North Lakhimpur College (Autonomous)

Department of Physics

Semester	Paper code, title	Course outcome
1	C I, Mathematical Physics- I Credit: Theory: 04	**Unit I: Calculus**
		Provides a recapitulation of the basic ideas of calculus, deals with solving of differential equations of various types, partial derivatives with simple illustrations and introduction to Lagrange's Multipliers.
		Unit II: Vector calculus
		It deals with the basics of vector and scalar fields, differentiation and integration of vectors and provides ample scope of developing problem solving skill in this field.
		Unit III: Orthogonal Curvilinear Co-ordinates
		It deals with the orthogonal curvilinear system and expressions for gradient, divergence, curl and Laplacian in different co-ordinate systems.
		Unit IV: Introduction to probability
		It deals with the independent random variables and dependent events.
		Unit V: Dirac Delta function and its properties
		Provides the basic idea of Dirac delta function and its properties
	C I, Lab Credit: 02	Deals with basics of scientific computing, errors and analysis, review of C and C++ programming fundamentals, random number generation, solution of algebraic and transcendental equations, interpolation and numerical differentiation.
	C II, Mechanics Credit: Theory : 04	**Unit I: Fundamental of dynamics**
		This unit gives the basics of Newtonian mechanics, frame of references and dynamics of a system of particles including the conservation principles.
		Unit II: Work and energy
		It deals with conservative and non conservative forces, mechanical energies and laws of conservation of energy.

		Unit III: Collisions
		It deals with the study of elastic and inelastic collision in center of mass frame and laboratory frame of reference
		Unit IV: Rotational dynamics
		It deals with mechanics of a rigid body in rotational motion.
		Unit V: Elasticity
		It deals in the study the relation between elastic constants and twisting torque on a cylinder or wire.
		Unit VI: Fluid motion
		It deals with the kinematics of moving fluids with special reference to Poiseuille's equation.
		Unit VII: Gravitation and Central force motion
		It deals with the laws of gravitation, gravitational force, potential and energy. It also provides concepts on the behavior of a particle under the influence of a central force, Keplar's law and motion of satellites.
		Unit VIII: Oscillations
		It deals with the entire study of simple harmonic motion. It also deals with the forced and damped oscillations and quality factor
		Unit IX: Non inertial systems
		It provides introduction to non inertial frames of references, different fictitious forces and their applications and components of velocity and acceleration in cylindrical and spherical co ordinate system.
		Unit X: Special theory of relativity
		Provides insights to various relativistic phenomena such as length contraction, time dilation, transformation of velocity, frequency and wave numbers, relativistic addition of velocities, mass energy equivalence, relativistic Doppler effect and relativistic kinematics.
	C II, Lab Credit: 02	It deals with an effort to enhance the hand on learning of measurements in different mechanical phenomena and to determine the errors incurred during measurement.
2	**C III, Electricity**	**Unit I: Field and Electric Potential**

	and Magnetism Credit: Theory : 04	It deals with the Gauss's law and its application in various fields, conservative nature of the electric field and electrostatic energy of system of charges.
		Unit II: Dielectric Properties of Matter
		Deals with study of electric field in matter, capacitor and Gauss's law in dielectric.
		Unit III: Magnetic fields
		It provides a systematic study of various laws such as the Bio-Savart law, Ampere's law and their applications.
		Unit IV: Magnetic properties of matter
		It is related to the study of various magnetic properties exhibited by matter.
		Unit V: Electromagnetic induction
		It deals with the important laws in electromagnetic induction such as the Faraday's law, Lenz's law and their applications, Maxwell's equation and concept of charge conservation.
		Unit VI: Electrical circuits:
		It deals with the Kirchhoff's law for AC circuits, complex reactance and impedance, study of various parameters in a series LCR circuit and introduction to parallel LCR circuit.
		Unit VII: Network theorems
		It deals with the introduction of ideal constant voltage and constant current sources, different network theorems and their applications in dc circuit.
		Unit VIII: Ballistic galvanometer
		It provides a thorough insight to the theory, working and various aspects of ballistic galvanometer
	C III, Lab Credit: 02	This paper is aimed at acquaintance of various measurement techniques in electricity and to translate the theoretical knowledge in electricity into practical application.
	C IV, Waves and	**Unit I: Superposition of collinear harmonic oscillations**

	Optics Credit : Theory: 04	It deals with the idea of superposition principle of two collinear oscillations having different parameters.
		Unit II: Superposition of two perpendicular harmonic oscillations
		It deals with the study of the superposition of two perpendicular harmonic oscillations both graphically and analytically and the Lissajous figures.
		Unit III: Wave motion
		It deals with study of different types of waves and wave motion, wave equation in differential form, water waves.
		Unit IV: Velocity of waves
		It is related to the study of transverse and longitudinal waves, Newton's formula for velocity of sound and Laplace correction.
		Unit V: Superposition of two harmonic waves
		It deals with the study of standing waves in strings, stretched string, plucked and struck string, longitudinal standing waves, normal modes, open and closed pipes and superposition of N harmonic waves.
		Unit VI: Wave optics
		It deals with the Huygen's principle and temporal and spatial coherency.
		Unit VII: Interference
		It deals with the interference by division of wavefront and division of amplitude in details.
		Unit VIII: Interferometer
		It deals with the study of Michelson and Fabrey –Perot interferometer and the measurements that could be done by it.
		Unit IX, X and XI: Diffraction, Fraunhoffer and Fresnel's diffraction
		It deals with the qualitative idea of Kirchhoff's Integral theorem and Fresnel- Kirchhoff's integral formula, idea of Fraunhoffer diffraction and its application in telescope and grating. It also deals with the Fresnel's diffraction and its application in Fresnel's zone and study of Fresnel's diffraction in straight edge, slit and wire.

		Unit IX: Holography
		This unit deals with the introduction to holography and its various applications.
	C IV, Lab Credit : 02	Experimental studies on issues pertaining to light and sound
3	**C V, Mathematical Physics-II Credit: Theory: 04**	**Unit I: Fourier Series**
		It gives an idea of the sine and cosine functions, complex representation of Fourier series, expansion of functions with arbitrary periods, expansion of non periodic functions and application of Fourier series.
		Unit II: Frobenius method and special functions
		It deals in application of the Frobenius method in solving various types of differential equations, properties of Legendre Polynomials, Bessels functions and zeros of Bessel functions and orthogonality.
		Unit III: Some special integrals
		It deals with the study of beta and gamma functions and the relation between them.
		Unit IV: Theory of errors
		It deals with the evaluation of different errors.
		Unit V: Partial differentiation equations
		It deals with the solution of partial differential equations, solution of Laplace equation in different co- ordinate systems, wave equation and diffusion equation.
	C V, Lab Credit: 02	It deals with the computational methods to solve physical problems
	C VI, Thermal PhysicsCredit: Theory: 04	**Unit I: Zeroth and First law of thermodynamics**
		It deals with the extensive study of the thermodynamic and state variables, first law of thermodynamics and its applications in various thermodynamic processes.
		Unit II: Second law of thermodynamics

		It deals with Carnot's cycle and the Carnot engine, second law of thermodynamics and its applications, thermodynamic scale of temperature and its equivalence to perfect gas scale.
		Unit III: Entropy
		It gives the idea of entropy , definition of different thermodynamic terms in term of entropy, entropy of different systems, entropy changes in different processes, third law of thermodynamics and unattainable of absolute zero temperature.
		Unit IV: Thermodynamic potentials
		It provides the study of internal energy of a thermodynamical system and enthalpy, free energies, their definitions, properties and applications, first and second order phase transitions with example, Clausius-Clapeyron equation and Ehrenfest equations
		Unit V: Maxwell's thermodynamic relations
		This unit deals with the derivation and application of Maxwell's relations in various equations and processes.
		Unit VI: Distribution of velocities
		It deals with the Maxwell- Boltzman law of distribution in an ideal gas and its experimental verification ,
		Doppler broadening of spectral lines and Stern's experiment, Mean, rms and most probable speed, degrees of freedom and idea about specific heat of gases.
		Unit V: Molecular collisions
		It is related to the study of the mean free path, collision of probability, estimates of mean free path and transport phenomena.
		Unit VI: Real gases
		This unit offers study of the deviation of the real gas from the ideal gas, equation of states for real gases, liquid and gaseous states, equation of state of real gases, law of corresponding states, adiabatic expansion of a perfect gas and Joule Thomson cooling.
	C VI, Lab Credit: 02	This course provides the experimental determination of (a)the thermal conductivity and the temperature co-efficient by various methods (b)

		thermo emf in a thermo couple and to calibrate a thermo couple.
	C VII, Digital systems and applications **Credit: Theory: 04**	**Unit I: Introduction to CRO**
		This unit gives the insight of the construction and working of a CRO along with the study of the application of it.
		Unit II: Integrated Circuit
		It provides qualitative idea on the different network components, their classifications along with the examples.
		Unit III: Digital Circuits
		It gives an idea of the difference between the digital and analogue circuits, decimal and binary system, different number system, gates, their application as parity and checkers.
		Unit IV: Boolean Algebra
		It provides detailed study on Boolean laws and their application. it also deals with the conversion of truth table to equivalent logic circuit by different methods.
		Unit V, VI and VII: Data processing circuits, Arithmetic circuits and Sequential Circuits
		Unit V gives basic idea on multiplexers, de multiplexers, decoders and encoders. Unit VI is related to binary operations using 2's components, half and full adders and substractors and 4 bit binary adder/substractors.
		Unit VII gives idea on different flip-flops, preset and clear operations, race around conditions in JK flip-flops, M/S JK flip-flops
		Unit VIII, IX and X: Timers, shift registers and Counters
		These units give the idea of multivibrators, registers and different types of counters (4 bits)
		Unit XI: Computer Organizations
		It provides the elementary idea on the different components of computer.
		Unit XII: Intel 8085 Microprocessor Architecture
		It deals with the main features of 8085 microprocessor and its functions
		Unit XIII: Introduction to Assembly language

		It provides basic idea on 1, 2 and 3 byte instructions

	C VII, Lab Credit: 02	This paper provides on hand knowledge on different electronic devices.
		This course deals with Scilab/C^{++} based simulations experiments based on Mathematical Physics problems.
4	**C VIII, Mathematical Physics Credit: Theory: 04**	**Unit I: Complex analysis**
		It deals with the recapitulation of the Complex number and their graphical representation, Function of complex numbers, singularity functions , integration of a function of a complex variable, Cauchy's inequality and formula, Laurent and Taylor's expansion, residue and residue theorem and their application in solving definite integrals.
		Unit II: Integral transforms
		It deals with detailed study of Fourier transformation, representation of Dirac delta function as a Fourier integral, Fourier transformation of derivatives, inverse Fourier transform, convolution theorem, properties of Fourier transforms, three dimensional Fourier transforms with examples and application of Fourier transforms to differential equation
		Unit III: Laplace transforms
		It deals with the Laplace transform of elementary functions, properties of Laplace transforms, LTs of 1^{st} and 2^{nd} order derivatives and integral of functions, LTs of Unit step functions, Dirac delta function, periodic function and Convolution theorem, inverse LT, and application of Laplace transform to various problems.
	C VIII, Lab Credit: 02	This course deals with Scilab/C^{++} based simulations experiments based on Mathematical Physics problems.
	C IX, Elements of Modern Physics Credit: Theory: 04	**Unit I: Quantum mechanics**
		It deals with the quantum theory of light, wave nature of light two slit experiment with electron, probability, wave amplitude and wave functions.

		It further deals with the Gamma ray microscope experiment and conclusions from it, derivation from wave packets impossibility of a particle following trajectory, estimating minimum energy of a confined particle using uncertainty principle, application of energy time uncertainty principle to virtual particles and range of interaction.
		The next sub unit deals with the two slit interference patter along with the solution of the Schrodinger's equation for non relativistic particles, momentum and energy operators, physical interpretation of the wave function, probability and probability current density in one dimension.
		The next sub unit deals with finding the energy eigen values and eigen functions for a particle in a rigid box, quantum mechanical scattering and tunneling in one dimension across a step potential and rectangular potential barrier.
		Unit II: Nuclear Physics
		The first subunit deals with the size of the nucleus and its relation with atomic weight, nature of nuclear force,
		Nuclear models and magic numbers.
		The second unit deals with radioactivity, Pauli's prediction of neutrino, gamma ray emission and energy momentum conservation.
		The third unit deals with fission and fusion which have special emphasis on nuclear reactors and stellar energy.
		Unit III: LASER
		It deals with the basics of Lasing action and introduction to some elementary Lasers.
	C IX, Lab Credit: 02	It deals with experiments related to Quantum mechanics and LASER
	CX: Analog Systems and Applications Credit: Theory: 04	**Unit I: Semiconductor Diodes**
		It deals with the basics of semiconductor diodes and the current flowing mechanism in them.
		Unit II: Two terminal devices and their applications
		It deals with the study an application of rectifier diode, zener diode and principle and structure of LED, photodiode and solar cell.

		Unit III: Bipolar Junction transistors
		It deals with the study of n-p-n and p-n-p transistor in different configurations, Load line analysis of transistors, DC load line and Q-point, physical mechanism of current flow, active, cutoff and saturation region.
		Unit IV, V, VI, VII, VIII: Amplifiers, Coupled amplifiers, feedback amplifiers, sinusoidal oscillators, operational amplifiers
		These units deal with transistor biasing and stabilization circuits, h parameter and equivalent circuits, analysis of a single stage CE amplifier using hybrid model, classification of class A,B and C amplifiers.
		Unit V deals with the two stage RC coupled amplifier and its frequency response.
		Unit VI deals with the effect of feedback, gain, stability, distortion and noise.
		Unit VII deals with sinusoidal oscillators such as RC phase shift oscillator, Hartley and Colpitt's oscillators.
		Unit VIII gives idea on operational amplifiers.
		Unit IX: Application of Op-Amps
		This unit deals with the application of operational amplifiers as inverting and non inverting amplifiers, adder, substractors, differentiators, integrators, log amplifier, zero crossing detector and Wein bridge oscillators.
		Unit X: Conversion
		It deals with resistive network, accuracy and resolution and analog to digital conversion.
	C X, Lab Credit: 02	It deals with different experiments regarding electronic devices
5	**CXI: Quantum Mechanics and Application Credit: Theory: 04**	**Unit I: Time dependent Schrodinger equation**
		It deals with the solution and application of time dependent Schrodinger equation, interpretation of wave function, linearity and superposition principles, energy operators, expectation values of

		position and momentum and wave function of a free particle.
		Unit II: Time independent Schrodinger equation
		It deals with the Hamiltonian, stationary states and energy eigen values, general solution of the time dependent Schrodinger's equation in terms of linear combination of stationary states, application to spread of Gaussian wave packet for a free particle in one dimension, Fourier transforms and momentum wavefunction and position momentum uncertainty principle.
		Unit III: General discussion of bound states in an arbitrary potential
		It deals with the bound state problems in addition to solution of quantum mechanical problem using Frobenius method, Hermite polynomial and uncertainty principle.
		Unit IV: Quantum theory of hydrogen like atoms
		It deals with the time independent Schrodinger equation in polar co ordinate, angular momentum operator and quantum numbers, radial wavefunctions from Frobenius method, orbital angular momentum quantum numbers.
		Unit V, VI: Atoms in electric and magnetic fields, Atoms in external magnetic fields
		Unit V deals with the study of quantization theory, behavior of atoms in presence of electric and magnetic field. Unit VI deals with the study of various magneto-optic and electro-optic phenomena.
		Unit VII: Many electron atoms
		This unit mainly deals with the spectral notions of atomic states, vector atom model, spin orbit coupling, various coupling schemes in an atom and spectra of hydrogen and hydrogen like atoms.
	C XI, Lab Credit: 02	This course deals with solving problems based on quantum mechanics with C/C^{++}/Scilab and laboratory based experiments on quantum mechanics

	CXII: Solid State Physics Credit: Theory: 04	**Unit I: Crystal structure**
		It deals with the structure of solids.
		Unit II: Elementary lattice dynamics
		This unit deals with the vibration of lattice and specific heat of lattice.
		Unit III: Magnetic properties of matter
		It deals with the classification of matter with respect to magnetic properties, discussion on B-H curve, hysteresis and energy loss.
		Unit IV: Dielectric properties of Materials
		This unit is related to dielectric properties of materials, dispersion, optical phenomena and their applications, plasma oscillation, plasma frequency, plasmons and TO modes.
		Unit V: Ferroelectric properties of materials
		It deals with the ferroelectric properties of materials, their classifications, different phenomena exhibited by them and laws associated with them.
		Unit VI: Elementary band theory
		It gives an idea of the band gap, classification of materials in terms of band gap as conductor, semiconductor and insulator and detailed study of the conductivity of semiconductor.
		Unit VII: Superconductivity
		It deals with the experimental results and theory in superconductivity.
	C XII, Lab Credit: 02	This course is about experimental studies of experiments in solid state Physics.
	Physics DSE I : Classical DynamicsCredit: Theory- 05 Tutorial- 01	**Unit I: Classical mechanics of point particles**
		It stars with the review of classical mechanics, motion of a charged particle in external electric and magnetic field, generalized coordinates, Hamilton's principle, Lagrangian, Euler Lagrange equation and its application, canonical momenta and Hamiltonian, Hamilton's equations and their applications.
		Unit II: Small amplitude oscillations
		It deals in study of small amplitude oscillations and different stages involved in it.

		Unit III: Special theory of relativity
		It deals with detailed study of the theory of relativity starting from the postulates of special theory of relativity, Minkowski space, metric and altering tensors, Doppler effect from a four vector perspective, relativistic kinematics and its application.
		Unit IV: Fluid dynamics
		It deals with the continuity equation and mass conservation in fluid, stream lined and turbulent motion, Poiseuille's equation, Navier-Stoke's equation and Reynolds number.
	Physics DSE II : Nuclear Physics Credit: Theory- 05 Tutorial- 01	**Unit I: General properties of nuclei**
		It deals with the constituents of the nucleus and their properties, binding energy and its main features, angular momentum, parity, magnetic and electric moment and nuclear excited state.
		Unit II: Nuclear Models
		It deals with different models like liquid drop model, Fermi gas model, shell model and concept of nuclear force.
		Unit III: Radioactive decay
		It deals with the kinematics of alpha, beta and gamma decay.
		Unit IV: Nuclear reaction
		It deals with different types of nuclear reactions, conservation laws, Q values of reaction, concept of compound and direct reactions and Coulomb's scattering.
		Unit V: Interaction of nuclear radiation with matter
		This unit deals with the interaction of different types of radiation such as ionization, Cerenkov radiation, Gamma rays. It further deals with the photoelectric effect, Compton scattering, pair production and neutron interaction with matter.
		Unit VI: Detector for nuclear radiation
		It deals with the study of nuclear detector like ionization chamber, GM counters, Scintillation counter, photomultiplier tubes, semiconductor detectors and neutron detectors.
		Unit V: Particle accelerator

		It deals with the accelerator facilities available in India like the Van de Graff accelerator, linear accelerator, cyclotron and the synchrotrons.
		Unit VI: Particle Physics
		It deals with the basic features and types of particle interactions, conservation laws, different parameters associated with particle physics, concept of quarks and gluons.
6	**CXIII: Electromagnetic theory Credit: Theory: 04**	**Unit I: Maxwell Equations**
		It starts with the review of the Maxwell equations and the consequences that could be drawn from them. it also deals with the physical concept of the electromagnetic field energy density, momentum density and angular momentum density.
		Unit II: EM wave propagation in unbound media
		It deals with the mechanism of propagation of the em wave in different unbound media such as conduction media, dilute plasma, ionized gases and application to propagation through ionosphere.
		Unit III: EM waves in bound media
		It deals with the mechanism of different phenomena of EM waves in a bounded medium.
		Unit III: Polarization of EM waves and Rotatory polarization
		It deals with the definition of different types of polarization (liner, circular and elliptical), methods and principle in producing polarized wave and analysis of polarized waves. It also deals with the phenomenon of optical rotation.
		Unit IV, V: Wave guides and optical fibres
		These units deal with the properties of wave guides and concept and definition of different parameters of optical fibres.
	C XIII, Lab Credit: 02	This course deals with the experimental learning of different phenomena exhibited by electromagnetic waves.
	C XIV: Statistical Mechanics Credit: Theory: 04	**Unit I: Classical Statistics**
		It deals with the idea of ensembles and other thermodynamic parameters, entropy, law of equipartition of energy and its

		applications.
		Unit II: Classical theory of radiation
		It deals with different classical radiation laws with special reference to the black body.
		Unit III: Quantum theory of radiation
		It deals with the spectral distribution of black body radiation, Plank's quantum postulates, Plank's black body distribution law and deduction of different radiation laws from Plank's law.
		Unit IV: Bose Einstein Statistics
		It deals with the BE distribution law, Bose Einstein condensation, properties of liquid He, concept of radiation as photon gas and Bose derivation of Plank's law.
		Unit V: Fermi-Dirac statistics
		It deals with the Fermi-Dirac distribution law, thermodynamic functions of a completely and strongly degenerate Fermi gas, Fermi energy, electrons ion metals, specific heat of metals and application to astronomy.
	C XIV, Lab Credit: 02	It deals with solving problems in statistical mechanics using C/C++/Scilab or other numerical simulation methods.
	Physics DSE III : Astronomy and Astrophysics Credit: Theory- 05 Tutorial- 01	**Unit I: Astronomical scale**
		It deals with the study of astronomical quantities and their measurements, astronomical coordinates, stellar spectral classifications and H-R diagram.
		Unit II: Astronomical techniques
		In involves the study of different techniques used in optical telescopes, detectors and use of detectors with telescopes.
		Unit III: Physical principles
		It deals with the study of gravitation in astrophysics and systems in thermodynamic equilibrium.

		Unit IV, V, VI: The sun, The solar family, Stellar spectra and classification structure
		These units mainly deal with the study of the Sun and the activities, the origin and evolution of the Solar system and solar spectra and their classification.
		Unit VII: Milky way
		This unit deals with the basic structure, properties and nature of the milky way, stars and star clusters of the milky way, properties of and around the galactic nucleus.
		Unit VIII: Galaxies
		It deals with the morphology of galaxies, Hubble's classification of galaxies, elliptical, spiral and lenticular galaxies, the Milky way, dust in galaxies and spiral arms of the galaxies.
		Unit IX: Large scale structure and expanding Universe
		It deal with the cosmic distance ladder, Hubble's law, clusters of galaxies including virial theorem and dark matter
6	**Physics DSE IV : Physics of earth Credit: Theory- 05 Tutorial- 01**	**Unit I: The Earth and the Universe**
		It deals with the creation of elements and the earth, general characteristics of the origin of the universe, energy and particles fluxes incident of earth and the cosmic microwave background.
		Unit II: Structure of the Earth
		It deals with the structure of the solid earth, the hydrosphere, the atmosphere, the cryosphere and the biosphere.
		Unit III: Dynamical processes
		It involves the study of the dynamical processes involved in the structure of the solid earth, the hydrosphere, the atmosphere and the biosphere.
		Unit VI: Evolution
		It deals with the study of the geo-chronological methods and their application in geological studies, history of development in concepts of uniformization, catastrophism and neptunism and introduction to geology and geomorphology of Indian subcontinent.
		Unit V: Disturbing the earth- Contemporary dilemmas
		It deals with the study of the factors causing harm to the atmosphere, hydrosphere, geosphere and the biosphere.

Program specific outcome :The programme provides

(a) An all encompassing knowledge of Physics from the very basics to the advanced one.
(b) Mathematical understanding of the physical problems.
(c) skills for solving numerical in Physics.
(d) Great scope for learning languages like C, C++ and programming details.
(e) Scope for use of softwares like Matlab and Scilab.
(f) Experimental knowledge on each branch of Physics
(g) Extended knowledge on allied/emerging subjects of/in Physics.
(h) Ample opportunity for innovation and research.

Total courses offered =32