M.D.K.G. COLLEGE

DEPARTMENT OF PHYSICS

(Class routine 2024; Odd Semester)

MONDAY

TIME / SEM	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	4:00-5:00
I			Minor-1 Lab-1 *(NJS)*	C-1 303 *(AS)*				Practical
III		C-3 303*(NJS)*	SEC-314 303(PG)	C-4 Lab-1 *(As)*	C-4 Lab-1(PG)	Minor-3 303 (SJC)		Remedial Class
V	DSE-1 Lab-1 *(AS)*	C-11 Lab-1 *(SJC)*		DSE-2 Lab-2 (PG)	C-12 303(NJS)	Practical		Remedial Class

NJS-3, AS-3, PG-3, SJC- 2

TUESDAY

TIME / SEM	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	4:00-5:00
I		C-1 Lab-2 (PG)		Minor-1 Lab-2 (AS)		SEC-113 Lab-1(AS)	Add on	Remedial Class
III	C-3 Lab-1(SJC)	SEC-314 Lab-1(NJS)	C-4 Lab-1 (NJS)	C-4 Lab-1(SJC)				Remedial Class
V		C-11 303*(AS)*	C-12 303(SJC)		DSE-1 303(NJS)	DSE-2 303(PG)	Add on	Remedial Class

NJS-3, AS-3, PG-2, SJC- 3

WEDNESDAY

TIME / SEM	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	4:00-5:00
I			C-1 303(AS)					Remedial Class
III	Minor-3 Lab-1(NJS)			C-3 303(NJS)	SEC-314 303(PG)	C-4 Lab-1 (SJC)		Remedial Class
V		*DSE-2* *Lab-1(PG)*	*DSE-1* *Lab-1 (NJS)*		C-12 Lab-1 (SJC)	C-11 Lab-1(AS)	Practical	Remedial Class

NJS-3, AS-2, PG-2, SJC- 2

THURSDAY

TIME / SEM	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	4:00-5:00
I		C-1 Lab 1(AS)	Minor-1 Lab 1(PG)				Add on	Practical
III	C-3 Lab-1 (SJC)		C-4 Lab1(NJS)	SEC-314 Lab 1(SJC)	Minor-3 Lab 1 (AS)			Remedial Class
V	*C-12 303 (NJS)*	*C-11 303(SJC)*		DSE-1 303(AS)	*DSE-2 303(PG)*		Add on	Remedial Class

NJS-2, AS-3, PG-2, SJC- 3

FRIDAY

TIME / SEM	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	4:00-5:00
I	SEC-113 lab 1(PG)						Add on	Remedial Class
III		C-3 Lab 1 *(NJS)*	C-4 Lab 1*(SJC)*					Remedial Class
V		*C-11 303(SJC)*	*DSE-1 303 (AS)*		*C-12 303(NJS)*	*DSE-2 303(PG)*	Add on	Remedial Class

NJS-2, AS-1, PG-2, SJC- 2

SATURDAY

TIME / SEM	9:00-10:00	10:00-11:00	11:00-12:00	12:00-1:00	1:00-2:00	2:00-3:00	3:00-4:00	4:00-5:00
I		Minor-1 Lab-1(SJC)			SEC -113 Lab-1(SJC)		Mentor-Mentee	Remedial Class
III	C-3 Lab-1(AS)	C-4 Lab-2(PG)			*Minor-3 Lab-2(AS)*		Mentor-Mentee	Remedial Class
V		*DSE-1 303(NJS)*	*DSE-2 303(PG)*	*C-12 303(NJS)*	C-11 303(AS)	Practical	Mentor-Mentee	Remedial Class

NJS-2, AS-3, PG-3, SJC- 2

Number of Classes/Week/Teacher

Teachers	Full Name	Number of classes/Week
NJS	Nayan Jyoti Sarmah	15
AS	Anirban Singha	15
PG	Purnima Gogoi	14
SJC	Sourabh Jyoti Changmai	14

Class-wise and subject-wise number of students

Class	Subject	No. of students
3rd Semester	Major (C-3, C-4)	3
3rd Semester	Minor (Min-3)	5
5th Semester	Honours (C-11, C-12, DSE-1, DSE-2)	4

Distribution of courses for the academic programme in CBCS of 1st,3rd& 5th semester

1st Semester

Course title: Mechanics and Properties of Matter

Course code: PHYC1

Nature of the course: Core

Total credits: 4

Distribution of marks: 80 (End sem) + 20 (In-sem)

Unit	Contents	L	Total Hours	Faculty
I (28 Marks)	**Unit-1: Newtonian Mechanics** **1.1:** Frames of Reference, Inertial Frames, Galilean Transformations, Galilean Invariance; Dynamics of a System of Particles, Centre of Mass, Principle of Conservation of Linear Momentum. **1.2:** The Work-Energy Theorem, Conservative and Non-conservative Forces, Conservation of Mechanical Energy, Work done by non-conservative forces, Force as gradient of potential energy, Energy Diagram, Stable and Unstable Equilibrium **1.3:** 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.	20	20	PG SJC
II (10 Marks)	**Unit-2: Properties of Matter** 2.1: Relation between Elastic constants, Twisting torque on a Cylinder or Wire. **2.2:** Kinematics of Moving Fluids, Poiseuille's Equation for Flow of a Liquid through a Capillary Tube	8	8	AS
III (12 Marks)	**Unit-3: Oscillations** Simple Harmonic Motion (SHM) and Oscillations, Differential Equation of SHM and its solution, Kinetic Energy, Potential Energy, Total energy and their time-	8	8	SJC

	average values, Damped oscillation, Forced oscillations, Resonance, Power Dissipation and Quality Factor.			
IV (10 Marks)	**Unit-4: Non-Inertial systems** 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.	**8**	**8**	**AS**
V (20 Marks)	**Unit-5: Special theory of Relativity** 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, Frequency and Wave-number, Relativistic addition of Velocities, Variation of Mass with Velocity, Massless Particles, Mass-energy Equivalence. Relativistic Kinematics, Transformation of Energy and Momentum, Relativistic Doppler effect	**16**	**16**	**NJS**
	Total	**60**	**60**	

1st Semester

Course title: Mechanics

Course code: MINPHY1

Nature of the course: Minor

Total credits: 4

Distribution of marks: 80 (End sem) + 20 (In-sem)

Unit	Contents	L	Total Hours	Faculty
I (31 Marks)	**Unit-1: Newtonian Mechanics** **1.1:** Frames of Reference, Inertial Frames, Galilean Transformations, Galilean Invariance; Dynamics of a System of Particles, Centre of Mass, Principle of Conservation of Linear Momentum. **1.2:** The Work-Energy Theorem, Conservative and Non-conservative Forces, Conservation of Mechanical Energy, Work done by non-conservative forces, Force as gradient of potential energy, Energy Diagram, Stable and Unstable Equilibrium **1.3:** 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.	**24**	**24**	**PG** **AS**
II (9 Marks)	**Unit-2: Properties of Matter** 2.1: Relation between Elastic constants, Twisting torque on a Cylinder or Wire. **2.2:** Kinematics of Moving Fluids, Poiseuille's Equation for Flow of a Liquid through a Capillary Tube	**11**	**11**	**AS**
III (15 Marks)	**Unit-3: Oscillations**	**10**	**10**	**SJC**

	Simple Harmonic Motion (SHM) and Oscillations, Differential Equation of SHM and its solution, Kinetic Energy, Potential Energy, Total energy and their time-average values, Damped oscillation, Forced oscillations, Resonance, Power Dissipation and Quality Factor.			
IV (25 Marks)	**Unit-5: Special theory of Relativity** 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, Frequency and Wave-number, Relativistic addition of Velocities, Variation of Mass with Velocity, Massless Particles, Mass-energy Equivalence.	**15**	**15**	**NJS**
	Total	**60**	**60**	

1st Semester

Course title: Electrical Circuits and Network Skills

Course code: SEC113

Nature of the course: Skill Enhancement Course

Total credits: 3

Distribution of credits: Theory – 1

Practical -2 Distribution of marks: 80 (End sem) + 20 (In-sem)

Unit	Contents	L	Total Hours	Faculty
I (5 Marks)	**Unit-1: Basic Electricity Principles** Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC, Electricity. Familiarization with multimeter, voltmeter and ammeter.	**2**	**2**	**PG**
II (5 Marks)	**Unit-2: Understanding Electrical Circuits** Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.	**2**	**2**	**PG**

III (5 Marks)	**Unit-3: Electrical drawing and symbols** Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identifying current flow and voltage drop.	**2**	**2**	**SJC**
IV (3 Marks)	**Unit-4: Generators and Transformers** DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Operation of transformers	**1**	**1**	**SJC**
V (5 Marks)	**Unit-5: Electric Motors** Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heater and motors, speed and power of ac motor	**2**	**2**	**NJS**
VI (4 Marks)	**Unit-6: Solid State devices** Resistors, inductors and capacitors , Diode and rectifiers, Components in series or in shunt, Response of Inductors and capacitors with AC or DC sources.	**1**	**1**	**AS**
VII (5 Marks)	**Unit-7: Electrical Protections** Relays, fuses and disconnect switches, Circuit breakers, Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device)	**2**	**2**	**NJS**
VIII (8 Marks)	**Unit-8: Electrical Wiring** Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wire nuts, crimps, terminal blocks, split bolts, and solder. Preparation of the extension board.	**3**	**3**	**AS**

	2-credits practical **(Demonstration and Laboratory)**	**P=30**	**H=60**	
Lab **(40 Marks)**	1. Identify different electrical components: Resistor, Capacitor, variable resistor, Rheostat, dc voltage sources: battery, battery eliminator, power supply. 2. Use ammeter and voltmeter in a circuit and measure current and voltage 3. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and Checking electrical continuity and fuses. 4. Connect resistances in series and parallel and measure the equivalent resistance using multimeter 5. Build a dc circuit using elements like battery, resistances and switch and measure current flow and voltage drop across the components. 6. Demonstration of dc motor and ac motor (like motor of a fan) and identify the differences between them. 7. Identify the electronic components like rectifying diodes, Zener diodes, transistor, carbon resistance, capacitors, and test them with multimeter. 8. Read electrical diagrams and draw an electrical diagram of room with proper symbols. 9. To study & find the specifications of various types of wires and cables. 10. Demonstrate different types of Splices (knot) and joints and practice. 11. Demonstration of different types of connectors used in electrical circuits: split bolts connector, Terminal blocks etc. 12. Identify the different types of Protection Devices: that prevents from electrical damages: Fuse, Circuit Breaker, MCB, Lighting Arrester 13. Demonstrate a distribution box with connections. 14. Preparation of extension board with switches, sockets and indicator.			
	Total	**45**	**75**	

3rd Semester

Course title: Mathematical Physics – I

Nature of the course: Core

Course code: PHYC3

Total credits: 4

Distribution of Marks: 80 (End sem) + 20 (In-sem)

Unit	Contents	L	Total Hours	Faculty
I (26 Marks)	**Unit-1: Calculus** **1.1:** Functions and their plotting, Continuity and Differentiability of functions, Approximation methods: Taylor series, Maclaurin series. **1.2:** First Order Differential Equations, Integrating Factor, Second Order Differential Equations, Homogeneous and Inhomogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral. **1.3:** Calculus of functions of more than one variable: Partial Derivatives, Exact and Inexact Differentials, Integrating Factor, Constrained Maximization using Lagrange Multipliers	**18**	**18**	**NJS PG**
II (30 Marks)	**Unit-2: Vector Calculus** **2.1:** Recapitulation of Vector algebra, Dot Product, Cross Product, Scalar Triple Product, Cartesian Components of a vector, Scalar and Vector Fields. **2.2:** 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. **2.3** Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Notion of Infinitesimal Line, Surface and Volume Elements, Line, Surface and Volume Integrals of Vector	**24**	**24**	**AS PG SJC**

	Fields, Flux of a Vector Field, Gauss' Divergence Theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).			
III (12 Marks)	**Unit-3: Orthogonal Curvilinear Coordinates** Orthogonal Curvilinear Coordinates, Spherical Polar Coordinates, Cylindrical Coordinates; Derivation of Gradient, Divergence and Curl in Cartesian, Spherical and Cylindrical Coordinate Systems	**8**	**8**	**AS**
IV (4 Marks)	**Unit-4: Dirac Delta Function** Definition of Dirac Delta Function, Representation as limit of a Gaussian function and rectangular function, Properties of Dirac Delta Function.	**4**	**4**	**SJC**
V (8 Marks)	**Unit-5: Matrices** Definition, Addition and Multiplication of matrices, Transpose of a matrix, Hermitian conjugate of a matrix, Trace and Determinant, Inverse of a matrix, Special types of square matrices- Diagonal, Symmetric and Skew-symmetric, Hermitian and Skew-hermitian.	**6**	**6**	**PG**
	Total	**60**	**60**	

3rd Semester

Course title: General Lab I

Nature of the course: Core

Course code: PHYC4

Total credits: 4

Distribution of Marks: 80 (End sem) + 20 (In-sem)

Unit	Contents	L	Total Hours	Faculty
I (40 Marks)	**Unit-1: Mechanics (List of Experiments)** (1) To determine the height of a building using a Sextant. (2) To study the Motion of Spring and calculate (a) Spring constant, (b) ***g*** and (c) Modulus of rigidity. (3) To determine the Moment of Inertia of a Flywheel. (4) To determine ***g*** and velocity for a freely falling body using Digital Timing Technique. (5) To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method). (6) To determine the Young's Modulus of a Wire by Optical Lever Method. (7) To determine the Modulus of Rigidity of a Wire by Maxwell's needle. (8) To determine the elastic Constants of a wire by Searle's method. (9) To determine the value of ***g*** using Bar Pendulum. (10) To determine the value of ***g*** using Kater's Pendulum	**30**	**60**	**NJS SJC**
II (40 Marks)	**Unit-2: Waves and Optics (List of Experiments)** (1) To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2–T Law (2) To determine the phase difference between two waves using Lissajous Figures. (3) To determine the refractive index of the Material of a prism using sodium source. (4) To determine the dispersive power and Cauchy	**30**	**60**	**AS PG**

	constants of the material of a prism using mercury source. (5) To determine the wavelength of sodium source using Michelson's interferometer. (6) To determine wavelength of sodium light using Fresnel Biprism. (7) To determine wavelength of sodium light using Newton's Rings. (8) To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film. (9) To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating. (10) To determine dispersive power and resolving power of a plane diffraction grating.			
	Total	**60**	**120**	

3rd Semester

Course title: General Lab 1

Course code: MINPHY3

Nature of the course: Minor

Total credits: 4

Distribution of Marks: 80 (End sem) + 20 (In-sem)

Unit	Contents	L	Total Hours	Faculty
I (40 Marks)	**Unit-1: Mechanics (List of Experiments)** (1) To determine the height of a building using a Sextant. (2) To study the Motion of Spring and calculate (a) Spring constant, (b) ***g*** and (c) Modulus of rigidity. (3) To determine the Moment of Inertia of a Flywheel. (4) To determine ***g*** and velocity for a freely falling body using Digital Timing Technique. (5) To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method). (6) To determine the Young's Modulus of a Wire by Optical Lever Method. (7) To determine the Modulus of Rigidity of a Wire by Maxwell's needle. (8) To determine the elastic Constants of a wire by Searle's method. (9) To determine the value of ***g*** using Bar Pendulum. (10) To determine the value of ***g*** using Kater's Pendulum.	**30**	**60**	**NJS SJC**
II (40 Marks)	**Unit-2: Waves and Optics (List of Experiments)** (1) To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2–T Law (2) To determine the phase difference between two waves using Lissajous Figures. (3) To determine the refractive index of the Material of a prism using sodium source. (4) To determine the dispersive power and Cauchy constants of the material of a prism using mercury	**30**	**60**	**AS PG**

	source. (5) To determine the wavelength of sodium source using Michelson's interferometer. (6) To determine wavelength of sodium light using Fresnel Biprism. (7) To determine wavelength of sodium light using Newton's Rings. (8) To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film. (9) To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating. (10) To determine dispersive power and resolving power of a plane diffraction grating.			
	Total	**60**	**120**	

3rd Semester

Course title: Renewable Energy and Energy Harvesting

Course code: SEC314

Nature of the course: Skill Enhancement Course

Total credits: 3

Distribution of credits: Theory – 2

, Practical - 1 Distribution of marks: 80 (End sem) + 20 (In-sem)

Unit	Contents	L	Total Hours	Faculty
I (6 Marks)	**Unit-1: Fossil fuels and Alternative Sources of energy** Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity	5	5	NJS
II (6 Marks)	**Unit-2: Solar energy** Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems	5	5	NJS
III (4 Marks)	**Unit-3: Wind energy and Harvesting** Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.	4	4	SJC

IV (8 Marks)	**Unit-4: Ocean Energy** Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Biomass.	**4**	**4**	**PG**
V (3 Marks)	**Unit-5: Geothermal Energy** Geothermal Resources, Geothermal Technologies.	**2**	**2**	**PG**
VI (3 Marks)	**Unit-6: Hydro Energy** Hydropower resources, hydropower technologies, environmental impact of hydro power sources.	**2**	**2**	**AS**
VII (4 Marks)	**Unit-7: Piezoelectric Energy harvesting** Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power	**3**	**3**	**AS**
VIII (6 Marks)	**Unit-8: Electromagnetic Energy harvesting** Linear generators, physics mathematical models, recent applications Carbon captured technologies, cell, batteries, power consumption. Environmental issues and Renewable sources of energy, sustainability.	**6**	**6**	**SJC**
	1-credit practical: **Demonstrations and Experiments/ Project**	**P=30**	**H=60**	

Lab (40 Marks)	1. Demonstration of Training modules on Solar energy, wind energy, etc. 2. Conversion of vibration to voltage using piezoelectric materials 3. Conversion of thermal energy into voltage using thermoelectric modules. **Project Preparation**			**NJS AS PG SJC**
	Total	31	31	

5th Semester (CBCS)

Course Code: PHYSICS-C-XI

Course Title: QUANTUM MECHANICS AND APPLICATIONS

Nature of the Course: Core

Total credits assigned: 06

Distribution of credits: Theory – 04, Practicals-02

Unit	Contents	L	Total Hours	Faculty
I (6 Marks)	**Unit-1: Time dependent Schrodinger equation**: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle.	**6**	**6**	**SJC**
II (10 Marks)	**Unit-2: Time independent Schrodinger equation** Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle	**10**	**10**	**SJC**

III (12 Marks)	**Unit-3: 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; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigen functions using Frobenius method; Hermite polynomials; ground state, zero point energy & uncertainty principle.	**12**	**12**	**SJC**
IV (10 Marks)	**Unit-4: Quantum theory of hydrogen-like atoms**: time independent Schrodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operator &quantum numbers; Radial wave functions from Frobenius method; shapes of the probability densities for ground & first excited states; Orbital angular momentum quantum numbers l and m; s, p, d... shells.	**10**	**10**	**AS**
V (8 Marks)	**Unit-5: Atoms in Electric & Magnetic Fields**: Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.	**8**	**8**	**AS**
VI (4 Marks)	**Unit-6: Atoms in External Magnetic Fields**: - Normal and Anomalous Zeeman Effect. Paschen Back and Stark Effect (Qualitative Discussion only).	**4**	**4**	**AS**

VII (10 Marks)	**Unit-7: Many electron atoms**: Pauli's Exclusion Principle. Symmetric & Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Vector Model. Spin-orbit coupling in atoms-L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali atoms (Na etc.)	**10**	**10**	**AS**
	Total	**60**	**60**	

5th Semester (CBCS)

Course Code: PHYSICS-C-XII

Course Title: SOLID STATE PHYSICS

Nature of the Course: Core

Total credits assigned: 06

Distribution of credits: Theory – 04, Practicals-02 (CBCS)

Unit	Contents	L	Total Hours	Faculty
I (12 Marks)	**Unit-1: Crystal Structure** Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.	12	12	SJC
II (10 Marks)	**Unit-2: Elementary Lattice Dynamics** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law	10	10	SJC
III (8 Marks)	**Unit-3:Magnetic Properties of Matter:** Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia– and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.	8	8	NJS

IV **(8 Marks)**	**Unit-4: Dielectric Properties of Materials:** Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons, TO modes.	**8**	**8**	**NJS**
V **(6 Marks)**	**Unit-5: Ferroelectric Properties of Materials:** Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains,PE hysteresis loop.	**6**	**6**	**NJS**
VI **(10 Marks)**	**Unit-6: Elementary band theory** Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (04 probe method) & Hall coefficient	**10**	**10**	**SJC**
VII **(6 Marks)**	**Unit-7: Superconductivity** Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation)	**6**	**6**	**NJS**

	Total	**60**	**60**	

5th Semester (CBCS)

Course code: PHYSICS DSE -I

Course title: CLASSICAL DYNAMICS

Nature of the course: DSE

Total credit assigned: 06

Distribution of credits: Theory – 05, Tutorial-01

Unit	Contents	L	Total Hours	Tutorial	Faculty
I (24 Marks)	**Unit-1: Classical Mechanics of point particles** Review of Newtonian Mechanics; Application to the motion of a charge particle in external electric and magnetic fields- motion in uniform electric field, magnetic field- gyroradius and gyrofrequency, motion in crossed electric and magnetic fields. Generalized coordinates and velocities, Hamilton's principle, Lagrangian and the Euler-Lagrange equations, one-dimensional examples of the Euler-Lagrange equations- one-dimensional Simple Harmonic Oscillations and falling body in uniform gravity; applications to simple systems such as coupled oscillators Canonical momenta & Hamiltonian. Hamilton's equations of motion. Applications: Hamiltonian for a harmonic oscillator, solution of Hamilton's equation for Simple Harmonic Oscillations; particle in a central force field- conservation of angular momentum and energy.	**22**	**22**	**01**	**AS**
II (10 Marks)	**Unit-2: Small Amplitude Oscillations** Minima of potential energy and points of stable equilibrium, expansion of the potential energy around a minimum, small amplitude oscillations about the minimum, normal modes of oscillations example of N identical masses connected in a linear fashion to (N -1) - identical springs.	**10**	**10**	**-**	**AS**

III (36 Marks)	**Unit-3:Special theory of Relativity** Postulates of Special Theory of Relativity. Lorentz Transformations. Minkowski space. The invariant interval, light cone and world lines. Space-time diagrams. Time -dilation, length contraction and twin paradox. Four-vectors: space-like, time-like and light-like. Four-velocity and acceleration. Metric and alternating tensors. Four-momentum and energy-momentum relation. Doppler effect from a four-vector perspective. Concept of four-force. Conservation of four-momentum. Relativistic kinematics. Application to two-body decay of an unstable particle.	**33**	**33**	**-**	**NJS**
IV (10 Marks)	**Unit-4: Fluid Dynamics** Density □ and pressure P in a fluid, an element of fluid and its velocity, continuity equation and mass conservation, stream-lined motion, laminar flow, Poiseuille's equation for flow of a liquid through a pipe, Navier-Stokes equation, qualitative description of turbulence, Reynolds number	**10**	**10**	**-**	**NJS**
	Total	**75**	**75**	**01**	

5th Semester (CBCS)

Course code: PHYSICS DSE -2

Course title: ASTRONOMY AND ASTROPHYSICS

Nature of the course: DSE

Total credit assigned: 06

Distribution of credits: Theory – 05, Tutorials-01

Unit	Contents	L	Total Hours	Tutorial	Faculty
I (5 Marks)	**Unit-1: Astronomical Scales:** Astronomical Distance, Mass and Time, Scales, Brightness, Radiant Flux and Luminosity, Measurement of Astronomical Quantities Astronomical Distances, Stellar Radii, Masses of Stars, Stellar Temperature	**4**	**4**	**01**	**PG**
II (20 Marks)	**Unit-2: Basic concepts of positional astronomy:** Celestial Sphere, Geometry of a Sphere, Spherical Triangle Astronomical Coordinate Systems, Geographical Coordinate Systems, Horizon System, Equatorial System, Diurnal Motion of the Stars, Conversion of Coordinates. Measurement of Time, Sidereal Time, Apparent Solar Time, Mean Solar Time, Equation of Time, Calendar. Basic Parameters of Stars: Determination of Distance by Parallax Method; Brightness, Radiant Flux and Luminosity, Apparent and Absolute magnitude scale, Distance Modulus; Determination of Temperature and Radius of a star; Determination of Masses from Binary orbits; Stellar Spectral Classification, Hertzsprung-Russell Diagram.	**20**	**20**	**-**	**PG**

III (6 Marks)	**Unit-3: Astronomical techniques**: Basic Optical Definitions for Astronomy (Magnification Light Gathering Power, Resolving Power and Diffraction Limit, Atmospheric Windows), Optical Telescopes (Types of Reflecting Telescopes, Telescope Mountings, Space Telescopes, Detectors and Their Use with Telescopes (Types of Detectors, detection Limits with Telescopes).	**6**	**6**	**-**	**PG**
IV (3 Marks)	**Unit-4: Physical Principles** Gravitation in Astrophysics (Virial Theorem, Newton versus Einstein), Systems in Thermodynamic Equilibrium.	**3**	**3**	**-**	**PG**
V (7 Marks)	**Unit-5: The Sun** (Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere. Corona, Solar Activity, Basics of Solar Magneto-hydrodynamics. Helioseismology). **The solar family** (Solar System: Facts and Figures, Origin of the Solar System: The Nebular Model, Tidal Forces and Planetary Rings, Extra-Solar Planets.	**6**	**6**	**-**	**PG**
VI (5 Marks)	**Unit-6: Stellar spectra and classification Structure** **(**Atomic Spectra Revisited, Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram, Luminosity Classification)	**5**	**5**	**-**	**PG**
VII (16 Marks)	**Unit-7: The milky way** : Basic Structure and Properties of the Milky Way, Nature of Rotation of the Milky Way (Differential Rotation of the Galaxy and Oort Constant, Rotation Curve of the Galaxy and the Dark Matter, Nature of	**14**	**14**	**-**	**PG**

	the Spiral Arms), Stars and Star Clusters of the Milky Way, Properties of and around the Galactic Nucleus.				
VIII (8 Marks)	**Unit-8: Galaxies:** Galaxy Morphology, Hubble's Classification of Galaxies, Elliptical Galaxies (The Intrinsic Shapes of Elliptical, de Vaucouleurs Law, Stars and Gas). Spiral and Lenticular Galaxies (Bulges, Disks, Galactic Halo) The Milky Way Galaxy, Gas and Dust in the Galaxy, Spiral Arms.	**7**	**7**	**-**	**PG**
IX (10 Marks)	**Unit-9: Large scale structure & expanding universe:** Cosmic Distance Ladder (An Example from Terrestrial Physics, Distance Measurement using Cepheid Variables), Hubble's Law (Distance-Velocity Relation), Clusters of Galaxies (Virial theorem and Dark Matter).	**10**	**10**	**-**	**PG**
	Total	**75**	**75**	**01**	