SEMESTER -I

Theory Paper AS-10l: Basic Physics

Unit – I - Electromagnetic Theory

Maxwell's Equations and their derivations and integral forms. Scalar and Vector potentials, Coulomb and Lorentz gauge. Electromagnetic waves. Poynting Theorem.

Unit – II - Transformations

Canonical transformations, Conditions for canonical transformation and problem, Poisson brackets, invariance of PB under canonical transformation, Rotating frames of reference, inertial forces in rotating frames.

Unit – III - Statistical Mechanics

Entropy and Probability, Ensembles, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Fermi energy, Mean energy of fermions at absolute zero, Fermi energy as a function of temperature, Electronic specific heat, Bose-Einstein Condensation

Unit – IV - Special Theory of Relativity

Concept of Special Theory of Relativity, Lorentz Transformation, Length Contraction and time dilation, Relativistic addition of velocities, conservation of mass and momentum,

Unit – V- Relativity Application

Concept of General Theory of Relativity, Equivalence of mass and energy, Relativistic Doppler shift and aberration of light. Lagrangian and Hamiltonian of relativistic particles, Relativistic degenerate electron gas.

REFERENCES

1. Introduction to Electrodynamics by David Griffiths.
2. Foundations of Electromagnetic Theory by J R Reitz and F J Milford.
3. Classical Mechanics by H. Goldstein, Narosa Publishing Home, New Delhi.
4. Classical Mechanics by N. C. Rana and P. S. Joag, Tata Mc-Graw Hill Publishing Company Limited, New Delhi.
5. Introduction to Classical Mechanics by R. G. Takawale and P. S. Puranik, Tata Mc-GrawHill Publishing, Company Limited, New Delhi.
6. Classical Mechanics by J. C. Upadhyaya, Himalaya Publishing House.
7. Statistical Mechanics by K. Huang, John Willey & Sons (2nd Edition).
8. Statistical Mechanics by Satya Prakash, KedarNath Ram Nath Publication (2008).
9. Statistical Mechanics by Loknathan and Gambhir.
10. Statistical Mechanics by Landau and Liftsiftz.
11. Special Theory of relativity by Resnik.
12. The Lighter side of Gravity by J. V. Narlikar.

Theory Paper AS-102: Mathematical Methods of Physics

Unit – I - Ordinary differential equations

Second order homogeneous and non-homogeneous differential equations with constant and variable coefficients, The Superposition Principle. Solution by power series method due to Frobenius method. Solutions of Legender's and Bessel's differential equations.

Unit – II - Partial differential equations

Solutions by the method of separation of variables. Wave equation in one and two dimensions, Poisson's and Laplace's equations, Heat Conduction (or Diffusion) equation and their solutions. Solution of Euler's differential equation, Riccati equation.

Unit – III - Special functions

The Hermite Polynomials, One-dimensional Linear Harmonic Oscillator, Solution of Hermite's Differential Equation, Gamma, Beta, Legendre and Associated Legendre, Bessel functions of the first kind and their properties.

Unit – IV - Fourier Series

Definition of Fourier Series and expansion of a functions of x. Extension of interval. Advantages of Fourier series. Complex form of Fourier series.

Unit – V - Fourier Transforms

Fourier's integrals. Fourier transform and their inverse. Transforms of Derivatives, Parseval's relation. Use of Fourier transform in solving some simple definite integrals.

REFERENCES

1. Shepley and Ross: Differential Equations.
2. Piper and Harvill: Applied Mathematics for Engineers and Physicists.
3. J. Irving and Mullineus: Mathematics in Physics and Engineering.
4. V. I. Awmianoc translated by D. E. Brown: A course of Higher Mathematics Vol. IV.
5. I. N. Sneddon: Fourier series.
6. Charlie Harper: Introduction to Mathematical Physics.

Theory Paper AS-103: Basic Astronomy

Unit - I – Positional Astronomy

Identificationof the objects visible in the night sky to the unaided eye: constellations and nomenclature of stars. The cardinal points and circles on the celestial sphere. Spherical triangle and related problems.

Sky coordinates and motions: Horizontal, Equatorial, ecliptic and galactic system of co-ordinates; Twilight, Seasons.

Unit – II – Astronomical Systems of Measurements

Timekeeping: Twilight, Sidereal, Apparent and Mean solar time and their relations, Equation of time, Calendar, Julian date and heliocentric correction. Effects of atmospheric refraction, aberration, parallax, precession, nutation and proper motion on the coordinates of stars.

Unit – III - Stars, Distances and Magnitudes

Stars and distances: Formation and evolution of stars, Star Clusters, Distances of stars, stellar motions, parallax methods to measure distances to stars.

Magnitudes: Magnitude scale and magnitude systems. Apparent and Absolute magnitudes and distance modulus. colour index. Atmospheric extinction.

Unit – IV - The Sun and its features

Universe: Origin of Universe-the Big Bang-Expansion of Universe, Formation and evolution of solar system. The Sun, Surface features of the sun in white and monochromatic light. Internal structure. Sun spots and magnetic fields on the sun. Solar activity.

Unit – V – Planetary physics

Planets: Their types - planet atmospheres - extra solar planets - Surface features of planets, Internal structure, Atmospheres and Magnetic fields of Planets and their moons. Results of space probes.
Minor Planets: Discovery and designation, Origin, Nature and orbits of Asteroids, Meteors -meteor showers, and Comets.

REFERENCES

1. W. M. Smart: Text book of Spherical Astronomy.
2. A. E. Roy: Orbital Motion.
3. Mc Cusky: Introduction to Celestial Mechanics.
4. K. D. Abhyankar: Astrophysics: Stars and Galaxies. Tata McGraw Hill Publication (Chap.2)
5. G. Abell: Exploration of the Universe.
6. A. Unsold: New Cosmos.
7. BaidyanathBasu: An Introduction to Astrophysics
8. An Introduction to Astrophysics by Ajit Kumar Sharma.
9. The Sun by M.Stix
10. Fundamental Astronomy by H.Karttunen, H.Oja and K.J.Donner.

Theory Paper AS-104: Classical (Celestial) Mechanics

Unit – I - The Two-Body Problem

Motion in a Central Force Field. Motion in an inverse square law force field. Kepler's Laws. Formulation of the two-body problem. Integrals of area, angular momentum, and energy. Equation of the relative orbit and its solution. Kepler's equation and its solution.

Unit – II –The Three-Body Problem

The Three-Body Problem – its equations of motion. Restricted three-body problem. Tisserand's criterion. Lagrange's solution for the motion of three bodies. Surfaces of zero relative velocity, Lagrangian points. Double points.

Unit – III – The Many-Body Problem

The Equations of Motion in the Many-body Problem. Stability of straight line and equilateral triangle solutions. The ten integrals of motion of the n-body problem. Transfer of origin to one of the particles. The perturbing function. Virial theorem.

Unit – IV - The Lagrangian and Hamiltonian Formulation

Lagrangian & Hamiltonian formulation of Mechanics. Equations of motion in Lagrangian formulation. Mechanics of a particle in Lagrangian formulation. Equations of motion of two-body problems and three body problem in Lagrangian formulation. Cyclic or ignorable coordinates. Contact transformation, Hamilton-Jacobi partial differential equation.

Unit – V –Rocket Dynamics and Transfer Orbits

Euler's theorem. Euler's equations of motion. Motion of a rocket. Step rockets. Minimum energy orbits. Transfer orbits. Parking orbits. Perturbations of artificial satellites due to atmospheric drag and flattening of the earth.

REFERENCES

1. H. Goldstein: Classical Mechanics, Narosa Publishing Home, New Delhi.
2. N. C. Rana: Classical Mechanics.
3. J.C.Upadhyaya: Classical Mechanics, Himalaya Publishing House.
4. R. G. Takwale and P. S. Puranik: Introduction to Classical Mechanics.
5. W. M. Smart: Text book of Spherical Astronomy.
6. A. E. Roy: Orbital Motion.
7. Mc Cusky: Introduction to Celestial Mechanics.
8. K. D. Abhyankar: Astrophysics of the solar system.
9. F. R. Moulton: An Introduction to Celestial Mechanics.
10. Danby: Fundamentals of Celestial Mechanics.

Practical Paper AS-151: Numerical Methods

1. Methods of least squares

3. Numerical interpolation: Forward, backward, central

4. Numerical differentiation and integration Trapeziodalrule, Simpson 1/3, 3/8 rules

5. Solution of ordinary differential equations using RK methods for first to fourth order DE

Practical Paper AS-152: Computer Applications

1. Operating Systems : LINUX.

2. Editors : Word and vi

3. Programming concepts: Language : C

4. Numerical Analysis using C.

Practical Paper AS-153: Data handling using GNUplot

1. Plotting 2D – 3D data
2. Polynomial and function fitting
3. Histograms, error determinations
4. Least – Square methods and fittings,
5. Correlation and Regression analysis

Practical Paper AS-154: Sky Observations

1. Familiarization of celestial sphere and time calculations
2. Types of telescopes, telescope mounts
3. Telescope operations - manual / remote controlled
4. Day time astronomy techniques
5. Astronomical Imaging

REFERENCES

1. J. B. Scarborough: Numerical Analysis.
2. R. Subramanian. P. Achutan. and K. Venkatesan (Translators): Numerical Analysis for Engineers and Physicists.
3. P. S. Grover: Programming and computing with FORTRAN IV.
4. M. K. Jain. S. R. K. Iyengar and R. K. Jain: Numerical Methods for Scientific and Engineering Computation.
5. R. C. Desai: FORTRAN Programming and Numerical Methods.
6. E. Balaguruswamy: Let us C
7. Norton's Atlas