ACADEMIC CALENDER FOR UNDER GRADUATE COURSE
LESSON PLAN 2015-16

(Explanation: 1st term- 14th July 2015-starting of Autumn vacation
2nd term- End of Autumn vacation-starting of winter recess
3rd term- 2nd January,2016-till test examination)*

PHYSICS HONOURS THEORETICAL

PART – I

PAPER I
UNIT IA

Total Marks : 50 Total No. of Lectures : 70

GROUP A : MATHEMATICAL METHODS OF PHYSICS

1st term

2. Vector Analysis
Transformation properties of vectors; scalar and vector products; Differentiation and integration of vectors; Concept of tensors; Line integral, volume integral and surface integral involving vector fields; Gradient, divergence and curl of a vector field; Gauss' divergence theorem, Stokes' theorem, Green's theorem - application to simple problems; Orthogonal curvilinear co-ordinate systems, unit vectors in such systems, illustration by spherical and cylindrical polar systems. (SC - 9)

3. Differential Equations (a)Ordinary Differential Equations :
Solution of second order linear differential equation with constant coefficients and variable coefficients by Frobenius' method; Solution of Legendre and Hermite equations about x=0; Legendre and Hermite polynomials - orthonormality properties. (SG - 8)

(b) Partial Differential Equations :
Solution by the method of separation of variables; Laplace's equation and its solution in Cartesian, spherical polar (axially symmetric problems), cylindrical polar (`infinite cylinder' problems) coordinate systems; Wave equation and its plane and spherical wave solutions. (SG- 8)

4. Fourier Series
Fourier expansion – statement of Dirichlet's condition, analysis of simple waveforms with Fourier series. Introduction to Fourier transforms; the Dirac-delta function and its Fourier transform; other simple examples.(SC - 5)

2nd term

5. Matrices
Hermitian adjoint and inverse of a matrix; Hermitian and unitary matrices; Eigenvalue and eigenvector; Similarity transformation; diagonalisation of real symmetric matrices with non-degenerate eigenvalues.(SC - 5)

3rd term

1. Preliminary Topics
Infinite sequences and series - convergence and divergence, conditional and absolute convergence, ratio test for convergence. Complex-valued functions - analytic functions defined in terms of Taylor series expansion. Functions of several real variables - partial differentiation,
Taylor's series, multiple integrals. (PM - 5)

Random variables and probabilities – -- examples (PM- 4),

GROUP B : CLASSICAL MECHANICS

1st term

1. Mechanics of a Single Particle,Velocity and acceleration of a particle in (i) plane polar coordinates - radial and crossradial components (ii) spherical polar and (iii) cylindrical polar co-ordinate system; Time and path integral of force; work and energy; Conservative force and concept of potential;Dissipative forces; Conservation of linear and angular momenta.(PM - 6)

2. Mechanics of a System of Particles
Linear momentum, angular momentum, and energy - centre of mass decompositon; Equations of motion, conservation of linear and angular momenta.(PM - 6)

2nd term

3. Rotational Motion
Moment of inertia, radius of gyration; Energy and angular momentum of rotating systems of particles; Parallel and perpendicular axes theorems of moment of inertia; Calculation of moment of inertia for simple symmetric systems; Ellipsoid of inertia and inertia tensor;Setting up of principal axes in simple symmetric cases. (PM-6)

3rd term

Rotating frames of reference – Coriolis and centrifugal forces, simple examples. Force-free motion of rigid bodies - free spherical top and free symmetric top.(PM - 3).

UNIT IB

Total Marks 50 Total No. of Lectures : 70

GROUP C GENERAL PROPERTIES OF MATTER

1st term

1. Gravitation Newton's law of Gravitation; Gravitational potential and intensity - application of Gauss' theorem and Laplace's equation in simple symmetric problems.(MM - 5)

2. Central Force Problem

Motion under central force; Nature of orbits in an attractive inverse square field; Kepler's laws of planetary motion. Rutherford scattering.(MM - 6)

2nd term

3. Elasticity

Stress and strain tensors at any point in a continuous medium; Small deformations, Hooke's law, Interrelations of elastic constants for an isotropic solid. Torsional rigidity; Bending moments and shearing forces, cantilever; Beam supported at both ends; strain energy.(MM -- 9)

3rd term

4. Mechanics of Ideal Fluids

Streamlines and flowlines; Equation of continuity; Euler's equation of motion; Streamline motion - Bernoulli's equation and its applications.(MM - 5)

5. Surface Tension

Surface energy and surface tension; Angle of contact; Excess pressure on a curved liquid surface; Capillary rise; Saturation vapour pressure on a curved surface.(MM - 4)

6. Viscosity

Steady flow of Newtonian fluids; Poiseuille's equation for incompressible fluids; Statement of Stokes' law - terminal velocity; effect of temperature on viscosity; Reynold's number - turbulent flow and critical velocity.(MM - 4)

GROUP D : VIBRATIONS, WAVES AND ACOUSTICS

1st term

1. Vibrations

Linear harmonic oscillator - differential equation and its solution . Free and forced vibrations of a damped harmonic oscillator; resonace; sharpness of resonance. A pair of linearly coupled harmonic oscillators - eigenfrequencies and normal modes. Lissajous figure; Vibrations of a weakly anharmonic oscillator - generation of harmonics, frequency shift. Basic principle underlying the production of combination tones.(ASG - 10)

2. Waves

Linear equation of plane progressive wave motion in one dimension, and in three dimensions; plane wave and spherical wave solutions; intensity of a plane progressive wave; dispersion in wave propagation - group velocity and phase velocity.(ASG - 7)

2nd term

3. Transverse vibrations in stretched strings

Wave equation in the linear approximation; eigenfrequencies and eigenmodes for plucked and struck strings; energy of transverse vibrations.(ASG - 6)

4. Velocity of acoustic waves in isotropic solids, liquids and gases

Derivation of the respective expressions with explanation of the approximations made.(ASG - 4)

3rd term

5. Doppler effect in acoustics

Derivation of expression for Doppler shift in frequency.(ASG-3)

6. Ultrasonics

Basic principles of generation and detection.(2) Tutorials on Problems and Discussions (ASG - 5)

PAPER IIA
UNIT IIA

THERMAL PHYSICS
Group A: Heat

1st term

1. Kinetic Theory of Gases

Basic assumptions of kinetic theory, Ideal gas approximation, deduction of perfect gas laws. Maxwell's distribution law (both in terms of velocity and energy), root mean square and most probable speeds. Finite size of molecules : Collision probability, Distribution of free paths and mean free path from Maxwell's distribution. Degrees of freedom, equipartition of energy (detailed derivation not required) : application to specific heat,
Dulong and Petit's law.(SB - 10)

2nd term

2. Transport Phenomena

(a) Viscosity, thermal conduction and diffusion in gases. (b) Brownian Motion :
Einstein's theory, Perrin's work, determination of Avogardo number.(SB - 5)

3. Real Gases

Nature of intermolecular interaction : isotherms of real gases. van der-Waal'sequation of state, Other equations of state (mention only), critical constants of a gas, law of corresponding states; Virial Coefficients, Boyle temperature; limitations of van der-
Waal's equation of state. (SB - 5)

Group B: Thermodynamics

1st term

1. Basic Concepts

Microscopic and macroscopic points of view: thermodynamic variables of a system, State function, exact and inexact differentials.(SNB - 2)

2. Zeroth Law of Thermodynamics

Thermal equilibrium,. Zeroth Law and the concept of temperature. (SNB - 1)

3. First Law of Thermodynamics

Thermodynamic equilibrium, internal energy, external work, quasistatic process, first law of thermodynamics and applications including magnetic systems, specific heats and their ratio, isothermal and adiabatic changes in perfect and real gases.(SNB - 5)

4. Second Law of Thermodynamics

Reversible and irreversible processes, indicator diagram. Carnot's cycles-efficiency,Carnot's theorem. Kelvin's scale of temperature, relation to perfect gas scale, second law of thermodynamics – different formulations and their equivalence, Clausius inequality, entropy, change of entropy in simple reversible and irreversible processes, entropy and disorder; equilibrium and entropy principle, principle of degradation of energy.(SNB - 10)

2nd term

5. Thermodynamic Functions

Enthalpy, Helmholtz and Gibbs' free energies; Legendre transformations, Maxwell's relations and simple deductions using these relations; thermodynamic equilibrium and free energies. (SNB - 5)

6. Heat Engines

External combustion engine - Rankine cycle, internal combustion engines – Otto and Diesel cycles.(SNB - 3)

7. Change of State

Equilibrium between phases, triple point : Gibbs' phase rule (statement only) and simple applications. First and higher order phase transitions, Ehrenfest criterion. Clausius-Clapeyron's equation. Joule-Thomson effect; inversion temperature, regenerative cooling.(SNB - 7)

3rd term

(c) Heat Transfer

Thermal conductivity, diffusivity. Fourier's equation for heat conduction – its solution for rectilinear and radial (spherical and cylindrical) flow of heat.

Radiation :

Spectral emissive and absorptive powers, Kirchoff's law, blackbody radiation, energy density, radiation pressure. Stefan-Boltzmann law, Planck's law (no detailed derivation), solar temperature and radiation pyrometer.

Convection :

Importance in atmospheric physics (qualitative), adiabatic lapse rate.(SNB - 12)

Tutorials on Problems and Discussions (SNB - 5)

PART II

PAPER III

UNIT IIIA
Total Marks 50
GROUP A
ELECTRICITY I
(SI system should be followed)

1st term

1. Units and dimensions

CGS, Gaussian and SI units; conversion between Gaussian and SI units; dimension of various quantities. (SB - 2)

2. Electrostatics

Coulomb's law of electrostatics, intensity and potential; Gauss' theorem – its application; Poisson and Laplace's equations; deduction from Gauss's theorem; Uniqueness theorem. Superposition theorem (statement only). Application of Laplace's equation to simple cases of symmetric spherical charge distribution.(SB - 9)

6. Steady current

Ohm's law – Differential form, Kirchoff's Law; Wheatstone bridge – its sensitivity (qualitative discussion only).(DR - 4)

7. Magnetic effect of steady current

Lorentz force and concept of magnetic induction; force on linear current element; Biot-Savart's law. Ñ. B=0; magnetic vector potential; calculation of vector potential and magnetic induction in simple cases – straight wire, magnetic field due to small current loop; magnetic dipole; field due to a dipole; magnetic shell; Ampere's theorem; Ampere's circuital law illustration (straight wire); force between long parallel current carrying conductors; ÑxB = mJ; comparison between static electric and magnetic fields. (JM – 12)

11. Network

Thevenin Theorem, Norton theorem, Maximum power transfer theorem, Superposition principle, T and P networks (DR - 3)

2nd term

3. Multipole expansion

Multipole expansion of scalar potential – monopole, dipole and quadrupole terms; potential and field due to a dipole; work done in deflecting a dipole;dipole-dipole interaction(for both electric and magnetic dipoles); force on dipole in a non- homogeneous field.(SB - 6)

4. Dielectrics

Polarisation, electric displacement vector (D); Gauss's theorem in dielectric media; boundary conditions; electrostatic field energy; computation of capacitance in simple cases (parallel

plates); spherical and cylindrical capacitors containing dielectrics – uniform and nonuniform.(SB - 6)

9. Field and magnetic materials

Free current and bound current; surface and volume density of current distribution; magnetisation; nonuniform magnetisation of matter; Jb = ÑxM ; Ampere's law in terms of free current density and introduction of H; line integral of H in terms of free current; boundary conditions for B and H; permanently magnetized body; magnetic scalar potential; application of Laplace's equation to the problem of a magnetic sphere in uniform magnetic field; hysteresis and energy loss in ferromagnetic material; magnetic circuit; energy stored in magnetic field.(JM - 12)

3rd term

5. Electrical Images

Solution of field problems in case of a point charge near a grounded conducting infinite plane. Boundary value problem : in uniform external field for (i) conducting spherical shell and (ii) dielectric sphere.(SB - 6)

10. Electromagnetic induction

Faraday's and Lenz's law; motional e.m.f.-simple problems; calculation of self and mutual inductance in simple cases; inductances in series and parallel; reciprocity theorem. (JM - 5)

UNIT – IIIB

Total Marks : 50 Total No. of lectures : 70

GROUP B ELECTRICITY II

2nd term

1. Transients in D.C.

Growth and decay of current-charging and discharging of capacitors in L-C-Rcircuits; oscillatory discharge; time constant; energy stored in an inductance.(DR - 4)

2. Alternating current

L-C-R circuits in sinusoidal e.m.f.; application of imaginary operator; phase diagram; power; power factor; resonance in series and parallel circuits; Q-factor; filter selectivity; elementary theory of transformer. A.C. bridge – principle of generalized A.C. bridge; Anderson bridge. Theory of rotating magnetic field – induction motor. (DR - 13)

GROUP C : ELECTROMAGNETIC THEORY

2nd term(contd.)

1.Generalization of Ampere's Law, Displacement Current, Maxwell's Field Equations,
Wave equation for electromagnetic (EM) field and its solution – plane wave and spherical wave solutions, transverse nature of field, relation between E and B; energy density of field, Poynting vector and Poynting's theorem, boundary conditions. (SC - 8)

2.EM Waves in an isotropic dielectric; wave equation, reflection and refraction at plane boundary, reflection and transmission coefficients, Fresnel's formula, change of phase on reflection, polarization on reflection and Brewster's law, total internal reflection.(SC - 6)

3rd term

3.EM waves in conducting medium; wave equation in conducting medium, reflection and transmission at metallic surface – skin effect and skin depth, propagation of E-M waves between parallel and conducting plates – wave guides (rectangular only).(SC - 5)

4.Dispersion : Equation of motion of an electron in a radiation field : Lorentz theory of dispersion – normal and anomalous; Sellmeier's and Cauchy's formulae, absorptive and dispersive mode, half power frequency, band width. (SC - 3)

5.Scattering : Scattering of radiation by a bound charge, Rayleigh's scattering (qualitative ideas), blue of the sky, absorption. (SC - 3)

GROUP D : ELECTRONICS I

1st term

1. **Diodes**

Conductor, insulator and semiconductor (distinction on the basis of band theory of solids– qualitative study); concept of hole, extrinsic semiconductor, p-n junction – space charge and electric field distribution at junctions, forward and reversed bias junctions, depletion region, avalanche and Zener breakdown; I-V characteristics and use of Zener as voltage regulator; light emitting diode; analysis of half-wave and full-wave rectifiers; bridge rectifier with C and P filter.(SKM - 7)

2nd term

2. Bipolar Junction Transistors (BJT)

Current component in junction transistor; characteristics in CB and CE configuration, cut off, saturation and active regions; a and b of a transistor and their relations. Output characteristics; load line and Q point; biasing of a transistor – stability factors; hybrid parameters and small signal single stage low frequency CE amplifier (analysis with h-parameter model)-current and voltage gains; input and output impedances, effect of source resistance, power gain; comparison of CB, CC & CE amplifiers (qualitative discussion); emitter follower.(SKM - 9)

3rd term

3. Boolean Algebra

Binary, decimal and hexadecimal systems; conversion from one system to another system; 1's complement and 2's complement of a binary number; binary addition and subtraction. (SKM - 2)

4. Logic Gates

AND, OR, NOT gates – truth tables, circuits of AND and OR gates using diodes and transistors; circuit of NOT gate using transistor; NAND and NOR as universal gate.

Combination of gates for obtaining different Boolean function. de Morgan's theorem – simplification of Boolean's expressions. (SKM - 5)

PAPER IVA
UNIT IVA
Total Marks : 50 Total No. of lectures : 70
OPTICS (65 Lectures)
Group A : Ray Optics

1st term

1.Light as electromagnetic waves wave normals and rays : short wavelength limit and ray(geometrical) optics.(ASR - 2)
2.Fermat principle, application to reflection and refraction at curved surfaces.(3)
3.Cardinal points of an optical system : two thin lenses separated by a distance, equivalent lens, different types of magnification : Helmholtz and Lagrange, paraxial approximation, introduction to matrix methods in paraxial optics – simple application.
(ASR - 5)
4.Dispersion : Dispersive power of optical systems, dispersive power of prism, chromatic aberration – methods of reduction, achromatic lens combination.(ASR - 3)

2nd term

5.Seidel aberration : (only qualitative discussion) Nature and cause of different seidel aberrations, methods of reducting these. (ASR - 3)
6.Optical instruments : Field of view, entrance and exit pupil microscope, eyepieces-

Ramsden and Huygen.(ASR - 4)

Group B: Physical Optics

1st term

1.Wave theory of light : Huygen's principle; deduction of law of reflection and refraction.(5)
2.Interference of light waves : Young's experiment; spatial and temporal coherence; intensity distribution; Fresnel's biprism, interference in thin film; fringes of equal inclination and equal thickness; Newton's ring. Michelson's interferometer, application in fine structure study. Multiple beam interference – reflected and transmitted pattern. Fabry-Perot interferometer and application to fine structure study. (SM - 15)

2nd term

3.Diffraction of light waves : Fresnel and Fraunhofer class, Fresnel's half period zones; explanation of rectilinear propagation of light; zone plate. Fraunhofer diffraction due to a single slit, double slit and circular aperature (qualitative). Plane diffraction grating (transmission).(SM-12).

3rd term

3.(contd) Rayleigh criterion of resolution; resolving power of prism, telescope, microscope and transmission grating. (SM - 3)

4.Polarisation : Different states of polarisation; double refraction (Explanation from Electromagnetic theory), Huygen's construction for uniaxial crystals; polaroids and their uses. Production and analysis of plane, circularly and elliptically polarised light by retardation plates and rotatory polarisation and optical activity; Fresnel's explanation of optical activity; Biquartz and half shade polarimeter. (SM - 10)

Part III

B.Sc. Part III Theoretical
Paper V

Group A: ADVANCED CLASSICAL MECHANICS

1st term

Advanced Classical Mechanics: Generalized coordinates, constraints and degrees of freedom; D'Alembart's principle; Lagranges equation for conservative systems and its application to simple cases; Idea of cyclic coordinates, its relation with conservation principles; Definition of Hamiltonian, Hamilton's equation

(Statement, Derivation by Legendre transformation) and its application to simple cases. Canonically conjugate variables, canonical transformations, Poisson brackets. (PM – 16)

2nd term

Small Oscillation- normal modes and eigen frequencies, simple examples. (PM – 4)

Group B: SPECIAL THEORY OF RELATIVITY

1st term

Special theory of relativity: Velocity of light: Micleson Morley Experiment and Newtonian Relativity. Postulates of special theory of relativity; simultaneity; Lorentz transformation along one of the axes- length contraction, time dilation and velocity addition theorem. Fizeau's experiment. (JM - 7)

2nd term

Four vectors; relativistic dynamics- variation of mass with velocity. Energy momentum and mass energy relations.Light cone: space like, time like and light like four vectors, light cone, causality (JM - 8)

Group C: STATISTICAL PHYSICS

1st term

1. **Statistical Mechanics:** microstates and macrostates-classical description in terms of phase space and quantum description in terms of wave functions. Idea of ensemble. Hypothesis of equal a priori probability for microstates of an isolated system in equilibrium.: Microcannonical ensemble. Ergodic hypothesis. Interactions between two systems- thermal, mechanical and diffusive. Statistical definition of temperature, pressure, entropy and chemical potential. Cannonical and Grand cannonical ensemble. Partition function of a system in thermal equilibrium with heat bath. Law of equipartition of energy, its limit of validity and application. (SNB-8)

2. **Classical Statistics:** Maxwell-Boltzmann (MB) distribution law: Derivation (microcannonical) , Calculation of thermodynamic quantities for ideal monatomic gases. (SNB-2)

2nd term

3. **Quantum Statistics:** Gibbs' Paradox, Identical particle and symmetry requiremnetnt. Derivation of FD and BE statistics as the most probable distributions (micro- cannonical ensemble). Classical limit of quantum statistics. (SNB-5)

4. **Bose Einstein (BE) distribution law:** Derivation, Application of BE statistics to derive Planck's law. Rayleigh Jean's and Wien's law as limiting cases of Planck's law. Phonons and lattice, specific heat of solids: Einstein and Debye's theory, Bose- Einstein condensation (qualitative discussion) (SNB-5)

3rd term

5. **Fermi-Dirac (FD) distribution law:** Derivation, Fermi distribution at zero and nonzero temperatures. Expression for Fermi energy in terms of particle density, Degenerate and non-degenerate Fermi gases. Application of FD statistics to derive specific heat of electrons in metals at low temperatures. Richardson Dushman equation of thermoionic emission. (SNB-5)

Unit VB

Group D Quantum Mechanics

1st term

1. **Basic Quantum Mechanics:** de Broglie hypothesis, Compton effect,Davision-Germer experiment, Heisenberg uncertainty principle. Concept of wave function as describing the dynamical state of a single particle. Group velocity and phase velocities. Classical velocity of a particle an teh group velocity of the wave representing the particle. Principle of superposition. Schrödinger equation, Probabilistic interpretation, equation of continuity, probability current density, Boundary conditions on wave function. (ASR – 9)

2. **Operators in quantum mechanics:** Basic postulates of quantum mechanics, Dynamical variables as linear hermitian operators, eigenvalue equation satisfied by them. Momentum energy and angular momentum operators. Results of measurement of variables. Expectation values. Commutation relations between the operators. Compatible observables and simultaneous measurements. Ehrenfest theorem. (ASR – 9)

2nd term

3.Time dependent and time independent Schrödinger equation. Solutions, eigenstates, normalization and orthonormality of wave function.
(ASR- 4)

4. Simple application of Quantum Mechanics:

One dimensional potential well, boundary condition.

Penetration of rectangular potential barrier in one dimension: derivation of reflection and transmission coefficients.-explanation of alpha decay.

Box normalization. Momentum eigenfunction for a free particle. Linear Harmonic Oscillator (LHO). Solution of the equation of LHO (by the method of solution of Hermite differential equation approach), zero point energy. Parity of wave function. (ASR- 10)

3rd term

Angular momentum operator and their commutation relation. eigen values and eigen functions of L2 and Lz Theorem of addition of angular momenta (statement with example). Hydrogen atom problem. Schrödinger equation for hydrogen atom

problem, Solution of the radial part and energy eigenvalues (Laguerre polynomial solution to be assumed). Degeneracy of the energy eigenvalues.
(ASR – 8)

Group E: ATOMIC SPECTRA, MOLECULAR SPECTRA, X-RAY

1st term

Atomic Spectra: Spectrum of hydrogen atom. Spectra of alkali metal atoms and its relation to hydrogen spectra. Stern Gerlach experiment and intrinsic spin of electron. Spectra of sodium atom. Doublet structure of D lines of sodium. coupling schemes: L-S, j-j and intermediate coupling.

Magnetic moment of electron, Lande g factor, Vector atom model, space quantization, Normal and Anomalous Zeeman effect. (SG-12)

2nd term

Pauli exclusion principle, shell structure, Hund's rule. Spectroscopic terms of many electron atoms in the ground state.

Molecular spectra: Diatomic molecules-rotational and vibrational energy levels. Basic ideas about molecular spectra. Raman effect and its application (qualitative)

X-Ray: Continuous and Characteristic X-rays, Mosley's law and its explanation from Bohr theory.
(SG-9)

Paper VI

Unit VI A

Group A: NUCLEAR PHYSICS

1st term

1. **Gross Properties of nuclei:**
Nuclear mass, charge, size, binding energy, spin and magnetic moment. Isobar, isotope and isotones. Mass spectrometer (Bainbridge). Binding energy per nucleon versus mass number curve and its characteristics.(SM-5)

2. Nuclear Structure:
Nature of forces between nucleons, nuclear stability and nuclear binding, the liquid drop model (descriptive), Bethe Weizsacker mass formula, application to stability considerations, extreme single particle shell model (qualitative discussions with emphasis on phenomenology with examples) (SM-9)

2nd term

3.Unstable Nuclei:
(a) Alpha decay: Alpha particle spectra, velocity and energy of alpha particles, Geiger Nuttal law. (SM-3**)**
(b) Beta Decay: nature of beta ray spectra, the neutrino, energy levels and decay schemes, positron emission and electron capture, selection rules, beta absorption and range of beta particles, Curie plot.(SM-4**)**
(c)
Gamma decay: gamma ray spectra and nuclear energy level, isomeric states, multipolarity transition and selection rules (no derivation). Gamma absorption in
matter- photoelectric process, Compton scattering and pair production (qualitative) (SM-4)

3rd term

4.(a) Nuclear Reaction:
Conservation principles in nuclear reactions, Q value, Q equation, Threshold energy, nuclear reaction cross-sections, examples of different types of reactions and their characteristics, Bohr's postulate of compound nuclear reaction, verification of Bohr's compound nucleus hypothesis, stripping and pick up reactions (qualitative discussion). (SM-4)

(b)Neutron Physics and Nuclear fission:
Neutrons: discovery, properties and decay of isolated neutrons.
Discovery of nuclear fission, Explanation of nuclear fission using liquid drop model, fission products and energy release. Spontaneous and induced fission transuranic elements. Chain reaction and basic principle of reactors. (SM-4)

5. Elementary Particles:

Four basic interactions in nature and their relative strengths, examples of different types of interactions, Quantum numbers-mass, charge, spin, isotropic spin, intrinsic parity, hypercharge, Charge conjugation. Conservation of various quantum numbers, Classification of elementary particles, hadrons and leptons, baryons and mesons, elementary idea about quark structure of hadrons, octet and decuplet families (SG-7)

Group B: Instrumental Method (SB - 20 LECTURE PERIODS) 1.

1st term

Vacuum Techniques: Production of vacuum. Condunctance and pumping speed.
Rotary oil pump. Mercurt diffusion pump. Measurement of high vacuum. McLeod, Penning and Pirani gauges. Leak detector. (SB-6)

2nd term

6. Particle Accelerators:
Linear Accererators, Simple theory, Usefulness, Cyclotron, basic theory, synchrotron. Electron storage ring (ESR). (SB-8)

3rd term

7. Nuclear Detectors:
GM counter, semiconductor detector for charge particles and γ-rays,phodiodes, charge coupled device camera for detection of em Radiation. (SB-6).

Unit VI B
Group C: SOLID STATE PHYSICS

1st term

1. Crystal Structure:
Crystalline and Amorphous solids, translational symmetry. Elementary idea about crystal structure, lattice and bases, unit cell, reciprocal lattice, fundamental types of lattices, Miller indices, simple cubic, f.c.c. and b.c.c. lattices, Laue and Bragg equation-simple deduction. (DR-6)

2.Structure of Solids:
Different types of binding, ionic, covalent, metallic and van der Wall's. Band theory of solids, Kronig-Penny Model, energy band structure. Electrons and holes.
conductors, semiconductors and insulators. Free electron theory of metals, effective mass, drift current, mobility and conductivity, Wiedemann-Franz law, Hall effect in metals. (DR-12)

2rd term

3 Dielectric properties of materials:
Electronic, ionic and dipolar polarizability, local fields, induced and oriented polarization-molecular field in dielectric, Clasius-Mosotti relation. (DR-5)

4 Magnetic Properties of materials:
Dia, para and ferromagnetic properties of solids, Langevin's theory of diamagnetism, Classical and quantum theory of paramagnetism. \ (DR-5)

3rd term

Curie's law, spontaneous magnetization and domain structure, spontaneous magnetization and its temperature dependence. Curie-Weiss law, explanation of hysteresis. (DR-10)

GROUP D: LASER AND FIBRE OPTICS

1st term

1.Laser: Principle of Laser action, Population Inversion, Einstein's A and B coefficients, feedback of energy in a resonator,3 level and 4 level systems, Helium- Neon and Semiconductor Lasers. Application of Laser. Principle of holography (basic principle), isotope separation. Precision measurements (frequency and distance) (ASG-12)

2nd and 3rd term

2.Fibre Optics: Optical fibre, core and cladding, total internal reflection, optical fibre as waveguide, step index and graded index fibre, communication through optical fibres, energy loss, band width and channel capacity for a typical system, attenuation and dispersion, splicing and couplers, Fibre optic sensors. (ASG-10)

Paper VI

Unit VIIA (No of Lectures: 65) [The setting of questions from different groups is as follows; Question No 1 will be of short answer type carrying 2 marks each. 5 out of 8 questions distributed uniformly over the entire syllabus are to be answered. Question Nos 2, 3, 4, 5,6 and 7: 6 Questions are to be set, 4 to be answered.]

ELECTRONICS II

1st term

1. Field Effect Transistors (FET):
JFET structure, JFET operation, static, drain and transfer characteristics, pinch off Common source FET amplifier, small signal low frequency equivalent circuit- voltage gain. MOSFET- enhancement and depletion type, principle of operation, drain and transfer characteristics, idea of CMOS. (SB-8)

2. Feedback in amplifier
Principle of feedback, negative and positive feedback, voltage and current feedback, advantages of negative feedback. (SB-5)

2nd term

3.Multistage Amplifier:

Idea of multistage amplifiers, frequency response of a two stage R-C coupled amplifier. Gain and bandwidth. Class A, B, AB and C amplifiers. Analysis of a single
tuned votage amplifier. Operating points, principle of operation of power amplifiers. Class B push pull amplifier. (SB-8)

4.Oscillators:
Barkhausen condition of sustained oscillation, sinusoidal oscillators-Hartley, Colpit,
Wien bridge and crystal oscillators. Relaxation Oscillators-astable, monostable and bistable multivibrators (MM-8)

5.Operational Amplifiers:
Ideal OP-AMP characteristics, concept of virtual ground, Definition of important terms in connection with OP-AMP: Offset voltage, CMRR, slew rate. Application of OP-AMP: Design of Inverting and non-inverting amplifier, Differential amplifier, Schmitt trigger, Integrator and Differentiator, comparator and function generator and half wave rectifier.. Solution of linear algebraic equation usingOP-AMP. (MM-8)

3^{rd} term

6.Combinational Logic:
Half adder, full adder, digital comparator, decoder, encoder (ROM), multiplexer. Digital to analog and Analog to digital conversions (MM-6)

7.Sequential Logic:
Flip flops-RS, D, JK, edge triggering and clocked operations. Idea about the construction of shift registers and counters. (MM-5)

8. Communication Principles:
Modulation - elementary theory of Amplitude Modulation (AM) and Frequency Modulation (FM) modulation index. Detection of AM and FM waves. (MM-6)

9.Electronic Measuring Instruments: Electronic multimeter; digital voltmeter;CRO-cathod ray tube-electron emission mechanism, brightness and focussing control, fluorescent of volatge frequency and phase with CRO. (MM-6)

* If classes are delayed due to late publication of result special classes will be arranged after

test examination