crystal.
6. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
7. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150^0 C) and to determine its band gap.
8. To determine the Hall coefficient of a semiconductor sample.
9. Calculation of d-values of a given Laue's pattern.
10. Calculation of d-values of powder diffraction method.
12. To study the spectral characteristics of a Photo- Voltaic cell.
13. Verification of Bragg's equation.

Reference Books

• Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
• Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
• A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, KitabMahal
• Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

B.Sc. Semester V-Theory Syllabus

42 hrs

Subject :(Physics) **(DSE- Elective-I)**

Paper-VI-B –QUANTUM MECHANICS AND APPLICATIONS

Unit-I (11hrs)

Schrodinger equation & the operators: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions.Normalization.Linearity and Superposition Principles.Hermitian operator, Eigen values and Eigen functions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum.Wave Function of a Free Particle.

Unit II(11 hrs)

Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigen values; expansion of an arbitrary wave function as a linear combination of energy eigen functions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wave function; Position-momentum uncertainty principle.

Unit-III(10 hrs)

General discussion of bound states in an arbitrary potential- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigen functions ground state, zero point energy & uncertainty principle. One dimensional infinitely rigid box- energy eigen values and eigen functions, normalization; Quantum dot as example; Quantum mechanical scattering and tunnelling in one dimensionacross a step potential & rectangular potential barrier.

Unit-IV(10hrs)

Atoms in Electric & Magnetic Fields: Electron angular momentum. Space quantization.Electron Spin and Spin Angular Momentum.Larmor's Theorem. Spin Magnetic Moment. SternGerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. Atoms in External Magnetic Fields:- Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only). (12 Lectures)

Text Books:

1. A Text book of Quantum Mechanics, P. M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.

Reference Books:

1. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
2. Cohen-Tannoudji, B Diu and F Laloë, Quantum Mechanics (2 vols) Wiley-VCH 1977 • Basic Quantum Mechanics –A.Ghatak (McMillan India) 2012
3. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson • Quantum Physics----S. Gasiorowicz (Wiley India) 2013

36hrs

V –SEMESTERPracticals Paper – VI B

Quantum Mechanics and Applications

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom: Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take e = 3.795 (eVÅ)1/2, ħc = 1973 (eVÅ) and m = 0.511x106 eV/c2.
2. Solve the s-wave radial Schrodinger equation for an atom: where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take e = 3.795 (eVÅ)1/2, m = 0.511x106 eV/c2, and a = 3 Å, 5 Å, 7 Å. In these units ħc = 1973 (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.
3. Solve the s-wave radial Schrodinger equation for a particle of mass m: For the anharmonic oscillator potential for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c2, k = 100 MeV fm-2, b = 0, 10, 30 MeV fm-3In these units, cħ = 197.3 MeV fm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.
4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule: Where μ is the reduced mass of the two-atom system for the Morse potential Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function. Take: m = 940x106eV/C2, D = 0.755501 eV, α = 1.44, ro = 0.131349 Å

Laboratory based experiments:

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
7. To show the tunneling effect in tunnel diode using I-V characteristics.
8. Quantum efficiency of CCDs

Reference Books:

1. Schaum's outline of Programming with C++. J.Hubbard, 2000,McGraw---Hill Publication
2. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal., 3rd Edn., 2007, Cambridge University Press.
3. An introduction to computational Physics, T.Pang, 2nd Edn.,2006, Cambridge Univ. Press • Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific & Engineering Applications: A. VandeWouwer, P. Saucez, C. V. Fernández.2014 Springer.
4. Scilab(A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co.
5. Scilab Image Processing: L.M.Surhone.2010 Betascript Publishing ISBN:978-613345927

B.Sc. Semester VI-Theory Syllabus

42hrs

Subject :(Physics) **(DSC- Compulsory)**

Paper-VII–MODERN PHYSICS

UNIT-I (11hrs)

Atomic Spectra and Models Inadequacy of classical physics:

Brief Review of Black body Radiation , Photoelectric effect, Compton effect, dual nature of radiation, wave nature of particles. Atomic spectra, Line spectra of hydrogen atom, Ritz Rydberg combination principle. Alpha Particle Scattering, Rutherford Scattering Formula, Rutherford Model of atom and its limitations, Bohr's model of H atom, explanation of atomic spectra, correction for finite mass of the nucleus, Bohr correspondence principle, limitations of Bohr model, discrete energy exchange by atom, Frank Hertz Expt. Sommerfeld'sModification of Bohr's Theory.

UNIT-II(11hrs)

Wave Particle Duality de Broglie hypothesis, Experimental confirmation of matter wave, Davisson Germer Experiment, velocity of de Broglie wave, wave particle duality, Complementarity. Superposition of two waves, phase velocity and group velocity , wave packets ,Gaussian Wave Packet , spatial distribution of wave packet, Localization of wave packet in time. Time development of a wave Packet; Wave Particle Duality, Complementarity . Heisenberg Uncertainty Principle,Illustration of the Principle through thought Experiments of Gamma ray microscope and electron diffraction through a slit. Time independent and time dependent Schrodinger wave equation.Estimation of ground state energy of harmonic oscillator and hydrogen atom, non-existence of electron in the nucleus.Uncertainty and Complementarities.

UNIT-III(9hrs)

Nuclear Physics Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

Unit IV(11hrs)

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus. Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions), Classification of Elementary Particles

Text Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Modern Physics ---Murugesan and Sivaprasad –(S. Chand Higher Academics)
3. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
4. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
5. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning. •
6. Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004, Macmillan

Reference Books

1. Modern Physics – Bernstein, Fishbane and Gasiorowicz (Pearson India) 2010
2. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles -- R. Eisberg (Wiley India) 2012 Additional Books for Reference
3. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
4. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
5. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
6. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
7. Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGraw Hill
8. Modern Physics-Serway (CENGAGE Learnings) 2014
9. Physics of Atoms and Molecules – Bransden (Pearson India) 2003

36hrs

VI SEMISTERPracticals Paper – VII :
Modern Physics

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine the Planck's constant using LEDs of at least 4 different colors.
4. To determine the ionization potential of mercury.
5. To determine the absorption lines in the rotational spectrum of Iodine vapour.
6. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
7. To setup the Millikan oil drop apparatus and determine the charge of an electron.
8. To show the tunneling effect in tunnel diode using I-V characteristics.
9. To determine the wavelength of laser source using diffraction of single slit.
10. To determine the wavelength of laser source using diffraction of double slits.
11. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating
12. To determine the value of e/m for electron by long solenoid method.
13. Photo Cell – Determination of Planck's constant.
14. To verify the inverse square law of radiation using a photo-electric cell.
15. To find the value of photo electric work function of a material of the cathode using a photo-electric cell.
16. Measurement of magnetic field – Hall probe method.
17. To determine the dead time of a given G.M. tube using double source.
18. Hydrogen spectrum – Determination of Ridge berg's constant
19. Energy gap of intrinsic semi-conductor
20. G. M. Counter – Absorption coefficients of a material.
21. To draw the plateau curve for a Geiger Muller counter.
22. To find the half-life period of a given radioactive substance using a G.M. Counter.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

B.Sc. Semester VI-Theory Syllabus

42 hrs

Subject :(Physics) **(DSE- Elective-II)**

Paper-VIII-A :Basic Electronics

Unit-I: (10hrs)

Network Elements and Network Theorems

Passive elements, Power sources, Active Elements, Network Models: T and π Transformations, Superposition theorem,Thevenin's Theorem, Norton's theorem. Reciprocity Theorem and Maximum power transfer theorem (Simple problems).

Two-port Networks – Introduction- Z-parameters, Y-parameters, h-parameters and ABCD-parameters (Simple problems).

Unit – II: (10hrs)

Band theory of P-N junction

1. Energy band in solids (band theory), valence band, conduction band and forbidden energy gap solids, Insulators, semi conductors and, pure or intrinsic semiconductors and impurity or extrinsic semi-conductors. N-type extrinsic semi-conductors, P-type extrinsic semi-conductors, Fermi level, continuity equation.

2. Diodes: P-N junction diode, Bridge rectifier. Zener diode & its Characteristics.Zener diode as voltage regulator.

Unit-III: (11hrs)

1. Bipolar Junction Transistor (BJT) – p-n-p and n-p-n transistors, current components in transistors, CB, CE and CC configurations – transistor as an amplifier -RC coupled amplifier. (Qualitative analysis)

2. Feedback Concept & Oscillators: Feedback, General theory of feedback–Concepts of a Oscillators, Barkhausen's criteria, Phase shift Oscillator.

Unit-IV: (11hrs)

1. Digital Electronics

Binary number system, converting Binary to Decimal and vice versa.Binary addition and subtraction (1's and 2's complement methods).Hexadecimal number system.Conversion from Binary to Hexadecimal – vice versa and Decimal to Hexadecimal vice versa.

1. **Logic gates:**

OR, AND, NOT gates, truth tables, realization of these gates using discrete components. NAND, NOR as universal gates, Exclusive – OR gate (EX-OR). De Morgan's Laws – Statement and proof.

NOTE: Problems should be solved from every chapter of all units.

Textbooks

1. Electronic devices and circuits – Millman and Halkias. *Mc.Graw-Hill Education.*
2. Principles of Electronics by V.K. Mehta – *S. Chand & Co.*
3. Basic Electronics (Solid state) – B. L. Theraja , S. Chand & Co.
4. A First Course in Electronics- Anwar A. Khan&Kanchan K. Dey, PHI.

Reference Books

1. Basic Electronics – BernodGrob.
2. Third year Electronics – Telugu Academy
3. Digital Principles & Applications – A.P. Malvino and D.P. Leach
4. Circuit theory- Umesh.

36hrs

VI SEMISTERPracticals Paper – VIII A :

Basic Electronics

1. AND, OR, NOT, gates – Truth table Verification
2. AND, OR, NOT – gates constructions using universal gates – Verification of truth tables.
3. NAND and NOR gates truth table verification
4. Characteristics of a Transistor in CE configuration
5. R.C. coupled amplifier – frequency response.
6. Verification of De Morgan's Theorem.
7. Zener diode V-I characteristics.
8. Verification Thevenin's theorem.
9. Maximum Power Transfer theorem
10. P-n junction diode V- I characteristics.
11. Zener diode as a voltage regulator
12. Construction of a model D.C. power supply
13. R C phase shift Oscillator –determination of output frequency

❖ Every student should complete minimum 06 experiments.

Text Books for LAB (Practical 6)

1. B.Sc. Practical Physics – C. L. Arora – S. Chand & Co.
2. Viva-voce in Physics – R.C. Gupta, PragathiPrakashan, Meerut.
3. Laboratory manual for Physics Course by B.P. Khandelwal.
4. Practical Physics by M. Arul Thakpathi by Comptex Publishers.
5. B.Sc. practical physics – Subbi Reddy.

B.Sc. Semester VI-Theory Syllabus

Subject :(Physics) **(DSE- Elective-II)** **42 hrs**

Paper-VIII-B :Physics of Semiconductor Devices

Unit-I: (11hrs)

Semiconductor Physics: Conductors, Semiconductors, forbidden orbits, energy levels, crystals and covalent bonds, free electrons and holes, recombination and life-time, energy bands. Intrinsic Semiconductor- intrinsic carrier concentration, density of electrons in conduction band, fermi-level, mass action law. Carrier transport phenomena- mobility, resistivity, diffusivity, Einstein's relation, current density equation. Extrinsic semiconductor- n-type semiconductor, p-type semiconductor, energy band diagram of extrinsic semiconductor. Hall effect- mobility and Hall angle, experiment arrangement for the study of Hall effect, significance of Hall effect.

Unit – II: (11hrs)

P-N junction-Depletion layer, Energy level diagram of p-n junction, Band structure of an open circuited p-n junction, Biasing of p-n junction, effect of barrier potential on forward bias, reverse leakage current, reverse breakdown, P-n junction under various conditions- thermal equilibrium, forward and reverse bias, current-voltage characteristics. Derivation of ideal diode equation of p-n junction, diode model and its approximations.Forward and reverse resistance of diode.Dynamic characteristic of diode.

Unit-III: (10hrs)

Special diodes-Zener diode, Light –emitting diode (LED), Photo-diode, Schottky diode, Backward diodes and Tunnel diode.
Transistors- Bipolar junction transistor (BJT), transistor characteristics, transistor equation in active region, field effect transistor (FET), Phototransistor and MOSFETTs.

Unit-IV: (10 hrs)

Control devices- Shockley Diode, Silicon Controlled Rectifier (SCR), Silicon Controlled Switch (SCS), Unijunction transistor (UJT), Solar Cells, Opto-couplers.

Textbooks

1. A First Course in Electronics- Anwar A. Khan&Kanchan K. Dey, PHI
2. Physics of Semiconductor Devices- S. M. Sze
3. Physics of Semiconductors- Streetman

36hrs

VI SEMISTERPracticals Paper – VIII-B :

Physics of Semiconductor Devices

1. Characteristics of a Transistor in CE configuration
2. Zener diode V-I characteristics.
3. P-n junction diode V- I characteristics.
4. Zener diode as a voltage regulator
5. Determination of carrier concentration using Hall effect
6. Thermistor characteristics
7. Efficiency of a LED
8. Solar cell: fill factor and efficiency
9. FET characteristics
10. SCR characteristics
11. UJT characteristics

- Every student should complete minimum 06 experiments.

Text Books for LAB (Practical 6)

1. Basic electronics Grob
2. Practical Electronics Zbar

Skill Enhancement Courses (02 to 04 papers) (Credit: 02 each)- SEC1 to SEC4

SEC 1. Weather Forecasting	semester III
SEC 2. Renewable Energy and Energy harvesting	semester IV
SEC 3. Electrical circuit network Skills	semester V
SEC 4. Basic Instrumentation Skills	semester VI
SEC 5. Radiation safety	

- Experiments suggested are optional

SEC 1 :WEATHER FORECASTING

(Credits: 02)Theory: 30 Lectures

The aim of this course is not just to impart theoretical knowledge to the students butto enable them to develop an awareness and understanding regarding the causes andeffects of different weather phenomenon and basic forecasting techniques

Introduction to atmosphere: Elementary idea of atmosphere: physical structure andcomposition; compositional layering of the atmosphere; variation of pressure andtemperature with height; air temperature; requirements to measure air temperature;temperature sensors: types; atmospheric pressure: its measurement; cyclones andanticyclones: its characteristics. **(9 Periods)**

Measuring the weather: Wind; forces acting to produce wind; wind speed direction:units, its direction; measuring wind speed and direction; humidity, clouds and rainfall,radiation: absorption, emission and scattering in atmosphere; radiation laws.**(4 Periods)**

Weather systems: Global wind systems; air masses and fronts: classifications; jetstreams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes.**(3 Periods)**

Climate and Climate Change: Climate: its classification; causes of climate change;global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain,environmental issues related to climate. **(6 Periods)**

Basics of weather forecasting: Weather forecasting: analysis and its historicalbackground; need of measuring weather; types of weather forecasting; weatherforecasting methods; criteria of choosing weather station; basics of choosing site andexposure; satellites observations in weather forecasting; weather maps; uncertainty andpredictability; probability forecasts. **(8 Periods)**

Demonstrations and Experiments:

1. Study of synoptic charts & weather reports, working principle of weather station.
2. Processing and analysis of weather data:

(a) To calculate the sunniest time of the year.
(b) To study the variation of rainfall amount and intensity by wind direction.
(c) To observe the sunniest/driest day of the week.
(d) To examine the maximum and minimum temperature throughout the year.
(e) To evaluate the relative humidity of the day.
(f) To examine the rainfall amount month wise.

3. Exercises in chart reading: Plotting of constant pressure charts, surfaces charts,upper wind charts and its analysis.
4. Formats and elements in different types of weather forecasts/ warning (both aviation and non aviation)

Reference books:

1. Aviation Meteorology, I.C. Joshi, 3rd edition 2014, Himalayan Books
2. The weather Observers Hand book, Stephen Burt, 2012, CambridgeUniversity Press.
3. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur.
4. Text Book of Agrometeorology, S.R. Ghadekar, 2005, Agromet Publishers,Nagpur.
5. Why the weather, Charls Franklin Brooks, 1924, Chpraman& Hall, London.
6. Atmosphere and Ocean, John G. Harvey, 1995, The Artemis Press.

SEC 2: RENEWABLE ENERGY AND ENERGY HARVESTING

The aim of this course is not just to impart theoretical knowledge to the students but to provide themwith exposure and hands-on learning wherever possible

UNIT-I

Fossil fuels and Alternate Sources of energy: Fossil fuels and nuclear energy, their limitation,need of renewable energy, non-conventional energy sources. An overview of developments inOffshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion,solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy,Hydroelectricity.

UNIT-II

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non plate collector,solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need andcharacteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun trackingsystems.

UNIT-III

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

UNIT-IV

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics,Wave Energy Devices.Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, OsmoticPower, Ocean Bio-mass.

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydropower sources.

Reference Books:

• Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
• Solar energy - M P Agarwal - S Chand and Co. Ltd.
• Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
• Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford UniversityPress, in association with The Open University.
• Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
• J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

SEC 3: ELECTRICAL CIRCUIT NETWORK SKILLS
(Credits: 02)Theory: 30 Lectures

The aim of this course is to enable the students to design and trouble shoots theelectrical circuits, networks and appliances through hands-on mode

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law.Series, parallel, and series-parallel combinations.AC Electricity and DC Electricity.Familiarization with multimeter, voltmeter and ammeter.**(3 Lectures)**

Understanding Electrical Circuits: Main electric circuit elements and theircombination. Rules to analyze DC sourced electrical circuits. Current and voltage dropacross the DC circuit elements. Single-phase and three-phase alternating current sources.Rules to analyze AC sourced electrical circuits. Real, imaginary and complex powercomponents of AC source.Power factor.Saving energy and money.**(4 Lectures)**

Electrical Drawing and Symbols: Drawing symbols. Blueprints.Reading Schematics.Ladder diagrams. Electrical Schematics.Power circuits. Control circuits. Reading ofcircuit schematics. Tracking the connections of elements and identify current flow andvoltage drop. **(4 Lectures)**

Generators and Transformers: DC Power sources. AC/DC generators.Inductance,capacitance, and impedance.Operation of transformers.**(3 Lectures)**

Electric Motors: Single-phase, three-phase & DC motors. Basic design.Interfacing DCor AC sources to control heaters & motors. Speed & power of ac motor. **(4 Lectures)**

Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers.Components in Series or in shunt. Response of inductors and capacitors with DC or ACsources **(3 Lectures)**

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers.Overload devices. Ground-fault protection.Grounding and isolating. Phase reversal.Surge protection. Interfacing DC or AC sources to control elements (relay protectiondevice) **(4 Lectures)**

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star anddelta connection.Voltage drop and losses across cables and conductors.Instruments tomeasure current, voltage, power in DC and AC circuits.Insulation.Solid and strandedcable.Conduit.Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, andsolder. Preparation of extension board.**(5 Lectures)**

Reference Books:

A text book in Electrical Technology - B L Theraja - S Chand & Co.
A text book of Electrical Technology - A K Theraja
Performance and design of AC machines - M G Say ELBS Edn.

SEC 4: BASIC INSTRUMENTATION SKILLS
(Credits: 02)Theory: 30 Lectures

This course is to get exposure with various aspects of instruments and their usage throughhands-on mode. Experiments listed below are to be done in continuation of the topics.

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution rangeetc. Errors in measurements and loading effects.**Multimeter:** Principles of measurementof dc voltage and dc current, ac voltage, ac current and resistance. Specifications of amultimeter and their significance.**(4 Lectures)**

Electronic Voltmeter: Advantage over conventional multimeter for voltagemeasurement with respect to input impedance and sensitivity. Principles of voltage,measurement (block diagram only). Specifications of an electronic Voltmeter/Multimeter and their significance.**AC millivoltmeter:** Type of AC millivoltmeters:Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter**,**specifications and their significance. **(4 Lectures)**

Cathode Ray **Oscilloscope:** Block diagram of basic CRO. Construction of CRT,Electron gun, electrostatic focusing and acceleration (Explanation only– nomathematical treatment), brief discussion on screen phosphor, visual persistence &chemical composition.Time base operation, synchronization. Front panel controls.Specifications of a CRO and their significance. **(6 Lectures)**

Use of CRO for the measurement of voltage (dc and ac frequency, time period.Specialfeatures of dual trace, introduction to digital oscilloscope, probes. Digital storageOscilloscope: Block diagram and principle of working. **(3 Lectures)**

Signal Generators and Analysis Instruments: Block diagram, explanation andspecifications of low frequency signal generators. pulse generator, and functiongenerator. Brief idea for testing, specifications.Distortion factor meter, wave analysis.**(4 Lectures)**

Impedance Bridges & Q-Meters: Block diagram of bridge. working principles of basic(balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges.**(3 Lectures)**

Digital Instruments: Principle and working of digital meters. Comparison of analog &digital instruments.Characteristics of a digital meter.Working principles of digitalvoltmeter.**(3 Lectures)**

Digital Multimeter: Block diagram and working of a digital multimeter. Workingprinciple of time interval, frequency and period measurement using universal counter/frequency counter, time- base stability, accuracy and resolution.**(3 Lectures)**

The test of lab skills will be of the following test items:

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

Laboratory Exercises:

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

Open Ended Experiments:

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

Reference Books:

A text book in Electrical Technology - B L Theraja - S Chand and Co.
Performance and design of AC machines - M G Say ELBS Edn.
Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
Logic circuit design, Shimon P. Vingron, 2012, Springer.
Digital Electronics, SubrataGhoshal, 2012, Cengage Learning.
Electronic Devices and circuits, S. Salivahanan& N. S.Kumar, 3rd Ed., 2012,Tata Mc-Graw Hill
Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk,2008, Springer
Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

SEC 5: Radiation Safety (Credits: 02)Theory: 30 Lectures

The aim of this course is for awareness and understanding regarding radiation hazardsand safety. The list of laboratory skills and experiments listed below the course are to bedone in continuation of the topics

Basics of Atomic and Nuclear Physics: Basic concept of atomic structure; X rayscharacteristic and production; concept of bremsstrahlung and auger electron, Thecomposition of nucleus and its properties, mass number, isotopes of element, spin,binding energy, stable and unstable isotopes, law of radioactive decay, Mean life andhalf life, basic concept of alpha, beta and gamma decay, concept of cross section andkinematics of nuclear reactions, types of nuclear reaction, Fusion, fission. **(6 Lectures)**

Interaction of Radiation with matter: Types of Radiation: Alpha, Beta, Gamma andNeutron and their sources, sealed and unsealed sources, **Interaction of Photons** – Photoelectriceffect, Compton Scattering, Pair Production, Linear and Mass AttenuationCoefficients, **Interaction of Charged Particles:** Heavy charged particles - Beth-BlochFormula, Scaling laws, Mass Stopping Power, Range, Straggling, Channeling andCherenkov radiation. Beta Particles- Collision and Radiation loss (Bremsstrahlung),**Interaction of Neutrons**- Collision, slowing down and Moderation.**(7 Lectures)**

Radiation detection and monitoring devices: Radiation Quantities and Units: Basicidea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose,effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived AirConcentration (DAC). **Radiation detection:** Basic concept and working principle of*gas detectors* (Ionization Chambers, Proportional Counter, Multi-Wire ProportionalCounters (MWPC) and Gieger Muller Counter), *Scintillation Detectors* **(**Inorganic andOrganic Scintillators), *Solid States Detectors* and *Neutron Detectors, Thermoluminescent Dosimetry.* **(7 Lectures)**

Radiation safety management: *Biological effects of ionizing radiation*, Operationallimits and basics of radiation hazards evaluation and control: radiation protectionstandards, International Commission on Radiological Protection (ICRP) principles,justification, optimization, limitation, introduction of safety and risk management ofradiation. Nuclear waste and disposal management.Brief idea about Accelerator drivenSub-critical system (ADS) for waste management.**(5 Lectures)**

Application of nuclear techniques: Application in medical science (e.g., MRI, PET,Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crimedetection, Mining and oil. *Industrial Uses:* Tracing, Gauging, Material Modification,Sterization, Food preservation. **(5 Lectures)**

Experiments:

1. Study the background radiation levels using Radiation meter

Characteristics of Geiger Muller (GM) Counter:

2) Study of characteristics of GM tube and determination of operating voltage and plateaulength using background radiation as source (without commercial source).

3) Study of counting statistics using background radiation using GM counter.

4) Study of radiation in various materials (e.g. KSO4 etc.). Investigation of possibleradiation in different routine materials by operating GM at operating voltage.

5) Study of absorption of beta particles in Aluminum using GM counter.

6) Detection of α particles using reference source & determining its half life using spark counter

7) Gamma spectrum of Gas Light mantle (Source of Thorium)

Reference Books:

1. W.E. Burcham and M. Jobes – Nuclear and Particle Physics – Longman (1995)
2. G.F.Knoll, Radiation detection and measurements
3. ThermoluninescenseDosimetry, Mcknlay, A.F., Bristol, Adam Hilger (MedicalPhysics Handbook 5)
4. W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology". JohnWright and Sons, UK, 1989.
5. J.R. Greening, "Fundamentals of Radiation Dosimetry", Medical Physics HandBook Series, No.6, Adam Hilger Ltd., Bristol 1981.
6. Practical Applications of Radioactivity and Nuclear Radiations, G.C. Lowentaland P.L. Airey, Cambridge University Press, U.K., 2001
7. A. Martin and S.A. Harbisor, An Introduction to Radiation Protection, JohnWilley & Sons, Inc. New York, 1981.
8. NCRP, ICRP, ICRU, IAEA, AERB Publications.
9. W.R. Hendee, "Medical Radiation Physics", Year Book – Medical PublishersInc. London,.

Generic Elective Papers (GE) (Minor-Physics) (any two) for other departments/Disciplines: (Credit: 02 each)

GE 1. Waves and Optics	Semester V
GE 2. Electricity and Magnetism	Semester VI

GENERIC ELECTIVE PAPERS (GE) -(ANY TWO) FOR OTHERDEPARTMENTS/DISCIPLINES: (CREDIT: 06 EACH)

GE- I: WAVES AND OPTICS
(Credits: Theory-04, Practicals-02)
Theory: 60 Lectures

Superposition of Two Collinear Harmonic oscillations: Linearity & Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).(5 Lectures)

Superposition of two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures (1:1) and their uses.(2 Lectures)

Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string.

Group velocity, Phase velocity.Plane waves. Spherical waves, Wave intensity. (7 Lectures)

Sound: Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria. (12 Lectures)

Wave Optics: Electromagnetic nature of light.Definition and Properties of wave front.Huygens Principle.(3 Lectures)

Interference: Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index. (12 Lectures)

Michelson's Interferometer: (1) Idea of form of fringes (no theory needed), (2) Determination of wavelength, (3) Wavelength difference, (4) Refractive index, and (5) Visibility of fringes. (3 Lectures)

Diffraction: Fraunhofer diffraction- Single slit; Elementaryidea of Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate.Fresnel Diffraction pattern of a straight edge using half-period zone analysis.(11 Lectures)

Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.(5 Lectures)

Reference Books:

• Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill
• Principles of Optics, B.K. Mathur, 1995, Gopal Printing
• Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publications
• University Physics. F.W. Sears, M.W. Zemansky and H.D. Young.13/e, 1986. Addison-Wesley

PHYSICS LAB: GE- I LAB: WAVES AND OPTICS

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

2. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method)

3. To determine the Refractive Index of the Material of a Prism using Sodium Light.

4. To determine wavelength of sodium light using Newton's Rings.

5. Determine velocity of sound by Kundt's Tube.

Reference Books:

• Advanced Practical Physics for students, B.L. Flint and H.T.Worsnop, 1971, Asia Publishing House.

• Advanced level Physics Practicals, Michael Nelson and Jon M. Osborn, 4th Edition, reprinted 1985, Heinemann Educational
Publishers

• A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.

GE: II
ELECTRICITY , MAGNETISM AND EMT
(Credits: Theory-04, Practicals-02)
UNIT-I
Vector Analysis: Scalar and Vector product, gradient, divergence, Curl and their significance,Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem
andStoke's theorem of vectors (statement only).
UNIT-II
Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications ofGauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical
shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of
electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and
solid sphere. Calculation of electric field from potential.
Capacitance : Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical
condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation,Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with
dielectric.
UNIT-III
Magnetism: Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil,
solenoid carrying current. Divergence and curl of magnetic field.Magnetic vector potential.Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction,permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferromagnetic materials.
Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self andmutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.
UNIT-IV
Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity of current,
Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field,
electromagnetic wave propagation through vacuum and isotropic dielectric medium, transversenature of EM waves, polarization.
Reference Books:

• Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
• Electricity & Magnetism, J.H. Fewkes&J.Yarwood. Vol. I, 1991, Oxford Univ. Press
• Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
• University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
• D.J.Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.
•Electricity and Magnetism- K.K Tewari (S. Chand Higher Academics)2013

GE II LAB: ELECTRICITY, MAGNETISM AND EMT

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current,and (d) checking electrical fuses.
2. Ballistic Galvanometer:
(i) Measurement of charge and current sensitivity
(ii) Measurement of CDR
(iii) Determine a high resistance by Leakage Method
(iv) To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and
(b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorems
10. To verify the Superposition, and Maximum Power Transfer Theorems

Reference Books

• Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
• Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
• A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed.2011, KitabMahal

GE III: DIGITAL, ANALOG CIRCUITS AND INSTRUMENTATION
(Credits: Theory-04, Practicals-02) Theory: 60 Lectures

UNIT-1: Digital Circuits

Difference between Analog and Digital Circuits.Binary Numbers. Decimal to Binaryand Binary to Decimal Conversion, AND, OR and NOT Gates (Realization usingDiodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNORGates.**(4 Lectures)**

De Morgan's Theorems.Boolean Laws. Simplification of Logic Circuit using BooleanAlgebra. Fundamental Products.Minterms and Maxterms.Conversion of a TruthTable into an Equivalent Logic Circuit by (1) Sum of Products Method and (2)Karnaugh Map.**(5 Lectures)**

Binary Addition. Binary Subtraction using 2's Complement Method). Half Adders andFull Adders and Subtractors, 4-bit binary Adder-Subtractor.**(4 Lectures)**

UNIT-2: Semiconductor Devices and Amplifiers:

Semiconductor Diodes: P and N type semiconductors. Barrier Formation in PNJunction Diode. Qualitative Idea of Current Flow Mechanism in Forward and ReverseBiased Diode. PN junction and its characteristics.Static and Dynamic Resistance.Principle and structure of (1) LEDs, (2) Photodiode, (3) Solar Cell.**(5 Lectures)**

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CEand CC Configurations.Current gains α and β. Relations between α and β. Load Lineanalysis of Transistors.DC Load line & Q-point.Active, Cutoff & Saturation regions.Voltage Divider Bias Circuit for CE Amplifier.h-parameter Equivalent Circuit.Analysis of single-stage CE amplifier using hybrid Model. Input & output Impedance.Current, Voltage and Power gains. Class A, B & C Amplifiers. **(12 Lectures)**

UNIT-3: Operational Amplifiers (Black Box approach):

Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop and closedloopGain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1)Inverting and non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator,(5) Integrator, (6) Zero crossing detector. **(13 Lectures)**

Sinusoidal Oscillators: Barkhausen's Criterion for Self-sustained Oscillations.Determination of Frequency of RC Oscillator **(5 Lectures)**

UNIT-4: Instrumentations: Introduction to CRO: Block Diagram of CRO.Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current,Frequency, and Phase Difference. **(3 Lectures)**

Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave RectifiersCalculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitorfilter, Zener Diode and Voltage Regulation. **(6 Lectures)**

Timer IC: IC 555 Pin diagram and its application as Astable and MonostableMultivibrator. **(3 Lectures)**

Reference Books:

• Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
• Electronic devices & circuits, S. Salivahanan& N.S. Kumar, 2012, Tata Mc-Graw Hill
• Microelectronic Circuits, M.H. Rashid, 2nd Edn., 2011, Cengage Learning.
• Modern Electronic Instrumentation and Measurement Tech., Helfrick andCooper, 1990, PHI Learning
• Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7th Ed.,2011, Tata McGraw Hill
• Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHILearning Pvt. Ltd.
• OP-AMP & Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.

GE LAB: DIGITAL, ANALOG CIRCUITS AND INSTRUMENTS

60 Lectures

1. To measure (a) Voltage, and (b) Frequency of a periodic waveform usingCRO
2. To verify and design AND, OR, NOT and XOR gates using NAND gates.
3. To minimize a given logic circuit.
4. Half adder, Full adder and 4-bit Binary Adder.
5. Adder-Subtractor using Full Adder I.C.
6. To design an astablemultivibrator of given specifications using 555 Timer.
7. To design a monostablemultivibrator of given specifications using 555 Timer.
8. To study IV characteristics of PN diode, Zener and Light emitting diode
9. To study the characteristics of a Transistor in CE configuration.
10. To design a CE amplifier of given gain (mid-gain) using voltage divider bias.
11. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response.
12. To design a non-inverting amplifier of given gain using Op-amp 741 and studyits Frequency Response.
13. To study Differential Amplifier of given I/O specification using Op-amp.
14. To investigate a differentiator made using op-amp.
15. To design a Wien Bridge Oscillator using an op-amp.

Reference Books:

• Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller,1994, Mc-Graw Hill.

• Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.

• OP-Amps & Linear Integrated Circuit, R.A. Gayakwad, 4th Edn, 2000, Prentice Hall.

• Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.