TEACHING PLAN

(July, 2025 to November, 2025)

Name of the Teacher: ANUSHKA JAIN
Subject: MATHEMATICAL PHYSICS
Class: MSC PHYSICS (FIRST YEAR)
Paper: 24PHY201DS01

1st week	Vector space (Introduction Group Theory), Norm of a vector, Linear independence & dependence, Basis and dimension, Isomorphism of vector space, scaler/Inner product of vectors, orthonormal basis, Gram schmidt orthogonalisation process
2nd week	Matrices (Introduction), Properties of Matrices, orthogonal Matrix, Unitary and Hermitian Matrices, Inverse of Matrix, Cayley-Hamilton Theorem, Eigen values and Eigen vectors.
3rd week	Revise complete Matrix upto Eigen values and eigen vectors, and vector space, similarity transformation, Matrix diagonalization, simultaneous diagonalization,
4th week	Introduction linear differential equation, second order differential eqn with constant coefficients and variable coefficients, ordinary point, singular point.
5th week	Discussion on Ordinary point, Series soln around an ordinary point, Discussion on Singular point, Regular Singular point, Frobenius method, Wronskian method;
6th week	Soln of legendre's eqn, Bessel's eqn, soln of Bessel's eqn, Test discussion on Second order Differential eqn of all type, Assignment.
7th week	Introduction to special functions :- Bessel Equation, Generating function; integral form of $J_n(x)$, Recurrence Reln. legendre polynomial $P_n(x)$, Generating function, Recurrence relation, orthogonality, Rodrigue Reln.
8th week	Hermite polynomials, Generating function, Rodrigue Reln, orthogonality, Laguerre Polynomial, Generating function, orthogonality, Rodrigue Reln, Recurrence Reln, Gamma function. Dirac Delta function.

9th week	Test Rivision of special function ; Bessel function, legendre function and their Recurrence Rel^n , Rodrigue Rel^n , orthogonality.
10th week	Test Revision of special function , Hamite Polynomial , Generating function, Rodrigue Rel^n , Recurrance Rel^n . Gamma function
11th week	(Diwali Break) Assignment
12th week	Revision - Second order differential eq^n with variable coefficients , Ordinary & Singular point , Regular Singular point , sol^n using Frobenius method , ~~Wronskian method to get second sol^n~~
13th week	Integral transform , laplace transform , Properties of laplace Transform ; L.T. of Periodic functions , L.T. of derivative , L.T. of integrals , I.L.T.
14th week	Numerical Problem Discussion on L.T. , Introduction of Fourier series , Different Problems of Fourier Series (some particular functions)
15th week	Problem Discussion , Cosine and sine Series .
16th week	Fourier Transform , Properties Discussion , Fourier Sine Transform / Cosine Transform , Fourier Transform of Derivative . Application .
~~17th week~~	
~~18th week~~	

TEACHING PLAN

(July, 2025 to November, 2025)

Name of the Teacher: ANUSHKA JAIN
Subject: Quantum Mechanics - I
Class: M.Sc PHYSICS (Ist Year)
Paper: 24PHY201DSC03

1st week	Introduction of wave function, quantum state, Postulate, Representation of states, operators, dynamical variables representation, Bra Ket Notation, linear operators, orthonormal set of vectors, Completeness Rel^n, Hermitian operators; Eigen values, Eigen vectors
2nd week	Simultaneous eigenstate of commuting operators, solution of linear H.O. problems, Revision.
3rd week	operator introduction, Angular momentum operator and their representation in spherical polar coordinates, Eigen values and Eigen vectors of L^2. Spherical Harmonics. Commutation Rel^n among L_x, L_y, L_z.
4th week	conservational of angular momentum, Eigen values of J^2 and J_z and their matrix representation; Pauli spin Matrices.
5th week	Solution of schrodinger equation; 3-D Harmonic oscillator in Cartesian coordinate system and spherical coordinate system. Eigen values, Eigen functions
6th week	The degeneracy of state in 3-D H.O. Sol^n of H-atom problem; the eigen values, Eigen functions and the degeneracy.
7th week	Revision. Discussion of 3-D H.O., Assignment, Eigen values and eigen functions for 3-D Problems.
8th week	Numerical Problems of Previous Questions Discussion.

9th week	Revision and test of Angular Momentum operator and their representation Eigen values and eigen vectors of L^2.
10th week	Introduction of Perturbation theory, how it helps to find the solution of perturbed system using unperturbed system (known state).
11th week	(Diwali Break), Assignment.
12th week	Perturbation Theory - Non degenerate case, the energies and wave functions in 1st order correction, in second order correction.
13th week	Anharmonic perturbations of the form λx^3 and λx^4. Problems Discussion on non-degenerate Perturbation theory.
14th week	Degenerate Perturbation Theory Discussion; Stark effect of First excited state of Hydrogen.
15th week	Revision of Perturbation Theory, Numerical Problems of P.T. using different unperturbed system (Determine energy correction & correction in wave function.
16th week	Test and Discussion on Previous year questions Problems, Assignment complete.
~~17th week~~	
~~18th week~~	

TEACHING PLAN

(July, 2025 to November, 2025)

Name of the Teacher/ Mentor of subject - ANUSHKA JAIN
Subject: Classical Mechanics
Class: M-Sc (Ist Year)
Paper: 24PHY201DS02

1st week	Introduction to Newtonian Mechanics; Frame of reference, Newton laws of motion, Inertial Frame, Mechanics of particle; conservation laws, work energy Theorem.
2nd week	Mechanics of a system of particles; Internal and External forces, Centre of mass; conservation of linear momentum, conservation of angular momentum, conservation of energy. Conservation Theorem.
3rd week	Lagrangian Dynamics; Basic concepts, coordinate system, Degree of freedom, Constraint and their classification, Generalised coordinates.
4th week	Principle of virtual work, D'Alembert Principle, Lagrange's eqn from D'Alembert Principle, Formulation of Lagrange's Eqn, Lagrange's eqn in presence of non-conservative forces.
5th week	Generalised Potential, Hamilton's Principle and Lagrange's Eqn, Symmetry Properties of space and time and conservation laws; Invariance under Galilean transformation.
6th week	Two body central force Problem; Reduction of Two body Problem to equivalent one-body problem, central force and motion in a plane, Eqn of motion under central force and First integrals.
7th week	Differential Eqn for an orbit, Inverse square law of force, Kepler's law of planetary Motion and their deduction: First, second, third law.
8th week	Stability of orbit under central force, Artificial satellite, Virial Theorem. Scattering in central Force field; scattering cross-section, scattering angle, Impact parameter.

9th week	Rutherford scattering cross-section, Legendre Transformation and Hamilton's eqn of motion, Variational Principle, Hamilton's Principle from D'Alembert's Principle, Lagrange's eqn From Hamilton's principle.
10th week	Principle of least action and its forms. Hamilton – Jacobi eqn and their Solutions. Using Hamilton – Jacobi method for soln of Harmonic oscillator Problem.
11th week	Diwali Break.
12th week	Canonical transformation, Generating functions, Properties of Poisson Bracket, Eqn of motion in Poisson Bracket
13th week	Angular momentum and Poisson bracket relations, Jacobi identity, invariance of Poisson Brackets using canonical transformation.
14th week	Potential energy and equilibrium: stable and unstable and neutral equilibrium, Problems :- 1-D oscillator, Two coupled oscillators.
15th week	Solution of differential eqn to find normal coordinates and normal modes. , Assignment
16th week	Theory of small oscillations, Examples - Coupled oscillators ; Two coupled Pendulum, double Pendulum, Free vibrations of linear triatomic molecule.
~~17th week~~	
~~18th week~~	

TEACHING PLAN

(July, 2025 to November, 2025)

Name of the Teacher: Mentor of subject - ANUSHKA JAIN
Subject: Physics of Electronic Devices
Class: M.Sc Physics (Ist Year)
Paper: 24PHY201DS04

1st week	Introduction of solid, Band Theory of Solids, Band formation and accordingly classification of solids into metals, semiconductors and insulators, Direct and indirect Band gap semiconductors, Variation of energy bands with alloy composition, Electrons and holes.
2nd week	Effective mass, intrinsic and extrinsic semiconductors, concept of fermi level and general discussion.
3rd week	Electron and hole conc. at equilibrium, temperature dependence, compensation and space charge neutrality.
4th week	Conductivity and mobility, effect of temperature and doping on mobility, Hall effect, invariance of Fermi Level.
5th week	Carrier Transport in semiconductors: optical absorption and luminiscence, carrier lifetime and photoconductivity, direct/indirect recombination.
6th week	Traps and defects, steady state carrier generation, quasi fermi levels, Diffusion and drift of carriers.
7th week	Diffusion and recombination, Diffusion length, Haynes Shockley experiment,
8th week	Gradient in Quasi-Fermi level, External and internal photo-electric effect.

9th week	Diode Physics and optoelectronic Devices :- P-N junction diode (Basic, Energy band diagram, built in potential, electric field, space-charge width, current flow)
10th week	Derivation of diode current eqn, Zener diode (breakdown mechanism and voltage regulator ckt), power diode, varactor diode.
11th week	Diwali Break
12th week	Opto electronic Devices: Vacuum photodiode, P-N junction Photodiode, PIN photodiode, Avalanche Photodiode, phototransistor, Solar cell, LED intro.
13th week	LED (Light emitting diode), Diode Laser, condition for laser action and optical gain.
14th week	Transistor: Bipolar junction transistor (action, biasing configuration, characteristics) FET: (junction field effect transistor), MOSFET.
15th week	Negative resistance devices: Tunnel Diode, Backward Diode, UJT, p-n-p-n devices and their characteristics.
16th week	Silicon Controlled Rectifier (SCR) and switch and their characteristics. Assignment
~~15th week~~	
~~16th week~~	

TEACHING PLAN

(July, 2025 to November, 2025)

Name of the Teacher: ANUSHKA JAIN
Subject: Nuclear and Particle Physics
Class: M-Sc Physics (Final Year)
Paper: 25 PHY 203 DS01

1st week	Two Nucleon problem; Introduction of nuclear forces, common potentials - Wigner, Majorana, Bartlett, - The ground state of deutron, square well soln of Deutron.
2nd week	Discussion on nucleon - nucleon scattering, Effective range theory of n-p scattering, Scattering length, Meson Theory of Nuclear force, Types of nuclear reaction, Reaction cross-section in terms of partial wave treatment.
3rd week	Test Rivision on Effective Range Theory, n-p scattering, n-n scattering. Introduction of Liquid Drop Model.
4th week	Liquid Drop model: Similarities btw liquid drop and nucleus; Semi-empirical mass formula, Merits and Demerits of Liquid Drop Model.
5th week	Shell Model: Experiment evidence for shell effect, Magic Numbers, Single Particle shell Model; Assumptions.
6th week	Spin-orbit coupling in single particle shell model; Estimation of spin, parities and magnetic moment of nuclei by single particle shell Model.
7th week	Revision of shell Model - single particle shell Model, L-S Coupling in single particle.
8th week	Nuclear Decays: Alpha decay, Disintegration energy, Range of α-Particles, Range - energy relationship for α-particle and Geiger Nuttall law.

9th week	β-decay, Pauli's Neutrino hypothesis, Fermi Theory of β-decay, Curie plot, selection Rules for β-decay.
10th week	Fermi and Gamow-Teller Transitions, Detection and Properties of neutrino; Gamma Decay, Multipole transition in nuclei, Angular momentum and parity selection rules.
11th week	(Diwali Break), Assignment
12th week	Revision test of α-decay, β-decay, γ-decay.
13th week	Introduction of Particle Physics, classification of elementary particles, fermions, Bosons (Mesons) and antiparticles, fundamental interactions in nature.
14th week	fundamental type of interaction b/w elementary particles; symmetry and conservation. classifications of particles - leptons, Hadrons (Mesons & Baryons). Strangeness, hypercharge, conservation of charge, Multiplicity.
15th week	Gell-Mann Nishijima formula, Elementary ideas of CP & CPT invariance, Quark Model, Baryon octet.
16th week	Revision Quark Model, Meson octet, Baryon decuplet, introduction of colour quantum No., SU(2), SU(3) symmetry. Assignment.
~~17th week~~	
~~18th week~~	

TEACHING PLAN

(July, 2025 to November, 2025)

Name of the Teacher: ANUSHKA JAIN
Subject: Electronics - I
Class: M.Sc. (Final Year) PHYSICS
Paper: 25PHY203DS04

1st week	for op-amp - Differential amplifier, Block diagram of op-amp, circuit configurations of op-amp, emitter coupled supplied with constant current, transfer characteristics, CMRR, off set current, voltages, PSRR, slew Rate.
2nd week	Again Recap of op-amp and their necessary parameters, slew Rate, universal Balancing techniques. Inverting and non-inverting op-amp.
3rd week	Basic application - summing, scaling, I to V conversion and V to I conversion, Differential DC amplifier, voltage follower, A.C-coupled Amplifier. (only Discussion)
4th week	Voltage follower, A.C coupled amplifier, Revision all application of op-amp.
5th week	comparator, AC/DC Converters: Half wave & full wave rectifier, Clamping ckt, Logarithmic amplifier.
6th week	Antilogarithmic amplifier, Sample and hold ckt, DAC - ladder and weighted resistor types, ADC - Counter type, regenerative comparator
7th week	Oscillator using op-amp - Square wave generator, triangular wave generator. Sinusoidal oscillators: Phase shift, Colpitt, Hartley.
8th week	Introduction of semiconductor diodes, BJT: transistor action, Biasing techniques and characteristics, Amplifying action. AC/DC load line

9th week	Transistor models and parameters, equivalent ckt, Two port Devices and Hybrid Model, Transistor hybrid Model and h-parameters.
10th week	Conversion of h-parameters for CE, CB, CC configuration, Linear Analysis of transistor ckt, Miller's Theorem, Classification of amplifiers, Frequency response.
11th week	RC coupled Amplifier (Diwali Break) Assignment
12th week	Types of feedback → positive and negative, effect of negative feedback on gain, Non linear distortion, input resistance, Frequency response.
13th week	Transistor Power Amplifiers – Class A, Class B, Class C. Introduction of oscillator.
14th week	Principle of Oscillations, condition for sustained oscillation, RF oscillator using BJT, Hartley oscillator.
15th week	Colpitt oscillator (Principle of working and frequency oscillation), Revision.
16th week	AF oscillators using BJT - Wein Bridge, Phase shift oscillator, Multivibrator (Astable, Bistable).
~~17th week~~	
~~18th week~~	

TEACHING PLAN

(July, 2025 to November, 2025)

Name of the Teacher/Mentor of Subject - ANUSHKA JAIN
Subject: Electrodynamics and wave Propagation
Class: M-Sc Physics (final Year)
Paper: 25PHY203DS02

1st week	Review and covariance: Review of four vector and lorentz transformation in four dimensional space.
2nd week	Rivision of 4-vector space and conservation of charge and four current density.
3rd week	Electromagnetic field tensor in 4-D and Maxwell's eq^n's; Lorentz invariant of electromagnetic fields.
4th week	Dual field tensor; Transformation of electric and magnetic field vectors; covariance of force equation.
5th week	Radiating system: Field and radiation of a localized source; Oscillating electric dipole.
6th week	Centre fed linear antenna; Lienard - Wiechart potential.
7th week	Electric and magnetic fields due to uniformly moving charge and accelerated charge.
8th week	Linear and circular acceleration and angular distribution of power radiated.

9th week	Radiative Effects and Ionosphere : Radiative reaction force ; scattering and absorption of radiation. Thompson scattering and Rayleigh scattering.
10th week	Revision scattering, Normal and anomalous dispersion, Ionosphere ; propagation of electromagnetic wave through ionosphere.
11th week	Diwali Break.
12th week	Reflection of electromagnetic waves by ionosphere ; Motion of charged particles in uniform E and B fields ; Time varying fields.
13th week	Conductors and waveguide :- fields at the surface of and within a conductor ; Waveguides ; Modes in Rectangular waveguide ; Attenuation in waveguide
14th week	Dielectric waveguides ; Circuit Representation of parallel plate transmission lines.
15th week	Transmission line equations and their solution ; characteristic impedance and propagation coefficient.
16th week	Low loss radio frequency and UHF transmission lines. Assignment
~~17th week~~	
~~18th week~~	

TEACHING PLAN

(July, 2025 to November, 2025)

Name of the Teacher/Mentor of subject: ANUSHKA JAIN
Subject: Computational Physics - I
Class: MSC Physics (Final Year)
Paper: 25PHY203DS06

1st week	Unit - 1 : Numerical Integration & Differentiation : Newton Cotes formulae : Trapezoidal Rule , Simpson's 1/3rd rule . Error estimates using Richardson deffered limit approach.
2nd week	Gauss - legendre quadrature method ; Monte Carlo method for single, double, triple integral , Numerical Differentiation : Taylor Series method , generalized numerical differentiation, truncation errors.
3rd week	Roots of Eq^n and Curve fitting : Root of linear and Non linear algebraic and transcedental eq^n : Newton Raphson method , Curve fitting : Principle of least Square intro.
4th week	Principle of least square ; linear regression, Polynomial regression, Exponential and Geometric Regression.
5th week	Interpolation : Finite differences , interpolation with equally spaced points ; Gregory Newton's Interpolation formula for forward and backward interpolation
6th week	Interpolation with unequally spaced points : Lagrangian interpolation.
7th week	Simultaneous linear Equations & Eigenvalues : Sol^n of Simultaneous linear equations: Gauss elimination method , Pivoting, Gauss - Jordan Method
8th week	Matrix Inversion , Eigen values and Eigen vectors : Jacobi's method for symmetric matrix.

9th week	Numerical Soln of Differential Eq^{n}'s : First order Taylor Series method ; Euler method , Runge-Kutta methods , Predictor corrector method .
10th week	Elementary ideas of solution of partial differential eq^{n}'s.
11th week	Diwali Break.
12th week	Initial and boundary value problems : shooting method.
13th week	Computer Basic and FORTRAN 77 :- Elementary information about digital computer Principles , Basic ideas of operating system, DOS and its use.
14th week	Various Commands of DOS , Compiler , interpreters , Directory structure ; File operators.
15th week	Introduction to FORTRAN 77 : Data types : integer and floating arithmetic , variables , i/p and o/p statements , Formats , Expressions , Executable and non-executable statements , control statement , GOTO statement , Arithmetic IF and logical IF.
16th week	Flowchart , Block IF statement , DO statement , character DATA management , Arrays , Subprograms . New features of FORTRAN 90 . - Assignment
17th week	
18th week	