**CBCS SYLLABUS**
**FOR**
**THREE YEARS UNDER-GRADUATE COURSE**
**IN**
**PHYSICS (PROGRAMME)**
**(w.e.f. 2017-2018)**

**T1 – Physics I (4 Credits)**

**1.Vector Analysis**

Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.

Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

**2. Laws of Motion**

Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass.

**3.Momentum and Energy**

Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.

**4.Rotational Motion**

Angular velocity and angular momentum. Torque. Conservation of angular momentum.

**5.Gravitation**

Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications.

**6.Elasticity**

Hooke's law –stress-strain diagram, Elastic moduli- relation between elastic constants, poisson's ratio expression for Poisson's ratio in terms of elastic constants- work done in stretching and work done in twisting a wire – twisting couple on a cylinder –Determination of Rigidity modulus by static torsion- Torsional pendulum- Determination of Rigidity modulus and moment of inertia by Searles method.

**7. Special Theory of Relativity**

Postulate of special theory of relativity. Lorentz transformations. Simultaneity and order of events. lorentz contraction. Time dilation, relativistic transformation of velocity, relativistic addition of velocities.

**8. Sound**

Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Linearity & Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). Graphical and APnalytical Methods. Lissajous Figures with equal an unequal frequency and their uses. Damped oscillations. Forced vibrations and resonance.

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.

**9. Electrostatics**

Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss 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 of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Parallel plate capacitor completely filled with dielectric.

**Reference Books**


► University Physics. F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison-Wesley

► Mechanics Berkeley Physics, v.1: Charles Kittel, et.al. 2007, Tata McGraw-Hill.

► Physics – Resnick, Halliday& Walker 9/e, 2010, Wiley

► Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press

► University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.


**P1 – Physics I Lab (2 Credits)**

**List of Practical**

1. Measurements of length (or diameter) using verniercaliper, screw gauge and travelling microscope.
2. To determine the Moment of Inertia of a Flywheel.
3. To determine the Young's Modulus of a Wire by Optical Lever Method.
4. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
5. To determine the Elastic Constants of a Wire by Searle's method.
6. To determine g by Kater's Pendulum.
7. To study the Motion of a Spring and calculate (a) Spring Constant, (b) g.
8. To investigate the motion of coupled oscillators
9. To study Lissajous Figures
10. To determine the Moment of Inertia of cylindrical body about an axis passing through its centre of gravity.
11. Frequency f vs 1/l curve for a sonometer- wire and hence unknown frequency of a tuning fork.
12. To determine the Modulus of Rigidity of a Wire by dynamical method.

**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.

► Engineering Practical Physics, S.Panigrahi&B.Mallick, 2015, Cengage Learning India Pvt. Ltd.

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

**T2 –Physics II (4 Credits)**

**1,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 ferro- magnetic materials.

Electromagnetic Induction

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

**2. 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, transverse nature of EM waves.

**3.Kinetic Theory of Gases**

Mean free path (zeroth order ), Law of equipartion of energy (no derivation ) and its applications to specific heat of gases, mono-atomic and diatomic gases.

**4.Theory of Radiation**

Blackbody radiation, Plank’s distribution law (statement only), Stefan Boltzmann Law and Wien’s displacement law (statement only and graphical explanation)

**5.Laws of Thermodynamics**

Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnot’s cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

**6.Statistical Mechanics**

Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law ( Only distribution formula with explanation ) comparison of three statistics.

**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 ► Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
► A Treatise on Heat, MeghnadSaha, and B.N. Srivastava, 1969, Indian Press.
► Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
► Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
► Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears and
► G.L. Salinger. 1988, Narosa
► University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
► Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications

**P2 –Physics II Lab (2 Credits)**

**List of Practical**

1. Measurement of Planck's constant using black body radiation.
2. To determine Stefan's Constant.
3. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
4. To use a Multimeter for measuring

a. Resistances
b. AC and DC Voltages
c. DC Current
d. Checking electrical fuses.

5. Ballistic Galvanometer:

a. Measurement of charge and current sensitivity
b. Measurement of CDR
c. Determine a high resistance by Leakage Method

6. To study the Characteristics of a Series RC Circuit.
7. To study a series LCR circuit LCR circuit and determine its

a. Resonant frequency
b. Quality factor

8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorems
10. To verify the Maximum Power Transfer Theorems
11. Resistance of suspended coil galvanometer by half deflection method and hence the current sensitivity of the galvanometer.
12. Potential difference across a low resistance and hence the current through it with the help of a meter bridge (without end correction )
13. To determine the coefficient of linear expansion of the material of a rod using Optical Lever Method

**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

**T3 –Physics.III(4 Credits)**

**1.Wave Optics**

Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.

**2. Interference**

Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. 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.

Diffraction

Fraunhofer diffraction- Single slit; Double Slit. Multiple slits and Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate.

**3.Polarization**

Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

**4.Crystal Structure**

Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Diffraction of X-rays by Crystals. Bragg's Law.

**5.Quantum Mechanics**

Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle**.**

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. Eigenvalues and Eigenfunctions. Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle

**6.Nuclear Physics**

General properties of atomic nucleas. Packing fraction, mass defect, binding energy, systematics of stable nuclei.

Radioactivity. Law of radioactive decay; Mean life and half-life. Transient and secular equilibrium.

Fission and fusion. Mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with $U^{235}$; Fusion and thermonuclear reactions.

**Reference Books**

► A Text book of Quantum Mechanics, P.M. Mathews & K. Venkatesan, 2nd Ed., 2010, McGraw Hill
► Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
► Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
► Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
► Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
► Quantum Mechanics for Scientists and Engineers, D.A.B. Miller, 2008, Cambridge University Press
► Quantum Mechanics, EugenMerzbacher, 2004, John Wiley and Sons, Inc
► Introduction to Quantum Mechanics, David J. Griffith, 2nd Ed. 2005, Pearson Education
► Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer
► Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
► Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
► Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004)
► Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
► Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
► Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, 2004).
► Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
► Theoretical Nuclear Physics, J.M. Blatt &V.F.Weisskopf (Dover Pub.Inc., 1991)
► 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

**P3 - Physics Lab III (2 Credits)**

**List of Practical**

1. Familiarization with Schuster`s focussing; determination of angle of prism.
2. To determine the Refractive Index of the Material of a Prism using Sodium Light.
3. To determine Dispersive Power of the Material of a Prism using Mercury Light
4. To determine the Resolving Power of a Prism.
5. To determine wavelength of sodium light using Newton’s Rings
6. To determine the Resolving Power of a Plane Diffraction Grating.
7. To determine value of Boltzmann constant using V-I characteristic of PN diode.
8. To determine work function of material of filament of directly heated vacuum diode.
9. To determine value of Planck’s constant using LEDs of at least 4 different colours.
10. Refractive index of water by travelling microscope .
11. Refractive index of the material of a lens by lens mirror method .
12. Refractive index of the liquid by lens- mirror method.
13. Focal length of a convex lens by combination method and calculation of its power.

**T4 –Physics IV (4 Credits)**

**1.Elementary band theory**

Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect (only statement), Hall coefficient.

**2.Semiconductor Devices and Amplifiers**

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

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff& Saturation regions Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line & Q- point. 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.

**3.Operational Amplifiers (Black Box approach)**

Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop and closed- loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator.

**4.Digital Electronics**

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates.

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

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

**5.Instrumentations**

Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation.

**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 and Cooper, 1990, PHI Learning

► Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7th Ed., 2011, Tata McGraw Hill

► Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.

► Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
► OP-AMP & Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.

**P4 – Physics IV Lab.(2 Credits)**

**List of Practical**

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To minimize a given logic circuit.
3. Adder-Subtractor using Full Adder I.C.
4. Study of zener diode characteristics and its application as voltage regulator.
5. To study the characteristics of a Transistor in CE configuration.
6. To design a CE amplifier of given gain (mid-gain) using voltage divider bias.
7. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response.
8. To design a non-inverting amplifier of given gain using Op-amp 741 and study its Frequency Response.
9. Band gap measurement of for thermistor.
10. To draw the I-V characteristics of a suitable resistance and that of a junction diode within specified limit on a graph, and hence to find d.c. and a.c. resistance of both the elements at the point of intersection.