

Module I - AABEL - Completed

Mathematical Methods of Physics

Curvilinear coordinates, circular cylindrical and spherical polar coordinates Vector algebra and Vector calculus,

Matrices – Cayley Hamilton Theorem, Eigen values and Eigen vectors.

Special Functions (Gamma, Beta, Hermite, Bessel, Laguerre, Legendre)

Complex Analysis – Analytic function, Taylor and Laurent expansions, poles, residue and evaluation of integrals.

Fourier Series, Fourier and Laplace transforms. Tensors, Introductory group theory, representation of groups. Irreducible representation $SU(2)$, $SU(3)$.

Module II - VINU - AABEL MAY 15

Classical Mechanics

Newtons laws, Lagrangian and Hamiltonian formalism. Canonical Transformation and Poisson Bracket

Hamilton Jacobi Theory

Rigid body Dynamics -

Small oscillations

Special theory of relativity

Non linear Dynamics – logistic map – bifurcation – attractors – fractal, fractal dimension.

Module III - SALEEM

Quantum Mechanics

Wave particle duality, Fundamental postulates of Q.M.,

Schrodinger picture & Heisenberg picture Eigen value problem (particle in a box, harmonic oscillator). Tunneling through a barrier.

Heisenberg uncertainty principle. Algebra of linear vector space, Dirac notation, Angular Momentum algebra (spin, addition of angular momentum).

Time independent perturbation theory and applications :

Variational method.

Time dependent perturbation theory and Fermi Golden Rule.

Elementary theory of Scattering phase shifts, partial waves, Born approximation.

Relativistic Quantum Mechanics : Klein Gordon – Dirac equations.

Module IV A) SAEED

Electro Dynamics & Statistical Physics

Review of Electrostatics and Magnetostatics (Gauss's law, Biot Savart Law, Amperes theorem) Maxwell's equation in free space and linear isotropic media – boundary conditions on the fields at interfaces. Scalar and vector potentials.

(Retarded potential Lienard Wiehert potential, field of a moving point charge)

Electromagnetic waves in free space. Dielectrics and conductors. Reflection, refraction, polarisation Transmission lines and Wave guides.

Statistical Physics- FASIL

B) Laws of thermodynamics. Thermodynamic potentials

Phase space, micro and macrostates, Micro canonical, canonical and grand canonical ensembles and partition functions. Classical and quantum statistics, Ideal Bose and Fermi gases. First and second order phase transitions. Diamagnetism, paramagnetism and ferromagnetism.

Module V -Priyil mathew April 26 and 27 - Completed

Spectroscopy and Condensed Matter Physics

A) Spectroscopy

Introduction to Atomic Spectroscopy :- LS coupling, - J J coupling, - Zeeman effect, - Stark effect, Lande - g factor

Electronic, rotational, vibrational and Raman Spectra of diatomic molecules, selection rules.

Spin Resonance Spectroscopy : NMR, ESR, Mossbauer Spectroscopy.

Laser : Spontaneous and stimulated emission, Einstein coefficients. Optical pumping, population inversions, rate equation. Modes of resonators and coherence length.

SHEMINA May 5 and 6

B) Condensed Matter Physics

Bravais lattice, Reciprocal lattice. Diffraction and the structure factor. Brillouin zone.

Vibrations of crystals with monoatomic and diatomic basis – Phonon heat capacity – Density of states in one and three dimensions – Einstein and Debye models

Free electron theory and electronic specific heat.

Hall Effect

Super conductivity Type I and Type II superconductors.

Josephson functions, BCS theory

Module VI- SALEEM

Nuclear and Particle Physics & Electronics

A) Nuclear Properties : size shape and charge distribution, spin and parity – Binding energy, semi empirical mass formula, liquid drop model, Nature of nuclear force. Elementary ideas of alpha, beta and gamma decay and their selection rules. Fission and fusion. Nuclear reactions. Reaction cross section, Q value.

Elementary particles and their Quantum numbers.

Quark Model

Dr. Prejil

B) Electronics : Semi conductor devices (diodes, transistors, FET) Amplifiers, Oscillators. Opto electronic devices (solar cells, photo detection, LED), Operational amplifiers and their applications. Digital techniques and applications (registers, counters, comparators) A/D and D/A converters.

Not allotted

Module VII - VINU

Recent Developments in Physics

Nanotechnology

Properties of metal, semi conductor, rare gas and molecular nanoclusters – superconducting fullerene – quantum confined materials – quantum wells, wires, dots and rings – meta materials – graphene

Non Linear Dynamics

Soliton – Effect of nonlinearity and dispersion.

Non Conventional Energy Resources

Wind Energy, Solar Energy, Tidal energy, Bio.

Evolution of Universe

Big Bang Theory : Spontaneous symmetry breaking, Higgs Boson

Basis of Quantum Computing