**SEMESTER - I: PAPER - 101**

**MATHEMATICAL METHODS OF PHYSICS**

**MODULE – I**

**Special Functions**: (Without Power Series Solutions)

Beta and Gamma Functions: Definition and Simple Properties

Bessel Functions of the first kind: Generating Function, Recurrence Relations, Differential Equation satisfied by Bessel functions, and Integral representation.

Hermite, Laguerre And Legendre Polynomials: Generating Functions, Recurrence Relations, Rodrigue's Formulae, Orthogonality andNormalisation properties, and Differential Equations satisfied by these Polynomials, Associated Legendre Polynomials and SphericalHarmonics.

**Text Book/Reference Book**: Mathematical Methods for Physicists, G. ArfkenCh 1O. sec1O.1,.4; Ch 11 sec11.1; Ch 1Z Gec1Z.1,.Z,.s,.5,.6; Ch 1s sec1s.1,.Z

# M0DULE - II

**Laplace Transforms**: Definition and Simple properties of Laplace Transforms, Laplace transforms of Elementary functions, Laplace transforms of Derivatives, Inverse Laplace Transform, Applications of Laplace Transforms

**Text and Reference Book:** Mathematical Methods for Physicists by G. Arfken

Ch 15 Gec 1,7,8, P,11,

**Tensor Analysis**: Concepts of Tensor, Contravariant, Covarient and Mixed Tensors, Addition and Subtraction of Tensors, Contraction of a Tensor, Outer product and inner product of two tensors, Quotient law,

**Text and Reference Book:** Tensor Calculus by Barry Spain, Ch-1 Sec. 1 to 1s

Text Book: Functions of Complex Variable with applications. By E. G. Phillips

# Nuclear physics Department

# SEMESTER – I, PAPER – 102; CLASSICAL MECHANICS

(For the academic year 2020-21 admitted batch syllabus)

# MODULE-I

Mechanics of a Particle, Mechanics of system of particles, Constraints, D’Alembert’s Principle and Lagrange’s Equations, Application of Lagrangian Formalism.

Hamilton’s Principle, Calculus of Variations, Lagrange’s equations from Hamilton’s Principle, Hamilton’s Principle for Nonholonomic Systems, Conservation Theorems, Energy function and Conservation of Energy.

Central Force Problem: Reduction of two-body problem into one-body problem, Equations of motion and first integrals, Equivalent one-dimensional problem, Classification of orbits, Virial Theorem, The differential equation for the orbit, Bertrand’s theorem, Kepler Problem: Inverse square law of force, Motion in Time in Kepler Problem, Scattering in a Central Force field, transforming the scattering problem to Laboratory coordinates, Three-body Problem.

Kinematics of Rigid Body Motion: Independent Coordinates of a Rigid Body, Orthogonal Transformations, Formal Properties of Transformation Matrix, Euler Angles, Cayley-Klein Parameters, Euler’s Theorem for Rigid Body motion, Finite Rotations, Infinitesimal Rotations, Coriolis effect.

Text Book: Classical Mechanics (3rd Edition) Chapters 1,2,3,4,5 By Herbert Goldstein, Charles P. Poole and John L. Safko .

# MODULE – II

Equations of motion of Rigid Body: Angular momentum and Kinetic Energy of Motion about a Point, Tensors, Inertia Tensor and Moment of Inertia, Solving Rigid Body Problems and Euler equations of motion, Torque free motion, Heavy symmetric top with one point fixed, Precession of equinoxes and Satellite orbits, Precession of system of charges in a magnetic field.

Classical Mechanics of Special Theory of Relativity: Postulates of Special Theory, Lorentz Transformations, Velocity Addition and Thomas Precession, Vectors and Metric Tensor, Forces in Special Theory: Electromagnetism, relativistic kinematics of Collisions and many particle systems, Introduction to General Theory of Relativity.

Hamilton’s equations of motion: Legendre Transformations and Hamilton equations of Motion. Cyclic Coordinates and conservation Theorems.Hamilton’s equations from a Variational Principle.Principle of Least Action.

Canonical Transformations: Equations of Canonical Transformation. Examples.Harmonic Oscillator. Poisson Brackets, Infinitesimal Canonical Transformations. Conservation Theorems in Poisson Bracket Formalism.Angular Momentum Poisson Bracket Relations.Liouville’s Theorem.

Text Book: 1. Classical Mechanics (3rd Edition) Chapters 7,8,9,10 By Herbert Goldstein, Charles P. Poole and John L. Safko.

# Department of Nuclear Physics

# SEMESTER – I PAPER –103

**ELECTRODYNAMICS**

(For the academic year 2020-21 admitted batch)

# MODULE - I

Maxwell’s equations: Maxwell’s Equations in Free Space and Linear isotropic media. Boundary conditions on the fields at interfaces.

(Scope: DJG, Ch.7, Sec.3 and JDJ: Ch.1 Sec5)

Potential formulation of electrodynamics: Scalar and Vector potentials, Gauge transformations - Coulomb gauge, Lorentz gauge, Gauge invariance, Lorentz force law in potential form. Poynting’s theorem, Maxwell’s Stress Tensor, Conservation of Energy and Momentum.

(Scope: DJG, Ch.8, Sec.1, 2, Ch.10 Sec1. And JDJ: Ch.6, Sec1, 2, 3, 7)

Electromagnetic waves: The Wave Equation, Electromagnetic waves in non-conducting media Plane waves in Vacuum - Energy and Momentum of electromagnetic waves - Propagation through Linear media – Polarization Reflection and Transmission at a Conducting surface/thin layer. Dispersion - The frequency dependence of Permittivity, Permeability and Conductivity - Dispersion in non-conducting media-Cauchy’s Equation.

(Scope: DJG, Ch.9, Sec.1,2,3,4 and GKS, Ch.7, Sec.1,2,3,5: Ch.8, Sec.1,2,4,7,19.)

# MODULE-II

Fields and Radiation by Moving Charges: Retarded Potentials - ‘Lienard-Wiechert Potentials’ – Electric and Magnetic fields due to a uniformly moving point charge and an accelerated charge. Power radiated by accelerated charge - Larmour’s formula and its relativistic generalisation - Radiation losses in charged particle accelerators. Electric and Magnetic dipole radiation. Linear and Circular acceleration and angular distribution of power radiated, Bremsstrahlung, Synchrotron radiation and Cerenkov radiation, Radiation reaction force.

(Scope: DJG, Ch.10, Sec. 1, 2, 3 Ch.11 Sec 1, 2 and GKS, Ch.10, Sec.7,8. And JDJ: Ch.13 Sec4, Ch.14 Sec 1, 2, 6, Ch.15 Sec 2, Ch.16 Sec 2, 3)

Text and Reference Books:

1. DJG: David J. Griffiths: ‘Introduction to Electromagnetics’. 3rd Edition. Pearson Education Asia.
2. JDJ: J.D. Jackson: ‘Classical Electromagnetics’. 3rd Edition 2005. John Wiley & sons, Inc.
3. GKS: Gupta, Kumar and Sharma: ‘Foundations of Electromagnetic Theory’. Addison-Wesley
4. L.B. Laud: ‘Electromagnetics’. Wiley Eastern Ltd.

# SEMESTER – I PAPER –104

# ELECTRONIC DEVICES AND CIRCUITS

(For the academic year 2020-21 admitted batch)

# MODULE I

Network theorems: - Thevenin theorem, Norton’s theorem and maximum power transfer theorem. Semiconductor Devices: - Tunnel diode, Photo diode, Solar cell, LED, Varactor diode, silicon-controlled Rectifier, Photo Transistor.

UJT- characteristics and relaxation oscillator. JFET and MOSFET – construction and characteristics – and their applications. JFET as common source amplifier.

BJT – CE amplifier – voltage gain, input and output resistance, graphical analysis and analysis using h-parameter equivalent circuit.

Feedback Amplifiers: Feedback concept, types of feedback, general characteristics of negative feedback in amplifiers, voltage series feedback, current series feedback and voltage shunt feedback.

# MODULE II

Digital Electronics: (Sequential Logic) Flip-Flops, one-bit memory – RS flip-flop, JK flip-flop, JK – master slave flip-flop, T flip-flop. Modulo N counters.

Operational Amplifiers: Ideal Operational amplifier. Op. Amp. Architecture - differential stage, gain stage, dc level shifting and output stage. Practical inverting and Non inverting Op. Amp configurations, voltage follower.

Op. Amp parameters – input offset voltage (Vio) input bias current (Iio), Output offset voltage, Common Mode Rejection Ratio (CMRR), Slew rate, Op. Amp. Open loop gain

Op. Amplifier applications: - Summing, scaling and difference of input voltages, Integrator and Differentiator. RC phase shift Oscillator. Comparators; Window -comparator, Schmitt trigger, Voltage regulators – fixed regulators and adjustable voltage regulators.

Text and Reference Books:

1. “Basic Electronics (solid state)” B.L. Theraja
2. “Electronic devices and circuits” Theodore F. Bogart, Jr.
3. “Electronic devices and circuits” Allen Mottershead.
4. “Digital principles and Applications” - A.P. Malvino and D.P. Leach.