COURSE CURRICULAM AND SYLLABII OF THREE YEAR DEGREE COURSE 2017-2020

PHYSICS

COURSE CURRICULAM

First Year T.D.C. Science 2017-2018

Paper code	Paper	Nomenclature	Lecture per		Duration of exam	Max. Marks		Min. Marks
			Year	Week		Ext.	Int.	
PHY111	I	Mechanics	60 hrs	2 hrs	3 hrs	35	15	18
PHY112	II	Electricity and Magnetism	60 hrs	2 hrs	3 hrs	35	15	18
PHY113	III	Oscillations and Waves	60 hrs	2 hrs	3 hrs	35	15	18
PHY114	IV	Physics Practical	120 hrs	4 hrs	5 hrs	75		27

Second Year T.D.C. Science 2018-2019

Paper code	Paper	Nomenclature	Lecture per		Duration of exam	Max. Marks		Min. Marks
			Year	Week		Ext.	Int.	
PHY211	I	Optics	60 hrs	2 hrs	3 hrs	35	15	18
PHY212	II	Electronic circuits and Instrumentation	60 hrs	2 hrs	3 hrs	35	15	18
PHY213	III	Thermal Physics and Statistical Mechanics	60 hrs	2 hrs	3 hrs	35	15	18
PHY214	IV	Physics Practical	120 hrs	4 hrs	5 hrs	75		27

Third Year T.D.C. Science 2019-2020

Paper code	Paper	Nomenclature	Lecture per		Duration of exam	Max. Marks		Min. Marks
			Year	Week		Ext.	Int.	
PHY311	I	Quantum Mechanics and Solid state physics	60 hrs	2 hrs	3 hrs	35	15	18
PHY312	II	Atomic, Molecular and Nuclear Physics	60 hrs	2 hrs	3 hrs	35	15	18
PHY313	III	Relativity and Electromagnetic Field theory	60 hrs	2 hrs	3 hrs	35	15	18
PHY314	IV	Physics Practical	120 hrs	4 hrs	5 hrs	75		27

Each theory paper in the annual examination shall have three sections.

- Section A shall contain one compulsory question of 5 marks having 15 parts. Three parts shall be set from each unit. The candidate is required to answer two parts from each unit in about 20 words.

- Section B shall contain five compulsory questions of 4 marks each with internal choice. One question with internal choice will be set from each unit. The answer may be given in approximately 250 words.
- Section C shall contain five descriptive questions, one question shall be set from each unit and candidate has to answer any two questions of 5 marks each. The answer may be given in approximately 300 words. There can be two parts in a question from this section.

First Year T.D.C. Science 2017-2018

PAPER-I

MECHANICS

Unit – I

Laws of motion and Frame of reference: Laws of motion, conservation of momentum and energy, Co-ordinate frames, inertial and non-inertial frame of reference, Galilean transformation and invariance, fictitious force, centrifugal force, transformation of coordinate, velocity, acceleration and displacement in a rotating frame of reference, uniformly rotating frame of reference, Coriolis force, effect of centrifugal and Coriolis force due to earth's rotation, Foucault's pendulum.

Gravitational Field and Potential: Newton's universal law of gravitation, gravitational field intensity, gravitational potential due to spherical shell and solid sphere, gravitational potential energy, Laplace and Poisson's equations, Gauss's law, gravitational self energy of a uniform sphere.

Unit – II

Dynamics of System of Particles: Centre of mass, calculation of centre of mass of regular rigid bodies like circular disc, hemispherical body, right circular cone, triangular plate, motion of centre of mass, centre of mass frame, conservation of linear momentum, kinetic energy of a system of particles, elastic, inelastic and perfectly inelastic collisions, rocket propulsion, two body problem, reduced mass, application of reduced mass, binary stars.

Rotational Motion and Rigid Body dynamics: Angular momentum, torque, law of conservation of angular momentum and its applications, physical significance of conservation of angular momentum, angular momentum of system of particle in with respect to centre of mass frame, rigid body, the general motion of rigid body, equation of rotational motion, Newton's law of rotation motion, comparison of linear and rotational motion, degrees of freedom.

Unit - III

Motion under a Central force field: Central force, equation of motion under central force field, orbital motion of particle under central force field, constants of the elliptical orbit, circular orbit and their stability, Kepler's laws.

Molecular rotations and Gyroscopic motion: Molecular rotations, moment of inertia of diatomic and tri-atomic molecules, intrinsic spin, precession of a symmetric top, gyroscope and its applications.

Unit - IV

Elasticity: Stress and strain, their types, Hooke's law, stress-strain curve, elastic behavior of solid, types of elasticity, poisson's ratio, work done in stretching a wire, theorems of stress and strain, relation between various elastic constant, limiting value of poisson's ratio and its experimental determination.

Bending of Beam: Torsion of cylinder, bending of beam, cantilever, beam supported at its ends and loaded in the middle, applications of bending of beams.

Unit - V

Kinematics of moving fluid: Streamline and turbulent flow, Reynold's number, equation of continuity, energy of a liquid, Euler's equation of motion for fluidity, Bernoulli's theorem and its applications.

Viscosity: Introduction, coefficient of viscosity, Poiseuille's equation-limitations and correction, Poiseuille's method for determination of coefficient of viscosity, Stoke's law, measurement of viscosity by rotating cylinder method, variation of viscosity with temperature and pressure.

Text and Reference Books:

1. Mechanics by D.S. Mathur
2. Mechanics by P.K. Srivastava
3. Mechanics by J.C.Upadhyay
4. Mechanics by Keith R. Symon
5. Mechanics by V. Saraswat
6. Mechanics Berkeley Physics course,v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill.
7. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
8. Mechanics (Hindi Edition)- Kalra, Himanshu Publications

PAPER-II

ELECTRICITY and MAGNETISM

Unit - I

Electrostatics: Charge and its properties, Coulomb's law, superposition principle, continuous distribution of charge, electric field due to point charge and due to different types of distribution of charge, field due to an infinitely long straight charged wire, electric potential due to an arbitrary distribution of charge, electric potential energy, electric dipole, a dipole in uniform and non-uniform electric field, electric quadrupole.

Gauss's Law: Electric flux, Gauss's law and its applications, electrostatic energy of a uniformly charged sphere, classical radius of an electron, force on the surface of a charged spherical conductor.

Unit - II

Electric field around conductors: Poisson and Laplace equations in different Cartesian coordinate system (without derivation), boundary conditions, uniqueness theorem, solution of Laplace equation in Cartesian coordinate system, potential at a point inside rectangular body, electrical image method.

Electric field in matter: Coulomb's law, atomic and molecular dipoles, polarization, atomic polarisability, capacitor, capacity of a parallel plate capacitor in the presence and absence of dielectric, field of a charge in dielectric medium (Gauss's law), Clausius-Mossoti equation.

Unit - III

Magnetostatics: Magnetic field, laws for the direction of magnetic field, Biot Savart law and its applications, magnetic dipole and current loop, magnetic Lorentz force, force on a current carrying conductor, Ampere's law and its applications, torque on a current carrying loop in magnetic field.

Electric current: Current and current density, equation of continuity, drift velocity, mobility, resistance, resistivity, conductance, conductivity, electron theory of resistivity, classification of material, ohmic and non-ohmic circuit, dark current, thermistor, thermoelectricity, growth and decay of current in LR and RC circuit, differentiating and integrating circuit.

Unit - IV

Alternating current circuit: Representation of a.c. quantities by complex number system, impedance, quality factor, power factor, series and parallel a.c. circuit and their resonance, principle of a.c. bridges, Anderson's bridge, de Sauty's bridge, Owen's bridge, self inductance, mutual inductance, Neumann's formula, energy stored in magnetic field, coupled circuit, coefficient of coupling, transformer, skin effect.

Unit - V

Moving coil ballistic galvanometer and its applications: Introduction, current and charge sensitivity, condition for a galvanometer to become a ballistic galvanometer, different equation of B.G. and its solution under the condition of critical damping, over damping and under damping, logarithmic decrement, applications of B.G. for the mutual inductance by Carey foster bridge method, magnetic field using search coil, low resistance by Kelvin's double bridge method, high resistance by leakage method.

Text and Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education..
2. Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. Electricity and Magnetism, V. Saraswat, 2017, Himanshu Publications.
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
6. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.
7. Electricity and Magnetism (Hindi) – Kalra, Himanshu Publications

PAPER-III

OSCILLATIONS and WAVES

Unit – I

Free oscillations of simple systems: Introduction and some important definitions, equilibrium and concept of potential well, motion of a particle in a parabolic potential well and its solution, dynamical quantities associated with S.H.M., energy of simple harmonic oscillator, free oscillations of physical systems, effective force constant of springs connected in parallel and in series, linear and transverse oscillations of a mass connected with two springs, oscillations of two masses connected by a spring, diatomic molecule and reduced mass.

Damped harmonic oscillations: Equation of damped harmonic oscillator and its solution under the condition of over damping, critical damping and under damping, energy, power dissipation, relaxation time, quality factor and examples of a damped harmonic oscillator.

Unit - II

Forced harmonic oscillations: Equation of forced harmonic oscillator and its solution, phase, amplitude, sharpness, velocity, energy, band width, and quality factor of forced harmonic oscillator, resonance and their examples.

Free oscillations of system with two degrees of freedom: Two coupled pendula, the general method of finding normal modes, energy exchange in coupled oscillations, transverse oscillations of a system of many coupled

oscillators, longitudinal oscillations of many coupled oscillator, differential equation of a continuous system and normal modes.

Unit - III

Fourier theorem and its applications: Fourier theorem, exponential from of Fourier series, analysis of a rectangular wave, square wave, saw tooth wave, half wave rectifier and full wave rectifier using Fourier's theorem, Fourier integral for odd and even function, complex form of Fourier integral, Fourier transform and its applications in top het and in Gaussian functions.

Wave equation and waves in continuous media: Type of wave motion, wave equation, plane progressive wave, classical wave equation, energy, energy density, energy flux and intensity of a plane progressive harmonic wave, example of one dimensional traveling wave, velocities of waves in a strings, in a solid bar and in fluids, pressure wave, Newtons's formula, Laplace correction, effect of various factors on velocity of sound, general solution of wave equation, boundary conditions and normal modes, phase velocity and group velocity.

Unit- IV

Superposition of waves: Principle of superposition and its limitations, coherent sources, interference of sound and its experimental determination, beats and amplitude modulation, combination tones.

Ultrasonic: Production, detection, and applications of ultrasonic waves

Vibrations in bounded systems: Transverse vibration of stretched string and their modes, laws of vibrations of strings, longitudinal and transverse vibrations of bars, vibration of air columns, Galtons' whistle, vibration of drum.

Unit- V

Reflection, refraction, and diffraction of sound: Reflection of sound and their laws, reflection of sound from different surfaces, practical application of reflection of sound, echo sounding, refraction of sound waves, silent zone, diffraction of sound, Fresnel's half period zone, sound ranging, characteristic impedance of a string, reflection and transmission of wave energy and their intensities, acoustic impedance of a medium, sonar.

Applied acoustics: Transducers and their characteristics, recording and reproduction of sound, acoustics of buildings, reverberation, absorption and transmission of sound, factor affecting the architectural acoustics, Sabine's formula, optimum reverberation, echelon effect.

Text and Reference Books:

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication
4. Oscillation, Waves and Acoustics by V. Saraswat, Himanshu Publications
5. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison-Wesley.
6. Optics- Bhandari, Sultan Chand and Sons
7. Oscillations, Waves and Acoustics (Hindi Ed.)- Kakani, Himanshu Publications

PAPER-IV

PHYSICS PRACTICAL

Note: Students are expected to perform sixteen experiments in all taking the eight experiments from each section. One experiment from section A and one from section B will be set in the examination paper. The distribution of marks in the practical examination will be as follows:

(i)	Two experiments		50 Marks
	For each experiment, distribution of marks will be as follows:		
		Figure:	3 Marks
		Formula/Theory:	4 Marks
		Observation table along with least count:	10 Marks
		Calculation and Result:	6 Marks
		Precautions and source of error:	2 Marks
(ii)	Viva voce		10 Marks
(iii)	Record		15 Marks
	Total		**75 Marks**

For X-student each practical will be of 25 marks and viva voce will be of 25 marks.

Section-A

1. Determine the elastic constants of a given material using Searle's method.
2. Determine the thermal conductivity of a bad conductor by Lee's method.
3. Determine Joule's constant by Callender and Barne's method.
4. Study of variation of surface tension with temperature/height by Jaeger's method.
5. Determine the value of acceleration due to gravity 'g' at a place using Kater's pendulum.
6. Determine the coefficient of damping k, relaxation time T and quality factor of a damped SHM using a simple pendulum.
7. Determine the velocity of sound in air at room temperature with Kundt's tube.
8. Using scattering to deduce the nature of potential hump or well (two dimensional).
9. Study of laws of parallel and perpendicular axes for estimation of moment of inertia.
10. Study of motion of a top and a gyroscope.
11. Determine the modulus of rigidity of the given wire using torsion oscillator and study of torsion of a wire and its dependence on radius, length, torque and material (dynamical method).
12. Determine the modulus of rigidity of the material of a wire by statistical method using Bortan's apparatus
13. Determine the value of modulus of rigidity of the material of a given wire by dynamical method using Maxwell's needle
14. Determine the coefficient of viscosity of water by Poiseuill's method.
15. Studying the fall of solids through a liquid.
16. Determine the coefficient of viscosity of a liquid by Stoke's method
17. To determine Poisson's ratio of rubber

Section -B

1. Calibrate Carey Foster's bridge wire and determine the specific resistance of the material of the given wire.
2. Measure the thermo e.m.f. of given thermocouple.
3. Study the growth and decay of current in R.C. circuit and determine the time constant.
4. Determine the impedance of L-R circuit and find phase relationship in current and voltage.
5. Determine the impedance of LCR series circuit.
6. Determine the resonance frequency, band width and quality factor of LCR series circuit.
7. Determine the ballistic constant, current and charge sensitivity, time period, logarithmic decrement and resistance of a given ballistic galvanometer.
8. Determine the intensity of magnetic field using search coil and ballistic galvanometer.
9. Determine high resistance by leakage method, and measure the leakage resistance of a condenser.
10. Determine low resistance by Kelvin's double bridge.

11. Determine dielectric constant of a given liquid.
12. Determine self inductance of a given coil using Anderson's method.
13. Compare the capacities of two capacitors using de-Sauty's bridge method.
14. Find the capacity of unknown capacitors using de-Sauty's bridge method.
15. Determine the mutual inductance by Carry Foster's bridge method.
16. Study of magnetic field using a vibration magnetometer.
17. Study of the rise and decay of current in a LR circuits.

Any other experiment can be set as per the availability in the laboratory.

Second Year T.D.C. Science 2018-2019

PAPER-I

OPTICS

Unit – I

Format's Principle and General theory of image formation: Principle of experiments path, the aplantic points of a sphere and other applications, cardinal points of a lens system and their general relationship, thick lenses, lens combinations, telephoto lenses.

Aberration in images and optical instruments: Chromatic aberration, achromatic combination of lenses in contact and separated lenses. Monochromatic aberrations and their reduction, Ramsden and Huygen's eye piece, their working principal, image formation and difference between them.

Unit – II

Interference of light: Principle of superposition, two slit interference, coherence requirement for the sources, localized fringes in thin films, transition from fringes of equal thickness to those of equal inclination, Newton's rings, Michelson interferrometer its uses for determination of wavelength, wavelength difference and refractive index. Febry-Perot interferrometer and its uss, Lummer Gehrke plate and its used.

Unit - III

Fresnel diffraction of light: Half period zones, circular aperture and obstacles, straight edge, explanation of rectilinear propagation, Zone plate with multi focii.

Fraunhofer diffraction: Diffraction at a slit, a circular aperture and a circular disc, resolution of images; diffraction grating or diffraction at N parallel slits, Rayleigh criterion, Resolving power of a telescope and plane diffraction grating.

Unit - IV

Polarization of light: Double refraction and optical rotations : Double refraction in uniaxial crystals, explanation in terms of electro-magnetic theory, Malus Law, Phase retardation plates, rotation of plane of polarization, origin of optical rotation in liquids and in crystals. Babinet Compensator, Polarimeters and their applications in measurement of specific rotation.

Unit - V

Lasers: Purity of spectral line, coherence length and coherence time, spatial and temporal coherence, relation between Einstein's A and B coefficients, spontaneous and induced emissions, conditions for laser action, existence of a metastable state, population inversion. He-Ne and Ruby laser, application of lasers.

Holography: Working, principle and applications.

Text and Reference Books:

9. Principle of optics by B.K. Mathur
10. Text book of optics by Brijlal and Subrahmanyam
11. Optics by Jankins and White
12. Text book of Optics by Khandelwal
13. Optics by Ajay Ghatak
14. Optics by Kalra, Kakani and Bhandari

PAPER-II

ELECTRONIC CIRCUITS and INSTRUMENTATION

UNIT – I

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.

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 SOP and POS method and by Karnaugh map (upto 4 varibles).

Binary addition, binary subtraction using 2's complement method, half adders and full adders and subtractors, 4-bit binary adder-subtractor.

UNIT – II

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 LEDs, photodiode and solar cell.

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 (Only basic differences).

UNIT – III

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.

Feed Back Amplifier:

Basics of negative feedback, merits and demerits of negative feedback and its application, voltage series and current series amplifier.

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

UNIT – IV

Basic circuit analysis:

Voltage and current sources, Open and Short Circuits, Kirchoff's laws, Voltage and current divider rules, Mesh and node analysis, Principle of superposition, Thevenin's and Norton's theorem, Maximum Power transfer theorem.

Instrumentations (Basic Circuits):

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.

UNIT – V

Introduction to CRO: Block Diagram of CRO. Applications of CRO, study of waveform, measurement of voltage, current, frequency and phase difference.

Modulation and demodulation: Basics of modulation, amplitude and frequency modulation, sidebands, comparison between AM and FM, power of amplitude modulation and spectrum, Block diagram and principle of AM and FM transmitter, demodulation of AM and FM waves, linear envelope detector, astable & monostable multivibrator.

Text and Reference Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.
3. Microelectronic Circuits, M.H. Rashid, 2ndEdn.,2011, Cengage Learning.
4. Modern Electronic Instrumentation & Measurement Tech., Helfrick&Cooper,1990, PHI Learning
5. Digital Principles & Applications, A.P. Malvino, D.P. Leach & Saha, 7th Ed.,2011, Tata McGraw Hill
6. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
7. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
8. OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.
9. Electronics (Hindi Ed.)- Bhandari, Himanshu Publications

PAPER-III

THERMAL PHYSICS and STATISTICAL MECHANICS

The laws of thermodynamics: The zeroth law of thermodynamics, various indicator diagrams, work done by and on the system, first law of thermodynamics, internal energy as a state function. Carnot cycle and its efficiency, Carnot theorem and the second law of thermodynamics, different versions of the second law, reversible and irreversible changes, practical cycles used in internal combustion engines. entropy, principle of increase of entropy. thermodynamic scale of temperature; its identity with the perfect gas scale, impossibility of attaining absolute zero, third law of thermodynamics.

Thermodynamic relationships: Thermodynamic variables; extensive and intensive, Maxwell's general relationships; applications to J-T cooling and adiabatic cooling in a general system, Vander Waals gas, and the Clausius-Clapeyron heat equation.

Thermodynamic Potentials: Relation to the thermodynamic variables, Equilibrium of thermodynamic systems, Cooling due to adiabatic demagnetization.

UNIT – II

Ideal Gas: Kinetic Model, Deduction of Boyle's law, Review of the kinetic model of an ideal gas, Interpretation of temperature, Brownian motion, Estimate of the Avogadro number, equi-partition of energy, specific heat of monatomic gas, extension to diatomic and tri-atomic gases, behaviour at low temperatures, Adiabatic expansion of an ideal gas. Application to atmospheric physics (derivation of barometric equation)

Real Gas: Vander Waals model; equation of state, nature of Van der Waals forces, comparison with experimental P-V curves. The critical constants, gas and vapour. Joule-Thomson expansion of an Ideal gas and Van der Waals gas; Constancy of U+ PV, Joule coefficients, Estimates of J-T cooling, adiabatic expansion of an ideal gas.

Liquification of gases: Joule Expansion, Joule-Thomson and adiabatic cooling, Boyle temperature and inversion temperature, principles of regenerative cooling and cascade cooling, Liquification of hydrogen and helium, meaning of efficiency.

UNIT – III

Transport phenomena in gases: Molecular collisions, mean free path and collision cross-sections, Estimates of molecular diameter and mean free path, Experimental determination of mean free path, transport of mass, momentum and energy and interrelationship, dependence on temperature and pressure.

Maxwellian distribution of speeds in gas: Derivation of distribution of speeds and velocities, experimental verification, distinction between mean, rms and the most probable speed values, Doppler broadening of spectral lines.

UNIT – IV

Black Body Radiation: Spectral distribution of BB radiation; pure temperature dependence, Stefan-Boltzmann law, Wien's displacement law, Rayleigh-Jeans law and the ultraviolet catastrophy, pressure of radiation, Planck's hypothesis, mean energy of an oscillator and the Planck's law, complete fit with the experiment, interpretation of specific heats of gases at low temperature.

UNIT – V

Statistical basis of the thermodynamics: Micro and macro state, phase space, probability and thermodynamic probability, principle of equal a *priori* probabilities, probability distribution and its narrowing with the increasing n, average properties, Accessible and inaccessible states, distribution of particles with a given total energy into a discrete set of energy states.

Transition to quantum statistics: 'h' as a natural constant and its implications, cases of particles in a box and simple harmonic oscillator, indistinguishability of particles and its consequences. Maxwell-Botzmann, Bose-Einstein and Fermi-Dirac statistics, comparison of three statistics, Planck's law and derivation of other laws from it.

Text and Reference Books:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
5. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears & G.L.Salinger. 1988, Narosa
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
7. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications.
8. Kinetic theory, thermodynamics and Statistical Mechanics (Hindi Ed.)- Kalra, Himanshu Publications.

PAPER-IV

PHYSICS PRACTICAL

Note: Students are expected to perform sixteen experiments in all taking the eight experiments from each section. One experiment from section A and one from section B will be set in the examination paper. The distribution of marks in the practical examination will be as follows:

(iv)	Two experiments	50 Marks
	For each experiment, distribution of marks will be as follows:	
	Figure:	3 Marks
	Formula/Theory:	4 Marks
	Observation table along with least count:	10 Marks
	Calculation and Result:	6 Marks
	Precautions and source of error:	2 Marks
(v)	Viva voce	10 Marks
(vi)	Record	15 Marks
	Total	**75 Marks**

For X-student each practical will be of 25 marks and viva voce will be of 25 marks.

Section-A

18. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
19. To determine Dispersive Power of the Material of a given Prism using Mercury Light
20. To determine the Resolving Power of a Prism.
21. To determine wavelength of sodium light using Newton's Rings.
22. To determine wavelength of Sodium light using plane diffraction Grating.
23. To determine wavelength of Mercury light using plane diffraction Grating.
24. To determine the Resolving Power of a Plane Diffraction Grating.
25. Determination of the size of the Lycopodium grains using Cornu's method.
26. Determination of wavelength of sodium light using Fresnel's biprism
27. Determination of specific rotation of cane sugar solution by polarimeter.
28. Determination of radii of curvature using Newton's ring method.
29. Resolving limit of telescope.
30. Fraunhoffer diffraction at a single slit

Section -B

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. Half adder, Full adder and 4-bit Binary Adder.
3. Adder-Subtractor using Full Adder I.C.
4. Study of multiplexer and de-multiplexer
5. To study VI characteristics of PN diode, Zener and Light emitting diode
6. To study the characteristics of a transistor in CE configuration.
7. To draw the characteristic curve of single stage RC coupled amplifier and find its band width.
8. Study of characteristic curve of a varactor diode.
9. Find the voltage regulation factor of a Zener diode
10. Determine the barrier height of a pn junction diode
11. Study of various types of Flip Flops

Any other experiment can be set as per the availability in the laboratory.

Third Year T.D.C. Science 2019-2020

PAPER-I

QUANTUM MECHANICS and SOLID STATE PHYSICS

Unit – I

Background of Quantum Mechanics: Black body spectrum, limitations of classical theory, photo-electric effect, laws of photo electric emission, Einstein's photoelectric equation, de-Broglie wavelength and matter waves; Davisson-Germer experiment, Compton's effect.

Wave and Particle theory: Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory, position measurement- gamma ray microscope thought experiment photon interpretation of two slit interference, diffraction of a beam of electron, particle in a box, Bohr's orbit, estimating minimum energy of a confined particle using uncertainty principle; energy-time uncertainty principle, non-existence of electron in nucleus, photon emission from an excited atom.

Unit – II

Wave function and Quantum Mechanical operators: Position, momentum and energy operators, time dependent and time independent Schrodinger equation, physical interpretation of wave function, equation of continuity and its interpretation, normalization and orthogonality of wave function, postulates of quantum mechanics, eigen value equation, Hermitian operator and its properties, expectation value of operators, Ehrenfest theorem, commutation relation.

Applications of Schrodinger equation I: One dimensional infinitely rigid box: energy eigenvalues and eigenfunctions, degeneracy, three dimensional rigid box, finite and infinite potential well, tunneling in one dimension-across a step potential and across a rectangular potential barrier, alpha decay.

Unit - III

Applications of Schrodinger equation II: Simple harmonic oscillator (classical and quantum view), hydrogen atom, Schrodinger equation for hydrogen atom and its separation of variables.

Angular momentum and spin Central force: Angular momentum and magnetic moment of electron due to orbital motion, Bhor mageton, Orbital angular momentum operators for its cartesian components, commutation relations, mutual as well as with L_z, operators L_+ and L_-, their interpretation as step up and step down operators , eigen values of L_z, half integral values for quantum numbers.

Unit - IV

Crystal geometry: Amorphous and crystalline Materials, lattice translation vectors. lattice with a basis crystal lattice, crystal planes and Miller indices, unit cells, typical crystal structures, coordination number, packing fraction, symmetry elements, rotation, inversion and reflection, point groups and crystal classes, space groups, reciprocal lattice, types of lattices.

Crystallography: Brillouin zones, diffraction of X-rays by crystals, Bragg's Law Bloch functions, Bloch's theorem, diffraction of X-rays by a crystal lattice, Laue's formulation of X-ray diffraction, reciprocal lattice, Brillouin zones, Laue spots, rotating crystal and Debye-Scherrer methods.

Unit - V

Types of binding in solids: Covalent binding and its origin, ionic binding, energy of binding, transition between covalent and ionic binding, metallic binding, Vander Waal's binding, hydrogen bond.

Conduction in metals: Drude's theory, DC conductivity, AC conductivity, plasma frequency, thermal conductivity of metals, Fermi-Dirac distribution, thermal properties of free-electron gas, Sommerfeld's theory of conduction in metals, Kronig penny model.

Text and Reference Books:

15. Quantum Mechanics by Singh and Bagde
16. Modern Physics by Beiser
17. Quantum Mechanics by Rajput
18. Solid state physics by Kittel
19. Solid state physics by Kakani and Hemrajani
20. Optics by Kalra, Kakani and Bhandari
21. Solid State Physics, Nuclear Physics and Particle Physics by Kalra,Kakani and Mandot
22. Quantum Mechnics, Atomic and Molecular Physics by Kalra, Kakani and Saraswat

PAPER-II

ATOMIC, MOLECULAR and NUCLEAR PHYSICS

UNIT – I

Structure of nucleus: Discovery of the nucleus, composition, basic properties: charge, mass, size, spin, magnetic moment, electric quadrupole moment, binding energy, binding energy per nucleon and its observed variation with mass number of the nucleus, Coulomb energy, volume energy, surface energy, other corrections, explanation of the binding energy curve, liquid drop model of the nucleus.

Nuclear forces: Two-nucleon system, deuteron problem, binding energy, meson theory of nuclear forces e.g. Bartlett, Heisenberg, Majorana forces and potentials (no derivation).

Radioactivity: Law of radioactive decay, mean life and half life, α-decay, Geiger-Nuttal law, range of α-particles, β-decay, Gamow's explanation of β-decay, energy released spectrum and Pauli's prediction of neutrino, antineutrino, γ -ray emission, nuclear fission and fusion, nuclear reactor.

UNIT – II

Detectors for charged particles: Characteristic curve, ionization chamber, cloud chamber, proportional counter, Geiger counter, resolving time, dead time, quenching effect, scintillation counter.

Rutherford scattering formula, different types of nuclear reactions

Discovery of cosmic rays: hard and soft components, discovery of muon, pion, heavy mesons and hyperons, mass and life time determination for muon and pion. Primary cosmic rays: Extensive air showers, solar modulation of primary cosmic rays, effect of earth's magnetic field on the cosmic ray trajectories.

UNIT – III

Elementary particles: Discovery and important properties, standard model, strangeness, conservation of strangeness in particle interactions, quark hypothesis, high energy electron scattering from protons, basic interactions of quarks and leptons, interrelation between particle physics and cosmology, big bang theory (No derivations).

Mono-valent and divalent atoms: Back ground from quantum theory, four quantum numbers, spectral terms arising from L-S coupling, s, p, d, f, notation, selection rules, half life of excited states, width of a spectral line.

UNIT – IV

X-ray spectra: The continuous x-ray spectrum, Duane and Hunt limit, characteristic x-rays, Mosley's law, doublet fine structure, H-like character of x-ray states, x-ray absorption spectra, absorption edges.

Sharing of electrons: Formation of molecular orbitals, H_2^+ ions H_2^- molecule, electronic levels, singlet and triplet characters, rotational energy levels, inter-nuclear distance.

UNIT – V

Vibrational energy levels, force constants, anharmonicity dissociation energy, isotope effects on rotational and vibrational energies, Raman effect.

Spectra of diatomic molecules : Pure rotation spectra ; selection rules, vibrationrotation spectra, selection rules, vibration-rotation spectra ; selection rules, P, Q and R branches, electronic band systems, sequences and progressions, statement of Frank-Candon principle.

Text and Reference Books:

10. Atomic and Nuclear Physics by A.B. Gupta.
11. Introduction to Modern Physics by Mani and Mehta.
12. Modern Physics by Beiser.
13. Nuclear Physics by S.N. Ghosal
14. Solid State Physics, Nuclear Physics and Particle Physics by Kalra,Kakani and Mandot
15. Quantum Mechnics, Atomic and Molecular Physics by Kalra, Kakani and Saraswat

PAPER-III

RELATIVITY and ELECTROMAGNETIC FIELD THEORY

UNIT – I

Theory of Relativity: Galilean transformations, Newtonian relativity, instances of their failure; electromagnetism, aberration of light, Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformation equation, length contraction, time dilation, relativistic addition of velocities, relativity of mass, mass energy equivalence, relativistic formula for momentum and energy, Doppler effect in light. Relativistic gravitational Red Shift.

UNIT – II

Structure of space-time: Four vectors; invariance of an interval, time-like, space-like and light-like intervals, Minkowski space.

Faraday's law for electromagnetic induction: Faraday's law integral and differential forms; self-inductance of a solenoid and of a straight conductor, energy stored in an inductor and in the magnetic field, displacement current, modified form of Ampere's law, Maxwell's equation for time-dependent electromagnetic field in vacuum and in material media, boundary conditions.

UNIT – III

Electromagnetic potentials: Magnetic vector and magnetic scalar potential, Poisson's equation for **A** in terms of current density, solutions for line surface currents, Coulomb and Lorentz gauge transformations, Lorentz law in terms of potentials.

Maxwell's equations and electromagnetic waves: Plane-wave solution for Maxwell's equation, orthogonality of E, B and propagation vector, poynting vector, energy and momentum propagation, reflection and transmission at dielectric boundaries, polarization by reflection, Brewster's angle.

UNIT – IV

Electromagnetic waves in conductors: Modified field equation, attenuation of the wave, reflection and transmission through a conducting surface, total internal reflection.

Radiation from accelerated charges: Modification of Coulomb's law to include velocity and acceleration dependent terms in **E** field. Radiation from an oscillating dipole and its polarization. Radial and spherical power of electromagnetic radiation, Radiation pressure equation in free space and medium

UNIT – V

Nuclear Accelerator: Need for nuclear accelerators, cyclic accelerators, cyclotron, betatron, synchrocyclotron, variable energy cyclotron, phase stability.

Text and Reference Books:

9. Introduction to Electrodynamics by Griffiths.
10. Introduction to Electrodynamics by Reitz and Manifold.
11. Electrodynamics by Gupta and Kumar.
12. Electromagnetics by Laud
13. Electrodynmics, Electromagnetic Waves and Relativity by Kalra, Kakani and Bhandari
14. Solid State Physics, Nuclear Physics and Particle Physics by Kalra,Kakani and Mandot

PAPER-IV

PHYSICS PRACTICAL

Note: Students are expected to perform sixteen experiments in all taking the eight experiments from each section. One experiment from section A and one from section B will be set in the examination paper. The distribution of marks in the practical examination will be as follows:

(vii)	Two experiments		50 Marks
	For each experiment, distribution of marks will be as follows:		
		Figure:	3 Marks
		Formula/Theory:	4 Marks
		Observation table along with least count:	10 Marks
		Calculation and Result:	6 Marks
		Precautions and source of error:	2 Marks
(viii)	Viva voce		10 Marks
(ix)	Record		15 Marks
	Total		**75 Marks**

For X-student each practical will be of 25 marks and viva voce will be of 25 marks.

Section-A

31. To determine the value of Cauchy Constants of a material of a prism.
32. To determine the wavelength of Laser light using Diffraction of Single Slit.
33. To determine the Brewster's angle of prism.
34. To verify the Malus law.
35. To determine the wavelength of monochromatic light using Michelson's interferomenter.

36. Determination of e/m, specific charge of an electron by helical method.
37. Determination of Planck's constant by photo conductivity method.
38. Verification of Fresnels law of reflection by a plane surface.
39. To analyze elliptically polarized light by photoelectric cell/Babinets compensator.
40. Determination of viscosity of a fluid by rotation viscometer.
41. Study of ferromagnetic material by plotting hysteresis curve of the specimen by Ballistic galvanometer/ CRO.
42. Study of Photoelectric effect and to determine electronic charge and work function
43. To determine value of Boltzmann constant using V-I characteristic of PN diode.
44. To determine work function of material of filament of directly heated vacuum diode.
45. To setup the Millikan oil drop apparatus and determine the charge of an electron.
46. To study of Faraday's law

Section -B

1. To design an astable multivibrator.
2. To design a monostable multivibrator.
3. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias.
4. To design an inverting amplifier of given gain using OP-Amp and study its frequency response.
5. To design a non-inverting amplifier of given gain using OP-Amp and study its frequency response.
6. To study a precision differential amplifier of given I/O specification using OP-Amp.
7. To investigate the use of an op-amp as a differentiator
8. To design a Wien Bridge Oscillator using an op-amp.
9. To draw the characteristic curve of negative feedback amplifier.
10. Design and construction of phase shift oscillator.
11. Study the characteristics of a Field effect Transistor and to determine mutual conductance, output resistance and voltage gain.
12. Study clipping and clamping using diode.
13. Study detection efficiency of a diode by direct method.
14. Study amplitude modulation with the help of CRO
15. Study variation of output power with load impedance in Push-Pull amplifier.
16. Study frequency response of a transformer coupled amplifier.
17. To measure the Dielectric Constant of a dielectric Materials with frequency
18. To determine the Hall coefficient of a semiconductor sample.

Any other experiment can be set as per the availability in the laboratory.