SYLLABUS DISTRIBUTION

CLASS ALLOTMENT: **EVEN SEMESTER**

SEMESTER	PAPERS	FACULTIES
SEM II	Core T3 - Electricity and Magnetism	TS+SC
	Core P3 – Electricity and Magnetism Lab	TM+ TS
	Core T4 - Waves and Optics	TM+RM
	Core P4 – Wave and Optics Lab	SC+RM
	GEN SEM 2T - Electricity and Magnetism	RM+ TS
	GEN SEM 2P - Electricity and Magnetism LAB	TM+ TS
SEM IV	Core T8 - Mathematical Physics III	TM+ TS
	Core P8 – Mathematical Physics III Lab	DB+SS
	Core T9 - Elements of Modern Physics	RM+TM
	Core P9 – Elements of Modern Physics Lab	TS +TM
	Core T10 - Analog Systems and Applications	SC+DB
	Core P10 – Analog Systems and Applications Lab	SC+DB
	GEN SEM 4T - Waves and Optics	DB+SS
	GEN SEM 4P - Waves and Optics LAB	RM+SC
	SEC	SS+DB
SEM VI	Core T13 - Electromagnetic Theory	SS+SC
	Core P13 – Electromagnetic Theory Lab	SS+RM
	Core T14- Statistical Mech	DB+RM
	Core T14- Statistical Mech LAB	DB+SS
	DSE T6 – Communication Electronics	DB+SS
	DSE P6 – Communication Electronics LAB	DB+SS
	DSE T5 - Astronomy and Astrophysics	SC+SS
	GEN SEM 6T - Nuclear and Particle Physics	TM+ TS

FACULTY		**FACULTY**	
DR. TAPAS MUKHERJEE:	**TM**	DR. TUKTUK SUR :	**TS**
DR. SAHANA CHAKRABORTY:	**SC**	DR. RENA MAJUMDAR:	**RM**
DR. DEBABRATA BHADRA:	**DB**	SHIRSENDU SARKAR:	**SS**

SEM II (HONS)

Core T3 - Electricity and Magnetism **CLASS TEACHER: TS+SC**

60 class hours	**4 Credits**
Electric Field and Electric Potential (SC)	**15 Lectures**
Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Charge density of a point charge – Definition of Dirac delta function. Properties of Dirac delta function. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. Potential and Electric Field of a dipole. Force and Torque on a dipole. Uniqueness theorem. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere. 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. Energy stored in Electrostatic field.	
Dielectric Properties of Matter (SC)	**8 Lectures**
Electric Field in matter. Polarization, Polarization Charges. Electrical 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. Boudary conditions at the interface of two media.	
Magnetic Field (TS)	**10 Lectures**
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) infinite straight wire, (2) Infinite planar	

surface current, and (3) Solenoid. Properties of B: curl and divergence. . Axial vector property of B and its consequences. Vector Potential. Calculation of vector potential and magnetic induction in simple cases – straight wire, magnetic field due to small current-loop. 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 (TS)	**5 Lectures**
Magnetization vector (M). Magnetic Intensity (H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis. Boundary conditions at the interface of two media.	
Electromagnetic Induction (TS)	**6 Lectures**
Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance, calculation in simple cases (e.g. circular loops, solenoids). Reciprocity Theorem. Energy stored in a Magnetic Field.	
Electrical Circuits (TS)	**10 Lectures**
Charge Conservation – equation of continuity. Transients in D.C.:Growth and decay of current, charging and discharging of capacitors in CR, LR & LCR circuits; oscillatory discharge; time constant; time variation of total energy in LCR circuit. AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Phasor diagram. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit	
Network theorems (SC)	**6 Lectures**
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	

Core P3 – Electricity and Magnetism Lab   CLASS TEACHER: TM & TS

60 class hours	**2 Credits**
List of Practicals	
1. To determine an unknown Low Resistance using Carey Foster's Bridge. 2. To verify the Thevenin and Norton theorems. 3. To verify the Superposition and Maximum power transfer theorems. 4. To determine self-inductance of a coil by Anderson's bridge. 5. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width. 6. To study the response curve of a parallel LCR circuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q. 7. To study the characteristics of a series RC Circuit. 8. To determine an unknown Low Resistance using Potentiometer. 9. To determine the resistance of a galvanometer using Thomson's method. 10. Measurement of field strength B and its variation in a solenoid (determine dB/dx)	

CORE 4T : Waves and Optics **CLASS TEACHER: RM & TM**

60 Lectures	**4 Credits**
Superposition of Collinear Harmonic oscillations (RM)	**4 Lectures**
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.	
Superposition of two perpendicular Harmonic Oscillations (RM)	**3 Lectures**
Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.	
Wave Motion (RM)	**4 Lectures**
Plane and Spherical Waves. Longitudinal and Transverse Waves. Progressive (Travelling) Wave and its differential equation. phase and group velocities for harmonic waves. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves	
Velocity of Waves (RM)	**5 Lectures**
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.	
Superposition of Two Harmonic Waves (RM)	**7 Lectures**
Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Changes of wavefunction with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.	

Wave Optics (RM)	**4 Lectures**
Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. Characteristics of Laser light.	
Interference (TM)	**9 Lectures**
Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.	
Interferometer (TM)	**4 Lectures**
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. Fabry-Perot interferometer.	
Diffraction and Holography (TM)	**20 Lectures**
Kirchhoff's Integral Theorem and Fresnel-Kirchhoff's Integral formula (Qualitative discussion only). Fraunhofer diffraction: Single slit, rectangular aperture. Resolving Power of an optical instrument – Rayleigh's criteria. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. 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. Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.	

CORE 4P: Wave and Optics Lab **CLASS TEACHER: SC +RM**

Wave and Optics	
60 class hours	**2 Credits**
List of Practical	

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.
2. To determine refractive index of the Material of a prism using sodium source.
3. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
4. To determine wavelength of sodium light using Fresnel Biprism.
5. To determine wavelength of sodium light using Newton's Rings.
6. To determine dispersive power and resolving power of a plane diffraction grating.
7. To study Lissajous Figures to derermine the phase difference between two harmonic oscillatiions.
8. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
9. Familiarization with: Schuster`s focusing; determination of angle of prism.
10. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
11. To investigate the motion of coupled oscillators.
12. To determine the wavelength of sodium source using Michelson's interferometer.

SEM II (GENERAL)

PHSGCOR02T - Electricity and Magnetism   CLASS TEACHER: TS & RM

60 Lectures	**4 Credits**
Vector Analysis (TS)	
Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).	
Electrostatics (TS)	
Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field. Electric potential due to an electric dipole. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.	
Magnetism (RM)	
Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.	

Electromagnetic Induction (RM)
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.
Linear Network (TS)
Impedance of L, C, R and their combinations. Thevenin & Norton’s Theorem. Maximum power transfer theorem and superposition theorem. Anderson’s bridge.
Maxwell`s Equations and Electromagnetic Wave Propagation (RM)
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.

GENP2 – Electricity and Magnetism Lab **CLASS TEACHER: TM & TS**

60 class hours	**2 Credits**
List of Practicals	

1. To determine an unknown Low Resistance using Carey Foster's Bridge.
2. To verify the Thevenin and Norton theorems.
3. To verify the Superposition and Maximum power transfer theorems.
4. To determine self-inductance of a coil by Anderson's bridge.
5. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
6. To study the response curve of a parallel LCR circuit and determine its (a) Anti- resonant frequency and (b) Quality factor Q.
7. To study the characteristics of a series RC Circuit.
8. To determine an unknown Low Resistance using Potentiometer.
9. To determine the resistance of a galvanometer using Thomson's method.
10. Measurement of field strength B and its variation in a solenoid (determine dB/dx)

SEM IV (HONS.)

Core T8 - Mathematical Physics III CLASS TEACHER: TM & TS

60 Lectures	4 Credits
Complex Analysis (TM)	**20 Lectures**
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.	
Integrals Transforms (TS)	**15 Lectures**
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.	
Boundary Value Problems (TM)	**10 Lectures**
Solutions of Laplaces equation in problems with cyldically and spherically symmetric boundary conditions. Examples from Electrostatics. Solutions of heat diffusion equation with boundary conditions of rectangular symmetry.	
Matrices (TS)	**7 Lectures**
Hermitian conjugate of a Matrix. Hermitian and Skew- Hermitian Matrices with properties. Singular and Non-Singular matrices. Orthogonal and Unitary Matrices. Trace of a Matrix. Inner Product of matrices.	
Eigen-values and Eigenvectors (TS)	**8 Lectures**
Eigenvalues and eigenvectors – calculation, charateristic equation. Cayley- Hamiliton Theorem. Similarity transformation with properties. Diagonalization of Matrices. Solutions of Coupled Linear Ordinary Differential Equations. Functions of a Matrix.	

Core P8 – Mathematical Physics III Lab **CLASS TEACHER: DB & SS**

60 class hours	**2 Credits**
List of Practical	

1. ODE initial value problems by RK2 & RK4
2. Solution of Linear system of equations by Gauss elimination method, determinant by Gauss Jordan method.
3. Inverse of a matrix by Gauss-Seidal iterative method.
4. Gram-Schmidt orthogonalisation method with 3 vectors.
5. Explicit calculation of largest eigenvalue calculation by power iterative method for real symmetric matrix and corresponding eigenvector
6. Eigen vectors, eigen values problems (by numpy.linalg)
7. Boudary value problems (by finite difference method with fixed grid size):
   a. Laplace eqn in 1D with Dirichlet boundary condition
   b. 1D Fourier heat equation with Dirichlet boundary condition
   c. Poisson equations
   d. Wave equation
8. Find square roots, cube roots of a complex number using two dimensional Newton-Raphson method.
9. Integral transform: FT of $\exp(-kx^2)$
10. Dirac Delta Function: Evaluate $\frac{1}{\sqrt{2\pi\sigma^2}}\int e^{\frac{-(x-2)^2}{2\sigma^2}}(x+3)dx$, for σ=1, .1, .01 and show it tends to 5

Octave:

- Introduction of Octave with its basic features.
- Few examples of solving (a) differential equations and (b) matrix eigenvalue problems -- are to be performed using Octave

Core T9 - Elements of Modern Physics **CLASS TEACHER: TM & RM**

60 Lectures	**4 Credits**
Relativistic Dynamics (TM)	**12 Lectures**
Invariance of space-time interval under Lorentz transformation. Idea of 4-vector – contravariant and contravariant components, metric. 4-scalar. Space-like, time-like and light-like separation, causality in relativity. Proper time. 4-velocity and 4-momentum. Conservation law of 4- momentum. Relativistic mass. Relativistic energy. Rest energy. Equivalence of mass & energy. Applications in two body decay of a particle, two body collisions.	
Collection of Identical Entities – Classical Approach (RM)	**6 Lectures**
Large collection of identical entities in an enclosure at thermal equilibrium. Idea of averaging over the collection, relation with bulk variables. Boltzmann weight factor. Law of equipartition of energy for single entity. Example: Cavity radiation and black body, classical theory of blackbody radiation, Rayleigh-Jeans law. Ultraviolet catastrophe.	
Emergence of Quantum Theory (TM)	**20 Lectures**
Planck's quantum postulate to avoid ultraviolet catastrophe, Planck's constant and Planck's ditribution law for blackbody Radiation. Photo-electric effect and Compton scattering. Light as a collection of photons; Wilson-Sommerfield quantization rule unifying Planck's quantization rule and Bohr's angular momentum quantization rule. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Position measurement- gamma ray microscope thought experiment; Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables) as a consequence of wave description. Estimating minimum energy of a confined particle using uncertainty principle. Energy-time uncertainty principle- application to virtual particles and range of an interaction.	

Two-Slit interference experiment with electrons and photons. Wave-particle duality, Bohr's complementarity principle. Matter waves and wave function, linear superposition principle as a consequence; Born's probabilistic interpretation of wave function bridging between wave description and particle description.	
Lasers (RM)	**4 Lectures**
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.	
Nuclear Physics (RM)	**18 Lectures**
Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers. 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; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus. Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions).	

Core P9 – Elements of Modern Physics Lab **CLASS TEACHER: TM & TS**

60 class hours	**2 Credits**
List of Practical	

1. To determine the wavelength of H-alpha emission line of Hydrogen atom.
2. To determine the absorption lines in the rotational spectrum of Iodine vapour.
3. To determine the value of e/m by Bar magnet.
4. To determine the wavelength of laser source using diffraction of double slits.
5. To determine wavelength using He-Ne/ solid state laser using plane diffraction grating
6. To determine angular spread of He-Ne/ solid state laser using plane diffraction grating
7. To determine work function of material of filament of directly heated vacuum diode.
8. To show the tunneling effect in tunnel diode using I-V characteristics.
9. Measurement of Planck's constant using black body radiation and photo-detector
10. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
11. To determine the Planck's constant using LEDs of at least 4 different colours.
12. To determine the ionization potential of mercury.
13. To setup the Millikan oil drop apparatus and determine the charge of an electron.
14. To determine the wavelength of laser source using diffraction of single slit.

Core T10- Analog Systems and Applications CLASS TEACHER: SC & DB

60 Lectures	**4 Credits**
History of the development of electronics (SC)	**3 Lectures**
Valve circuits and advantages of using semiconductor devices in modern electronic systems.	
Semiconductor Diodes (SC)	**7 Lectures**
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. Derivation for Barrier Potential, Barrier Width and Current for Step Junction.	
Two-terminal Devices and their Applications (SC)	**7 Lectures**
Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter & π- filter(qualitative, expression only), Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell.	
Bipolar Junction transistors (SC)	**8 Lectures**
n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Physical Mechanism of Current Flow (unbiased).Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Active, Cutoff and Saturation Regions.	
Field Effect transistors (SC)	**3 Lectures**
Basic principle of operation of JFET, JFET parameters and CS characteristics	
Amplifiers (DB)	**8 Lectures**
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.	
Coupled Amplifier (DB)	**3 Lectures**
Two stage RC-coupled amplifier and its frequency response.	
Feedback in Amplifiers (DB)	**4 Lectures**
Concept of feedback, Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.	
Sinusoidal Oscillators (DB)	**4 Lectures**
Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.	
Operational Amplifiers (Black Box approach) (DB)	**4 Lectures**
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.	
Applications of Op-Amps (DB)	**7 Lectures**
Linear - (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator. Non-linear – (1) inverting and non-inverting comparators, (2) Schmidt triggers.	
Conversion (DB)	**2 Lectures**
Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation)	

Core P10– Analog Systems and Applications Lab **CLASS TEACHER: SC & DB**

60 class hours	**2 Credits**
List of Practical	

1. To study V-I characteristics of PN junction diode and Light emitting diode (LED) (using both current and voltage source).
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of Solar Cells and find maximum power point and efficiency.
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
5. To study the frequency response of voltage gain of a RC – coupled transistor amplifier.
6. To design inverting, non- inverting and buffer amplifiers using Op-amp (741/351) for dc voltage.
7. To design a Wien bridge oscillator for given frequency using a Op-Amp.
8. To add dc voltages using Op-amp in inverting and non-inverting mode.
9. a) To investigate the use of an op-amp as an Integrator.

   b) To investigate the use of an op-amp as a Differentiator.
10. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
11. To study the various biasing configurations of BJT for normal class A operation.
12. To design a Phase Shift Oscillator of given specification using Op-Amp.

13. To study the Colpitt's Oscillator.

14. To design a digital to analog converter (DAC) of given specifications.

15. To study the analog to digital converter (ADC) IC.

16. To design a precision Differential amplifier of given I/O specification using Op-Amp.

17. To design a circuit to simulate the solution of a $1^{st}/2^{nd}$ order differential equation.

18. To design inverting amplifier using Op-amp (741/351) and study its frequency response

19. To design non-inverting amplifier using Op-amp (741/351) & study its frequency response

20. To study the zero – crossing detector and comparator.

21. Using Schmitt trigger and associated circuit (with OPAMP) generate different wave forms.

SEC T2 - Computational Physics CLASS TEACHER : DB & SS

30 class hours	**2 Credits**
Introduction (DB/SS)	
Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor. Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin(x) as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.	
Scientific Programming (SS)	
Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN/ C++, Basic elements of FORTRAN 90/95 or C++: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran 90/95 or C++ Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.	
Control Statements (DB/SS)	
Types of Logic (Sequential, Selection, Repetition), Branching Statements, Looping Statements, Jumping Statements, Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems.	
Programming(SS)	
1. Exercises on syntax on usage of FORTRAN 90/95 or C++ 2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN 90/95 or C++. 3. To print out all natural even/ odd numbers between given limits. 4. To find maximum, minimum and range of a given set of numbers.	

5. Calculating Euler number using exp(x) series evaluated at x=1

Scientific word processing: Introduction to LaTeX (DB)

TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. 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, Fonts, Picture environment and colors, errors.

Visualization(DB)

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 file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot

Hands on exercises

1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of finite series and the area under a curve.
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series.
5. To write program to open a file and generate data for plotting using Gnuplot.
6. Plotting trajectory of a projectile projected horizontally.
7. Plotting trajectory of a projectile projected making an angle with the horizontally.
8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation.
10. Motion of a projectile using simulation and plot the output for visualization.
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12. Motion of particle in a central force field and plot the output for visualization.

SEM IV (GENERAL)

GE T4 - Waves and Optics **CLASS TEACHER: DB & SS**

PAPER CODE : PHSGCORE04T

60 Lectures	**4 Credits**
Superposition of Two Collinear Harmonic oscillations (DB)	
Linearity & Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).	
Superposition of Two Perpendicular Harmonic Oscillations (DB)	
Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.	
Waves Motion- General (DB)	
Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.	
Fluids (DB)	
Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature lubrication. Qualitative discussion on water waves.	
Sound (DB)	
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.

Wave Optics (SS)

Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.

Interference (SS)

Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.

Michelson's Interferometer (SS)

Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index, and Visibility of fringes.

Diffraction (SS)

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.

Polarization (SS)

Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

GE P4 – Waves and Optics LAB **CLASS TEACHER: RM & SC**

List of Practical
1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law. 2. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method). 3. To determine 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 source. 5. To determine wavelength of sodium light using Fresnel Biprism. 6. To determine wavelength of sodium light using Newton's Rings. 7. To determine dispersive power and resolving power of a plane diffraction grating. 8. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film. 9. Familiarization with: Schuster`s focusing; determination of angle of prism. 10. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating. 11. To investigate the motion of coupled oscillators. 12. To determine the wavelength of sodium source using Michelson's interferometer.

SEM VI (HONS.)

Core T13 - Electromagnetic Theory **CLASS TEACHER: SC & SS**

60 Lectures	**4 Credits**
Maxwell Equations (SC)	**12 Lectures**
Maxwell’s equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density. Momentum Density and Angular Momentum Density (statement only).	
EM Wave Propagation in Unbounded Media (SC)	**10 Lectures**
Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.	
EM Wave in Bounded Media (SC)	**10 Lectures**
Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence).	
Polarization of Electromagnetic Waves (SS)	**17 Lectures**
Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel’s Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by	

Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light Rotatory Polarization: Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter.	
Wave guides (SS)	**8 Lectures**
Planar optical wave guides. Planar dielectric wave guide. Condition of continuity at interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission.	
Optical Fibres (SS)	**3 Lectures**
Numerical Aperture. Step and Graded Indices (Definitions Only). Single and Multiple Mode Fibres (Concept and Definition Only).	

Core P13 – Electromagnetic Theory Lab **CLASS TEACHER: SS & RM**

60 class hours **2 Credits**

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
4. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
5. To verify Fresnel's formula for reflection of polarized light incident on a dielectric interface
6. To determine the Boltzmann constant using V-I characteristics of PN junction diode.
7. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
9. To study the reflection, refraction of microwaves
10. To study Polarization and double slit interference in microwaves.
11. To analyze elliptically polarized Light by using a Babinet's compensator.
12. To study dependence of radiation on angle for a simple Dipole antenna.

Core T14 – Statistical Mechanics CLASS TEACHER: DB & RM

60 Lectures	**4 Credits**
Classical Statistical Mechanics (DB)	**20 Lectures**
Macrostate & Microstate, concept of time averaging in a macroscopic measurement. Ergodic hypothesis (statement only). Elementary Concept of Ensemble, Liouville's theorem. Microcanonical ensemble, Phase Space, postulate of equal a priori probability, Entropy and Thermodynamic Probability, Canonical ensemble, Partition Function, Density of states: for ideal gas, for standing waves in a cavity. Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature. Grand canonical ensemble and chemical potential. Equivalence of microcanonical, canonical and grand canonical ensemble for large systems (qualitative discussion only).	
Chemical Equilibrium (DB)	**5 Lectures**
Chemical potential and chemical reaction. Law of chemical equilibrium. Chemical potential for ideal gas, for photon gas. Ionisation potential. Saha's Ionization Formula.	
Theory of Blackbody Radiation (DB)	**6 Lectures**
Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Recapitulation of 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.	
System of identical particles (RM)	**6 Lectures**
Collection of non-interacting identical particles. Classical approach and quantum approach: Distinguishability and indistinguishability. Occupation number and MB distribution,	

emergence of Boltzmann factor. Composite system postulate and symmetry postulate of quantum mechanics (for a pair of particles only). Bosons and Fermions. Spin statistics theorem (statement only). Pauli exclusion principle for Fermions.	
Bose-Einstein Statistics: (RM)	**12 Lectures**
B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck’s law. Phonon gas. Debye theory of specific heat of solids. T3 law	
Fermi-Dirac Statistics: (RM)	**11 Lectures**
Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Fermi temperature, Fermi momentum, Sommerfield correction to free electron theory in a Metal. Specific Heat of Metals, Wiedemann-Franz law,	

Core P14 – Statistical Mechanics Lab CLASS TEACHER: SS & DB

60 Class Hours	**2 Credits**
List of Practical	

1. Computational analysis of the behavior of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initial conditions:
   a) Study of local number density in the equilibrium state (i) average; (ii) fluctuations
   b) Study of transient behavior of the system (approach to equilibrium)
   c) Relationship of large N and the arrow of time
   d) Computation of the velocity distribution of particles for the system and comparison with the Maxwell velocity distribution
   e) Computation and study of mean molecular speed and its dependence on particle mass
   f) Computation of fraction of molecules in an ideal gas having speed near the most probable speed
2. Computation of the partition function $Z(\beta)$ for examples of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and a finite number of non-interacting particles N under Maxwell-Boltzmann, Fermi-Dirac and Bose- Einstein statistics:
   a) Study of how $Z(\beta)$, average energy <E>, energy fluctuation ΔE, specific heat at constant volume Cv, depend upon the temperature, total number of particles N and the spectrum of single particle states.
   b) Ratios of occupation numbers of various states for the systems considered above
   c) Computation of physical quantities at large and small temperature T and comparison of various statistics at large and small temperature T.
3. Plot Planck's law for Black Body radiation and compare it with Raleigh-Jeans Law at high temperature and low temperature.
4. Plot Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature and low temperature and compare them for these two cases.
5. Plot the following functions with energy at different temperatures
   a) Maxwell-Boltzmann distribution
   b) Fermi-Dirac distribution
   c) Bose-Einstein distribution

DSE T5- Astronomy and Astrophysics CLASS TEACHER: SS & SC

75 Lectures	**6 Credits**
Astronomical Scales (SS)	**24 Lectures**
Astronomical Distance, Mass and Time, Scales, Brightness, Radiant Flux and Luminosity, Measurement of Astronomical Quantities Astronomical Distances, Stellar Radii, Masses of Stars, Stellar Temperature. 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.	
Astronomical techniques (SS)	**5 Lectures**
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)	
Physical principles (SC)	**4 Lectures**
Gravitation in Astrophysics (Virial Theorem, Newton versus Einstein), Systems in Thermodynamic Equilibrium.	
The sun and solar family (SC)	**11 Lectures**
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. Stellar spectra and classification Structure (Atomic Spectra Revisited, Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram, Luminosity Classification). Main sequence, red giants and white dwarfs, Chandrashekhar mass limit.	
The milky way (SC)	**14 Lectures**
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 the Spiral Arms), Stars and Star Clusters of the Milky Way, Properties of and around the Galactic Nucleus.	
Galaxies (SS)	**7 Lectures**
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	
Large scale structure & expanding universe (SC)	**10 Lectures**
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).	

DSE T6- Communication Electronics CLASS TEACHER: DB & SS

60 Lectures	4 Credits
Electronic communication (DB)	**8 Lectures**
Introduction to communication – means and modes. Need for modulation. Block diagram of an electronic communication system. Brief idea of frequency allocation for radio communication system in India (TRAI). Electromagnetic communication spectrum, band designations and usage. Channels and base-band signals. Concept of Noise, signal-to-noise (S/N) ratio.	
Analog Modulation (DB)	**12 Lectures**
Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Emitter Modulation), Amplitude Demodulation (diode detector), Concept of Single side band generation and detection. Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM using VCO, FM detector (slope detector), Qualitative idea of Super heterodyne receiver	
Analog Pulse Modulation (DB)	**10 Lectures**
Channel capacity, Sampling theorem, Basic Principles- PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing.	
Digital Pulse Modulation (SS)	**10 Lectures**
Need for digital transmission, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), and Binary Phase Shift Keying (BPSK).	
Introduction to Communication and Navigation systems:(SS)	**10 Lectures**
Satellite Communication– Introduction, need, Geosynchronous satellite orbits geostationary satellite advantages of geostationary satellites. Satellite visibility, transponders (C - Band), path loss, ground station, simplified block diagram of earth station. Uplink and downlink.	
Mobile Telephony System: (SS)	**10 Lectures**
Mobile Telephony System – Basic concept of mobile communication, frequency bands used in mobile communication, concept of cell sectoring and cell splitting, SIM number, IMEI number, need for data	

encryption, architecture (block diagram) of mobile communication network, idea of GSM, CDMA, TDMA and FDMA technologies, simplified block diagram of mobile phone handset, 2G, 3G and 4G concepts (qualitative only). GPS navigation system (qualitative idea only)

DSE P6 – Communication Electronics Lab

Communication Electronics Lab (SS+DB)	
60 Class Hours	**2 Credits**
List of Practical	
1. To design an Amplitude Modulator using Transistor 2. To study envelope detector for demodulation of AM signal 3. To study FM - Generator and Detector circuit 4. To study AM Transmitter and Receiver 5. To study FM Transmitter and Receiver 6. To study Time Division Multiplexing (TDM) 7. To study Pulse Amplitude Modulation (PAM) 8. To study Pulse Width Modulation (PWM) 9. To study Pulse Position Modulation (PPM) 10. To study ASK, PSK and FSK modulators	

<u>SEM VI (GENERAL)</u>

Nuclear and Particle Physics **CLASS TEACHER: TM & TS**

PAPER CODE: PHSGDSE04T

75 Lectures	**6 Credits**
Preliminary Topics (TM)	
Review of mass-energy equivalence, quantum tunnelling. Discussion on properties of semiconductors.	
General Properties of Nuclei (TM)	
Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.	
Nuclear Models (TM)	
Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.	
Radioactivity decay (TS)	
(a) Alpha decay: basics of α-decay processes, theory of α- emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) -decay: energy kinematics for□-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.	
Nuclear Reactions (TS)	
Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering(Rutherford scattering).	
Interaction of Nuclear Radiation with matter (TS)	

Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.

Detector for Nuclear Radiations (TS)

Basic principles of ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

Particle Accelerators (TM)

Linear accelerator, Cyclotron, Synchrotrons.

Particle physics (TM)

Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.

Shirsendu Sarkar

INCHARGE