B.Sc. Semester – I

Subject: PHYSICS

Discipline Specific Core Course (DSCC)

Course No.1 (Theory): Title of the Course (Theory): **Mechanics and Properties of Matter**

Total Hrs: 56

Unit-I

Frames of Reference and Special Theory of Relativity:

Frames of Reference: Inertial frames, Galilean transformation equations (derivation), invariance of Newton's laws under Galilean transformations, invariance of the laws of conservation of momentum and energy under Galilean transformations. Non-inertial frames and fictitious force, rotating frame of reference, concept of the Coriolis force and its importance with derivation.

Special Theory of Relativity: The Michelson-Morley experiment, significance of negative result. Postulates of special theory of relativity. The Lorentz transformation equations (derivation), length contraction (derivation), time dilation (derivation), simultaneity, twin paradox, addition of velocities (derivation), variation of mass with velocity, mass-energy equivalence (derivation). Four vectors in relativity: space-time and energy-momentum vectors and their Lorentz transformation. **14 hrs**

Unit-II

Collisions and Rotational Dynamics:

Collisions: Two-dimensional elastic and inelastic collisions in center of mass and laboratory frames of reference: i) relation between velocities in center of mass system and laboratory system ii) relation between angle of recoil in laboratory system and angle of scattering in center of mass system. Conservation of linear momentum in case of variable mass. Double stage rocket (derivation for final velocity).

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque, principle of conservation of angular momentum. Rotation about a fixed axis, moment of inertia, theorem of parallel and perpendicular axes (derivation). M.I. of rectangular lamina, and circular disc, (derivations), hallow and solid cylinders (mention of expressions). Theory of flywheel and experimental determination of radius of gyration. Theory of gyroscope: effect of external torque on gyroscope. **14 hrs**

Unit-III

Gravitation and Elasticity:

Gravitation: Theory of compound pendulum, interchangeability of centers of suspension and oscillation, four points collinear with the C.G. about which the time period is same, conditions for maximum and minimum time periods. Bar pendulum, experimental determination of 'g' using bar pendulum. Bifilar suspension with parallel threads. Satellite in circular orbit and geosynchronous orbits. Global Positioning System (GPS): basic principle, working and its applications in various fields. Qualitative discussions on applications of artificial satellites.

Elasticity: Review of basic concepts of elasticity: Relation between elastic constants (derivation), Poisson's ratio in terms of elastic constants (derivation). Twisting couple on a solid cylinder (wire), work done in twisting solid cylinder (wire). Determination of coefficient of rigidity by torsional pendulum and Maxwell needle method. Bending of beams- neutral surface, neutral axis, plane of bending, bending moment. Expression for bending moment (derivation), uniform bending (mention formula). Theory of light cantilever (derivation). **14 hrs**

Unit-IV

Fluid Mechanics:

Surface Tension: Review of basics of surface tension. Pressure difference across a liquid surface: excess pressure inside a spherical liquid drop and excess pressure inside a soap bubble. Derivation of relation between radius of curvature, pressure and surface tension. Angle of contact: case of two liquids in contact with each other and with air, case of solid, liquid and air in contact. Experimental determination of surface tension by Jaeger's method with relevant theory. Determination of surface tension and angle of contact of mercury by Quincke's method.

Viscosity: Review of basics of viscosity. Expression for critical velocity, significance of Reynolds's number. Derivation of Poiseuille's equation. Experimental determination of co-efficient of viscosity for a liquid by Poiseuille's method. Motion of a spherical body in a viscous medium: expression for co-efficient of viscosity from Stokes law. **14 hrs**

Books recommended.

1. Mechanics (VI-Edition) - J. C. Upadhyay –Ramprasad & Sons, Agra, 2005.
2. Mechanics (XX-Edition) – D. S. Mathur- S. Chand & Company Ltd., New-Delhi, 2007.
3. Mechanics & Electrodynamics (XVII-Edition, Course- 1 & 2) – Brijlal, Subramanyam & Jivan Seshan, S. Chand & Company Ltd., New-Delhi, 2008.
4. Properties of Matter (XIII-Edition) – Brijlal & Subramanyam, Eurasia Publishing House Pvt. Ltd., New-Delhi, 2001.
5. Elements of Properties of Matter (XXVIII-Edition), D. S. Mathur - S. Chand & Company Ltd., New-Delhi, 2005.
6. Physics, Vol. No. I (V-Edition)– Resnick, Halliday & Krane – John Wiley & Sons Inc., New-York, Singapore, 2005.
7. Berkeley Physics, Vol. No. I – ABC Publications, Bangalore & New-Delhi.
8. University Physics (XI-Edition)- Young & Freedman – Pearson Education, 2004.
9. Introduction to Relativity- R. Resnik.
10. Relativistic Mechanics- Gupta and Kumar.

B.Sc. Semester – I

Course No.1 (**Practical**)
Title of the Course (Practical): **Mechanics and Properties of Matter**

List of the Experiments for 52 hrs / Semesters

1. Estimation of errors (Average deviation, Standard deviation, standard error and Probable error) in
the experimental determination of physical quantities like length, diameter, thickness, time, mass, temperature and resistance from the given data. And also fit the given data to a straight-line graph and calculate from the given observation's Standard deviation, standard error and Probable error.
2. Y by bending/cantilever.
3. Parallel/perpendicular axes theorem.
4. Bar Pendulum /Kater's pendulum.
5. Fly-Wheel
6. Bifilar Suspension.
7. Koenig's method.
8. Co-efficient of viscosity of liquid by Poiseuille's method.
9. Surface Tension by Jaeger's Method / Quincke's method.
10. Modulus of Rigidity of a wire using disc/ Maxwell's needle.
11. To find Youngs modulus, modulus of rigidity and Poisson's ratio for the material of a wire by Searle's method.
12. Problem based learning in physics: Problems on, gravitation (especially on satellite communication), special theory of relativity, rigid body dynamics and center of mass of different bodies.

Books recommended.

1. Physics For Degree Students B. Sc. First Year, S. Chand & Company.
2. Electronics Instrumentation by H. S. Kalasi.
3. B.Sc. practical Physics – C.L. Arora.
4. Advanced practical Physics – Samir Kumar Ghosh.
5. Advanced practical Physics – Worsnop and Flint.

B.Sc. Semester – I

Subject: PHYSICS
Open Elective Course (OEC-1)
(OEC for other students)

OEC-1: Title of the Course: **Energy Sources**

Total Hrs: 42

Unit-I

Introduction to Energy Sources: Energy concepts, sources in general, its significance and necessity. Classification of energy sources: primary and secondary sources. Energy consumption as a measure of prosperity. Need of renewable energy sources. Conventional (commercial) energy sources, Non- Conventional energy sources (Renewable energy). Advantages of renewable energy. Obstacles to the implementation of renewable energy systems. Prospects of renewable energy sources. Fossil fuels & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues& challenges. **14 hrs**

Unit-II

Solar-Energy and its Applications: Potential of solar energy, solar radiation and measurements, different types of solar energy collectors, advantages and disadvantages of different collectors, solar energy storage. Solar hot water supply systems. Solar air heating and cooling systems. Solar thermal electric power generation. Solar pumping, distillation, furnace and green houses. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. **14 hrs**

Unit-III

Wind energy harvesting and Ocean Energy and energy from Biomass:
Fundamental of wind energy, wind turbines and different electrical machines in wind turbines, power electronic interfaces and grid interconnection topologies.

Ocean Energy: Ocean energy potential against wind and solar, wave characteristics and statics wave energy devices. Tide characteristics and statistics, tide energy technologies ocean thermal energy, osmotic power, ocean bio-mass.

Energy from Biomass: Biomass conversion technologies: wet process, dry process, photosynthesis. Biogas generation: Factors affecting bio-digestion. Classification of biogas plants: Floating drum plant, fixed dome plant, advantages and disadvantages of these plants.

14 hrs

Books recommended.

1. Non-conventional energy sources by G. D. Rai Khanna Publishers New Delhi.
2. Solar energy by M. P. Agarwal S. Chand and Co. Ltd.
3. Solar energy by Suhas P. Sukhative Tata McGraw-Hill publishing Company Ltd.
4. Dr. P. Jayakumar, solar Energy: Resources Assesment Handbook, 2009.

B.Sc. Semester – II
Subject: PHYSICS

Discipline Specific Core Course (DSCC)

Course No.2 (**Theory**): Title of the Course (Theory): **ELECTRICITY and MAGNETISM**

Total Hrs: 56

Unit-I

Theory of Dielectrics and Electric Instruments, Measurements:

Theory of Dielectrics: Introduction to dielectric materials. Polar and nonpolar molecules with examples. Gauss law in a dielectric medium. Dielectric in an electric field, electric polarization (**P**), electric displacement (**D**), electric susceptibility (χ) and atomic polarizability (α), relation between **D**, **E** and **P**. Mechanism of polarization. Boundary condition at a dielectric surface (derivation). Derivation of Clausius–Mosotti equation and its limitations. Langevin-Debye theory of polarization in polar dielectrics. Dielectric constant and its determination for liquids and solids by Hopkinson's method.

Electrical Instruments, Measurements: Theory of moving coil galvanometer to be ballistic & dead beat. Charge and current sensitivity and their relationship, correction for damping. Measurement of capacitance of a capacitor by absolute method using B.G. Measurement of high resistance by leakage method using B.G. **14 hrs**

Unit-II

Resonance Circuits, D. C. & AC Bridges:

Resonance Circuits: Overview of AC circuits: Operator j, Argand diagram. LCR series circuit- Expression for current, impedance and phase (using j–operator method). Condition for resonance, resonant frequency, bandwidth, quality factor & their relation. LCR parallel circuit (Series L-R in parallel with C) - Expression for admittance & condition for resonance (using j-operator method). Comparison between series & parallel resonant circuits.

D. C. & A.C. Bridges: D.C. Wheatstone Bridge and its demerits (qualitative discussion without derivation). Theory of low resistance measurement using Kelvin's double bridge method. Measurement of inductance, Theory of Maxwell's bridge and Anderson's bridge. Comparison of capacities of two condensers by de Sauty's method. **14 hrs**

Unit-III

Magnetostatics and Thermoelectricity:

Magnetostatics: Overview of basics of Magnetostatics: Statement of Biot-Savart' law, derive the expression for magnetic field due to Straight conductor carrying current, mention the expression for the field along the axis of a circular coil & discuss the special cases. Tangent law, Helmholtz galvanometer-principle, construction & working. Ampere's circuital law-statement, proof & its applications (for D. C.) to derive the magnetic field due to Solenoid & Toroid.

Thermoelectricity: Seebeck effect, Variation of thermo emf with temperature, neutral temperature & temperature of inversion. Thermoelectric series. Peltier effect, Thomson effect. Thermoelectric laws. Derivation of the relations $\pi = T\,(de/dT)$ and $\sigma_a - \sigma_b = T\,(d^2e/dT^2)$. Tait diagram and its uses. Thermoelectric generators (TEG), Peltier-cooling, Thermoelectric cooler (TEC). Qualitative discussion on different types of Thermocouples (J-type, K-type and RTD type). **14 hrs**

Unit-IV

Electromagnetic Induction and Electromagnetic Theory:

Overview of basics of EMI, Determination of self-inductance (L) by Rayleigh's method and mutual inductance by direct method, with necessary theory.

Electromagnetic Theory: Fields, types of fields, flux and circulation of a vector field, gradient of a scalar field and its significance, vector point function (electric field intensity) and scalar point function (electric potential) and relation between them for an electrostatic charge distribution. Divergence and curl of a vector field and their significance; Gauss divergence theorem (derivation), Stokes theorem (derivation) and Green's theorem (statement and explanation). Electromotive force (emf) as the circulation of electric field intensity (derivation); continuity equation (proof) and its significance. Inconsistency in Ampere's circuital law and the concept of displacement current. Integral form of Maxwell's equations of electromagnetic theory (mention and explanation); Setting up of the differential form of Maxwell's equations (derivations). Application of Maxwell's equations to dielectric and conducting media; electromagnetic potentials - their non-uniqueness and significance; Coulomb, Lorenz gauge and their significance; Poynting's theorem (statement and derivation). **14 hrs**

Books recommended.

1. Fundamentals of Electricity and Magnetism – Basudev Ghosh – Books & Allied New Central Book
Agency, Calcutta, 2009.
2. Electricity and magnetism- D.N. Vasudev- S. Chand Publication, New Dehli.
3. Electricity and Magnetism- B.S.Agarwal- S. Chand Publication, New Dehli.
4. Electricity and magnetism- Brij lal & Subramasnyam.
5. Electricity and magnetism and Atomic physics vol-I – John Yarwood.
6. Electricity and magnetism – A. N. Matveer-Mir publisher,Moscow 1986.
7. Introduction to electrodynamics- D. J. Griffith (3rd ed)Prentice Hall of India, New Delhi.
8. Electricity and Magnetism by R. Murgeshan.
9. Vector Analysis-Hague
10. Electricity and Magnetism- D. Chattopadhya & Rakshit.
11. Electricity and magnetism- K. K. Tiwari
12. Electricity and magnetism by B. S. Agarwal.
13. Fundamentals of electricity and magnetism- D. N. Vasudev.
14. Electricity and Magnetism- Segal and Chopra
15. Text book of Electrical Technology, Vol. 1 – B.L. Theraja and A.K Theraja.
16. Feynmenn Lectures in Physics Volume II
17. Electromagnetics by B. B. Laud.
18. Introduction to Electrodynamics Third Edition by David J. Griffiths.
19. Electrodynamics by Jacson

B.Sc. Semester – II
Subject: PHYSICS
Discipline Specific Core Course (DSCC)
Course No.-2 (Practical)

Title of the Course (**Practical**) **- ELECTRICITY and MAGNETISM**

List of the Experiments for 52 hrs / Semesters

1. Determination of dielectric constant of a liquid.
2. Determination of the constants of B.G.
3. Helmholtz galvanometer
4. Determination of magnetic field along the axis of a coil
5. Measurement of capacity by absolute method, using B.G.
6. Determination of high resistance by leakage method
7. Measurement of capacity by method of mixtures
8. Determination of coefficient of self-inductance (L) by Rayleigh's method/ Anderson's bridge method.
9. Low resistance measurement using Kelvin's double bridge method.
10. Measurement of thermo-emf and verification of laws of thermoelectricity using / ordinary potentiometer/Crompton potentiometer.
11. Thermoelectricity power Generator (TEG)
12. Study of Seeback / Peltier Effect (Thermoelectric Cooler-TEC).
13. Series /parallel resonance circuit.

Books recommended.

1. Physics for Degree Students B. Sc. First Year, S. Chand & Company.
2. Electronics Instrumentation by H. S. Kalasi.
3. B.Sc. practical Physics – C.L. Arora.
4. Advanced practical Physics – Samir Kumar Ghosh.
5. Advanced practical Physics – Worsnop and Flint.

B.Sc. Semester – II
Subject: PHYSICS
Open Elective Course (OEC-2)
(OEC for other students)

OEC-2: Title of the Course: **Climate Science**

Total Hrs: 42

Unit-I

Atmosphere: Atmospheric Science (Meteorology) as a multidisciplinary science. Physical and dynamic meteorology, some terminology, difference between weather and climate, weather and climate variables, composition of the present atmosphere: fixed and variable gases, volume mixing ratio (VMR), sources and sinks of gases in the atmosphere. Greenhouse gases. Structure (layers) of the atmosphere. Temperature variation in the atmosphere, temperature lapse rate, mass, pressure and density variation in the atmosphere. Distribution of winds. **14 hrs**

Unit-II

Climate Science: Overview of meteorological observations, measurement of : temperature, humidity, wind speed and direction and pressure. Surface weather stations, upper air observational network, satellite observation. Overview of clouds and precipitation, aerosol size and concentration, nucleation, droplet growth and condensation (qualitative description). Cloud seeding, lightning and discharge. Formation of trade winds, cyclones. Modelling of the atmosphere: General principles, Overview of General Circulation Models (GCM) for weather forecasting and prediction. Limitations of the models. R and D institutions in India and abroad dedicated to climate Science, NARL, IITM, CSIR Centre for Mathematical Modeling and Computer Simulation, and many more. **14 hrs**

Unit-III

Global Climate Change: Greenhouse effect and global warming, enhancement in concentration of carbon dioxide and other green house gases in the atmosphere, conventional and non-conventional energy sources and their usage. EL Nino/LA Nino Southern oscillations. Causes for global warming: Deforestation, fossil fuel burning, industrialization. Manifestations of global warming: Sea level rise, melting of glaciers, variation in monsoon patterns, increase in frequency and intensity of cyclones, hurricanes, tornadoes. Geo-engineering as a tool to mitigate global warming? Schemes of geo-engineering. **14 hrs**

Books recommended.

1. Basics of Atmospheric Science:A Chndrashekar,PHILearning Private Ltd. New Delhi, 2010.
2. Fundamentals of Atmospheric Modelling-Mark Z Jacbson, Cambridge University Press, 2000
3. Aviation Meteorology, I.C. Joshi, 3rd edition 2014, Himalayan Books
4. The weather Observers Hand book, Stephen Burt, 2012, Cambridge University Press.
5. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur.
6. Text Book of Agrometeorology, S.R. Ghadekar, 2005, Agromet Publishers, Nagpur.
7. Why the weather, Charles Franklin Brooks, 1924, Chpraman & Hall, London.
8. Atmosphere and Ocean, John G. Harvey, 1995, The Artemis Press