GOUR MAHAVIDYALAYA

REACCREDITED BY NAAC (2nd Cycle) B+

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Curriculum Plan of Dept. of Physics(2022-2023)

	DC-1T:Mathematical Physics-I, Course Instructor: Tajnur Khatun	
	To be executed across Month of July, August, September, October and November with 16 classes per month	**Lecture (1hr)**
1)	**Calculus**	
	(a) 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).	July(5)
	(b) First Order and Second Order Differential equations: 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. (c) Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration .Constrained Maximization using Lagrange Multipliers.	July(10)
	(c) Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration .Constrained Maximization using Lagrange Multipliers.	July(3)
2)	**Vector Calculus**	
	(a) Recapitulation of vectors: 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.	July(5)
	(b) Vector Differentiation: 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.	July(5)
	(c) Vector Integration: 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)	July(4) August(6)
3)	**Orthogonal Curvilinear Coordinates**	
	(a) Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.	August(20)

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4)	**Dirac Delta function and its properties** (a) Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.	August(8) September(2)
5)	Tutorial and Internal	October(4)

	DC-2T:Mechanics Course Instructor: Dr. Anirban Ray, Assistant Professor	
	To be executed across Month of July, August, September, Octoberand November with 16 classes per month	**Lecture(1Hrs)**
1)	**Calculus:**	
	(a) Review of Newton's Laws: Mechanistic view of the Universe. Concepts of Inertial frames, force and mass. Solution of the equations of motion (E.O.M.) in simple force fields in one, two and three dimensions using Cartesian, cylindrical polar and spherical polar coordinate systems.	3
	(b) Dynamics of systems of particles: Difficulty of solving the E.O.M. for systems of particles. Newton's third Law. External and Internal forces. Momentum and Angular Momentum of a system. Torque acting on a system. Conservation of Linear and Angular Momentum. Centre of mass and its properties. Two-body problem.	3
	(c) Variable- mass system: motion of rocket.	
2)	**Work and energy:**	
	(a) Work - Kinetic Energy Theorem. Conservative Forces: Force as the gradient of a scalar field - concept of Potential Energy. Other equivalent definitions of a Conservative Force. Conservation of Energy.	3
	(b) Qualitative study of one dimensional motion from potential energy curves. Stable and Unstable equilibrium.	2
	(c) Energy of a system of particles.	2

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3)	**Gravitation and Central Force Motion**	
	(a) Central Force. Reduction of the two body central force problem to a one-body problem. Setting up the E.O.M. in plane polar coordinates.	5
	(b) Differential equation for the path. Motion under an Inverse-square force. Newton's Law of Gravitation. Inertial and gravitational mass. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).	5
	(c) Gravitational potential energy. Potential and field due to spherical shell and solid sphere.	5
4)	**Non-Inertial Systems**	
	(a) Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.	6
	(b) Galilean transformations and Galilean invariance.	2
	(c) Non-inertial frames and idea of fictitious forces. E.O.M with respect to a uniformly accelerating frame. E.O.M with respect to a uniformly rotating frame - Centrifugal and Corioli’s forces. Laws of Physics in a laboratory on the surface of the earth.	2
5)	**Rotational Dynamics**	
	(a) The Rigid Body: Constraints defining the rigid body. Degrees of freedom for a rigid body;	4
	(b) Relation between Angular momentum and Angular Velocity - Moment of Inertia Tensor. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies.	2
	(c) E.O.M for rotation about a fixed axis.	2
	(d) Principal Axes transformation. Transformation to a body fixed frame. E.O.M for the rigid body with one point fixed (Euler's equations of motion). General motion of a rigid body - translation plus rotation. Kinetic energy of rotation.	2
6)	**Elasticity**	
	Relation between Elastic constants. Twisting torque on a Cylinder or Wire. Bending of a beam . Internal bending moment. Elastic potential energy.	10

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7)	**Fluid Motion**	
	(a) Kinematics of Moving Fluids: Idea of compressible and incompressible fluids, Equation of continuity; streamline and turbulent flow, Reynold's number. Euler's Equation. The special case of fluid statics $\vec{F} = \nabla p$: Simple applications (e.g: Pascal's law and Archimedes principle).	8
	(b) Poiseuille's equation for Flow of a viscous Liquid through a Capillary Tube.	2
8)	Tutorial & Exam	4

	GE-1T:Mechanics, Course Instructor: Dr. Arka Chaudhuri	
	To be executed across Month of July, August, September, Octoberand November with 16 classes per month	
1)	**Mathematical Methods**	10
	(a) Vector Algebra: Vectors as directed line segments. Addition of vectors and multiplication by a scalar. Scalar and vector products. Basis and representation of vectors.	
	(b) Vector Analysis: Derivatives of a vector with respect to a parameter. Gradient, divergence and Curl.	
	(c) Vector integration, line, surface and volume integrals of vector fields. Gauss'-divergence theorem and Stoke's theorem of vectors (Statement only).	
2)	**Laws of Motion**	3
	(a) Laws of Motion: Frames of reference. Newton's Laws of motion.	
	(b) Dynamics of a system of particles. Conservation of momentum. Centre of Mass	
3)	**Work and Energy**	2
	(a) Work-energy theorem. Conservative forces.	
	(b) Concept of Potential Energy. Conservation of energy.	
4)	**Gravitation**	10
	(a) Motion of a particle in a central force field. Conservation of angular momentum leading to restriction of the motion to a plane and constancy of areal velocity	
	(b) Newton's Law of Gravitation. Kepler's Laws (statement only).	
	(c) Satellite in circular orbit and applications. Geosynchronous orbits. Basic idea of global positioning system (GPS). Weightlessness.	

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5)	**Oscillations**	10
	(a) Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy	
	(b) Total Energy and their time averages. Damped oscillations.	
	(c) Forced oscillations with harmonic forces. Compound pendulum.	
6)	**Rotational Motion**	10
	(a) Rotation of a rigid body about a fixed axis. Angular velocity and angular momentum. Moment of Inertia.	
	(b) Torque. Conservation of angular momentum.	
7)	**Elasticity**	10
	(a) 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.	
	(b) Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion. Torsional pendulum.	
	(c) Bending of beams. Work done in stretching and work done in twisting a wire.	
8)	**Surface Tension**	9
	Synclastic and anticlastic surface - Excess of pressure - Application to spherical drops and bubbles - variation of surface tension with temperature.	
9)	**Viscosity**	4
	Rate of liquid in a capillary tube - Poiseuille's formula.	
10)	Tutorial and Internal Exam	4

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	DC-3T: Electricity and Magnetism, Course Instructor: Sadhan Biswas, Tajnur Khatun	
	To be executed across Month of January, February, March, April and May with 16 classes per month	**Lecture (1 hr)**
	Electrostatic Field	
1)	(a) Coulombs law and Principle of superposition leading to the definition of Electrostatic Field and Field lines.	2
	(b) Divergence of the Electrostatic field. Flux, Gauss's theorem of electrostatics. Applications of Gauss theorem to and Electric field due to charge configurations with spherical, cylindrical and planar symmetry.	2
	(c) Curl of the Electrostatic Field and its conservative nature. Electric potential. Potential for a uniformly charged spherical shell and solid sphere. Calculation of electric field from potential	2
	(d) Laplace's and Poisson equations. Uniqueness Theorems. Method of Images and its application to: (i) Plane In finite Sheet and (ii) Sphere.	2
	(e) Conductors: Electric field and charge density inside and on the surface of a conductor. Conductors in an electrostatic field. Force per unit area on the surface. Capacitance of a conductor. Capacitance an isolated spherical conductor. Parallel plate condenser.	2
	(f) Electrostatic energy of system of charges. Electrostatic energy of a charged sphere.	2
	(g) Energy per unit volume in electrostatic field.	2
2)	**Dielectric properties of matter**	
	(a) Electric potential and field due to an electric dipole. Electric dipole moment. Force and torque on a dipole.	2
	(b) Electric Fields inside matter: Electric Polarization. Bound charges. Displacement vector. Relations between E, P and D. Gauss's theorem in dielectrics. Linear Dielectric medium. Electric Susceptibility and Permittivity. Capacitor (parallel plate, spherical, cylindrical) with dielectric.	4
3)	**The Magnetostatic Field**	
	(a) Biot-Savart's law. Force on a moving point charge due to a magnetic field: Lorentz force law. Application of Biot-Savart's law to determine the magnetic field of a straight conductor, circular coil. Force between two straight current carrying wires.	4
	(b) Divergence of the magnetic field - its solenoidal nature. Magnetic vector potential.	3

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	(c) Curl of the magnetic field. Ampere's circuital law and its application to (i) Infinite straight wire, (ii) Infinite planar surface current, (iii) Solenoid.	2
4)	**Magnetic properties of matter**	
	(a) Potential and field due to a magnetic dipole. Magnetic dipole moment. Force and torque on a magnetic dipole in a uniform magnetic field.	3
	(b) Magnetization. Bound currents. The magnetic intensity - H. Relation between B, H and M. Linear media. Magnetic Susceptibility and Permeability. Brief introduction of dia-, para- and ferro-magnetic materials. B-H curve and hysteresis.	5
5)	**Electro-magnetic induction**	
	(a) Ohms law and definition of E.M.F. Faraday's laws of electromagnetic induction, Lenz's law. Self-Inductance and Mutual Inductance. Reciprocity Theorem. Introduction to Maxwell's Equations. Charge conservation. Displacement current and resurrection of Equation of Continuity.	8
	(b) Energy stored in magnetic field.	3
6)	**Electrical circuits:**	
	AC Circuits: Kirchhoff 's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (i) Resonance, (ii) Power Dis- sipation and (iii) Quality Factor, and (iv) Band Width. Parallel LCR Circuit	
7)	**Network theorems:**	10
	Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem and their applications to dc circuits.	10
8)	Tutorial and Internal	4

	DC-4T: Waves and Optics, Course Instructor: Dr. Anirban Ray, Assistant Professor	
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		hr)
1)	**Oscillations:**	
	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.	5
2)	**Superposition of Harmonic Oscillations:**	
	(a) Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (i) equal frequencies and (ii) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (i) equal phase differences and (ii) equal frequency differences.	3
	(b) Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.	3
3)	**Wave motion**	
	(a) Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Traveling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.	3
	(b) Water Waves: Ripple and Gravity Waves	2
4)	**Velocity of Waves**	
	(a) Velocity of Transverse Vibrations of Stretched Strings.	3
	(b) Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.	2
5)	**Superposition of Harmonic Waves**	
	(a) Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. 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.	6
	(b) Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes.	3

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	(c) Superposition of N Harmonic Waves. Phase and Group Velocities.	3
6)	Wave optics	
	Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.	3
7)	**Interference**	
	Division of amplitude and wave front. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reaction: 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
8)	**Interferometers**	
	(a) Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes.	4
	(b) Fabry-Perot interferometer.	3
9)	**Diffraction and Holography**	
	(a) Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Re- solving power of grating.	5
	(b) Fresnel Diffraction: 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.	5
	(c) Holography : Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two plane waves . Point source holograms.	5
10)	Tutorial & Exam	4

	GE-2T: Electricity and magnetism, Course Instructor: Tajnur Khatun and Dr. Arka Chaudhuri	
	To be executed across Month of January, February, March, April and May with 16 classes per month	**Lecture (1 hr)**
1)	**Electrostatics**	
	a) Coulombs law. Principle of superposition. Electrostatic Field	2

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	b) Divergence of the Electrostatic field. Flux, Gauss's theorem of electrostatics. Applications of Gauss theorem to and Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor.	4
	c) Curl of the Electrostatic Field. Electric potential as line integral of electric field. Potential for a uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Electric potential and field due to an electric dipole. Electric dipole moment. Force and Torque on a dipole.	4
	d) Conductors: Electric field and charge density inside and on the surface of a conductor. Force per unit area on the surface. Capacitance of a conductor. Capacitance an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic eld.	4
	e) Electric Fields inside matter: Electric Polarisation. Bound charges. Displacement vector. Gauss's theorem in dielectrics. Linear Dielectric medium. Electric Succeptibility and Permittivity. Parallel plate capacitor completely lled with dielectric.	4
2)	**Magnetism**	
	(a) Biot-Savart's law and the Lorentz force law. Application of Biot-Savart's law to determine the magnetic field of a straight conductor, circular coil, solenoid carrying current. Force between two straight current carrying wires.	6
	(b) Divergence of the magnetic field. Magnetic vector potential.	4
	(c) Curl of the magnetic field. Ampere's circuital law. Determination of the magnetic field of a straight current carrying wire. Potential and field due to a magnetic dipole. Magnetic dipole moment. Force and torque on a magnetic dipole.	4
	(d) Magnetic fields inside matter: Magnetization. Bound currents. The magnetic intensity - H. Linear media. Magnetic susceptibility and Permeability. Brief introduction of dia-, para- and ferro-magnetic materials.	4
3)	**Electromagnetic Induction**	
	(a) Ohms law and definition of E.M.F	2
	(b) Faraday's laws of electromagnetic induction, Lenz's law,	6
	(c) self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.	6
5)	**Linear Network**	8

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	(a) Impedance of L, C, R and their combinations. Thevenin & Norton's Theorem. Maximum power transfer theorem and superposition theorem. Anderson's bridge.	
6)	**Maxwell's Equations and Electromagnetic Wave**	10
	(a) 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 of E.M. waves..	
7)	Tutorial and Internal Exam	4

	DC-5T: Mathematical Physics – II (Theory), Course Instructor: Sadhan Biswas	**Lecture (1 hr)**
	To be executed across Month of July, August, September, Octoberand November with 16 classes per month	
1)	**Fourier Series**	12
	Periodic functions, Expansion of periodic function in a series of sine and cosine functions and determination of Fourier coefficients . Dirichlet conditions , complex representation of Fourier series. Even and odd functions and their Fourier expansion.	
2)	**Frobenius Method and special functions**	16
	Singular points of second order differential equation . Legendre , Bessel , Hermite and Laguerre differential equations . Polynomials ,Generating function and orthogonality . some recurrence relations	
3)	**Special integrals**	10
	Beta and Gamma functions and their relation. Expression of integrals in terms of Gamma function	
4)	**Variational calculus in physics**	16
	Functionals, Lagrangian formulation. Euler equations of motion for simple systems : Harmonic oscillator , simple pendulum , spherical pendulum , coupled oscillator, Cyclic coordinates. Canonical equation of motion , application to simple systems .	

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5)	**Partial differential equation**	14
	Solution to partial differential equation using separation of variables : Laplace's equation in rectangular coordinates , cylindrical coordinates and spherical coordinates . wave equation and its solution for vibrational modes of a stretched string .	
6)	Tutorial and Internal Exam	4

	DC-6T: Thermal Physics, Course Instructor: Priyanka Chaudhuri	
	To be executed across Month of July, August, September, Octoberand November with 16 classes per month	**Lecture(1 hr)**
	Introduction to Thermodynamics	
1)	(a) Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature. Concept of Work & Heat, State Functions, Internal Energy and First Law of Thermodynamics. Its differential form, 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.	10
	(b) Second Law of Thermodynamics: 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.	6
	(c) Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.	3
	(d)Entropy: 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 Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.	9
2)	**Thermodynamic Potentials**	
	(a) Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of	8

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	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	
	(b) Maxwell's Thermodynamic Relations	3
	(c) Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS Equations, (4) Joule-Kelvin coe cient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.	7
3)	**Kinetic Theory of Gases**	
	(a) Distribution of Velocities: 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). Speci c heats of Gases.	8
	(b) Molecular Collisions: 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.	4
	(c) Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO2 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 Correspond- ing 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 E ect for Real and Van der Waal Gases. Temperature of Inversion. Joule- Thomson Cooling.	6
4)	**Conduction of Heat**	4
	(a) Thermal conductivity, diffusivity. Fourier's equation for heat conduction its solution for rectilinear flow of heat.	
5)	Tutorial and Internal Exam	4
	DC-7T: Digital Systems and Applications Course Instructor: Dr. Anirban Ray, Assistant Professor	
	To be executed across Month of July, August, September, Octoberand November with 16 classes per month	**Lecture (1hr)**

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1)	Integrated Circuits : 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.	2
2)	Digital Circuits : 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.	3
3)	Boolean algebra : 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.	10
4)	**Circuits:**	10
	Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor.	
	Sequential Circuits: 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.	
5)	Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor.	10
	Sequential Circuits: 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.	
6)	Timers ICs: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator.	10
7)	Shift registers : Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).	10
	(a) Kinematics of Moving Fluids: Idea of compressible and incompressible fluids, Equation of continuity; streamline and turbulent flow, Reynold's number. Euler's Equation. The special case of fluid statics $\vec{F} = \nabla p$: Simple applications (e.g: Pascal's law and Archimedes principle).	
	(b) Poiseuille's equation for Flow of a viscous Liquid through a Capillary Tube.	
8)	Counters (4 bits) : Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.	
9)	Computer Organization	10

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	Input/Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization & addressing. Memory Inter- facing. Memory Map.	
10)	Tutorial and Internal Exam	7

	GE-3T: Thermal Physics and Statistical Mechanics, Course Instructor: Priyanka Chaudhuri	
	To be executed across Month of July, August, September, Octoberand November with 16 classes per month	**Lecture (1 hr)**
	Introduction to Thermodynamics	18
1)	(a) Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamically Processes, Applications of First Law: General Relation between Cp and Cv, Work Done during Isothermal and Adiabatic Processes. Compressibility and Expansion Coefficients, Reversible and irreversible processes. Second law and Entropy, Carnot's cycle & Carnot's theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, un-attainability of absolute zero.	
2)	**Thermodynamic Potentials**	9
	(a) Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications-Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for (cp-Cv), Cp/Cv, T dS equations	
3)	**Kinetic Theory of Gases**	10
	(a) 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.	
4)	**Theory of Radiation**	8
	(a) 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.	
5)	**Statistical Mechanics**	15

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	Phase space, Macrostate and Microstate. Ensemble - Ergodic hypothesis. Entropy and Thermodynamic probability - Boltzmann hypothesis. 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)	Tutorial and Internal Exam	4

	SEC1: Basics of Programming and Scientific Word Processing, Course Instructor: Dr. Arka Chaudhuri	
	To be executed across Month of July, August, September, Octoberand November with 16 classes per month	
1)	**Elements of Programming**	**Lecture (1 hr)**
	a) An overview computers: History of computers, overview of architecture of computer, compiler, assembler, machine language, high level language, object oriented language, programming language.	2
	b) Algorithms and Flowcharts: i. Algorithm - definition, properties and development. ii. Flowchart - Concept of flowchart, symbols, guidelines, types.	4
2)	**Basic programming in C/FORTRAN**	
	(a)Constants, Variables and Data types.	2
	(b) Operation and Expressions - Arithmetic operators, relational opera- tors, logical operators.	2
	(c) Managing input/output.	2
	(d) Decision Making and Branching.	2
	(e) Decision making and Looping.	2
	(f) Arrays : One-dimension, two-dimension and multidimensional arrays, declaration of arrays, initialization of one and multi-dimensional arrays.	2
	(g) User-defined Functions.	2
3)	**Visualization**	
	(a) Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a le, saving and exporting, multiple data sets	3

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	per le, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot.	
4)	**Scientific word processing**	
	(a) Introduction to LaTeX TeX/LaTeX word processor, preparing a basic LaTeX le, Document classes, Preparing an input le for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages.	5
	(b) Equation representation: Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents Bibliography and citation, Making an index and glossary, List making environments,	2
	(c) Fonts, Picture environment and colors, errors.	2
5)	Tutorial and Internal Exam	4

	DC-8T: Mathematical Physics III, Course Instructor: Sadhan Biswas	
	To be executed across Month of January, February, March, April and May with 16 classes per month	**Lecture (1hr)**
1)	**Complex Analysis**	
	(a) Brief Revision of Complex Numbers. and their Graphical Representation. Euler's formula, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions.	6
	(b) 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.	6
	(c) Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving De nite Integrals.	6
2)	**Integrals Transforms**	
	(a) 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.	6

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	(b) 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.	6
	(c) Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.	6
3)	**Introduction to probability**	
	Independent random variables: Sample space and Probability distribution functions. Binomial, Gaussian, and Poisson distribution with examples. Mean and variance.	16
4)	**Special theory of Relativity**	8
	(a) Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity. Relativistic Dynamics. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Transformation of Energy and Momentum.	
	(b) Relativity in Four Vector Notation: Four-vectors, Lorentz Transformation and Invariant interval, Space-time diagrams. Proper time and Proper velocity. Relativistic energy and momentum - Four momentum. Conservation of four momentum and applications to collisions. Minkowski Force.	8
5)	Tutorial and Internal Exam	4

	DC9T- Elements of Modern Physics, Course Instructor: Tajnur Khatun and Priyanka Chaudhuri	
	To be executed across Month of January, February, March, April and May with 16 classes per month	**Lecture (1hr)**
1)	**Unit 1**	
	a) Blackbody Radiation, Planck's quantum, Planck's constant. Photo- electric effect and Compton scattering - light as a collection of pho- tons. Davisson-Germer experiment. De-Broglie wavelength and matter waves. Wave-particle duality. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Probability interpretation: Normalized wave functions as probability amplitudes.	8

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	b) Two-Slit experiment with photons and electrons. Linear superposition principle as a consequence.	4
	c) Position measurement- gamma ray microscope thought experiment. Heisenberg uncertainty principle (Statement with illustrations). Impossibility of a particle following a trajectory.	6
2)	**Unit 2**	
	(a) Postulates of Quantum Mechanics: States as normalized vectors (normalized wave functions). Dynamical variables as linear Hermitian operators. Predictions of quantum mechanics from solving the eigenvalue equation for the observables. Illustration using two and three level systems. Expectation values of observables.	4
	(b) Time evolution: Schrodinger equation for non-relativistic particles. Stationary states. Solution of Schrodinger's equation using expansion in stationary states. Time evolution of expectation values.	4
	(c) Application to one dimensional systems. Particle moving in one dimension: Position, Momentum and Energy operators. Probability and probability current densities in one dimension. Boundary conditions on wave functions. Ehrenfest theorem. Particle in a one dimensional infinitely rigid box: energy eigenvalues and eigen functions, normalization. Quantum dot. Quantum mechanical scattering and tunneling in one dimension across a step potential & rectangular potential barrier.	6
	(d) Simultaneous measurements: Compatible and incompatible observables and their relation to commutativity. Heisenberg's uncertainty relation for a pair of incompatible observables. Complete and incomplete measurements - degeneracy. Ilustration of the ideas using the Angular momentum operators.	4
3)	**Unit 3**	
	(a)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.	6
	(b)Nature of nuclear force, NZ graph.	5
	(c) Nuclear Models: Liquid Drop model. semi-empirical mass formula and binding energy. Nuclear Shell Model. Magic numbers.	5
4)	**Unit 4**	
	(a) Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino;	6

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	Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.	
	(b) Fission and fusion: mass de cit, relativity and generation of energy. Fission - nature of fragments and emission of neutrons. Nuclear re- actor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions)	5
	(c) Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He- Ne Laser. Basic lasing.	5
5)	Tutorial and Internal Exam	4

	DC-10T:Analog Systems and Applications Course Instructor: Dr. Anirban Ray, Assistant Professor	
	To be executed across Month of January, February, March, April and May with 16 classes per month	**Lecture (1hr)**
1)	**Semiconductor Diodes**	
	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 Re- verse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode.	5
2)	**Two-terminal Devices and their Applications.**	
	(a) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C- filter.	4
	(b) Zener Diode and Voltage Regulation. Principle and structure of	3
	i. LEDs,	
	ii. Photodiode and	
	iii. Solar Cell.	

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3)	Bipolar Junction transistors n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations be- tween α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff and Saturation Regions.	10
4)	Field Effect transistors Basic principle of operations only.	10
5)	**Amplifiers**	
	(a) Amplifiers: 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. Frequency response of a CE amplifier.	5
	(b) Coupled amplifier: Two stage RC-coupled amplifier.	4
	(c) Feedback in amplifier: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.	5
	(d) Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.	4
	(e) Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground.	6
	(f) Applications of Op-Amps: Linear - (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integra- tor, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator. Non-linear (1) inverting and non-inverting comparators, (2) Schmidt triggers.	6
	(g) Conversion: Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation)	2
6)	Tutorial and Internal Exam	8

	GE-4T :Waves and Optics Course Instructor: Priyanka Chaudhuri

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1)	**Oscillations:**	
	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.	5
2)	**Superposition of Harmonic Oscillations:**	
	(a) Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (i) equal frequencies and (ii) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (i) equal phase differences and (ii) equal frequency differences.	3
	(b) Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.	2
3)	**Wave motion**	
	(a) Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Traveling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.	4
	(b) Water Waves: Ripple and Gravity Waves	1
4)	**Velocity of Waves**	
	(a) Velocity of Transverse Vibrations of Stretched Strings.	2
	(b) Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.	3
5)	**Superposition of Harmonic Waves**	

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	(a) Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. 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.	3
	(b) Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes.	4
	(c) Superposition of N Harmonic Waves. Phase and Group Velocities.	3
6)	**Wave optics**	
	Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.	3
7)	**Interference**	
	Division of amplitude and wave front. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reaction: 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
8)	**Interferometers**	
	(a) Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes.	7
	(b) Fabry-Perot interferometer.	
9)	**Diffraction**	
	(a) Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Re- solving power of grating.	8
	(b) Fresnel Diffraction: 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.	5
10)	**Polaraization**	
	a) Transverse nature of light waves .	3
	b) Plane polarized light- production and analysis, circular and elliptical polarization.	1
	c) Optical activity	1
11)	Tutorial and Internal Exam	4

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	DC-11T: Quantum Mechanics and Applications, Course Instructor: Dr. Anirban Ray	
	To be executed across Month of July, August, September, Octoberand November with 16 classes per month	**Lecture (1 hr)**
1)	**Schrodinger Equation**	
	Description of a particle using wave packets. Spread of the Gaussian wave-packet for a free particle in one dimension. Fourier transforms and momentum space wave function. Position-Momentum un-certainty.	1
2)	**General discussion of bound states in an arbitrary potential**	
	Continuity of wave function, boundary condition and emergence of discrete energy levels. Application to one-dimensional problem - square well potential.	1
3)	**Quantum mechanics of simple harmonic oscillator**	
	Setting up the eigenvalue equation for the Hamiltonian. Energy levels and energy eigenfunctions in terms of Hermite polynomials (Solution to Hermite di erential equation may be assumed). Ground state, zero point energy & uncertainty principle.	1
5)	**Quantum theory of hydrogen-like atoms**	
	Reduction of a two body problem to a one body problem. The time independent Schrodinger equation for a particle moving under a central force - the Schrodinger equation in spherical polar coordinates. Separation of variables. Angular equation and orbital angular momentum. Spherical Harmonics (Solution to Legendre differential equation may be assumed). Radial equation for attractive coulomb interaction - Hydrogen atom. Solution for the radial wavefunctions (Solution to Laguerre differential equation may be assumed). Shapes of the probability densities for ground & first excited states. Orbital angular momentum quantum numbers l and m; s, p, d,shells.	3
6)	**Generalized Angular Momenta and Spin**	
	(a) Generalized angular momentum. Electron's magnetic Moment and Spin Angular Momentum. Gyromagnetic Ratio and Bohr Magneton and the g - factor. Energy associated with a	**2**

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	magnetic dipole placed in magnetic field. Larmor's Theorem. Stern-Gerlach Experiment.	
	(b) Addition of angular momenta - statement only. Restriction of eigen- values from |j1 − j2| to |j1 + j2|.	1
7)	**Spectra of Hydrogen atom and its ne structure**	
	(a) Formula for first order nondegenerate perturbative correction to the eigenvalue - statement only	2
	(b) Spin-orbit interaction and relativistic correction to the kinetic energy and Darwin term.	1
	(c) Fine structure of the hydrogen atom spectrum	1
8)	**Atoms in Electric & Magnetic Fields**	
	(a) Zeeman Effect: Normal and Anomalous Zeeman Effect (Formula for first order perturbative correction to the eigenvalue to be assumed).	2
	(b) Paschen Back e ect & Stark e ects (Qualitative Discussion only).	1
9)	**Many electron atoms**	
	(a) Identical particles. Symmetric & Antisymmetric Wave Functions. Pauli's Exclusion Principle. Hund's Rule. Periodic table.	2
	(b) Fine structure splitting. L-S and J-J coupling scheme. Spectral No- tations for Atomic States and Term symbols. Spectra of Alkali Atoms (Na etc.).	2
10)	Tutorial and Internal Exam	4

	DC-12T: Solid State Physics, Course Instructor: Dr. Arka Chaudhuri	
	To be executed across Month of July, August, September, Octoberand November with 16 classes per month	**Lecture (1 hr)**
1)	**Crystal Structure**	
	a) Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis Central and Non-Central Elements. Unit Cell	2
	b) Miller Indices, Types of Lattices	3
	c)Reciprocal Lattice	5
	d)Brillouin Zones	2
	e)Diffraction of X-rays by Crystals. Bragg's Law	3

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	f) Atomic and Geometrical Factor	2
2)	**Elementary Lattice Dynamics**	
	(a) Lattice Vibrations and Phonons	2
	(b)Linear Monoatomic and Diatomic Chains.	2
	(c) Acoustical and Optical Phonons	3
	(d)Qualitative Description of the Phonon Spectrum in Solids.	2
	(e) Dulong and Petit's Law	2
	(f) Einstein	2
	(g) Debye theories of specific heat of solids. T3 law	3
3)	**Magnetic Properties of Matter**	
	(a) Dia-, Para-, Ferri- and Ferromagnetic Materials.	2
	(b) Classical Langevin Theory of Diamagnetic material	3
	(c) Classical Langevin Theory of Paramagnetic Domains	2
	(d) Quantum Mechanical Treatment of Paramagnetism. Curie's law,	3
	(e)Weiss's Theory of Ferro- magnetism and Ferromagnetic Domains	
	(f) Discussion of B-H Curve. Hysteresis and Energy Loss.	2
5)	**Dielectric Properties of Materials**	
	(a) Polarization, Electric Susceptibility. Polarizability	3
	(b) Local Electric Field at an Atom. Depolarization Field, Clausius Mosotti Equation	2
	(c) Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equa- tion. Complex Dielectric Constant	4
	(d) Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons, TO modes.	2
6)	**Ferroelectric Properties of Materials**	
	(a) Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop.	
7)	**Elementary band theory**	
	(a) Kronig Penny model	3
	(b) Band Gap. Conductor, Semiconductor (P and N type) and insulator	5

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	(c) Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (4 probe method) & Hall coefficient	4
	Tutorial and Internal Exam	4

	DC-14T: Statistical Mechanics, Course Instructor: Dr. Arka Chaudhur	
	To be executed across Month of January, February, March, April and May with 16 classes per month	**Lecture (1 hr)**
1)	**Classical Statistical Mechanics**	
	a) Macrostate & Microstate, Elementary Concept of Ensemble and Ergodic Hypothesis. Phase Space.	4
	b) Microcanonical ensemble, Postulate of Equal a-priori probabilities. Boltzmann hypothesis: Entropy and Thermodynamic Probability	5
	c) Canonical ensemble, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox	4
	d) Law of Equipartition of Energy(with proof) - Applications to Specific Heat and its Limitations. Thermodynamic Functions of a Two-Energy Level System. Negative Temperature.	4
	e) Grand canonical ensemble and chemical potential	2
2)	**Classical Theory of Radiation**	
	(a) Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff 's law	2
	(b) Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law. Rayleigh-Jean's Law. Ultraviolet Catastrophe	2
3)	**Quantum Theory of Radiation**	
	(a) Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates	3
	(b) Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh- Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law	4
5)	**Bose-Einstein Statistics**	
	(a) B-E distribution law. Thermodynamic functions of a strongly De- generate Bose Gas	4
	(b) Bose Einstein condensation, properties of liquid He (qualitative description)	2

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	(c) Radiation as a photon gas and Thermo- dynamic functions of photon gas. Bose derivation of Planck's lawt	4
7)	**Fermi-Dirac Statistics**	
	(a) Fermi-Dirac Distribution Law	3
	(b) Thermodynamic functions of a Com- pletely and strongly Degenerate Fermi Gas	4
	(c) Fermi Energy, Electron gas in a Metal, Specific Heat of Metals.	4
	Tutorial and Internal Exam	4

	DSE2AT: Applied Dynamics, Course Instructor: Sadhan Biswas	
	To be executed across Month of July, August, September, Octoberand November with 16 classes per month	**Lecture (1hr)**
1)	**Small amplitude oscillation**	
	(a) Minima of potential energy and points of stable equilibrium, expansion of potential energy around a minimum, small oscillation about minimum, normal modes and normal frequency of oscillations	6
2)	**Dynamical systems**	
	(a) Definition of a continuous first order dynamical system. Simple mechanical system as a dynamical system : the free particle , particle under uniform gravity , simple and damped harmonic oscillation.	4
	(b) Population models e.g. exponential growth and decay , logistic growth , predator - prey dynamics , rate equation for chemical reaction.	4
	(c) Fixed points , attractors, stability of fixed points , logistic map.	4
3)	**Introduction to chaos and fractals**	
	Chaotic system and its example , Fractals in nature. Chaos in nonlinear finite difference equations - logistic map	4

SEC1A : Electrical Circuits and Network skills, Course Instructor: Sadhan Biswas

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To be executed across Month of July, August, September, Octoberand November with 16 classes per month	**Lecture (1hr)**
Basic electricity principle :	
Voltage , current , resistance and power, Ohm law . series and parallel combination . AC and DC electricity .Familiarization with voltmeter and ammeter.	2
Understanding electrical circuits :	
Main electrical circuit elements and their combination . rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Rules to analyze AC sourced electrical circuits.	2
Electrical Drawing and symbols :	
Drawing symbols ,Blueprint ,reading Schematic . ladder diagram, power circuit , control circuit , reading of circuit schematics.	2
Generators and Transformers :	
DC power souces , AC/DC generators, Inductance ,capacitance, impedance , Operation of transformer	2
Electric Motors :	
Single phase ,Three phase and DC motors. Basic design , interfacing DC or AC sources to control heaters and motors. Speed and power AC motor.	2
Solid state Devices :	
Resistors , inductors , and capacitors . Diode and rectifiers , Components in series or in shunt. Response of inductors and capacitors with DC or AC sources.	2
Electrical protection :	
Relays , Fuses and disconnect , switch , circuit breakers, overload devices ,ground - fault protection,Grounding ans isolating , phases reversal, surge protection	2
Electrical wiring :	
Different types of conductors and cables ,basis of wiring - star and delta connection . Voltage drop and losses across cables and conductor. Instruments to measure current , voltage and power in DC and AC circuits. Insulation , solid and stranded cable ,	2

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