SYLLABUS FOR B.Sc. PHYSICS (HONOURS) DEGREE PROGRAM UNDER CBCS w.e.f. 2017-18 of SEM I & II

Discipline Specific Core courses (DSC) for Semester I to VI. These courses have total of 6 credits with 4 credits for theory component and 2 credits for laboratory component.

Discipline Specific Core Courses (DSC 1 to DSC 6)

Semester	Paper Code	Title	Credits
I	DSC 1	Mechanics and Properties of Matter	6
I	DSC 2	Electrical Circuit Theory	6
I	DSC 3	Mathematical Methods of Physics I & Fluid Mechanics	6
II	DSC 4	Heat and Thermodynamics	6
II	DSC 5	Modern Physics	6
II	DSC 6	Mathematical methods of Physics II	6
III	DSC 7	Wave motion & Optics	6
III	DSC 8	Electromagnetic Theory I	6
III	DSC 9	Classical Mechanics	6
IV	DSC 10	Basic Electronics	6
IV	DSC 11	Quantum Mechanics	6
IV	DSC 12	Electromagnetic Theory II	6
V	DSC 13	Atomic and Molecular Physics	6
VI	DSC 14	Thermodynamics and Statistical Mechanics	6

Discipline Specific Elective Courses (DSE) for Semester V and VI. These courses have total of 6 credits with 4 credits for theory component and 2 credits for laboratory component.

Note: Any two DSE for Semester V and Any two DSE or one DSE and DSP for Semester VI.

Semester	Paper Code	Title	Credits
V	DSE 1	Solid State Physics	6
V	DSE 2	Analog and Digital Electronics	6
V	DSE 3	Electrical and Electronic Instrumentation	6
V	DSE 4	Photonics & Applied Optics	6
V	DSE 5	Medical Physics	6
VI	DSE 6	Solid State Devices and Instrumentation	6
VI	DSE 7	Nuclear Physics	6
VI	DSE 8	Theory of Relativity	6

General Elective Courses (GE) for Semester I to IV. These courses have total of 4 credits with 3 credits for theory component and one credit for laboratory component.

1. **Mechanics and Properties of Matter**
2. **Electricity**
3. **Oscillations, Waves and Acoustics**
4. **Optics**
5. **Basic Electronics**
6. **Heat and Thermodynamics**
7. **Modern physics**
8. **Mechanics and Relativity**

Note: Generic Electives are same for programme Bachelor in Science and Bachelor in Science (Honours).

Skill Enhanced Courses (SEC) for Semester (Honours) III to VI.

Semester	Paper Code	Title	Credits
III	SEC 1	Numerical Techniques	4
IV	SEC 2	Physics of communication	4
V	SEC 3	Experiments in Physics	4
VI	SEC 4	Computational Physics or Microcontroller 8051 Programming (for those taken DSE 2) or Microprocessor 8085/8086 Programming (for those taken DSE 2)	4

Syllabus for B. Sc. Physics (Honours) Degree Program

DSC 1: MECHANICS AND PROPERTIES OF MATTER

(Theory) [4 credits]

Mechanics (Total 30 Hours)

Motion of a particle in one dimension: [15]

Discussion of the general problem of one dimensional motion. Dependence of force in general on position, velocity and time. Motion under a constant force with illustrations - Atwood's machine, Free fall near the surface of the earth. Motion along a rough inclined plane. The equation of motion, momentum and energy conservation theorems. Motion under a force which depends on time-general approach to the solution. Illustration using force of the type $F = F_o \sin(\omega t + \varphi)$. Motion under a conservative force dependent on position, potential energy. Motion under damping force depending on velocity - general dependence of resistive force on velocity. Motion in a medium with resistive force proportional to first power of velocity. Body falling under gravity in a resistive medium near the surface of the earth.

Motion in two dimensions : [5]

Equations of motion in plane polar coordinates. Momentum and energy theorems. Plane and vector angular momentum theorems.

Motion of a particle in a plane: [10]

Motion in a vertical circle, practical application of centripetal and centrifugal forces. Projectile motion in a non-resistive medium. Projectile motion in a resistive medium, (resistive force proportional to the first power of velocity).

Properties of Matter (30 Hours)

Moment of Inertia and gyroscopic motion: [5]

Moment of Inertia and its physical significance, radius of gyration, parallel axis and perpendicular axis theorems, moment of inertia of regular bodies. Precession, Gyrostat and Gyroscope.

Elasticity: [15]

Modulii of elasticity, Strain energy, equivalence of shear to compression and extension at right angles to each other, Poisson's ratio and its limiting values, Relationship between the elastic constants. Torsion in a string-couple per unit twist, Torsional Pendulum. Bending of beams-bending moment, flexural rigidity. Cantilever (rectangular bar). Transverse vibrations of a cantilever. Depression of a beam supported at the ends and loaded at the center. Determination of rigidity modulus and Young’s modulus for the material of a spiral spring. Theory of Loaded pillars, Critical load for pillars.

Surface Tension: [5]

Brief review of molecular theory of surface tension. Relation between surface tension and surface energy. Pressure difference across curved surfaces. Angle of contact. Capillarity, experimental determination of surface tension and angle of contact.

Flow of liquids and Viscosity: **[5]**
Streamline flow, Turbulent flow, Critical velocity. Coefficient of viscosity, Poiseuille's formula for flow of liquid through a capillary tube. Ostwald Viscometer, Viscosity of gases – Mayer's formula.

References

1. K. R. Symon, Mechanics, Addison Wesley (1971).
2. D. Kleppner and R. Kolenkov, An Introduction to Mechanics, Cambridge University Press (2014).
3. R. G. Takawale and P. S. Puranik, Introduction to Classical Mechanics, Tata McGraw-Hill (1997).
4. C. Kittel, W. D. Knight, M. A. Rudderman, A. C. Helmhotz and B. J. Moyer , Berkeley Physics Course, Volume I, Mechanics, (1973).
5. Eugine Hecht, College Physics, Schaum Outline Series, (2011).
6. P. V. Panat, Classical Mechanics, Narosa Publishing, (2013).
7. D.S.Mathur, Mechanics, S.Chand & Co. (1981).
8. D. S. Mathur , Elements of Properties of Matter, S. Chand and Sons, (2013)
9. R K Bansal, Fluid Mechanics, Firewall Media, 2005.
10. Merle Potter, David Wiggert, Fluid Mechanics, Schaum Outline Series, 2008.
11. George Mase, Continuum Mechanics, Schaum Outline Series. 1969.

DSC 1: MECHANICS AND PROPERTIES OF MATTER

(Practical) [2 credits]

Minimum 6 experiments

1. Helmholtz Resonator : Determination of unknown frequency.
2. Fly wheel: Determination of frictional couple and moment of inertia of a flywheel.
3. Torsional Pendulum: Determination of Rigidity Modulus of the material of a wire.
4. Motion in resistive medium.
5. Atwood's machine.
6. Bending of beams-single cantilever: determination of Young's modulus.
7. Bending of beams-double cantilever: determination of Young's modulus.
8. Capillarity: determination of Surface tension.
9. Viscosity of a liquid by Poiseuilles method.
10. Rigidity modulus and Young's modulus for the material of a spiral spring.
11. To determine the viscosity of fluid by viscometer.

DSC 2: ELECTRICAL CIRCUIT THEORY

(Theory) [4 Credits]

Circuit Analysis **[12]**
Concept of constant current and constant voltage source, Maxwell’s cyclic current method for circuit analysis, Nodal Analysis, Superposition theorem, Thevenin’s theorem, Norton's theorem, Maximum power transfer theorem (with proof) and their application to simple networks.

Inductance **[6]**
Self Inductance, self inductance per unit length of two parallel wires carrying equal current in opposite directions, Principle of non-inductive resistance coils, Self Inductance of co-axial cables, Mutual inductance, Coefficient of coupling, Inductance in series and parallel.

Response of circuits containing L C and R to DC (transients) **[7]**
Growth and decay of current in L-R circuit, Charging and discharging of capacitor in C-R circuit and in a series L-C-R circuit.

Ballistic Galvanometer **[6]**
General theory of a suspended coil ballistic galvanometer, Expression for charge, Figure of merit, Current sensitivity and voltage sensitivity, log decrement and correction for damping. Measurement of capacitance using ballistic galvanometer.

AC Circuits **[12]**
AC applied to L-R and C-R circuits, Inductive and Capacitive reactance, impedance and admittance, The j operator and vector or phasor method applied to LR, CR and LCR circuits. Series and parallel resonance. Q factor and Bandwidth. Graphic representation of resonance (Variation of impedance, inductive reactance, capacitive reactance with frequency)

Mutually Coupled L-R circuits **[6]**
AC applied to mutually coupled L-R circuits. Reflected impedance. Transformers, Effect of loading the secondary of a transformer. Mutually coupled coils for impedance matching.

AC Bridges **[6]**
General AC bridges, Maxwell's bridge, Maxwell's L/C bridge, De-Sauty's bridge. Wein's frequency bridge.

Frequency filter circuits [5]
High pass, Low Pass, Band pass and Band stop filters using passive components.

References

1. J. Yarwood and J. H. Fewkes, Electricity and Magnetism. University Tutorial Press (1991).
2. D. N. Vasudeva, Fundamentals of Electricity and Magnetism.S. Chand and Company Ltd. New Delhi.(2012).
3. Brijlal and Subramaniam, Electicity and Magnetism, Ratan Prakashan, New Delhi. (1966).
4. Mahmood Nahvi and Joseph Edminister, Electrical Circuits, Schaum outline Series, (2002).
5. Thereja B.L. Text Book of Electrical Technology, S. Chand and Co Ltd. New Delhi (1990).

6. A. Sudhakar and Shammohan S. Palli, Circuits and Networks Analysis and Synthesis, TMH, (2006).

DSC 2: ELECTRICAL CIRCUIT THEORY

(Practicals) [2 Credits]

Minimum of 6 Experiments

1. Verification of Thevenin’s Theorem.
2. Verification of Norton’s theorem.
3. Step Response of CR circuit / LR Circuit.
4. Response of LR and CR circuits to AC - phasor diagrams.
5. De Sauty’s Bridge and Maxwells L/C Bridge.
6. LCR Series and parallel resonance –Resonant frequency, Q value and Bandwidth.
7. Resistance of Table Galvanometer by Shunting.
8. Figure of Merit of Mirror Galvanometer and Determination of Current and Voltage Sensitivity.
9. Electrical Simulation of LR, CR, LCR Circuits: Computer Simulation
10. LDR Characteristics

DSC 3: MATHEMATICAL METHODS OF PHYSICS I & FLUID MECHANICS
(Theory) [4 credits]

Mathematical Methods of Physics I (**30 Hours)**

Limits and Continuity **[4]**
Definition, Intervals and Neighborhoods, Algebra of Limits, Limits of Trigonometric functions, Exponential limits. Concept of continuity, Left and Right hand Limits, Graphical representation of continuity.

Differentiation **[7]**
Differentiation from first principles, derivative of polynomials, trigonometric, exponential, logarithmic functions and implicit functions.Rules of differentiation, Leibnitz theorem, higher order derivatives.

Integration **[7]**
Integration from first principles,Integration as inverse of derivative, integration by inspection, Standard Integrals: (Algebraic, Trigonometric, exponential logarithmic), integration by parts, substitution methods, reduction formulae).

Complex numbers **[4]**
Complex numbers, notation of complex number, complex planes, Physical meaning of Complex Quantities, exponential,logarithmic and trigonometric functions, hyperbolic functions. De'Moivre's Theorem, Roots of unity.

Elementary Vector Analysis **[4]**
Scalars and vectors, Addition and subtraction of vectors , Multiplication by a scalar, Basis vectors and components, Magnitude of a vector, unit vector, dot and cross product of vectors and their Physical Interpretation. Gradient, divergence and curl operations in Cartesian coordinates.

Matrices and determinants; Linear equations **[4]**
System of linear equations, matrices and determinants

Fluid Mechanics (30 Hours)

Fluids and Their Properties **[4]**
Introduction, Fluid Classifications, Hypothesis of the continuum, Shear stress in a moving fluid, Compressibility and the Bulk Modulus.

Fluid Statics **[6]**
Types of Pressure, Pascal's law of pressure at a point, variation of pressure vertically in a fluid under gravity, equality of pressure at the same level in a static fluid, general equation for the variation of pressure due to gravity from a point to point in a static fluid, Measurement of pressure. Various units of pressure and their inter-conversion

The Energy Equation and its Applications **[6]**

Momentum and fluid flow, Mechanical energy of a flowing fluid - Bernoulli's theorem and its applications- Pitot's tube, principle of Venturi meter, viscous flow in a pipe, Reynolds number and its physical significance, Concept of pressure energy.

Acoustics **[9]**

Velocity of longitudinal waves in fluids. Newton's formula for velocity of sound,Vibrations in stretched strings. (transverse and longitudinal modes). Vibration in rods. Superposition of two simple harmonic motions, standing waves and beats.Doppler effect. Intensity level - Bel and Decibel.

Production and detection of Ultrasonic waves and its applications.

Reverberation of sound **[5]**

Reverberation of Sound, Reverberation time, Absorption coefficient, Sabine's formula for reverberation time, Acoustic requirements of an auditorium.

References

1. K. F. Riley, M. P. Hobson and S. J. Bence, Mathematical methods for Physics and Engineering, Cambridge University Press.(2006).
2. Robert Stainer and Philip Schmidt, Mathematics for Physics students, Schaum series, (2007).
3. Charlie Harper, Introduction to Mathematical Physics, PHI, (1978).
4. D. S. Mathur, Elements of Properties of Matter, S. Chand and Sons, (2013).
5. Lectures in elementary fluid dynamics, by J. M. McDonough (Lecture Notes available on Net, free download).
6. R K Bansal, Fluid Mechanics, Firewall Media, (2005).
7. Merle Potter and David Wiggert, Fluid Mechanics, Schaum Outline Series, (2008).
8. George Mase, Continuum Mechanics, Schaum Outline Series (1969).

DSC 3: MATHEMATICAL METHODS OF PHYSICS I & FLUID MECHANICS (Practical) [2 credits]

Minimum of Six Experiments

1. Range and Least Count of Instruments, Measurements using various instruments and error analysis (Vernier calipers, micrometer screw gauge, travelling microscope, spherometer, spectrometer).
2. Graphical analysis of one dimensional motion: Kinematics, Plotting and interpretation of displacement, velocity and acceleration v/s time graphs. Linear and non linear plots, determination of slopes and area under the curves for evaluation of physical quantities such as force, work and energy.
3. Superposition of Waves (Computer simulation).
4. Helmholtz Resonator: Determination of unknown frequency.
5. Verification of Bernoulli's theorem.
6. To measure the velocity of flow using Pitot tube.

7. To determine the coefficient of discharge through different flow meters (Orifice meter, Venturi meter and Nozzle meter).
8. To determine the different types of flow patterns by Reynold's experiment.
9. To determine the viscosity of fluid by viscometer.

DSC 4: HEAT AND THERMODYNAMICS

(Theory) [4 Credits]

Kinetic theory of gases: **[12]**
Three states of matter, concept of ideal gas, postulates of Kinetic Theory of gases, expression of pressure of a gas, relation between rms velocity and temperature, Average kinetic energy of a gas molecule, heat and temperature, kinetic interpretation of temperature, Degrees of freedom, Law of equipartition of energy and its application to specific heats of gases. Brownian motion and its features, Einstein's equation, Determination of Avogadro's number. Mean free path, Transport phenomena.

Behavior of real gases: **[12]**
Deviation from perfect gas behavior, Discussion of results of Andrew's experiments on CO2 and Amagat's experiment, critical constants, Van der Waal's equation of state, expression of Van der Waal's constants, Reduced equation of state, Law of corresponding state, relation between Boyle temperature and critical temperature, Critical Coefficients of Van der Waal's gas.

Zeroth and First Law of Thermodynamics: **[12]**
Basic concepts of thermodynamics, Thermodynamic system, Thermodynamic variables, Thermodynamic equilibrium, and Thermodynamic processes, Zeroth law of thermodynamics and concept of temperature, Internal energy and First law of thermodynamics, Relation between pressure, volume and temperature in adiabatic process, Work done in isothermal and adiabatic processes, Path dependence of heat and work.

Second Law of Thermodynamics: **[12]**
Reversible and irreversible process, condition of reversibility, Clausius' inequality, Second law of thermodynamics, Carnot's cycle, efficiency of Carnot's cycle, reversibility of Carnot's cycle, Carnot's theorem, coefficient of performance of a refrigerator, heat pump. Thermodynamic scale of temperature, its identity with perfect gas scale, Clausius' - Clapeyron latent heat equation and its applications.

Entropy: **[12]**
Entropy as a Thermodynamic variable, Entropy change in reversible and irreversible processes, Temperature–Entropy diagram of Carnot's Cycle, Entropy of a perfect gas, Physical significance of Entropy: Entropy and Unavailable Energy, Entropy and molecular disorder, Entropy and Second Law of Thermodynamics. Impossibility of attaining Absolute Zero (Third law of Thermodynamics).

Reference Books:

1. M. N. Saha and B. N. Shrivastava, Treatise on heat, The Indian Press (1965).
2. S.C . Garg, R.M. Bansal and C. K. Ghosh, Thermal Physics, TMH (1993).
3. J.K. Roberts and A.R Miller, Thermodynamics, E.L.B.S. (1960).
4. G.R. Noakes, Text Book of Heat, Mcmilan & Co(1960).
5. William C . Reynolds Thermodynamics, McGraw-Hill, New York (1965).
6. M. W. Zemansky and R.H. Ditman, Heat and Thermodynamics, McGraw Hill (1997).

7. Brijlal, N. Subrahmanyam and P. S. Hemne, Heat, Thermodynamics and Statistical Physics, S. Chand & Company Ltd, (2014).
8. F.W. Sears and G.L. Salinger, Thermodynamics Kinetic Theory and Statistical Thermodynamics, Narosa Publishing House, (2013).

DSC 4: HEAT AND THERMODYNAMICS
(Practical) [2 credits]

Minimum 6 experiments

1. Resistance Thermometry (Cu wire and Pt 100).
2. Constant volume air thermometer.
3. Constant pressure air thermometer.
4. Thermister characteristics (PTC and NTC).
5. Study of thermocouples for temperature measurement.
6. Determination of Stefan's constant.
7. Calibration of Si diode as a temperature sensor
8. Thermal conductivity of bad conductors.
9. Thermal Conductivity by Searle's Method.
10. Measurement of coefficient of linear thermal expansion.

DSC 5: MODERN PHYSICS
(Theory) [4 credits]

Motion of charged particles in electric and magnetic fields **[6]**

Lorentz force, Motion in a uniform electric field, magnetic field, parallel and crossed fields. Electric discharge through gases, Determination of e/m for cathode rays, Charge and mass of the electron, Atomic masses, Energy and mass units.

Particle Accelerators **[2]**

Linear accelerator and Cyclotron.

Atomic Physics **[8]**

Measurement of Mass: Thomson's positive ray analysis, Dempster's Mass spectrometer, Bainbridge Mass spectrograph.
Review of Bohr's Hydrogen atom, Correction due to finite nuclear mass.
Frank-Hertz experiment and atomic energy levels.

Atomic Nucleus **[5]**

Mass/size (radius), mass defect and binding energy, BE versus A plot, characteristics of the nuclear force, Semi empirical mass formula - qualitative discussion. Liquid drop model,

Radioactivity **[13]**

Radiations, Nature of Nuclear Radiations, characteristic properties of Alpha, Beta and Gamma Rays, Natural and Artificial Radioactivity, Laws of Radioactivity, Radioactive series, isotopes, isomers, half life, mean life, growth and decay of parent and daughter elements. Transient and Secular Equilibrium. Carbon Dating, Age of the Earth, units of radiations, radiation damage, application of radioactivity, Q-value of nuclear reaction, nuclear composition, nuclear fission and fusion.

Properties of electromagnetic radiation **[10]**

Black Body Radiation, Kirchoff's laws, Stefan's law, Wien' law, Raleigh - Jean's law, Planck's law. Photoelectric effect and Compton Effect – observation, description, derivations of relevant equations and failure of classical physics to explain the same. Experimental verification of the Photoelectric and Compton effects.

X-rays **[5]**

Coolidge tube generator, Continuous X-ray spectra and its dependence on voltage, Duane and Hunt's law, Wave nature of X-rays – Laue's pattern, Diffraction of X-rays by crystal, Bragg's law, Bragg single crystal spectrometer, Analysis of crystal structure - simple cubic crystal.

Crystal Structure **[3]**

Crystal lattice, crystal planes and Miller indices, unit cells, typical crystal structures.

LASERs and Optical fibers **[8]**

Population inversion, Spontaneous emission, Stimulated emission, Properties of Lasers, Ruby laser, He-Ne laser, Semiconductor Laser, Applications of Lasers in Medicine, Industry and Science.
Optical Fibers: Basic principle, Fiber optic communication, fiber optic sensors.

Reference Books:

1. Arthur Beiser, Concepts of Modern Physics, 5th Edition, McGraw Hill (1985).
2. S.B. Patel, Nuclear Physics, TMH (1991).
3. Irving Kaplan, Nuclear Physics, Narosa Publishing House, (1997).
4. F. K. Richtmyer, E. H. Kennord, J.N. Cooper Introduction to Modern Physics, McGraw Hill (1997).
5. H. Semat and J. R. Albright, Introduction to Atomic and Nuclear Physics, Chapman and Hall (1973).
6. J. B. Rajam, Atomic Physics, S. Chand and Co. Ltd.(1950).
7. K. Thyagrajan and A. Ghatak Laser: Theory and Applications, McMillan (2009).
8. K. Thyagarajan and A. Ghatak, Optical Electronics, Cambridge University Press (1997).
9. B. B Laud, LASERs and Non-linear optics, Wiley Eastern (1991).

DSC 5: MODERN PHYSICS
(Practical) [2 credits]

Minimum Six Experiments

1. Study of properties of laser.
2. Study of one application of laser.
3. X-ray emission (characteristic lines of copper target) – calculation of wavelength and energy and assigning transitions.
4. Calculation of lattice constant by of Copper – x-ray diffraction pattern is given and student calculates, d-spacing, miller indices and lattice constant.
5. Frank Hertz Experiment.
6. Characteristics of photo cell.
7. Measurement of Boltzmann constant using transistor.
8. Photocell (verification of Photoelectric effect)
9. Michelson interferometer-determination of wavelength

DSC 6: MATHEMATICAL METHODS IN PHYSICS II

(Theory) [4 credits]

Vector Analysis **[15]**

Vectors and scalar fields, differentiation and integration of scalar and vector fields, directional derivative, gradient, the del operator, divergence and curl, Laplacian operator, Integration of Vector Functions - Line, Surface and Volume Integrals, Gauss Divergence Theorem, Greens Theorem, Stokes Theorem, Differential vector Identities with proof, Spherical polar coordinates and derivation of Gradient, Divergence, and Laplacian in spherical polar coordinates. Dirac delta function and its application.

Infinite series and Power Series **[10]**

Convergence of infinite series, Algebra of Series*,* Binomial and Taylor Series expansions

Differential equations **[20]**

Partial differentiation - Definition of the partial derivative, Total differential, Chain rule, Exact and inexact differentials, Useful theorems of partial differentiation, Change of variables, Ordinary Differential Equations, Linear first order equation and their solutions, Second order linear equations with constant coefficients and their solutions. Partial Differential equations and separable solutions.

Integral Transforms and some special functions in Mathematical Physics **[15]**

Fourier series (Sine and Cosine) and Fourier transforms. Laplace transforms- Definition and properties, Laplace transforms of some useful functions, Laplace transform theorems, Inverse Laplace transforms, Application of Laplace transforms to simple electrical circuits involving differential equations. Introduction to Legendre’s equation, Legendre polynomials.

References Books:

1. Mary L Boas, Mathematical methods in physical sciences, John Wiley and sons (1983).
2. Charlie Harper, Introduction to Mathematical Physics, PHI, (1976).
3. K. F. Riley, M. P. Hobson and S. J. Bence, Mathematical methods for Physics and Engineering, Cambridge University Press (reprint 2002).
4. Robert Stainer, Philip Schmidt, Mathematics for Physics students, Schaum outline series, 2007.
5. H K Das and Dr. Rama Verma, Higher Mathematical Physics, S Chand (2014).

DSC 6: MATHEMATICAL METHODS IN PHYSICS II
(Practical) [2 credits]

Minimum of 6 Experiments

Problem Solving and physical interpretation using the mathematical / numerical techniques

Examples: Coupled Oscillations, Electrical oscillations in LCR circuits, Resonance phenomena, bifilar oscillations.

1. Physical Experiment and/or stimulations using computers by developing appropriate algorithms and programme.

- Bifilar suspension.
- Log Decrement
- Study of damping of a pendulum under various kinds of damping mechanisms.
- Resonance pendulum – Study of Amplitude resonance.

2. Numerical solution of equation of motion using a personal computer (PC) /calculator.
3. Motion of a particle in a central force field using numerical analysis using calculator/PC.
4. Simulation of waves using Fourier series.
5. Introduction to Linux
6. Plotting of graphs on Linux platform (gnuplots, qtiplots, xmgrace)
7. Arranging of data and its graphical display.
8. Filtering of data by different techniques.

SYLLABUS FOR GENERAL ELECTIVES (GE) COURSES

GE-1 – MECHANICS AND PROPERTIES OF MATTER
(Theory) [3 Credits]

Mathematical Preliminaries –Limits and Continuity [4]
Intervals and Neighborhoods, Algebra of Limits, Limits of Trigonometric functions, Exponential limits. Concept of continuity, Left and Right hand Limits, Graphical representation of continuity.

Differentiation and Integration [6]
Differentiation from first principles, Derivative of polynomials, trigonometric, exponential and logarithmic functions, Rules of differentiation, Integration as inverse of derivative, Integration by inspection, Standard Integrals: (Algebraic, Trigonometric, exponential and logarithmic).

Scalars and Vectors [5]
Scalars and vector quantities, Vector notation, unit vector, graphical representation of vector, multiplication and division of vectors by scalars, Addition and subtraction of vectors , Rectangular components of a vector, position vector, Product of two Vectors - scalar and vector product, introduction to partial derivatives, vector derivatives.

Mechanics and Laws of motion [5]
Newton's Laws of motion, centre of mass, time integral of force, (impulse), path integral of force (work), Conservative and non-conservative forces. Work –energy theorem, Conservation of linear momentum. Angular velocity and angular momentum-torque, Conservation of angular momentum, illustrative examples of conservation of angular momentum.

Motion of a particle in one and two dimensions [9]
Motion under a constant force with illustrations-Atwood's machine, Free fall near the surface of the earth, Motion along a rough inclined plane. Motion under damping force depending on velocity (general dependence of resistive force on velocity), body falling under gravity in a resistive medium near the surface of the earth. Projectile motion in non-resistive and resistive media.

Elasticity [7]
Hooke's law - Stress-strain diagram - Elastic modulii, Poisson's ratio, Equivalence of a shear to a tensile and a compression strain at right angle to each other, relation between elastic constants, bending of beams, cantilever, Beam supported at both the ends and loaded at the centre, Twisting couple on a cylinder, torsional rigidity, Work done in twisting a wire.

Surface Tension [5]
Brief review of molecular theory of surface tension. Surface tension and surface energy. Excess pressure inside a soap bubble, angle of contact and wetting of surfaces, factors affecting surface tension of a liquid, Capillarity.

Viscosity [4]
Streamline flow, Turbulent flow, Coefficient of viscosity, Critical velocity and Reynold's number, Poiseuille's formula for flow of liquid through a capillary tube and its assumptions.

Reference Books:

1. K. F. Riley, M. P. Hobson and S. J. Bence, Mathematical methods for Physics and Engineering, Cambridge University Press, (2006).
2. Robert Stainer and Philip Schmidt, Mathematics for Physics students, Schaum series, 2007.
3. Charles Kittel, et. al., Mechanics Berkeley Physics, Vol..1, Tata McGraw-Hill (2007).
4. Resnick, Halliday & Walker , Physics –9/e, Wiley (2010).
5. R. G. Takawale and P. S. Puranik, Introduction to Classical Mechanics, Tata McGraw-Hill (1997).
6. D.C.Tayal, Mechanics, Himalaya Publication, (2013).
7. D.S. Mathur , Properties of Matter, S.Chand publication (2013).
8. Gupta, Kumar and Sharma,Classical Mechanics, PragatiPrakashan, Merut (2008).
9. P. V. Panat, Classical Mechanics, Narosa Publishing, (2013).
10. . F.W. Sears, M.W. Zemansky and H.D. Young University Physics, 13/e, Addison-Wesley (1986).
11. Eugine Hecht, College Physics, Schaum Outline Series, (2011).

GE-1 – MECHANICS AND PROPERTIES OF MATTER
(Practical) [1 Credit]

Minimum 4 Experiments:

1. Range, least Count and error in instruments such as Vernier calipers, micrometer screw gauge, travelling microscope and spectrometer, measurements of length (or diameter) using Vernier caliper, screw gauge and travelling microscope.
2. To determine *g* by Bar Pendulum.
3. Projectile motion (Computer Simulation).
4. To determine the Young's Modulus using cantilever.
5. To determine the Young's Modulus using beam supported at end and loaded at the centre.
6. To determine Surface tension of a liquid by capillary method.
7. To determine coefficient of Viscosity of a liquid.
8. Study of equation of motions (computer simulation).
9. Solving numerical problems on scalar, vector, differentiation and integration.

References

1. B.L. Flint and H.T. Worsnop, Advanced Practical Physics for students, ,Asia Publishing House, 1971.
2. Michael Nelson and Jon M. Ogborn, Advanced level Physics Practicals, , 4thEdition, reprinted 1985, Heinemann Educational Publishers.
3. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, 11thEdition, 2011, Kitab Mahal, New Delhi.

GE-2 – ELECTRICITY
(Theory) [3 Credits]

Mathematical preliminaries **[4]**
System of linear equations, matrices and determinants

Circuit Analysis **[9]**
Brief review of current, potential difference, electromotive force, resistance, Ohm's law, specific resistance, conductance, electric power, series and parallel circuits, sources, concept of current and voltage source-ideal and practical, Norton's theorem, Thevenin's theorem, Maximum power transfer theorem.

Electromagnetic Induction **[7]**
Laws of electromagnetic induction, eddy currents, application of eddy currents, Self Inductance, self inductance per unit length of two parallel wires carrying equal current in opposite directions, Principle of non-inductive resistance coils, Self Inductance of co-axial cables, Mutual inductance, Coefficient of coupling, Inductances in series and parallel.

Response of circuits containing L C and R to DC **[6]**
Transient phenomenon, Growth and decay of current in L-R circuit, Charging and discharging of capacitor in C-R circuit.

A.C. Circuits **[10]**
Mean and r.m.s value of sinusoidal functions, phase relation in pure resistance, pure inductor and capacitor, A.C. applied to L-R and C-R circuits, Inductive and Capacitive reactance, impedance and admittance, The j-operator, A.C. applied to L-C-R circuits, Series and parallel resonance. Q factor and Bandwidth. Graphical representation of resonance (Variation of resistance, inductive reactance, capacitance reactance with frequency).

Mutually Coupled L-R circuits. **[5]**
A.C. applied to mutually coupled L-R circuits, Reflected impedance, Transformers, Effect of loading the secondary of a transformer.

A. C. Bridges **[4]**
General A.C. bridge, Maxwell's bridge, Maxwell's L/C bridge, De-Sauty's capacitance bridge, Wein's frequency bridge.

Reference Books:

1. D. N. Vasudeva, S. Chand, Fundamentals of Electricity and Magnetism. and Company Ltd. New Delhi (1995).
2. F. A. Benson and D. Harrison, Electric Circuit and Theory, E.L.B.S. (1995).
3. J. Yarwood and J. H. Fewkes, Electricity and Magnetism.. University Tutorial Press (1991).
4. Brijlal and N. Subramanian, Electricity and Magnetism, Ratan Prakashan, Agra (1966).
5. Mahmood Nahvi and Joseph A. Edminister, Electrical Circuits :Schaum Series McGraw-Hill.
6. A. Sudhakar and S. P. Shyammohan, Circuits and Network, Tata McGraw-Hill Publishing Company Limited (1997).
7. Mac E. Van Valkenburg, Network Analysis, PHI (2014).

GE-2 – ELECTRICITY
(Practical) [1 Credit]

Minimum 4 Experiments
1. Verification of Thevenin’s theorem
2. Verification of Norton’s theorem
3. Verification of maximum power transfer theorem
4. Step Response of RC circuit.
5. Response of LR to A.C.
6. Response of CR to A. C.
7. LCR Series resonance- Resonant frequency, Q-value and Bandwidth.
8. LCR Parallel resonance-Resonant frequency, Q-value and Bandwidth.
9. Simulation of LR, CR, LCR Circuits: Computer Simulation by PSPICE / Electronics work bench.

GE-3- OSCILLATIONS, WAVES AND ACOUSTICS
(Theory) [3 Credits]

Oscillations **[20]**

Differential equation for harmonic oscillator and its solutions (case of harmonic oscillations), kinetic and potential energy, total energy of SHM, examples of simple harmonic oscillations, spring and mass system, simple pendulum, Helmholtz resonator, Torsional pendulum, compound pendulum. Superposition of two simple harmonic motions of the same frequency along the same line, Superposition of two mutually perpendicular simple harmonic vibrations of the same frequency, Lissajous figures.

Wave motion **[4]**

Transverse and longitudinal waves, progressive wave, equation representing a progressive wave, differential equation of wave motion, velocity of transverse vibrations along a string, laws of transverse vibration of strings.

Interferences of sound waves **[4]**

Stationary wave and its formation, interference of sound, conditions of interference, beats, frequency of beats, graphical explanation of beats, application of beats, comparison of beats and interference.

Velocity of sound waves **[7]**

Velocity of longitudinal waves in fluids- Newton's formula for velocity of sound, Laplace corrections, Effect of density, pressure, temperature, moisture and wind on the velocity of sound in air/gas. Kundt's tube experiments -determination of velocity of sound in solid, liquid and gases. Doppler Effect.

Ultrasonics **[2]**

Production and detection of Ultrasonic waves and its applications,

Acoustics of Building **[8]**

Growth and decay of intensity, Reverberation of Sound, Reverberation time, Absorption coefficient, Sabine’s formula for reverberation time, Acoustic requirements of a good auditorium, loudness, units of intensity and loudness, Weber Fechner law and sound absorbers.

Reference Books:

1. Brijlal and N. Subrahmanyam, Properties of Matter, S. Chand (1999).
2. D. S. Mathur, Elements of Properties of Matter, S. Chand Publishing.
3. Resnick, Halliday & Walker, Physics –9/e, Wiley (2010).
4. Starling H. S, Mcmillian and Co, Properties of Matter, (1961).
5. D. R. Khanna and R.S. Bedi, Text book of Sound, Atma Ram, New Delhi (1994).
6. S. Panigrahi & B.Mallick Engineering Practical Physics, , Cengage Learning India Pvt. Ltd. (2015).
7. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, 11th Edition, 2011, Kitab Mahal, New Delhi.

GE-3- OSCILLATIONS, WAVES AND ACOUSTICS
(Practical) [1 Credit]

Minimum 4 Experiments

1. Helmholtz Resonator: Determination of unknown frequency.
2. Flat Spiral Spring: determination of elastic constants by vertical and torsional oscillations of a loaded spring.
3. To find unknown frequency of the oscillating signal using Lissajos Figures.
4. Frequency of AC mains (Sonometer).
5. Sabine's Law; Calculation of reverberation Time & absorption Coefficient of room/hall (Numerical).
6. Study of simple harmonic motion using Torsional pendulum and Bifilar suspension
7. Kundt's tube experiment.
8. Wave superposition:(Computer Simulation).
9. To study the motion of a Spring mass system to calculate Spring constant and value of g
10. Analysis and interpretation of audiogram- to identify hearing defects.

GE-4- OPTICS
(Theory) [3 Credits]

Refraction at spherical surfaces **[10]**

Introduction to lenses, optical properties of lenses, thin lenses & thick lenses, Cardinal points of an optical system, Co-axial system of two thin converging lenses. Aberrations- Spherical & Chromatic aberrations in lenses, methods of minimizing Spherical & Chromatic aberrations. Introduction to eyepieces- Ramsden's and Huygens eyepieces.

Interference **[8]**

Coherent sources, Interference by division of wavefront & division of amplitude, formation of colors in thin film- reflected system and transmitted system, wedge shaped film and its application, Newton's rings and its applications.

Diffraction **[10]**

Concept of Diffraction, Fresnel and Fraunhoffer Diffraction,
Fraunhoffer diffraction at single slit, Double slit and Diffraction grating. Resolving power of optical instruments, Rayleigh's criteria and resolving power of a prism, telescope and a diffraction grating.

Polarization **[8]**

Concept of polarization, Plane of polarization, Polarization by reflection, Brewster's law, polarization by refraction, Double refraction, uniaxial and biaxial crystals, Nichol prism, Circularly and Elliptically polarized light, Optical activity, specific rotation, simple polarimeter.

Lasers **[9]**

spontaneous emission, stimulated emission, Population inversion, Ruby laser, He-Ne laser, CO_2 laser and semiconductor laser, applications of lasers in Medicine, Industry and Science.

Reference Books:

1. N. Subrahmayam and N. Brijlal, A text Book of Optics, S. Chand & Company Ltd. (1991).
2. B. K. Mathur, Principles of Optics, New Global Printing Press, Kanpur, (1995).
3. Ajoy Ghatak, Optics, Tata McGraw-Hill Publicashing Company Limited. (1977).
4. F.A.Jenkins and H.E. White, Fundamental of Optics, Tata McGraw-Hill Publishing Company Limited. (1981).
5. Ghatak and Tyagrajan, Contemporary Optics, McMillan (2003).
6. K. Thyagrajan and A. Ghatak Laser: Theory and Applications, McMillan (2009).
7. K.Thyagarajan and A.Ghatak, Optical Electronics, Cambridge University Press (1997).
8. B.B.Laud, LASERs and Non-linear optics, Wiley Eastern (1991).

GE-4- OPTICS
(Practical) [1 Credit]

Minimum 4 Experiments

1. Spectrometer: Determination of Prism angle and minimum angle of deviation and refractive index.
2. Dispersive power of prism using Spectrometer

3. To find the thickness of film or foil using Wedge shaped film
4. To find radius of curvature of the convex surface using Newton's rings
5. Verification of Brewster's law
6. To find wavelength of Sodium light using Single Slit Diffraction.
7. To find wavelength of Sodium light using Diffraction Grating.
8. Study of Cardinals points of two lenses.
9. Resolving Power of Telescope using striped sheets.
10. To determine the specific rotation of an optically active solution using a polarimeter.
11. Study of properties of laser (polarization and Gaussian nature)
12. To find pitch of a transmission grating using laser
13. To determine the wavelength of laser source using diffraction of single slit.
14. To determine the wavelength of laser source using diffraction of double slits.
15. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating.

GE-5- BASIS ELECTRONICS
(Theory) [3 credits]

Semiconductors and diodes **[6]**
Review of atomic structure, band theory of semiconductor, intrinsic and extrinsic semiconductor, conduction process in semiconductors, P-N junction diode, Volt-ampere characteristics of Junction diode, Breakdown voltage.

Rectifiers **[6]**
Half wave, Full wave and Bridge rectifiers using junction diodes. Concept of capacitive filters. Percentage regulation, Ripple factor and Rectification efficiency.

Zener diode, Thermistor and LDR **[6]**
Zener diode, V-I characteristics of Zener diode and its breakdown mechanism. Zener diode as a simple voltage regulator. Thermistor characteristics and its use for A.C. voltage regulation. Light dependant resistors (LDR).

Transistors **[5]**
Junction transistor, operation of transistor, Basic configurations of transistors, Transistor characteristic in CE and CB mode, Current gains α and β and their interrelation, Leakage current in transistors.

Basic Amplifier Characteristics **[5]**
Current gain, Voltage gain, Power gain, Input resistance, Output resistance, Conversion efficiency, DC and AC load line, Classes of amplifier operations, Frequency response and amplifier bandwidth.

Feedback **[5]**
Theory of a feedback amplifier, Positive and negative feedback, Voltage and current feedback, series and shunt feedback. Effects of negative feedback on gain, input resistance, output resistance, frequency response, and distortion.

Oscillators **[6]**
Barkhausen criterion for oscillations, LC oscillatory circuit, Phase shift oscillator, Wein bridge oscillator, Hartley oscillator and Colpitts oscillator.

Operation Amplifiers **[6]**
The Differential Amplifier, OP-Amp characteristics, OP-Amp as inverting and Non Inverting amplifier. Adder and Subtracting amplifier.

Reference Books:

1. A. P. Malvino, Electronic Principles –TMH 5th edition (1996).
2. Allen Mottershed, Electronics Devices and Circuits an Introduction- 3rd edition PHI (1997).
3. Millman and Halkias, Intergrated electronics- TMH (1972).
4. Bhargava, Kulshrestha and Gupta, Basic Electronics and Linear Circuits-. TMH (1984).
5. RamakantGayakwad, Op-amp and Linear Intergrated Circuits, PHI (2002).

GE-5- BASIS ELECTRONICS
(Practical) [1 credit]

Minimum 4 Experiments

1. V-I characteristics of P-N junction diode and Zener Diode.
2. Half wave rectifier and Full wave rectifier.
3. Bridge rectifier.
4. Zener diode as voltage regulator.
5. To study characteristics of LDR.
6. Transistor characteristics- Input and Output (C E mode).
7. Transistor C.E. Amplifier.
8. Colpitts oscillator.
9. Hartley oscillator.
10. Wein's Bridge oscillator.
11. OP-Amp: as inverting amplifier and non-inverting amplifier.

GE-6- HEAT AND THERMODYNAMICS
(Theory) [3 Credits]

Kinetic theory of gases **[9]**

Three states of matter, concept of ideal gas, postulates of Kinetic Theory of gases, expression of pressure of a gas, relation between rms velocity and temperature, Average kinetic energy of a gas molecule, heat and temperature, kinetic interpretation of temperature, Degrees of freedom, Law of equipartition of energy and its application to specific heats of gases. Brownian motion and its features.

Zeroth and First Law of Thermodynamics **[12]**

Basic concepts of thermodynamics: Thermodynamic system, Thermodynamic variables, Thermodynamic equilibrium, and Thermodynamic processes, Zeroth law of thermodynamics and concept of temperature, Internal energy and First law of thermodynamics, Relation between pressure, volume and temperature in adiabatic process, Work done in isothermal and adiabatic processes, Path dependence of heat and work.

Second Law of Thermodynamics **[12]**

Reversible and irreversible process, condition of reversibility, Clausius' inequality, Second law of thermodynamics, Carnot's cycle, efficiency of Carnot's cycle, reversibility of Carnot's cycle, Carnot's theorem, coefficient of performance of a refrigerator, heat pump. Thermodynamic scale of temperature, its identity with perfect gas scale, Clausius' - Clapeyron latent heat equation and its applications.

Entropy **[12]**

Entropy as a Thermodynamic variable, Entropy change in reversible and irreversible processes, Temperature–Entropy diagram of Carnot's Cycle, Entropy of a perfect gas, Physical significance of Entropy: Entropy and Unavailable Energy, Entropy and molecular disorder, Entropy and Second Law of Thermodynamics. Impossibility of attaining Absolute Zero (Third law of Thermodynamics).

Reference Books:

1. M. N. Saha and B. N. Shrivastava, Treatise on heat, The Indian Press (1965).
2. S. C . Garg, R. M. Bansal and C. K. Ghosh, Thermal Physics, TMH (1993).
3. J. K. Roberts and A. R Miller , Thermodynamics E.L.B.S. (1960).
4. G. R. Noakes, Text Book of Heat, Mcmilan & Co (1960).
5. William C . Reynolds Thermodynamics, McGraw-Hill, New York (1965).
6. M.W. Zemansky and R.H. Ditman, Heat and Thermodynamics McGraw Hill (1997).
7. Brijlal, N. Subrahmanyam and P. S. Hemne, Heat, Thermodynamics and Statistical Physics, S. Chand & Company Ltd, (2014).

GE-6- HEAT AND THERMODYNAMICS
(Practical) [1 Credit]

Minimum 4 Experiments

1. To find temperature coefficient of Thermister.
2. To find temperature coefficient of copper.
3. Study of thermocouples for temperature measurements.
4. Measurement of thermal conductivity of poor conductors.
5. Study of Brownian motion.
6. To verify Stefan’s law.
7. Calibration of Si diode as a temperature sensor.
8. Study of Resistance Thermometry.
9. Verification of Boyle’s law.
10. Constant volume and constant pressure air thermometers.

GE-7- MODERN PHYSICS
(Theory) [3 credits]

Cathode and Anode Rays **[10]**
Electrical conduction through gases, ionization of gas, methods of producing ionization, phenomenon of discharge through gases at low pressure, cathode rays, properties of cathode rays, specific charge of electron-Determination of e/m of an electron by Thomson's method, Millikan's oil drop experiment. Thomson's positive ray analysis, Dempster's Mass spectrograph, Bainbridge Mass spectrograph.

Atomic Structure **[10]**
Bohr's theory of atomic structure-Hydrogen atom, spectral series of hydrogen atom, short comings of Bohr's atomic model, finite nuclear mass correction model, Sommerfeld's extension of Bohr theory, Frank and Hertz experiment for existence of discrete energy states within an atom.

Properties of electromagnetic radiation **[5]**
Black Body Radiation, Stefan's law, Photoelectric effect, Einstein's photoelectric equation, photo cell and Compton Effect (concepts only).

X-rays **[5]**
Coolidge tube generator, Continuous X-ray spectra and its dependence on voltage, Duane and Hunt's law, Wave nature of X-rays.

Radioactivity **[15]**
Radiations, Nature of Nuclear Radiations, characteristic properties of Alpha, Beta and Gamma Rays, Natural and Artificial Radioactivity, Laws of Radioactivity, Radioactive series, isotopes, isomers, half life, mean life, growth and decay of parent and daughter elements. Carbon Dating, Age of the Earth, nuclear fission and fusion.

Reference Books:

1. Arthur Beiser, Concepts of Modern Physics, 5th Edition, McGraw Hill (1985).
2. S. B. Patel, Nuclear Physics, TMH (1991).
3. Irving Kaplan, Nuclear Physics, Narosa Publishing House,(1997).
4. F. K. Richtmyer, E. H. Kennord, J.N. Cooper Introduction to Modern Physics, McGraw Hill (1997).
5. H. Semat and J. R. Albright, Introduction to Atomic and nuclear Physics, Chapman and Hall (1973).
6. J. B. Rajam, Atomic Physics, S. Chand and Co. Ltd. (1950).
7. V. W. Kulkarni, Atomic and Nuclear Physics, Himalaya Publishing House (2004).
8. H. Semat and J. R. Albright, Introduction to Atomic and Nuclear Physics, MaGraw Hill Book Company (1972).

GE-7- MODERN PHYSICS
(Practical) [1 Credit]

Minimum 4 Experiments:

1. Determination of e/m of an electron by Thomson's method.
2. X-ray emission (characteristic lines of copper target) – calculation of wavelength and energy to assign relevant transitions.
3. Frank and Hertz Experiment.
4. Measurement of Planck's constant using black body radiation and photo-detector.
5. Characteristics of photo cell. (verification of Photoelectric effect).
6. Study of Stefan's Law.
7. Numerical solution on half life, mean life, decay constant.
8. Numerical solution on binding energy, mass defect and energy released.

GE-8- MECHANICS AND RELATIVITY
(Theory) [3 Credits]

Mathematical Preliminaries **[4]**

Review of vector derivatives –(velocity and acceleration), radial and transverse components of velocity and acceleration, partial derivatives-gradient, Del operator, Divergence and Curl.

Motion under a central force **[6]**

Central force and non-central force, central force-conservative force, Equivalent one body problem, Kepler's laws of planetary motion, determination of universal constant.

Motion of a system of particles **[7]**

System of particles, Center of mass, motion of centre of mass, law of conservation of linear momentum, law of conservation of angular momentum, kinetic energy of system of particles, Rigid body, motion of system with variable mass-rocket/conveyor belt, compound pendulum.

Frame of reference **[6]**

Reference frame, inertial frame of reference, non-inertial frame of reference, Moving origin of coordinate system, rotating coordinate systems, Coriolis force and its applications, centrifugal force and its applications.

Moment of inertia **[7]**

Moment of inertia and its significance, perpendicular axis and parallel axis theorems, calculation of moment of inertia of different regular solids (rectangular blocks, thin uniform rod, thin circular ring, disc), moment of flywheel.

Relativity **[2]**

Michelson-Morley experiment, postulates of the theory of special Relativity.

Relativistic Kinematics **[7]**

Relativity of simultaneity, Derivation of Lorentz transformation equations, some consequences of Lorentz transformation equations, Relativistic addition of velocities, relativistic transformation of velocities and Doppler effect in Relativity .

Relativistic Mechanics **[6]**

Mechanics and Relativity, Redefining momentum, Relativistic momentum, Relativistic mass, Equivalence of mass and energy.

Reference Books:

1. R. G. Takawale and P. S. Puranik, Introduction to Classical Mechanics, Tata McGraw-Hill (1997).
2. K. R. Symon, Mechanics, Addison Wesley (1971).
3. D. C. Tayal, Mechanics, Himalaya Publishing House (2013).
4. K. Muktavat and A. K. Upadhaya, Applied Physics I. K. International Publishing House Pvt. Ltd. (2010).
5. D. S. Mathur, Mechanics, S. Chand and Company Ltd. (2012).
6. A. B. Bhattacharya and R. Bhattacharya, Undergraduate Physics, New Central Book Agency (P) Ltd. (2007).

7. H. K. Dass and R. Verma, Mathematical Physics, S. Chand and Company Ltd. (2014).
8. R. K. Gaur and S. L. Gupta, Engineering Physics, Dhanpat Rai and Sons (1997).
9. Charlie Harper, Introduction to Mathematical Physics, PHI (1997).
10. Robert Resnik, Introduction to Special Relativity, Wiley (1968).
11. Arthur Beiser, Concepts of Modern Physics, 5th Edition, McGraw Hill (1985).

GE-8- MECHANICS AND RELATIVITY
(Practical) [1 Credit]

Minimum 4 Experiments:

1. To find length of equivalent simple pendulum- Resonance pendulum.
2. To find moment of inertia using Bifilar suspension.
3. To study moment of inertia of Fly wheel.
4. Study of damping using pendulum under various kinds of damping mechanics.
5. To find *g* using Kater’s Pendulum.
6. Numerical solution of equation of motion using a personal computer/calculator.
7. Motion of a particle in a central force field using numerical analysis and calculator/PC.
8. Numerical solution on time dilation, length contraction, relativistic, transformation etc.