CO-PO attainment
in
Outcome Based Education
General Programme
In
Physics

Department of Physics,

Government General Degree College, Kalna-I

Program Outcome (PO)

- PO1: Disciplinary knowledge
- PO2: Communication Skills
- PO3: Critical thinking
- PO4 : Problem solving
- PO5: Self directed learning
- PO6: Research-related skills
- PO7: Scientific reasoning
- PO8: Information/digital literacy
- PO9: Lifelong learning

Program Specific Outcome (PSO): UG Physics

- PSO1: **Foundation for Theoretical Concepts of Physics:** To use theoretical methodologies to explain physical laws around us.
- PSO2: **Foundation for Experimental/Numerical tools of Physics :** The ability to implement/visualize the theoretical knowledge through laboratory based experimental /numerical techniques.
- PSO3: **Foundation for possible further developments** : The ability to grasp the scientific ideas behind different physical laws and connecting them to broad area of real life applications and provide new ideas and innovations towards research.

Course Content

Semester: I **Course name: Mechanics** **Course Code: CC-1A/GE-1**
(Credits: Theory-04, Practicals-02)

CC –1A/GE-1: Mechanics
(Credits: Theory-04, Practicals-02)
F.M. = 75 (Theory - 40, Practical – 20, Internal Assessment – 15)
Theory:

Vectors: Vector algebra, Scalar and vector products, Derivatives of a vector with respect to a parameter. (4Lectures)

Ordinary Differential Equations: 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients. (6Lectures)

Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. (10Lectures)

Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. (6Lectures)

Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum. (5Lectures)

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. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). (8 Lectures)

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. (6 Lectures)

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 - q, η and σ by Searles method (8 Lectures)

Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities. (7Lectures**)**

Practicals:

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.

2. To determine the Moment of Inertia of a Flywheel/ regular shaped objects.

3. To determine Young's Modulus by flexure method.

4. To determine the Young's Modulus of a Wire by Optical Lever Method.

5. To determine the Modulus of Rigidity of a wire by Maxwell's needle / dynamical method.

6. To determine the Elastic Constants of a Wire by Searle's method.

7. To determine g by Bar/Kater's Pendulum.

8. To determine the coefficient of viscosity by Poiseuille's method.

9. To study the Motion of a Spring and calculate (a) Spring Constant (b)Value of g.

Course Outcome (CO) **Paper: CC1A/GE-1**

Sl. No.	Course Outcome (CO)	Knowledge Level	POs	PSOs
Theory				
1	**Discussion** of the fundamental concepts of Vectors and ODE.	**L1: Remembering**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
2	**Demonstrate** the laws of Newtonian Mechanics leading to the ideas behind inertial reference frame and free body diagram. **Demonstrate** the ideas behind rotational motion and moment of inertia in this aspect.	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
3	**Illustrate** the central force and outline Gravitational field as an example of the same.	**L4: Analyzing**	**1,2,3,4,5,6,7,9**	**1,2,3**
4	**Discussing** Simple Harmonic Oscillation as an generic platform to study bound systems in perturbative regime and analyze free and forced oscillators. **Outline** of the concept of the elasticity.	**L1: Remembering**	**1,2,3,4,5,6,7,9**	**1,2,3**
5	**Comprehension** of Einstein's postulate of Special Theory of Relativity **and derivation** of the Lorentz transformations for time and space coordinates.	**L2: Understanding**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
Practical				
1	**Demonstrate** experimental verifications of different Mechanical properties like Spring constant, Young's Modulus, Modulus of Rigidity etc. of material of a wire.	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
2	**Measure** gravitational acceleration due to Earth using Kater's pendulum method.	**L5: Evaluating**	**1,2,3,4,5,6,7,8,9**	**1,2,3**

Course Content

Semester: II **Course name: ELECTRICITY AND MAGNETISM** **Course Code: CC-1B/GE-2**
(Credits: Theory-04, Practicals-02)

CC – 1B/GE-2: ELECTRICITY AND MAGNETISM
(Credits: Theory-04, Practicals-02)
F.M. = 75 (Theory - 40, Practical – 20, Internal Assessment – 15)

Theory:

Vector Analysis: 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). (12Lectures)

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. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric. (22 Lectures)

Magnetism: Magnetostatics: Biot-Savart's law & 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. (10 Lectures)

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. (6 Lectures)
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, polarization. (10 Lectures)

Practicals:

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
3. To compare capacitances using De'Sauty's bridge.
4. To study the Characteristics of a Series RC Circuit.
5. To study the a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor
6. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
7. To determine a Low Resistance by Carey Foster's Bridge.
8. To verify the Thevenin and Norton theorem
9. To verify the Superposition, and Maximum Power Transfer Theorem
10. To determine the horizontal component of earth's magnetic field.
11. To determine the resistance of a suspended coil galvanometer by half deflection method and hence calculate the sensitivity of the galvanometer.

Course Outcome (CO) **Paper: CC-1B/GE-2**

Sl. No.	Course Outcome (CO)	Knowledge Level	POs	PSOs
Theory				
1	**Discussion** of the fundamental properties of vector algebra.	**L1: Remembering**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
2	**Understanding** electric fields and potential , Dielectric Properties of Matter	**L2: Understanding**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
3	**Illustrate** Magnetic fields and magnetic properties of matter	**L4: Analyzing**	**1,2,3,4,5,6,7,9**	**1,2,3**
4	**Assess** Electromagnetic Induction	**L5: Evaluating**	**1,2,3,4,5,6,7,9**	**1,2,3**
5	**Review** of Maxwell's equations. Explaining the same which represents the state of electromagnetic theory.	**L2: Understanding**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
Practical				
1	**Determination** of low and high resistance, capacitance, self and mutual inductance	**L5: Evaluating**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
2	**Explain** the characteristics of RC , Series and Parallel LCR circuits	**L2: Understanding**	**1,2,3,4,5,6,7,8,9**	**1,2,3**

Course Content

Semester: III **Course name: Thermal Physics and Statistical Mechanics** **Course Code: CC-1C/GE-3**
(Credits: Theory-04, Practicals-02)

CC –1C/GE-3: Thermal Physics and Statistical Mechanics
(Credits: Theory-04, Practicals-02)
F.M. = 75 (Theory - 40, Practical – 20, Internal Assessment – 15)
Theory:

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 & CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. (22Lectures)

Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations. (10 Lectures)

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases. (10Lectures)

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. (6 Lectures)

Statistical Mechanics: Phase space, Macro state and Micro state, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein Distribution law - photon gas - comparison of three statistics. (12Lectures)

Practicals:

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 determine the temperature co-efficient of resistance by Platinum resistance thermometer.

5. To study the variation of thermo emf across two junctions of a thermocouple with temperature.

6. To determine the coefficient of linear expansion by optical lever method.

7. To determine the pressure coefficient of air by constant volume method.

8. To determine the coefficient of linear expansion by travelling microscope.

9. To determine the coefficient of thermal conductivity of a good conductor by Searle's method.

Course Outcome (CO) **Paper: CC-1C/GE-3**

Sl. No.	Course Outcome (CO)	Knowledge Level	POs	PSOs
Theory				
1	**Description** of the fundamental concepts of Thermodynamics equilibrium and Principle of Conservation of Energy, and **identification** of the work-energy transfer mechanisms. **Explanation** of the Carnot engine and its efficiency. Extension of the Second Law of Thermodynamics and its application	**L1: Remembering**	**1,2,4,7,8,9**	**1,2,3**
2	**Illustration** of Maxwell's Thermodynamic relations and its applications. Identification of different kinds of Thermodynamic Potentials and **distinction** of two kinds of phase transitions.	**L4: Analyzing**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
3	**Computation** of Maxwell-Boltzmann velocity distribution law and calculation of velocity of gas. **Demonstration** of Transport Phenomenon of gas.	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
4	**Demonstrate** the ideas behind Classical formulation of theory of radiation and **compute** macroscopic results starting from microscopic descriptions.	**L3: Applying**	**1,2,3,4,5,7,8,9**	**1,2,3**
5	**Formulate** the B-E statistics and the F-D statistics and **construct** the ideas of B-E condensate and applying F-D statistics in semiconductor physics	**L6: Creating**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
Practical				
1	**Computational** analysis of the behavior of black body radiation and **measured** the value of Stefan constant.	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
2	**Estimate** the coefficient of thermal conductivity of bad and good conductor and **explain** temperature co-efficient of resistance, the coefficient of linear expansion, the pressure coefficient of air.	**L2: Understanding**	**1,2,3,4,5,6,7,8,9**	**1,2,3**

Course Content

Semester: III	Course Code: SEC-1
Course name: RENEWABLE ENERGY AND ENERGY HARVESTING	(Credits: Theory-02)

SEC-1: F.M.=50 (Theory-40, Internal Assessment–10)

Theory

COURSE OBJECTIVE: The aim of this course is to impart knowledge about Renewable energy and energy harvesting in context of energy crisis and provide them with exposure and hands-on learning wherever possible.

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 in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. (3 Lectures)

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. (6 Lectures)

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. (3 Lectures)

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. (3 Lectures)
Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. (2 Lectures)

Geothermal Energy: Geothermal Resources, Geothermal Technologies. (2 Lectures)

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. (2 Lectures)

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power. (4 Lectures)
Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications. (2 Lectures)
Carbon captured technologies, cell, batteries, power consumption. (2 Lectures)
Environmental issues and Renewable sources of energy, sustainability. (1 Lecture)

Course Outcome (CO) Paper: SEC-1

Sl. No.	Course Outcome (CO)	Knowledge Level	POs	PSOs
Theory				
1	**Identify** renewable and non-renewable energy sources in the context of energy crisis	**L1: Remembering**	1,2,4,7,8,9	1,2,3
2	**Give example** of Solar, Wind, Geothermal, Ocean, Hydro energy sources	**L2: Understanding**	1,2,3,4,5,6,7,8,9	1,2,3
3	**Demonstrating** the fundamental ideas of Piezoelectric and Electromagnetic Energy harvesting	**L3: Applying**	1,2,3,4,5,6,7,8,9	1,2,3
4	**Illustrate** the basic concepts of Carbon capture technologies and Environmental issues along with sustainability of Renewable sources of energy	**L4: Analyzing**	1,2,3,4,5,7,8,9	1,2,3

Course Content

Semester: IV

Course Code: CC-1D/GE-4

Course name : Waves and Optics

(Credits: Theory-04, Practicals-02)

F.M.=75 (Theory-40, Practical–20, Internal Assessment–15)

Theory

COURSE OBJECTIVE: The objectives of this course is to provide an in-depth understanding of the principles of wave mechanics and optics and apply them to solve problems involving the dynamics of oscillations and optical properties.

Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats) (4 Lectures)

Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency 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. (7Lectures)

Fluids: Surface Tension: Synclastic and anticlastic surface - Excess of pressure – Application to spherical and cylindrical drops and bubbles- variation of surface tension with temperature - Jaegar's method. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Physics of low pressure - production and measurement of low pressure- Rotary pump- Diffusion pump -Molecular pump - Knudsen absolute gauge - penning and pirani gauge – Detection of leakage. (6Lectures)

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. (6 Lectures)

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

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. (10 Lectures)

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

Diffraction: Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. (14Lectures)

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

Practical:

1. To determine the angle of prism by (i) Rotating telescope or (ii) Rotating prism method.
2. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
3. To determine Dispersive Power of the Material of a given Prism using Mercury Light
4. To determine the value of Cauchy Constants of a material of a prism.
5. To determine the Resolving Power of a Prism.
6. To determine wavelength of sodium light using Newton's Rings.
7. To determine the diameter of a thin wire by Diffraction.
8. To determine wavelength of Sodium light using plane diffraction Grating.
9. To determine the Resolving Power of a Plane Diffraction Grating.
10. To determine the refractive index of a liquid by travelling microscope.
11. To determine the focal length of a concave lens by combination method.

Course Outcome (CO) Paper: CC-1D/GE-4

Sl. No.	Course Outcome (CO)	Knowledge Level	POs	PSOs
Theory				
1	**Outline** the Superposition of two collinear and perpendicular Harmonic Oscillations	**L1: Remembering**	**1,2,4,7,8,9**	**1,2,3**
2	**Understanding** the fundamental aspects of sound along with simple harmonic motion, Fourier analysis of sound wave, reverberation.	**L2: Understanding**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
3	**Demonstrating** the fundamental ideas of interference and its applications in design and working of interferometers.	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
4	**Illustrate** the fundamental theory of diffraction and its applications	**L4: Analyzing**	**1,2,3,4,5,7,8,9**	**1,2,3**
5	**Outline** ideas of the phenomenon of Polarization	**L4: Analyzing**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
Practical				
1	**Demonstrate** the procedure of measuring angle of prism, refractive index of a prism. the dispersive power and Cauchy constants of the material of a prism	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
2	**Determination** of wavelength of sodium light by Fresnel Bi-prism, Newton's Rings, diffraction grating. **Determination** of dispersive power and resolving power of a plane diffraction grating	**L5: Evaluating**	**1,2,3,4,5,6,7,8,9**	**1,2,3**

Course Content

Semester: IV
Course name: WEATHER FORECASTING

Course Code: SEC-2
(Credits: Theory-02)

SEC-2: F.M.=50 (Theory-40, Internal Assessment–10)

Theory

COURSE OBJECTIVE: The aim of this course is not just to impart theoretical knowledge to the students but to enable them to develop an awareness and understanding regarding the causes and effects of different weather phenomenon and basic forecasting techniques.

Introduction to atmosphere: Elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere; variation of pressure and temperature with height; air temperature; requirements to measure air temperature; temperature sensors: types; atmospheric pressure: its measurement; cyclones and anti cyclones: its characteristics. (9Lectures)

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. (4Lectures)

Weather systems: Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes. (3 Lectures)

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. (6Lectures)

Basics of weather forecasting: Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts. (8Lectures)

Course Outcome (CO) Paper: SEC-2

Sl. No.	Course Outcome (CO)	Knowledge Level	POs	PSOs
Theory				
1	**Identify** elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere	**L1: Remembering**	1,2,4,7,8,9	1,2,3
2	**Measuring** the weather:	**L5:Evaluating**	1,2,3,4,5,6,7,8,9	1,2,3
3	**Demonstrate** the causes of climate change; global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain, environmental issues related to climate.	**L3: Applying**	1,2,3,4,5,6,7,8,9	1,2,3
4	**Illustrate** Basics of weather forecasting, analysis and its historical background; need of measuring weather; types of weather forecasting; methods of weather forecasting	**L4: Analyzing**	1,2,3,4,5,7,8,9	1,2,3

Course Content

Semester: V **Course name: Nuclear and Particle Physics** **Course Code: DSE-1A**
(Credits: Theory-06)

DSE-1A: Nuclear and Particle Physics
(Credits: Theory-06)
F.M. = 75 (Theory - 60, Internal Assessment – 15)

Theory:

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states. (10 Lectures)

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force. (12 Lectures)

Radioactivity decay: (a) Alpha decay: basics of α-decay processes, theory of α- emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion. (10 Lectures)

Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering). (8 Lectures)

Interaction of Nuclear Radiation with matter: Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter. (8 Lectures)

Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT).Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector. (8 Lectures)
Particle Accelerators: Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons. (5 Lectures)

Particle physics: Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons. (14 Lectures)

Course Outcome (CO) **Paper: DSE-1A**

Sl. No.	Course Outcome (CO)	Knowledge Level	POs	PSOs
Theory				
1	**Define** properties of atomic nuclei	**L1: Remembering**	**1,2,4,7,8,9**	**1,2,3**
2	**Outline** radioactive decay and nuclear reactions	**L4: Analyzing**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
3	**Analyze** interaction of nuclear radiation with matter	**L4: Analyzing**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
4	**Explain** the operation of nuclear detectors	**L2: Understanding**	**1,2,3,4,5,7,8,9**	**1,2,3**
5	**Outline** the fundamental characteristics of particle physics	**L4: Analyzing**	**1,2,3,4,5,6,7,8,9**	**1,2,3**

Course Content

Semester: VI
Course Code: DSE-1B

Course name: DIGITAL AND ANALOG CIRCUITS AND INSTRUMENTATION
(Credits: Theory-04, Practicals-02)

CC – DSE-1B: DIGITAL AND ANALOG CIRCUITS AND INSTRUMENTATION
(Credits: Theory-04, Practicals-02)
F.M. = 75 (Theory - 40, Practical – 20, Internal Assessment – 15)

Theory:

UNIT-1: Digital Circuits:

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. (4 Lectures)

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. (5 Lectures)

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

UNIT-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. (5Lectures)

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

UNIT-3:

Operational Amplifiers (Black Box approach):

Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop & 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, (6) Zero Crossing Detector. (13Lectures)

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

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. (3Lectures)

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. (6Lectures)

Timer IC: IC 555 Pin diagram and its application as Astable & Monostable Multivibrator. (3Lectures)

Practical:

1. To measure (a)Voltage, and (b) Frequency of a periodic wave form using a CRO
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 study I-V characteristics of PN diode and Zener diode.
7. To study the characteristics of a Transistor in CE configuration.
8. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias.
9. To design an inverting amplifier of given gain using an Op-amp 741 and study its frequency response.
10. To design an non-inverting amplifier of given gain an Op-amp 741 and study its frequency response.

Course Outcome (CO) **Paper: DSE-1B**

Sl. No.	Course Outcome (CO)	Knowledge Level	POs	PSOs
Theory				
1	**Understanding** principle of operation of different gates**, S**olution of the Boolean algebra problem and preparation for different Arithmetic Circuits.	**L2: Understanding**	**1,2,4,7,8,9**	**1,2,3**
2	**Describe** the formation of P-N junction diode and barrier potential across the junction along with mechanism of current flow in forward and reverse bias.	**L1: Remembering**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
3	**Demonstrate** the concept of transistor with the basic techniques of biasing the transistor	**L3: Applying**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
4	**Illustrate** the concept of OP-AMP and its uses as Inverting and non-inverting amplifiers, Adder, Subtractor, Differentiator, Integrator, Log amplifier, Zero crossing detector, Wein bridge oscillator.	**L4: Analyzing**	**1,2,3,4,5,7,8,9**	**1,2,3**
5	**Design** of CRO, Power Supply and 555 Timer	**L6: Creating**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
Practical				
1	**Illustration** of different gate and Boolean algebra, and identification of adder, subtractor using ICs.	**L4: Analyzing**	**1,2,3,4,5,6,7,8,9**	**1,2,3**
2	**Design** an inverting / non-inverting amplifier using Op-amp (741) for dc voltage of given gain, add two dc voltages using Op-amp in inverting and non-inverting mode	**L6: Creating**	**1,2,3,4,5,6,7,8,9**	**1,2,3**