Academic Calendar: 2017-2018

Department: Physics

Semester/ Year	Syllabus Module/Unit	No of Lectures	Name of Teacher
Paper-I	**Group A : Mechanics and General Properties of Matter** 1. Dimensions of Physical Quantities : Principle of dimensional homogeneity 2. Vectors : Axial and polar vectors, dot product and cross product, scalar triple product and vector triple product. Scalar and vector fields - gradient, divergence and curl, statement of divergence theorem, statement of Stokes' theorem. 3, Mechanics of a Particle : (a) Newton's laws of motion, principle of conservation of linear momentum, time and path integral of force, conservative force field, concept of potential, conservation of total energy, equation of motion of a system with variable mass. (b) Rotational motion, angular velocity, angular acceleration, angular momentum, torque, fundamental equation of rotational motion, principle of conservation of angular momentum, radial and cross-radial acceleration. 4. Dynamics of Rigid Bodies : Moment of inertia and radius of gyration their physical significance, theorems of parallel and perpendicular axes, rotational kinetic energy, calculation of moment of inertia for some simple symmetric systems. 5. Gravitation : Gravitational potential and intensity due to thin uniform spherical shell and solid sphere, escape velocity. 6. Elasticity : Elastic moduli for isotropic homogeneous bodies and their interrelations, torsion of a cylinder, internal bending moment, cantilever, simply supported light beam with concentrated load at the centre, strain energy. 7. Viscosity : Streamline and turbulent motion, Poiseuille's formula, critical velocity, Reynolds number, Bernoulli's theorem, Stokes' law (statement only). 8. Surface Tension : Surface tension and surface energy, molecular theory, angle of contact, elevation and depression of liquid columns in a capillary tube, excess pressure in a spherical bubble and spherical drop.	50	PPP

	Group B : Heat and Thermodynamics	30	
	9. Kinetic Theory of Gases : Perfect gas, pressure exerted by it, Maxwell's law of distribution of molecular velocities (statement only) - rms, mean and most probable velocities, degrees of freedom, principle of equipartition of energy - application in simple cases. Equation of state - defects of ideal gas equation, van der Waals equation (qualitative study), critical constants. 10. Thermal Conductivity : Steady state and variable state, thermal and thermometric conductivity, Fourier equation for one-dimensional heat flow and its solution, Ingen Hausz's experiment, cylindrical flow of heat. 11. Thermodynamics : Basic concepts (equilibrium state, state function, exact and inexact differential), internal energy as state function. First law of thermodynamics and its applications. Isothermal and adiabatic changes - relations, indicator diagrams. Reversible and irreversible processes, cyclic processes, second law of thermodynamics, Carnot cycle and its efficiency, entropy and its physical interpretation. 12. Radiation : Nature of radiant heat, emissive and absorptive power, Kirchhoff's law, black body radiation, Stefan's law, Newton's law of cooling, Planck's distribution law (only statement), Wien's displacement law, pyrometer.		
	Group C : Vibration - Waves and Acoustics	20	
	13. Simple Harmonic Motion : Differential equation and its solution. 14. Superposition of Simple Harmonic Motion : Analytical treatment, Lissajous figures, natural, damped and forced vibration, resonance, sharpness of resonance. 15. Differential Equation of Wave Motion : Plane progressive wave - energy and intensity. Bel, decibel and phon. Superposition of waves, stationary wave, beats. Velocity of longitudinal wave in solid and in gas, velocity of transverse wave in string, Doppler effect.		
	Group D : Electricity I	15	
	(Use of Vectors are to be encouraged. Only SI units are to be used) 16. Electrostatics: Quantization of charge, Milikan's oil drop experiments. Coulomb's law, intensity and potential - example of point charge, Gauss' theorem- simple applications, potential and field due to an elcetric dipole, mechanical force on the surface of a charged conductor.		

	17. Dielectric medium, polarization, electric displacement. Capacitor: parallel-plates and cylindrical, energy stored in parallel plate capacitor. 18. Steady Current: Network analysis - Kirchoff's laws, Thevenin and Norton's theorem, Wheatstone bridge, potentiometer. 19. Thermoelectricity : Seebeck, Peltier, and Thomson effects, laws of thermoelectricity, thermoelectric curve — neutral and inversion temperature, thermoelectric power.		
Paper-II	**(Only SI units are to be used)** **Group A: Geometrical Optics** 1. Geometrical Optics: Fermat's Principle, laws of reflection and refraction at a plane surface, refraction at a spherical surface, lens formula. Combination of thin lenses equivalent focal length. 2. Dispersion and dispersive power, chromatic aberration and its remedy, different types of Seidel aberration (qualitative) and their remedy. Eye-piece : Ramsden and Huygen's type. Astronomical telescope and compound microscope - their magnifying power. **Group B : Physical Optics** 3. Light as an electromagnetic wave, Full electromagnetic spectrum, properties of electromagnetic waves, Huygens' principle - explanation of the laws of reflection and refraction 4. Interference of light: Young's experiment, intensity distribution, conditions of interference, interference in thin films, Newton's ring. 5. Diffraction: Fresnel and Fraunhofer class, Fresnel's half-period zones- zone plate. Fraunhofer diffraction due to a single slit and plane transmission grating (elementary theory)- resolving power. 6. Polarization: Different states of polarization, Brewster's law, double refraction, retardation plate, polaroid, optical activity. **Group C : Electricity II** 7. Magnetic effect of current: Biot Savart's law, Ampere's circuital law (statement only), magnetic field due to a straight conductor, circular coil, solenoid, endless solenoid, Magnetic field due to a small current loop - concept of magnetic dipole, Ampere's equivalence theorem.	15 20 45	PPP

	8. Lorentz force, force on a current carrying conductor in a magnetic field. Torque on rectangular current loop in a uniform magnetic field. 9. Magnetic materials: intensity of magnetization, relation between B, H and M – illustration in the case of bar magnet, magnetic susceptibility - dia, para and ferromagnetic materials - statement of Curie's law. Hysteresis in a ferromagnetic material - hysteresis loss. 10. Electromagnetic induction: self and mutual inductances in simple cases, energy stored in inductor. 11. Varying currents: growth and decay of currents in L-R circuit; charging and discharging of capacitor in C-R circuit. 12. Alternating current: mean and r.m.s. Values of current and emf with sinusoidal wave form; LR, CR and series LCR circuits, reactance, impedance, phase-angle, power dissipation in AC circuit — power factor, vector diagram, resonance in a series LCR circuit, Q-factor, principle of ideal transformer. **Group D : Electronics** 13. p-n junction diode — bridge rectifier — capacitance input filter, Zener diode — voltage regulator, Transistors — α and β parameters and their interrelations; output characteristics in CE mode, single stage CE amplifier approximate expressions of current and voltage gain with the help of 'Load Line'. 14. Digital circuits : binary systems, binary numbers. Decimal to binary and reverse conversions; binary addition and subtraction. 15. Logic gates : OR, AND, NOT gates — truth tables. Statement of de Morgan's theorems, NOR and NAND as universal gates. **Group E : Modern Physics** 16. Postulates of the Special Theory of Relativity, Lorentz transformation equations (statement only)- formulae of (i) Length contraction; (ii) Time dilation; (iii) Velocity addition; (iv) Mass variation, and (v) Mass-energy equivalence. 17. Quantum theory of radiation : Planck's concept radiation formula (statement only) — qualitative discussion of photo-electric effect and Compton effect in support of quantum theory; Raman effect. 18. Bohr's theory of hydrogen spectra — concept of quantum number, Pauli exclusion principle. 19. Crystalline nature of solid, diffraction of X-ray, Bragg's law;	15 30	

	Moseley's law — explanation from Bohr's theory. 20. Wave nature of material particles, wave-particle duality, wavelength of de Broglie waves, Heisenberg uncertainty principle, Schroedinger equation, particle in a one-dimensional infinite well — energy eigenvalues, wavefunction and its probabilistic interpretation. 21. Binding energy of nucleus — binding energy curve and stability; Radioactivity successive disintegration radioactive equilibrium, radioactive dating, radioisotopes and their uses, nuclear transmutation — fission and fusion — nuclear reactor.		
Paper-III (Practical)	**Group A Marks – 30 Time – 2.5 hrs.** 1. Determination of modulus of rigidity of the material of a wire by dynamical method. 2. Determination of moment of inertia of a metallic cylinder – rectangular bar about an axis passing through its C. G. 3. Determination of the coefficient of linear expansion of a metallic rod using an optical lever. 4. Determination of the pressure coefficient of air. 5. Determination of the refractive index of the material of a lens and that on a liquid using a convex lens and a plane mirror. 6. Determination of the focal length of a concave lens by auxiliary lens method or by combination method. 7. Determination of the frequency of a tuning fork with the help of a sonometer (either by using formula or by n-e curve). 8. Determination of the horizontal component of the Earth's magnetic field using a deflection and an oscillation magnetometer. 9. Determination of the resistance of a suspended coil galvanometer by the method of half-deflection and to calculate the figure of merit of the galvanometer (using the same data). 10. To draw I – V characteristics of (i) resistor and (ii) a P-N junction diode in forward biased condition . (Plot both the characteristic curves on the same graph paper.		

Estimate from the graphs (i) the resistance of the resistor and (ii) the dynamic resistance of the diode for three different currents. One current should correspond to the intersecting point of the two curves.

Group B Marks – 40 Time – 3.5 hrs.
(At least ten experiments must be performed)

1. Determination of Young's modulus of the material of a beam bythe method of flexure. (single length only)

2. Determination of the coefficient of viscosity of water by Poiseuille's method. (the diameter of the
capillary tube to be measured by the travelling vernier microscope)

3. Determination of the surface tension of water by capillary rise method. (Capillary tubes to be supplied)

4. Determination of the refractive index of the material of a prism by drawing curve using spectrometer.

5. To determine the wavelength of a monochromatic light by Newton's ring method.

6. To calibrate a polarimeter and hence to determine the concentration of sugar solution.

7. Determination of the temperature coefficient of the material of a coil using a Carey-foster bridge. (3 sets of reading for both temperatures) (Resistance per unit length of the bridge wire has to be measured)

8. To draw the e-t curve of a thermocouple using potentiometer and dead-beat galvanometer, andhence to find out the thermo-electric power of the couple at a specified temperature. (Resistance of the potentiometer wire has to be measured using a P. O. Box).

9. To draw the I-V characteristics of the bridge rectifier (i) without using any filter and (ii) using a capacitance input filter. (The bridge rectifier should be fabricated by the student using four diodes. % voltage regulations has to be calculated from each graph at a specified load current.)

10. To draw the reverse characteristics of a Zener diode and to study its voltage regulation characteristics using a variable load. (Breakdown region should be identified in the graph. % voltage regulation has to be calculated for two load currents.)

11. To draw the output characteristics of a transistor in CE configuration (for atleast five base currents) and hence to determine the A. C. current gain from the active region of the characteristics.

12. To verify the truth tables of OR and AND logic gates using

	diodes. To construct AND, OR and NOT gates from NOR/NAND IC gates on breadboard. 13. To measure the voltage across the inductance (L) , capacitance (C) and resistance (R) of a series LCR circuit for different frequencies of the input voltage with the help of a A. C. milli-voltmeter (or suitable digital meter). Hence to study the variation of impedence of L and C with frequency of the impressed voltage. (value of R should be known) OR 14. To draw the resonance curve of a series LCR circuit and hence to determine the Q-factor of the circuit.		
Paper-IV	Mechanics and thermodynamics Production and measurement of high vacuum : Rotary and diffusion pump, Mcleod, Pirani, and Penning gauges. Heat engines, thermal efficiency, indicated Horse-power and brake Horse-power, Otto cycle and Diesel cycle, four-stroke petrol and diesel engines, calculation of efficiency and comparison. Energy sources : Conventional energy sources: thermal power plant, relevance of Rankine cycle (qualitative discussion), steam turbine, hydro-electric power plant — basic principle. Non-conventional energy sources: solar, wind, tidal, geothermal, and biogas sources, elementary idea of production and uses.(8 lectures) Electronics : Feedback — basic principle — positive and negative feedback, Barkhausen criterion, oscillator, OPAMP — characteristics, uses of OPAMP as amplifier, oscillator, and filter; light-emitting diodes, 7-segment display, SCR, diac and triac. Digital electronics : combinational circuits — adder and subtractor, multiplexer, demultiplexer, encoder, decoder, sequential circuits — flip-flop, D and J-K, registers and counters. Instruments : cathode-ray oscilloscope, digital multimeter, L and C measurements. Communications : Propagation of electromagnetic waves in atmosphere, various layers of atmosphere — ground and sky waves. Transmission of electromagnetic waves — amplitude and frequency modulation, calculation of power in amplitude modulation, sideband generation in frequency modulated wave; demodulation — linear diode detector, detection of FM waves, signal-to-noise ratio.	6 8 8 12 8 5 4 10	PPP

	Transmission through media : coaxial cables, optical fibre — cladding, energy loss, band width and channel capacity, information carrying capacity of lightwaves (qualitative); satellite communication, microwave link — modem and internet.	6	

Academic Calendar: 2018-2019

Department: Physics

Semester/ Year	Syllabus Module/Unit	No of Lectures	Name of Teacher
I **(PHSGCOR 01T - Mechanics)**	**Mathematical Methods** Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. Ordinary Differential Equations: 1 st order homogeneous differential equations. 2 nd order homogeneous and inhomogeneous differential equations with constant coefficients. **Particle Dynamics** Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum. **Gravitation** 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). **Oscillations** Oscillations: Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. Forced harmonic oscillations, resonance. **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 –Page 78	10 21 8 6	PPP PPP PPP PPP

	Torsional pendulum.- Bending of beam. **Special Theory of Relativity** Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.	8	PPP
Paper-II (2nd Year)	**(Only SI units are to be used)** **Group A: Geometrical Optics** 1. Geometrical Optics: Fermat's Principle, laws of reflection and refraction at a plane surface, refraction at a spherical surface, lens formula. Combination of thin lenses equivalent focal length. 2. Dispersion and dispersive power, chromatic aberration and its remedy, different types of Seidel aberration (qualitative) and their remedy. Eye-piece : Ramsden and Huygen's type. Astronomical telescope and compound microscope - their magnifying power. **Group B : Physical Optics** 3. Light as an electromagnetic wave, Full electromagnetic spectrum, properties of electromagnetic waves, Huygens' principle - explanation of the laws of reflection and refraction 4. Interference of light: Young's experiment, intensity distribution, conditions of interference, interference in thin films, Newton's ring. 5. Diffraction: Fresnel and Fraunhofer class, Fresnel's half-period zones- zone plate. Fraunhofer diffraction due to a single slit and plane transmission grating (elementary theory)- resolving power. 6. Polarization: Different states of polarization, Brewster's law, double refraction, retardation plate, polaroid, optical activity. **Group C : Electricity II** 7. Magnetic effect of current: Biot Savart's law, Ampere's circuital law (statement only), magnetic field due to a straight conductor, circular coil, solenoid, endless solenoid, Magnetic field due to a	15 20 45	PPP

	small current loop - concept of magnetic dipole, Ampere's equivalence theorem. 8. Lorentz force, force on a current carrying conductor in a magnetic field. Torque on rectangular current loop in a uniform magnetic field. 9. Magnetic materials: intensity of magnetization, relation between B, H and M – illustration in the case of bar magnet, magnetic susceptibility - dia, para and ferromagnetic materials - statement of Curie's law. Hysteresis in a ferromagnetic material - hysteresis loss. 10. Electromagnetic induction: self and mutual inductances in simple cases, energy stored in inductor. 11. Varying currents: growth and decay of currents in L-R circuit; charging and discharging of capacitor in C-R circuit. 12. Alternating current: mean and r.m.s. Values of current and emf with sinusoidal wave form; LR, CR and series LCR circuits, reactance, impedance, phase-angle, power dissipation in AC circuit — power factor, vector diagram, resonance in a series LCR circuit, Q-factor, principle of ideal transformer. **Group D : Electronics** 13. p-n junction diode — bridge rectifier — capacitance input filter, Zener diode — voltage regulator, Transistors — α and β parameters and their interrelations; output characteristics in CE mode, single stage CE amplifier approximate expressions of current and voltage gain with the help of 'Load Line'. 14. Digital circuits : binary systems, binary numbers. Decimal to binary and reverse conversions; binary addition and subtraction. 15. Logic gates : OR, AND, NOT gates — truth tables. Statement of de Morgan's theorems, NOR and NAND as universal gates. **Group E : Modern Physics** 16. Postulates of the Special Theory of Relativity, Lorentz transformation equations (statement only)- formulae of (i) Length contraction; (ii) Time dilation; (iii) Velocity addition; (iv) Mass variation, and (v) Mass-energy equivalence. 17. Quantum theory of radiation : Planck's concept radiation formula (statement only) — qualitative discussion of photo-electric effect and Compton effect in support of quantum theory; Raman effect. 18. Bohr's theory of hydrogen spectra — concept of quantum number, Pauli exclusion principle.	15 30	

	19. Crystalline nature of solid, diffraction of X-ray, Bragg's law; Moseley's law — explanation from Bohr's theory. 20. Wave nature of material particles, wave-particle duality, wavelength of de Broglie waves, Heisenberg uncertainty principle, Schroedinger equation, particle in a one-dimensional infinite well — energy eigenvalues, wavefunction and its probabilistic interpretation. 21. Binding energy of nucleus — binding energy curve and stability; Radioactivity successive disintegration radioactive equilibrium, radioactive dating, radioisotopes and their uses, nuclear transmutation — fission and fusion — nuclear reactor.		
Paper-III (2^{nd} Year) (Practical)	**Group A Marks – 30 Time – 2.5 hrs.** 1. Determination of modulus of rigidity of the material of a wire by dynamical method. 2. Determination of moment of inertia of a metallic cylinder – rectangular bar about an axis passing through its C. G. 3. Determination of the coefficient of linear expansion of a metallic rod using an optical lever. 4. Determination of the pressure coefficient of air. 5. Determination of the refractive index of the material of a lens and that on a liquid using a convex lens and a plane mirror. 6. Determination of the focal length of a concave lens by auxiliary lens method or by combination method. 7. Determination of the frequency of a tuning fork with the help of a sonometer (either by using formula or by n-e curve). 8. Determination of the horizontal component of the Earth's magnetic field using a deflection and an oscillation magnetometer. 9. Determination of the resistance of a suspended coil galvanometer by the method of half-deflection and to calculate the figure of merit of the galvanometer (using the same data). 10. To draw I – V characteristics of (i) resistor and (ii) a P-N junction diode in forward biased condition .		

(Plot both the characteristic curves on the same graph paper. Estimate from the graphs (i) the resistance of the resistor and (ii) the dynamic resistance of the diode for three different currents. One current should correspond to the intersecting point of the two curves.

Group B Marks – 40 Time – 3.5 hrs.
(At least ten experiments must be performed)

1. Determination of Young's modulus of the material of a beam bythe method of flexure. (single length only)

2. Determination of the coefficient of viscosity of water by Poiseuille's method. (the diameter of the
capillary tube to be measured by the travelling vernier microscope)

3. Determination of the surface tension of water by capillary rise method. (Capillary tubes to be supplied)

4. Determination of the refractive index of the material of a prism by drawing curve using spectrometer.

5. To determine the wavelength of a monochromatic light by Newton's ring method.

6. To calibrate a polarimeter and hence to determine the concentration of sugar solution.

7. Determination of the temperature coefficient of the material of a coil using a Carey-foster bridge. (3 sets of reading for both temperatures) (Resistance per unit length of the bridge wire has to be measured)

8. To draw the e-t curve of a thermocouple using potentiometer and dead-beat galvanometer, andhence to find out the thermo-electric power of the couple at a specified temperature. (Resistance of the potentiometer wire has to be measured using a P. O. Box).

9. To draw the I-V characteristics of the bridge rectifier (i) without using any filter and (ii) using a capacitance input filter. (The bridge rectifier should be fabricated by the student using four diodes. % voltage regulations has to be calculated from each graph at a specified load current.)

10. To draw the reverse characteristics of a Zener diode and to study its voltage regulation characteristics using a variable load. (Breakdown region should be identified in the graph. % voltage regulation has to be calculated for two load currents.)

11. To draw the output characteristics of a transistor in CE configuration (for atleast five base currents) and hence to determine the A. C. current gain from the active region of the characteristics.

	12. To verify the truth tables of OR and AND logic gates using diodes. To construct AND, OR and NOT gates from NOR/NAND IC gates on breadboard. 13. To measure the voltage across the inductance (L) , capacitance (C) and resistance (R) of a series LCR circuit for different frequencies of the input voltage with the help of a A. C. milli-voltmeter (or suitable digital meter). Hence to study the variation of impedence of L and C with frequency of the impressed voltage. (value of R should be known) OR 14. To draw the resonance curve of a series LCR circuit and hence to determine the Q-factor of the circuit.		
Paper-IV (3rd Year)	Mechanics and thermodynamics Production and measurement of high vacuum : Rotary and diffusion pump, Mcleod, Pirani, and Penning gauges. Heat engines, thermal efficiency, indicated Horse-power and brake Horse-power, Otto cycle and Diesel cycle, four-stroke petrol and diesel engines, calculation of efficiency and comparison. Energy sources : Conventional energy sources: thermal power plant, relevance of Rankine cycle (qualitative discussion), steam turbine, hydro-electric power plant — basic principle. Non-conventional energy sources: solar, wind, tidal, geothermal, and biogas sources, elementary idea of production and uses.(8 lectures) Electronics : Feedback — basic principle — positive and negative feedback, Barkhausen criterion, oscillator, OPAMP — characteristics, uses of OPAMP as amplifier, oscillator, and filter; light-emitting diodes, 7-segment display, SCR, diac and triac. Digital electronics : combinational circuits — adder and subtractor, multiplexer, demultiplexer, encoder, decoder, sequential circuits — flip-flop, D and J-K, registers and counters. Instruments : cathode-ray oscilloscope, digital multimeter, L and C measurements. Communications : Propagation of electromagnetic waves in atmosphere, various layers of atmosphere — ground and sky waves. Transmission of electromagnetic waves — amplitude and frequency modulation, calculation of power in amplitude modulation, sideband generation in frequency modulated wave; demodulation — linear	6 8 8 12 8 5 4 10	PPP

	diode detector, detection of FM waves, signal-to-noise ratio. Transmission through media : coaxial cables, optical fibre — cladding, energy loss, band width and channel capacity, information carrying capacity of light waves (qualitative); satellite communication, microwave link — modem and internet.	6	

Academic Calendar: 2019-2020

Department: Physics

Semester/ Year	Syllabus Module/Unit	No of Lectures	Name of Teacher
Sem-I **(PHSGCOR01T - Mechanics)**	**Mathematical Methods** Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. Ordinary Differential Equations: 1 st order homogeneous differential equations. 2 nd order homogeneous and inhomogeneous differential equations with constant coefficients. **Particle Dynamics** Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum. **Gravitation** 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). **Oscillations** Oscillations: Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. Forced harmonic oscillations, resonance. **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 –	10 21 8 6	PPP PPP PPP PPP

	Page 78 Torsional pendulum.- Bending of beam. **Special Theory of Relativity** Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.	8	PPP
Sem-II PHSGCOR02T (Electricity and Magnetism)	**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). **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. Electric potential due to an electric dipole. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate 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. **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. **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.	2 18 10 06	PPP

	Linear Network Impedance of L, C, R and their combinations. Thevenin & Norton's Theorem. Maximum power transfer theorem and superposition theorem. Anderson's bridge.	05	
	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.	09	
	General topic Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances (e) Checking electrical fuses and (f) circuit continuity check. Demonstration on Carey Foster's bridge, potentiometer, resistance box, inductor coil, moving coil galvanometer (in dead beat and ballistic mode) etc.	10 Hours	
	List of Practicals		
	1. To determine an unknown Low Resistance using Carey Foster's Bridge.	5 Hours	
	2. To verify the Thevenin and Norton theorems.	5 Hours	
	3. To verify the Superposition and Maximum power transfer theorems.	5 Hours	
	4. To determine self-inductance of a coil by Anderson's bridge.	5 Hours	
	5. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.	5 Hours	
	6. To study the response curve of a parallel LCR cir cuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q.	5 Hours	
	7. To study the characteristics of a series RC Circuit.	5 Hours	
	8. To determine an unknown Low Resistance using Potentiometer.	5 Hours	
	9. To determine the resistance of a galvanometer using Thomson's	5	

	method. 10. Measurement of field strength B and its variation in a solenoid (determine dB/dx)	Hours 5 Hours	
Paper-II (2nd Year)	**(Only SI units are to be used)** **Group A: Geometrical Optics** 1. Geometrical Optics: Fermat's Principle, laws of reflection and refraction at a plane surface, refraction at a spherical surface, lens formula. Combination of thin lenses equivalent focal length. 2. Dispersion and dispersive power, chromatic aberration and its remedy, different types of Seidel aberration (qualitative) and their remedy. Eye-piece : Ramsden and Huygen's type. Astronomical telescope and compound microscope - their magnifying power. **Group B : Physical Optics** 3. Light as an electromagnetic wave, Full electromagnetic spectrum, properties of electromagnetic waves, Huygens' principle - explanation of the laws of reflection and refraction 4. Interference of light: Young's experiment, intensity distribution, conditions of interference, interference in thin films, Newton's ring. 5. Diffraction: Fresnel and Fraunhofer class, Fresnel's half-period zones- zone plate. Fraunhofer diffraction due to a single slit and plane transmission grating (elementary theory)- resolving power. 6. Polarization: Different states of polarization, Brewster's law, double refraction, retardation plate, polaroid, optical activity. **Group C : Electricity II** 7. Magnetic effect of current: Biot Savart's law, Ampere's circuital	15 20 45	PPP

law (statement only), magnetic field due to a straight conductor, circular coil, solenoid, endless solenoid, Magnetic field due to a small current loop - concept of magnetic dipole, Ampere's equivalence theorem.

8. Lorentz force, force on a current carrying conductor in a magnetic field. Torque on rectangular current loop in a uniform magnetic field.

9. Magnetic materials: intensity of magnetization, relation between B, H and M – illustration in the case of bar magnet, magnetic susceptibility - dia, para and ferromagnetic materials - statement of Curie's law. Hysteresis in a ferromagnetic material - hysteresis loss.

10. Electromagnetic induction: self and mutual inductances in simple cases, energy stored in inductor.

11. Varying currents: growth and decay of currents in L-R circuit; charging and discharging of capacitor in C-R circuit.

12. Alternating current: mean and r.m.s. Values of current and emf with sinusoidal wave form; LR, CR and series LCR circuits, reactance, impedance, phase-angle, power dissipation in AC circuit — power factor, vector diagram, resonance in a series LCR circuit, Q-factor, principle of ideal transformer.

Group D : Electronics

15

13. p-n junction diode — bridge rectifier — capacitance input filter, Zener diode — voltage regulator, Transistors — α and β parameters and their interrelations; output characteristics in CE mode, single stage CE amplifier approximate expressions of current and voltage gain with the help of 'Load Line'.

14. Digital circuits : binary systems, binary numbers. Decimal to binary and reverse conversions; binary addition and subtraction.

15. Logic gates : OR, AND, NOT gates — truth tables. Statement of de Morgan's theorems, NOR and NAND as universal gates.

Group E : Modern Physics

30

16. Postulates of the Special Theory of Relativity, Lorentz transformation equations (statement only)- formulae of (i) Length contraction; (ii) Time dilation; (iii) Velocity addition; (iv) Mass variation, and (v) Mass-energy equivalence.

17. Quantum theory of radiation : Planck's concept radiation formula (statement only) — qualitative discussion of photo-electric effect and Compton effect in support of quantum theory; Raman effect.

	18. Bohr's theory of hydrogen spectra — concept of quantum number, Pauli exclusion principle. 19. Crystalline nature of solid, diffraction of X-ray, Bragg's law; Moseley's law — explanation from Bohr's theory. 20. Wave nature of material particles, wave-particle duality, wavelength of de Broglie waves, Heisenberg uncertainty principle, Schroedinger equation, particle in a one-dimensional infinite well — energy eigenvalues, wavefunction and its probabilistic interpretation. 21. Binding energy of nucleus — binding energy curve and stability; Radioactivity successive disintegration radioactive equilibrium, radioactive dating, radioisotopes and their uses, nuclear transmutation — fission and fusion — nuclear reactor.		
Paper-III (2nd Year) (Practical)	**Group A Marks – 30 Time – 2.5 hrs.** 1. Determination of modulus of rigidity of the material of a wire by dynamical method. 2. Determination of moment of inertia of a metallic cylinder – rectangular bar about an axis passing through its C. G. 3. Determination of the coefficient of linear expansion of a metallic rod using an optical lever. 4. Determination of the pressure coefficient of air. 5. Determination of the refractive index of the material of a lens and that on a liquid using a convex lens and a plane mirror. 6. Determination of the focal length of a concave lens by auxiliary lens method or by combination method. 7. Determination of the frequency of a tuning fork with the help of a sonometer (either by using formula or by n-e curve). 8. Determination of the horizontal component of the Earth's magnetic field using a deflection and an oscillation magnetometer. 9. Determination of the resistance of a suspended coil galvanometer by the method of half-deflection and to		

calculate the figure of merit of the galvanometer (using the same data).

10. To draw I – V characteristics of (i) resistor and (ii) a P-N junction diode in forward biased condition .

(Plot both the characteristic curves on the same graph paper. Estimate from the graphs (i) the resistance of the resistor and (ii) the dynamic resistance of the diode for three different currents. One current should correspond to the intersecting point of the two curves.

Group B Marks – 40 Time – 3.5 hrs.

(At least ten experiments must be performed)

1. Determination of Young's modulus of the material of a beam bythe method of flexure. (single length only)

2. Determination of the coefficient of viscosity of water by Poiseuille's method. (the diameter of the capillary tube to be measured by the travelling vernier microscope)

3. Determination of the surface tension of water by capillary rise method. (Capillary tubes to be supplied)

4. Determination of the refractive index of the material of a prism by drawing curve using spectrometer.

5. To determine the wavelength of a monochromatic light by Newton's ring method.

6. To calibrate a polarimeter and hence to determine the concentration of sugar solution.

7. Determination of the temperature coefficient of the material of a coil using a Carey-foster bridge. (3 sets of reading for both temperatures) (Resistance per unit length of the bridge wire has to be measured)

8. To draw the e-t curve of a thermocouple using potentiometer and dead-beat galvanometer, andhence to find out the thermo-electric power of the couple at a specified temperature. (Resistance of the potentiometer wire has to be measured using a P. O. Box).

9. To draw the I-V characteristics of the bridge rectifier (i) without using any filter and (ii) using a capacitance input filter. (The bridge rectifier should be fabricated by the student using four diodes. % voltage regulations has to be calculated from each graph at a specified load current.)

10. To draw the reverse characteristics of a Zener diode and to study its voltage regulation characteristics using a variable load.

	(Breakdown region should be identified in the graph. % voltage regulation has to be calculated for two load currents.) 11. To draw the output characteristics of a transistor in CE configuration (for atleast five base currents) and hence to determine the A. C. current gain from the active region of the characteristics. 12. To verify the truth tables of OR and AND logic gates using diodes. To construct AND, OR and NOT gates from NOR/NAND IC gates on breadboard. 13. To measure the voltage across the inductance (L) , capacitance (C) and resistance (R) of a series LCR circuit for different frequencies of the input voltage with the help of a A. C. milli-voltmeter (or suitable digital meter). Hence to study the variation of impedence of L and C with frequency of the impressed voltage. (value of R should be known) OR 14. To draw the resonance curve of a series LCR circuit and hence to determine the Q-factor of the circuit.		
Paper-IV (3rd Year)	Mechanics and thermodynamics Production and measurement of high vacuum : Rotary and diffusion pump, Mcleod, Pirani, and Penning gauges. Heat engines, thermal efficiency, indicated Horse-power and brake Horse-power, Otto cycle and Diesel cycle, four-stroke petrol and diesel engines, calculation of efficiency and comparison. Energy sources : Conventional energy sources: thermal power plant, relevance of Rankine cycle (qualitative discussion), steam turbine, hydro-electric power plant — basic principle. Non-conventional energy sources: solar, wind, tidal, geothermal, and biogas sources, elementary idea of production and uses.(8 lectures) Electronics : Feedback — basic principle — positive and negative feedback, Barkhausen criterion, oscillator, OPAMP — characteristics, uses of OPAMP as amplifier, oscillator, and filter; light-emitting diodes, 7-segment display, SCR, diac and triac. Digital electronics : combinational circuits — adder and subtractor, multiplexer, demultiplexer, encoder, decoder, sequential circuits — flip-flop, D and J-K, registers and counters. Instruments : cathode-ray oscilloscope, digital multimeter, L and C	6 8 8 12 8 5	PPP

	measurements. Communications : Propagation of electromagnetic waves in atmosphere, various layers of atmosphere — ground and sky waves. Transmission of electromagnetic waves — amplitude and frequency modulation, calculation of power in amplitude modulation, sideband generation in frequency modulated wave; demodulation — linear diode detector, detection of FM waves, signal-to-noise ratio. Transmission through media : coaxial cables, optical fibre — cladding, energy loss, band width and channel capacity, information carrying capacity of light waves (qualitative); satellite communication, microwave link — modem and internet.	4 10 6	

Academic Calendar: 2020-2021

Department: Physics

Semester/ Year	Syllabus Module/Unit	No of Lectures	Name of Teacher
Sem-I **(PHSGCOR01T - Mechanics)**	**Mathematical Methods** Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. Ordinary Differential Equations: 1 st order homogeneous differential equations. 2 nd order homogeneous and inhomogeneous differential equations with constant coefficients. **Particle Dynamics** Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum. **Gravitation** 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). **Oscillations** Oscillations: Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. Forced harmonic oscillations, resonance. **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 –	10 21 8 6	PPP PPP PPP PPP

	Page 78 Torsional pendulum.- Bending of beam. **Special Theory of Relativity** Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.	8	PPP
Sem-II PHSGCOR02T (Electricity and Magnetism)	**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). **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. Electric potential due to an electric dipole. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate 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. **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. **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.	2 18 10 06	PPP

	Linear Network Impedance of L, C, R and their combinations. Thevenin & Norton's Theorem. Maximum power transfer theorem and superposition theorem. Anderson's bridge.	05	
	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.	09	
	General topic Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances (e) Checking electrical fuses and (f) circuit continuity check. Demonstration on Carey Foster's bridge, potentiometer, resistance box, inductor coil, moving coil galvanometer (in dead beat and ballistic mode) etc.	10 Hours	
	List of Practicals		
	1. To determine an unknown Low Resistance using Carey Foster's Bridge.	5 Hours	
	2. To verify the Thevenin and Norton theorems.	5 Hours	
	3. To verify the Superposition and Maximum power transfer theorems.	5 Hours	
	4. To determine self-inductance of a coil by Anderson's bridge.	5 Hours	
	5. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.	5 Hours	
	6. To study the response curve of a parallel LCR cir cuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q.	5 Hours	
	7. To study the characteristics of a series RC Circuit.	5 Hours	
	8. To determine an unknown Low Resistance using Potentiometer.	5 Hours	
	9. To determine the resistance of a galvanometer using Thomson's	5	

	method. 10. Measurement of field strength B and its variation in a solenoid (determine dB/dx)	Hours 5 Hours	
Sem-III (PHSGCOR03T) Thermal Physics and Statistical Mechanics	**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 and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. **Thermodynamic Potentials** Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations. **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. **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	22 10 10	PPP PPP PPP

	Wien's displacement law from Planck's law. **Statistical Mechanics** Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics (qualitative discussion only) - Fermi-Dirac distribution law (statement only) - electron gas as an example of Fermi gas - Bose-Einstein distribution law (statement only) - photon gas as an example of Bose gas- comparison of three statistics.	6 12	PPP PPP
Paper-IV (3rd Year)	Mechanics and thermodynamics Production and measurement of high vacuum : Rotary and diffusion pump, Mcleod, Pirani, and Penning gauges. Heat engines, thermal efficiency, indicated Horse-power and brake Horse-power, Otto cycle and Diesel cycle, four-stroke petrol and diesel engines, calculation of efficiency and comparison. Energy sources : Conventional energy sources: thermal power plant, relevance of Rankine cycle (qualitative discussion), steam turbine, hydro-electric power plant — basic principle. Non-conventional energy sources: solar, wind, tidal, geothermal, and biogas sources, elementary idea of production and uses.(8 lectures) Electronics : Feedback — basic principle — positive and negative feedback, Barkhausen criterion, oscillator, OPAMP — characteristics, uses of OPAMP as amplifier, oscillator, and filter; light-emitting diodes, 7-segment display, SCR, diac and triac. Digital electronics : combinational circuits — adder and subtractor, multiplexer, demultiplexer, encoder, decoder, sequential circuits — flip-flop, D and J-K, registers and counters. Instruments : cathode-ray oscilloscope, digital multimeter, L and C measurements. Communications : Propagation of electromagnetic waves in atmosphere, various layers of atmosphere — ground and sky waves. Transmission of electromagnetic waves — amplitude and frequency modulation, calculation of power in amplitude	6 8 8 12 8 5 4 10	PPP

	modulation, sideband generation in frequency modulated wave; demodulation — linear diode detector, detection of FM waves, signal-to-noise ratio. Transmission through media : coaxial cables, optical fibre — cladding, energy loss, band width and channel capacity, information carrying capacity of light waves (qualitative); satellite communication, microwave link — modem and internet.	6	

Academic Calendar

Department: Physics

Semester/ Year	Syllabus Module/Unit	No of Lectures	Name of Teacher	Distribution
V **PHSGDS E02T - (Perspectives of Modern Physics)**	**Relativistic Dynamics-** Brief summary of Lorentz transformation and time dilation, length contraction, velocity addition etc. (no derivation required). Elastic collision between two particles as observed from two inertial frames with relative velocity, idea of relativistic momentum and relativistic mass. Mass-energy equivalence.	08	PPP	June-July (2020)
	Quantum Theory of Light- Review on the limitations of classical theory of electromagnetic radiation within a cavity and its solution by Planck's quantum hypothesis (no derivation required). Statement of Planck's law of black body radiation. Photoelectric effect. Einstein's postulate on light as a stream of photons. Compton's scattering and its explanation.	05	PPP	July-August (2020)
	Bohr's Model- Limitations of Ruherford's model of atomic structure. Bohr's model, its successes and limitations.	04	PPP	July-August (2020)
	Wave-Particle Duality- De Broglie's hypothesis – wave particle duality. Davisson-Germer experiment. Connection with Einstein's postulate on photons and with Bohr's quantization postulate for stationary orbits. Heisenberg's uncertainty relation as a consequence of wave-particle duality. Demonstration by γ-ray microscope thought experiment. Estimating minimum energy of a confined particle using uncertainty principle.	06	PPP	August-September (2020)

Semester/ Year	Syllabus Module/Unit	No of Lectures	Name of Teacher	Distribution
	Wave-function Description- Two slit interference experiment with photons, atoms & particles; linear superposition principle of associated wave functions as a consequence; Departure from matter wave interpretation and probabilistic interpretation of wave function; Schroedinger equation for non-relativistic particles; Momentum and Energy operators; stationary states. Properties of wave function. Probability and probability current densities in one dimension.	07	PPP	September-October (2020)
	Stationary State Problems- One Dimensional infinitely rigid box, energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example. Quantum mechanical scattering and tunnelling in one dimension - across a step potential andPage 93 across a rectangular potential barrier (qualitative discussion with statements of end results only).	05	PPP	October-November (2020)
	Atomic Physics - Quantization rules energy and orbital angular momentum from Hydrogen and Hydrogen like atoms (no derivation); s, p, d,shells-subshells. Space quantization. Orbital Magnetic Moment and Magnetic Energy of electron, Gyromagnetic Ratio and Bohr magneton. Zeeman effect. Electron Spin as relativistic quantum effect (qualitative discussion only), Spin Angular Momentum. Spin Magnetic Moment. Stern-Gerlach Experiment. Larmor Precession. Spin-orbit interaction. Addition of angular momentum (statement only). Energy correction due to relativistic effect and spin-orbit ineraction (statementonly). Fine-structure splitting. Multi-electron atoms. Pauli's Exclusion Principle (statement only). Spectral Notations for atomic States. Aufbau principle, n+l rule (qualitative discussion only). Periodic table.	15	PPP	October-November (2020)

Semester/ Year	Syllabus Module/Unit	No of Lectures	Name of Teacher	Distribution
	X-ray and Crystal Structure of Solids- Generation of X-ray. Mosley's law, explanation from Bohr's theory. Amorphous and crystalline solids. Lattice structure of crystalline (no categorisation required). Unit cell and basis vectors of a lattice. Diffraction of X-ray by crystalline solid. Bragg's law. **Nuclear Physics** Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph. Binding energy curve. Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay, beta decay, gamma emission – basic characteristics. Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Basic principle of a nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and basic principle of thermonuclear reactions	10 15	PPP PPP	November-December (2020) December-January (2021)
III (PHSGCOR03T)	NA			
I (PHSGCOR01T - Mechanics)	NA			

Academic Calendar-2021-22 (Odd-Semester)

Department: Physics

Semester/ Year	Syllabus Module/Unit	No of Lectures	Name of Teacher	Distribution
I **(PHSGCOR01T - Mechanics)**	**Mathematical Methods** Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. Ordinary Differential Equations: 1 st order homogeneous differential equations. 2 nd order homogeneous and inhomogeneous differential equations with constant coefficients.	10	PPP	July-August:-2021
	Particle Dynamics Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum.	21	PPP	September-October: 2021
	Gravitation 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	PPP	November-December: 2021
	Oscillations Oscillations: Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. Forced harmonic oscillations, resonance.	6	PPP	December-2021
	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 –Page 78 Torsional pendulum.- Bending of beam. **Special Theory of Relativity** Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.	8 7	PPP PPP	December-2021
III (PHSGCOR03T) Thermal Physics and Statistical Mechanics	**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 and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. **Thermodynamic Potentials** Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations. **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	22 10 10	PPP PPP PPP	September-October:-2021 October-2021 November-2021

	derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases. **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. **Statistical Mechanics** Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics (qualitative discussion only) - Fermi-Dirac distribution law (statement only) - electron gas as an example of Fermi gas - Bose-Einstein distribution law (statement only) - photon gas as an example of Bose gas- comparison of three statistics.	6 12	PPP PPP	November-2021 December -2021
V **PHSGDSE02T - (Perspectives of Modern Physics)**	**Relativistic Dynamics-** Brief summary of Lorentz transformation and time dilation, length contraction, velocity addition etc. (no derivation required). Elastic collision between two particles as observed from two inertial frames with relative velocity, idea of relativistic momentum and relativistic mass. Mass-energy equivalence. **Quantum Theory of Light-** Review on the limitations of classical theory of electromagnetic radiation within a cavity and its solution by Planck's quantum hypothesis (no derivation required). Statement of Planck's law of black body radiation. Photoelectric effect. Einstein's postulate on light as a stream o photons. Compton's scattering and its explanation. **Bohr's Model-** Limitations of Ruherford's model of atomic structure. Bohr's model, its successes and limitations.	08 05 04	PPP PPP PPP	June-July (2020) July-August (2020) July-August (2020)

	Wave-Particle Duality- De Broglie's hypothesis – wave particle duality. Davisson-Germer experiment. Connection with Einstein's postulate on photons and with Bohr's quantization postulate for stationary orbits. Heisenberg's uncertainty relation as a consequence of wave-particle duality. Demonstration by γ-ray microscope thought experiment. Estimating minimum energy of a confined particle using uncertainty principle.	06	PPP	August-September (2020)
	Wave-function Description- Two slit interference experiment with photons, atoms & particles; linear superposition principle of associated wave functions as a consequence; Departure from matter wave interpretation and probabilistic interpretation of wave function; Schroedinger equation for non-relativistic particles; Momentum and Energy operators; stationary states. Properties of wave function. Probability and probability current densities in one dimension.	07	PPP	September-October (2020)
	Stationary State Problems- One Dimensional infinitely rigid box, energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example. Quantum mechanical scattering and tunnelling in one dimension - across a step potential andPage 93 across a rectangular potential barrier (qualitative discussion with statements of end results only).	05	PPP	October-November (2020)
	Atomic Physics- Quantization rules energy and orbital angular momentum from Hydrogen and Hydrogen like atoms (no derivation); s, p, d,shells-subshells. Space quantization. Orbital Magnetic Moment and Magnetic Energy of electron, Gyromagnetic Ratio and Bohr magneton. Zeeman effect. Electron Spin as relativistic quantum effect (qualitative discussion only), Spin Angular Momentum. Spin Magnetic Moment. Stern-Gerlach Experiment. Larmor Precession. Spin-orbit interaction. Addition of angular momentum (statement only). Energy correction due to relativistic effect and spin-orbit ineraction (statement only). Fine-structure splitting. Multi-electron atoms. Pauli's Exclusion Principle (statement only). Spectral Notations for atomic	15	PPP	October-November (2020)

	States. Aufbau principle, n+l rule (qualitative discussion only). Periodic table. **X-ray and Crystal Structure of Solids-** Generation of X-ray. Mosley's law, explanation from Bohr's theory. Amorphous and crystalline solids. Lattice structure of crystalline (no categorisation required). Unit cell and basis vectors of a lattice. Diffraction of X-ray by crystalline solid. Bragg's law. **Nuclear Physics** Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph. Binding energy curve. Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay, beta decay, gamma emission – basic characteristics. Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Basic principle of a nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and basic principle of thermonuclear reactions	10 15	PPP PPP	November-December (2020) December-January (2021)

Academic Calendar: 2021-22
(Even Semester)

Department: Physics

Semester/ Year	Syllabus Module/Unit	No of Lectures	Name of Teacher	Distribution
II PHSGCOR02T (Electricity and Magnetism)	**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).		PPP	January (2022)
	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. Electric potential due to an electric dipole. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate 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.	18	PPP	January-February (2022)
	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	PPP	February (2022)

	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.	06	PPP	March (2022)
	Linear Network Impedance of L, C, R and their combinations. Thevenin & Norton's Theorem. Maximum power transfer theorem and superposition theorem. Anderson's bridge.	05	PPP	March (2022)
	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.	09	PPP	April (2022)
	General topic Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances (e) Checking electrical fuses and (f) circuit continuity check. Demonstration on Carey Foster's bridge, potentiometer, resistance box, inductor coil, moving coil galvanometer (in dead beat and ballistic mode) etc.	10 Hours	PPP	April-May (2022)
	List of Practicals 1. To determine an unknown Low Resistance using Carey Foster's Bridge.	5 Hours		
	2. To verify the Thevenin and Norton theorems.	5 Hours	PPP	May-June (2022)
	3. To verify the Superposition and Maximum power transfer theorems.	5 Hours		
	4. To determine self-inductance of a coil by	5		

	Anderson's bridge. 5. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width. 6. To study the response curve of a parallel LCR cir cuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q. 7. To study the characteristics of a series RC Circuit. 8. To determine an unknown Low Resistance using Potentiometer. 9. To determine the resistance of a galvanometer using Thomson's method. 10. Measurement of field strength B and its variation in a solenoid (determine dB/dx)	Hours 5 Hours 5 Hours 5 Hours 5 Hours 5 Hours	PPP PPP	
IV **PHSGCOR04T - (Waves and Optics)**	**Superposition of Two Collinear Harmonic oscillations** Linearity & Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). **Superposition of Two Perpendicular Harmonic Oscillations** Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.	04 02	PPP PPP	January-2022 January-2022

	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.	07	PPP	January-2022
	Fluids Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature. 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. Qualitative discussion on water waves.	06	PPP	January-2022
	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.	06	PPP	February 2022
	Wave Optics Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.	03	PPP	February 2022
	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	PPP	February 2022

	Michelson's Interferometer Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index, and Visibility of fringes.	03	PPP	March 2022
	Diffraction Fraunhofer diffraction- Single slit; Double Slit. Multiple slits and 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.	14	PPP	March 2022
	Polarization Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.	05	PPP	April 2022
	List of Practical 1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ 2 –T law.	5 Hours	PPP	April 2022
	2. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).	5 Hours		
	3. To determine refractive index of the Material of a prism using sodium source.	5 Hours		
	4. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.	5 Hours		
	5. To determine wavelength of sodium light using Fresnel Biprism.	5 Hours		May-2022
	6. To determine wavelength of sodium light using Newton's Rings.	5 Hours		
	7. To determine dispersive power and resolving power of a plane diffraction grating.	5 Hours		
	8. To determine the thickness of a thin paper by	5		

	measuring the width of the interference fringes produced by a wedge-shaped Film. 9. Familiarization with: Schuster`s focusing; determination of angle of prism. 10. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating. 11. To investigate the motion of coupled oscillators. 12. To determine the wavelength of sodium source using Michelson's interferometer.	Hours 5 Hours 5 Hours 5 Hours 5 Hours		June-2022
VI **PHSGDSE04T - (Nuclear and Particle Physics)**	**Preliminary Topics** Review of mass-energy equivalence, quantum tunnelling. Qualitative discussion on properties of semiconductors. **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. **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. **Radioactivity decay** (a) Alpha decay: basics of α-decay processes,	03 09 11 10	PPP PPP PPP PPP	January (2022) January (2022) January (2022) February

	theory of α- emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) beta-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.			(2022)
	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)	08	PPP	February (2022)
	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 interactionPage 98 with matter.	08	PPP	February (2022)
	Detector for Nuclear Radiations Basic principles of 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	07	PPP	March-2022
	Particle Accelerators Linear accelerator, Cyclotron, Synchrotrons.	05	PPP	March (2022)
	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	PPP	April (2022)