গড়গাঁও মহাবিদ্যালয়

GARGAON COLLEGE

TEACHING PLAN
DEPARTMENT OF PHYSICS
JULY 2020 - JUNE 2021

GARGAON COLLEGE
TEACHING PLAN
Course: B. Sc.
Session: Odd semester 2020

Subject: Physics
Name of the Teacher: DILIP BORDOLOI
Designation: Associate Professor
Methods to be applied: Lecture, Assignment and test, Seminar Presentation/Group Discussion/Micro Teaching.
Teaching Materials: Board and Marker, ICT tools like Projector, online platform like Google meet, zoom, Google Classroom etc.

Paper Code/ Title	Allotted Unit/ Topic	No. Of Class required	Detail of the topic to be taught
C2: Mechanics	**Fundamentals of Dynamics**	6	Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable-mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.
	Work and Energy	4	Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.
		3	**Collisions:** Elastic and inelastic collisions between particles. Centre of Mass and laboratory frame
	Rotational Dynamics	12	Angular momentum of particles and system of particles, Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.
	Elasticity	2	Relation between Elastic constants. Twisting torque on a Cylinder or Wire.
GE-1: Mechanics	**Elasticity**	8	Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion–Torsional pendulum-Determination of Rigidity modulus and moment of inertia- q, η and σ by Searles method.

	Special Theory of Relativity:	**7**	Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities
C6: Thermal Physics	**Zeroth and First Law of Thermodynamics**	**8**	Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.
	Second Law of Thermodynamics	**10**	Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.
	Entropy	**7**	Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.
GE-3: Thermal Physics and Statistical Mechanics	**Laws of Thermodynamics: Thermodynamic Description of system**:	**22**	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.
PHYM 50300 Atomic and Molecular Physics	Unit I: Quantum Theory of Atom	**15**	Background of Quantum Theory: Bohr's model of the hydrogen atom, origin of spectral lines, Bohr's correspondence principle, Sommerfeld's atom model, designation of spectral term symbol. Vector atom model, space quantization, Larmor precession, the four quantum numbers, spectral terms arising from L-S coupling and j-j coupling, selection rules

	Unit II: Fine Structure of Atom	**11**	Fine structure of hydrogen spectra, doublet spectra of Na-atom Gyromagnetic ratio for orbital and spin motion, Lande's 'g' factor, strong and weak field effects, Zeeman Effect (normal and anomalous), qualitative ideas of Stark effect
	Unit III: Molecular Spectra and Lasers	**14**	Molecular spectra: Pure rotation spectra, theory of pure rotation spectra, selection rules, vibration spectra and selection rules, theory of rotation-vibration spectra, P and R branches, Rayleigh and Raman scattering, Raman effect, classical theory of Raman effect Introduction to Lasers: Spontaneous and stimulated emission, population inversion, Einstein's A and B coefficients, qualitative ideas of Ammonia beam maser, ruby laser, He-Ne laser

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C-3: Electricity and Magnetism	**Electrical Circuits**	**4**	AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.
	Network theorems	**4**	Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits.
	Ballistic Galvanometer:	**3**	Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. CDR.

C4: Waves and Optics	**Fresnel Diffraction**	**7**	Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.
	Holography	**3**	Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.
GE-2: Electricity and Magnetism	**Electromagnetic Induction:**	**6**	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.
	Maxwell`s equations and Electromagnetic wave propagation	**10**	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.
C8: Mathematical physics-III	**Integrals Transforms**	**15**	Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.
	Laplace Transforms	**15**	Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits, Coupled differential equations of 1st order. Solution of heat flow along infinite bar using Laplace transform.
GE-4: Wave and Optics	**Diffraction**	**14**	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.
PHYM 60300 : Nuclear Physics	Unit I : Properties of Atomic Nuclei	**10**	Introduction, nuclear size and its determination, hypotheses of nuclear composition (proton-electron and proton-neutron hypothesis), mass of nucleus and

			nuclear atoms, quantum numbers of individual nucleus, quantum properties nuclear states, nuclear angular momentum, nuclear magnetic dipole moment, binding energy of nucleus, mass defect, packing fraction, disintegration energy, semi-empirical mass formula
	Unit II : Nuclear Model	**15**	Qualitative introduction to the nature of nuclear forces, qualitative discussion of the liquid drop model of the nucleus in relation to the semi-empirical mass formula, qualitative discussion on the Shell model of the nucleus
PHYM 60430: Laser and its Application	Unit I : Introduction to Laser	**12**	Absorption and emission of radiation, Spontaneous emission of radiation, stimulated emission, Einstein coefficients, significant of Einstein coefficients Basic Laser system requirements, Method of creation of population inversion, optical resonator, Q factor, optical cavity, Standing wave, Threshold condition for laser oscillator
	Unit II: Laser system	**8**	Laser. Description of Ammonia beam Maser, Ruby Laser, He-Ne Laser, Semi conductor

(Dilip Bordoloi)

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C-1 : Mathematical Physics-1	Calculus	**2**	Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). fields.
	First Order and Second Order Differential equations	**13**	First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral.
GE-1: Mechanics	**Momentum and Energy**	**6**	Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.
	Rotational Motion	**5**	Angular velocity and angular momentum. Torque. Conservation of angular momentum.
C5: Mathematical Physics-II	**Fourier Series**	**12**	Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity.
	Frobenius Method and Special Functions	**24**	Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations.

			Zeros of Bessel Functions (Jo(x) and J1(x)) and Orthogonality.
	Some Special Integrals		Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).
GE-3: Thermal Physics and Statistical Mechanics	**Theory of Radiation**	**6**	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.
PHYM 50100: Mathematical Physics	Unit I: Differential equation and Special function	**15**	Classification of differential equations, homogenous and non-homogeneous equations, solutions in simple cases of ordinary differential equations of second order, linear differential equations with constant and variable coefficients, Forbenius' method. Special functions: Legendre's polynomials, beta, gamma and error functions and their inter relations.
	Unit II: Complex variables	**15**	Graphical representation of complex numbers, functions of complex variables, limit `and continuity, analytic functions, Cauchy-Riemann conditions and applications, singularities, contour integration, Cauchy's theorem, Cauchy's integral formula, Taylor's and Laurent's expansion, residue theorem and its application in evaluation of integrals.

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C-3: Electricity and Magnetism	**Magnetic Field**	**9**	Magnetic force between current elements and definition of Magnetic Field**B**. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic, Field.
	Magnetic Properties of Matter	**4**	Magnetization vector (**M).** Magnetic Intensity(**H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis.
	Electromagnetic Induction:	**6**	Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.
GE-2: Electricity and Magnetism	**Electrostatics**	**22**	Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium,

			Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric..
C9: Elements of Modern physics	Planck's quantum theory, Radiation, ,	**14**	Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.
	Position measurement	**5**	Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range of an interaction.
	Schrödinger equation, Two slit interference experiments with photons,	**10**	Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.
	One dimensional rigid box.	**10**	One dimensional infinitely rigid box- energy eigen values and eigen functions, normalization; Quantum dot as example; Quantum mechanical scattering and tunneling in one dimension-across a step potential & rectangular potential barrier.
GE-4: Wave and Optics	**Michelson's Interferometer**	**15**	Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index, and Visibility of fringes.
	Unit VII Polarization:	**5**	Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.
PHYM 60200 : Condensed Matter physics	Unit I: Crystal structure	**13**	Crystal structure, idea of a lattice, unit cell, Bravais' lattice, primitive lattice vectors, translational lattice vectors, Wigner-Seitz cell, Miller indices, some simple crystal structures (sc, bcc, fcc, hcp, diamond, zinc blend, NaCl, CsCl structures). X-ray diffraction, Bragg's equation, reciprocal lattice for sc, bcc and fcc lattice, concept of Brillouin zone, lattice energy of ionic crystals, Born's theory, Madelung constant
	Unit II: Properties of solid	**12**	Electrical and thermal conductivity of metals from classical free electron theory,

			Ohm's law, Wiedemann-Franz's law Free electron Fermi gas, electron gas in one dimension and three dimensions, density of states, E-k diagram, Fermi-Dirac distribution and Fermi level of energy. Band theory of solids, formation of bands in a solid, classification of solids into metal, insulator and semiconductor, crystal potential due to periodic array of atoms, one dimensional Bloch theorem, Kronig-Penney model (qualitative idea only), important conclusions from the model, energy band diagram in reduced zone representation, effective mass
PHYM 60430: Laser and its Application	Unit III: Properties of Laser radiation	**8**	Intensity, Monochromaticity, Coherence properties of Laser radiation, spatial, and Temporal Coherence, Purity of spectral line and Temporal Coherence relation with Coherence, visibility of fringes and degree of coherence relation between visibility and coherence.

(Atul Borchetia)

HOD
Department of Physics
Gargaon College

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Name of the Teacher: MR. DIGANTA KONWAR

Designation: Associate Professor

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Paper Code/ Title	Allotted Unit/ Topic	No. Of Class required	Detail of the topic to be taught
C-2: Mechanics	**i. Fluid Motion**	3	Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube
	ii. Gravitation and Central Force Motion	9	Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).
	iii. Oscillations	7	SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor
	iv. Non-Inertial Systems:	4	Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems
C-7: Digital Electronics	**i. Introduction to CRO:**	3	Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference
	ii. Integrated Circuits (Qualitative treatment only)	3	Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital ICs.
	iii. Digital Circuits	6	Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers.

	iv. Boolean algebra	6	De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.
	v. Data processing circuits	4	Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders
	vi. Arithmetic Circuits	5	Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor.
	vii. Sequential Circuits	6	SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop.
	viii. Timers	3	IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator.
	ix. Shift registers	2	Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).
PHYM 50400 : Electronics	**Unit I: Semiconductor**	13	Charged particles, electronic structure of elements, energy band theory of crystals, conductors, semiconductors and insulators, electrons and holes in semiconductor, donor and acceptor impurity, generation and recombination of charge, diffusion, continuity equation. Junction diode characteristics: the open circuited P-N junction, I-V characteristics of P-N diode, breakdown diodes, diode as a rectifier, half-wave and full-wave rectifier with resistance load, ripple factor, smoothing filters, DC power supply
	Unit II: Transistor and Amplifier	10	Transistors: NPN and PNP transistors, transistor action, common emitter, common base and common collector connections, transistor biasing (fixed bias, base-registor, voltage divider) and thermal stabilization, amplifier equivalent circuits,hybrid parameters, small signal transistor voltage amplifier, RC coupled, LC coupled amplifier, power amplifier (Class A and Class B), distortion in amplifier, amplifier with negative feedback, effect of negative feedback on gain, output impedance and distortions
	Unit III: Oscillation and Integrated circuit	8	Oscillators: transistor as sinusoidal oscillator, Barkhausen criterion, tuned collector, Hartley, RC, Wein Bridge and crystal oscillator. AB mode Integrated Circuit: basic ideas, differential amplifier, operational amplifiers, common mode rejection ratio, inverting, non-inverting, basic mathematical operations- addition, differentiation, integration.
GE-1: Mechanics	**i. Gravitation**	8	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. Basic

			idea of global positioning system (GPS). Weightlessness. Physiological effects on astronauts.
	ii. Oscillations	6	Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.
GE-3: Thermal Physics and Statistical Mechanics	**iii. Kinetic Theory of Gases**	10	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.

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C-4: Wave and Optics	**i. Superposition of Collinear Harmonic oscillations**	5	Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.
	ii. Superposition of two perpendicular Harmonic Oscillations	2	Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their use.
	iii. Wave Motion	4	Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves.
	iv. Velocity of Waves	6	Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound.

			Laplace's Correction.
	v. Superposition of Two Harmonic Waves	7	Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.
GE-2: Electricity and Magnetism	**i. Electrostatics**	22	Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.
C-10: Analog system and Applications	**i. Semiconductor Diodes**	10	P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode.
	ii. Two-terminal Devices and their Applications	6	(1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell.
	iii. Bipolar Junction transistors	6	n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff and Saturation Regions.
	iv. Amplifiers	10	Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.
	v. Coupled amplifiers	4	Two stage RC coupled Amplifier and its frequency response.

	vi. Feedback in Amplifiers	4	Effect of positive and negative feedback on Input impedence, Output impedence, Gain , Stability, Distortion and noise.
GE4: Wave and Optics	**Superposiyion of waves**	6	Superposition of two collinear harmonic oscillations, Superposition of two perpendicular harmonic oscillations, Wave motion-General.
PHYM 60200 : Condensed Matter physics	Unit III: Semiconductor materials and Superconductivity	12	Semiconductor materials, intrinsic and extrinsic semiconductors, carrier concentration in an intrinsic semiconductor, Fermi energy, position of Fermi level in intrinsic and extrinsic semiconductors (qualitative ideas only), conductivity in semiconductor in terms of mobility. Superconductivity: electrical and magnetic properties in the superconducting state, Meisner effect, type I and type II superconductors
PHYM 60300 : Nuclear Physics	Unit III: Nuclear reaction and cosmic rays	10	Nuclear reactions, qualitative discussion on induced radioactivity, spontaneous and proton induced reaction, alpha induced reaction, sustained nuclear chain reaction, nuclear fission and fusion, particle accelerators-van de Graph generators, linear accelerators, cyclotron.
	Unit IV: Elementary particles	5	Cosmic ray and elementary particles: discovery and properties of cosmic rays, classification of elementary particles, qualitative introduction to leptons, quarks and gauge bosons
PHYM 60430: Laser and its Application	Unit IV: Laser application	6	Introduction: Basic principle of Fiber optics, structure and classification, acceptance angle and numerical aperture, Intermodel dispersion in a step index fiber, Ray path in index fiberAdvantages of fiber optics communication.

(Diganta Konwar)

H.O.D. Physics

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C-1 : Mathematical Physics-1	i. Recapitulation of vectors	**5**	Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.	**1**
	ii. Vector Differentiation	**8**	Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.	**2**
	iii. Vector Integration	**14**	Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).	**3**
GE-1: Mechanics	**i. Vectors**	**3**	Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.	
	ii. Ordinary Differential Equations	**7**	1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients.	**1**
C-6: Thermal Physics	**i. Thermodynamic Potentials**	**7**	Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations .	**1**
	ii. Maxwell's	**7**	Derivations and applications of Maxwell's	**1**

	Thermodynamic Relations		Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.	
	iii. Distribution of Velocities	**7**	Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases.	**2**
	iv. Molecular Collisions	**4**	Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.	**1**
	v. Real Gases	**10**	Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule- Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule- Thomson Cooling.	**3**
GE-3: Thermal Physics and Statistical Mechanics	**i. Statistical Mechanics:**	**12**	Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.	**3**
PHYM 50200: Electrodynmics and Spesial Relativity.	Unit I: Electromagnetic fields	**15**	Electromagnetic induction, displacement current, Maxwell's field equations and their interpretations (integral and differential forms), electromagnetic potentials, (scalar and vector potential) Derivation of Maxwell's wave equations, waves in free space, relation between wave vector and fields, Lorentz and Coulomb gauge, field energy and field momentum (Poynting vector and Poynting theorem), Radiation from accelerated charge, radiation from electric dipole	**3**
	Unit II: Propagation of electromagnetic		Plane waves in non-conducting media, polarization, plane waves in a conducting	**3**

	waves		medium, skin effect. Boundary conditions, Reflection and refraction of a plane wave at a plane interface (normal and oblique incidence) between two dielectrics, Fresnel's formula, total internal reflection, Brewster's angle.	

GARGAON COLLEGE
TEACHING PLAN
Course: B. Sc.
Session: Even semester 2021

Subject: Physics
Name of the Teacher: GUNA KANTA SONOWAL
Designation: Assistant Professor
Methods to be applied: Lecture, Assignment and test, Seminar Presentation/Group Discussion/Micro Teaching.
Teaching Materials: Board and Marker, ICT tools like Projector, online platform like Google meet, zoom, Google Classroom etc.

Paper Code/ Title	Allotted Unit/ Topic	No. Of Class required	Detail of the topic to be taught	No. Of tutorials
C-3: Electricity and Magnetism	**i. Electric Field al**	**6**	Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry.	
	ii. Electric Potential	**6**	Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole.	
	iii. Electrostatic energy	**10**	Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to (1) Plane Infinite Sheet and (2) Sphere.	**2**
	iv. Dielectric Properties of	**8**	Electric Field in matter. Polarization, Polarization Charges. Electrical	

	Matter		Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**,**P** and **D**. Gauss' Law in dielectrics.	
GE-2: Electricity and Magnetism	**i. Vector Analysis**	**12**	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).	**3**
C-8: Mathematical Physics- III	**i.** Complex Analysis.	**30**	Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.	**4**
GE-4: Wave and Optics	**i. Sound**	**10**	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.	**2**
PHYM 60100: Statistical Mechanics	Unit I: Classical statistical physics	**10**	Postulates of classical statistical mechanics, phase space, Liouville's theorem, Ensembles: micro canonical, canonical and grand canonical, Maxwell-Boltzmann (MB) distribution laws, thermodynamic interpretation of the Lagrange's undetermined multipliers appearing in the distribution laws	
	Unit II: Entropy and partition function	**8**	Postulates of classical statistical mechanics, phase space, Liouville's theorem, Ensembles: micro canonical, canonical and grand canonical, Maxwell-Boltzmann (MB) distribution laws, thermodynamic interpretation of the Lagrange's undetermined multipliers appearing in the distribution laws	

PHYM 60430: Laser and its Application	Unit V: Magneto-Optics and Electro Optics	**6**	Faraday effect- Determination of magnetic rotation, Classical theory of Faraday Effect, Kerr electro Optic effect, Harmonic generation, second harmonic generation	

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