SYLLABUS FOR LECTURER 10+2 PHYSICS

I. **MATHEMATICAL PHYSICS**

a) **Fourier Series**:

Fourier integral and Fourier transform, Laplace transform with simple applications.

b) **Complex Variables**:

Algebra of complex numbers, analycity of complex functions, Cauchy-Riemann equations, complex integrations, Cauchy integral theorem, Cauchy integral formula, Taylor and Laurent's series, residues and Cauchy residue theorem contour integrations.

c) **Differential Equations**:

Series solution for Bessel differential equation, Bessel function, Generating function for Bessel equations, Lagurre polynomials.

d) **Tensor analysis**:

Tensor algebra, covarient and contravarient vectors and tensors, fundamental metric tensors, line element, associated tensors, fundamental operations with tensors (addition, subtraction, inner and outer multiplication, contraction, quotient law)

II **CLASSICAL MECHANICS**

The Hamiltonan function H., physical significance of Hamiltonian, Hamilton's variational principle, Hamiltonian for central forces, electromagnetic forces and coupled oscillators, equation of canonical transformations, illustrations of cannonical transformations, problem of linear harmonic oscillator, Hamilton-Jacobi equation, one dimensional harmonic oscillator problem as an example of Ham-Jacobi method.

III. **ELECTRONICS**

Review of operating principle of BJT, various configurations (CB, CE and N CC), Biasing of BJT, equivalent circuit

FET -introduction, operation, characteristics (CS, CD configurations), equivalent circuit, BJT, FET h' parameters.

Performance of common base, common emitter, common collector amplifier, Push pull class B amplifier, advantages of push pull amplifier, feedback principle, merits and. demerits of positive and negative feedback.

Principles of operation of oscillator, Phase shift and Wein Bridge oscillator (circuit operation only) HF Hartley oscillator.

Classification of multi vibrators, Monostable and Bistable multivibrators (using transistors), their working and comparison saw tooth and stair case wave form generators

Amplitude modulation, frequency modulations, FM wave spectrum, AM & FM detection. Diode as AM detector.

DIGIT AL SYSTEMS decimal, Binarym, octal, Hazadecimal number system, Elements of Boelean Algebra, addition, subtraction and multiplication in Binary system. NOT, OR AND & NAND gates, Principle and their working using truth tables.

IV. **QUANTUM MECHANICS**

Review of wave mechanics, De Broglie waves, wave particle duality, uncertainty principle, exact statement and principle, wave packets, superposition principle, Schrodinger equation, solution of schrodinger equation for Hz atom, wave function and its interpretation, speed of wave packet, Ehrenfest theorem. Mathematical properties oflinear vector spaces, linear operator, adjoint of an operator, Hermitian operator, commuting and non commuting operators, Eigen values and Eigen vectors, Generalised uncertainty principle, change of basis of unitary transformation, Schrondinger and Heisenberg representation, Heisenberg equation of motion, particle in electromagnetic field,

Loretz force. Commutation relation of angular mom. operators, eigen functions, ladder operators and their matrix representation, addition of angular momenta. Time independant perturbation theory First and second term independant theory, application of perturbation theory to harmonic oscillator, first order Stark effect, and normal Zeeman effect without electron spin.

V. **SOLID STATE PHYSICS**

Crystal system, Bravis lattice, Miller indices of a crystal face, indices of a direction, application of reciprocal lattice, reciprocal lattice for bcc and fcc lattice, Generiltion and absorption of X-rays, scattering of X-rays by atom, scattering from a crystal, the diffraction condtions, Laue equations, Bragg's law, experimental techniques, Laue method, powder method (significance and diffraction geometry) applications of oscillations methods(elementary ideas).

Elements of neutron diffraction, different types of crystal bindings, simple theory of ionic crystals.

Thermal properties of crystals, specific heats of anisotropic crystals, thermal conductivity and thermal expansion.

Electron transport in metals, Boltzmann equation, free electron Fermi gas, electrical conductivity, thermoelectric power, Hall effect.

The origin of atomic magnetism, magnetic contribution due to orbital motion, spin of electron and due to nuclear spin, Diamagnetism, Langevin theory of diamagnetism, paramagnetism, quantum theory of paramagnetism, Langevin theory of paramagnetism, Weiss theory offerromagnetis, Quantum theory of ferromagnetism, Dielectric properties of solids, dielectric constants and polarizability, ionic and electronic polarizibility,

Ferroelectricity and ferroelectric domains, general properties of ferromagnetic materials.

VI. **NUCLEAR PHYSICS**

Properties of nuclei, nuclear size and its determination by various methods, spin and moments of nuclei, nuclear mass, Weizsacker mass formula,

Energy loss of a charged particle through matter, Bremestrahlung, Cerenkov radiations, scintillation counters, Bubble chambers, Photographic emulsion techniques.

Nuclear Forces Saturation, Exchange forces, charge symmetry, charge independance, isotropic spin formalism.

Theory of ground state of deuteron, Deuteron magnetic dipole and quadrupole moment, n-p scattering, effective range theory, p-p scattering at low energy of 10 MeV.

Fermi theory of B-decay, shape of B spectrum, rate of decay, conmparative life times, Fermi-Curie plots, mass of neutrino, parity violation and Wu's expt. Electric and magnetic multipole radiation, expressions for decay constants. selection rules angular correlations and parity of nuclei. Principle of oribital acelerators, synchcyclotron

Elementary Particles Classifications of particles, concepts of various 'quantum numbers, (isospin, Baryon number lepton number), Gell-Mann

Nishijima scheme, intrinsic parity, parity conservation and violation, Quark model Classifications, Basic fermion constuents (Quarks and Leptons)

VII. **ELECTRODYNAMICS**

Review of maxwell's equations, General boundary conditions, Reflection and refraction of em waves, in dielectric and conducting medium, Polarisation by reflection, Total internal reflection, Waves in metals, Low and high frequency approximation, Skin depth.

Dipole Radiation Radiation from an oscillatory dipole, Magnetic dipole radiation, Dipole moment

Radiation from a point charge, Fields of a point charge in motion, Fields of an accelerated charge, Electric and magnetic fields of a charge moving with a constant velocity, Power radiated by a point charge, Free electrons in a conductors and plasma, Reflection from plasma.

VIII. **SPECTROSCOPY**

Review of atomic spectra, Classification of atomic spectra, Spectra of
two electron atom, LS and JJ couplin (central field approximation) Energy level diagram for two electron atom, Molecular spectra (diatomic molecules), Energy states of diatomic molecules, Pure rotation and pure vibration, Vibration, rotation and electronic spectra.

Stimulated emission, Oscillation condition, Population inversion, He-Ne laser, Three-Four level laser system, and threshold conditions, Requirements of a good laser medium.

Electronic spectra of diatomic moleculesm, Vibrational and rotational structures of electronic bands, Intensity distribution in electronic vibrational band.

IX. **STATISTICAL MECHANICS**

Concepts of phase space, Statistical ensemble, Liouville's theorem, canonical and grand canonial ensemble, Derivation of entropy of a perfect gas using micro canonical ensemble, Partition functions and their properties, Calculation of thermodynamical quantities in terms of partition function (ideal mono-atomic gas), Validity of c'1assical approximation, Derivation of Vander Waal's equation from classical statistical mechanics, Quantum, statistics, Quantum ensemble theory, density operator and its physical significance, Quantum Liouville's equation, Determination of thermodynamic functions, Quantum statistics in the classical limit, Black body radiation, Debye model of lattice specific heat.