MANIPUR UNIVERSITY

Syllabus Drafting Committee

For Undergraduate Course: B.Sc. (PHYSICS)

[A Report]

The Syllabus Drafting Committee (Physics) comprises the following members:

1. Th. Jekendra Singh - Chairman
2. K. Yugindro Singh - Convenor
3. Sh. Dorendrajit Singh
4. L. Ibotombi Singh, D.M. College of Science
5. Md. Abdul Gaffar, G.P Women's College
6. SumitraPhanjoubarn- co-opted
7. S. Brajamani Singh - co-opted
8. H. Basantakumar Sharma- co-opted

The Committee met on 12th, 15th, and 19th May, 2010 at the Department of Physics, Manipur University and framed a syllabus for B.Sc. (physics). Four more teachers viz. O. Chaoba Devi of Thoubal college, K. Keinahanbi Devi of Oriental College, M. Bidyasagar of G.P. Women's College, and K. Biren Singh of Manipur College also attended the last meeting held on 19th May. In framing the syllabus the Committee took the following points into consideration.

1. Since the university is giving only a Honours degree, each paper in all the semesters is treated as an Honours Paper.
2. An attempt is made to provide broad perspectives of physics in the first four semesters keeping in view the needs of those students who are majoring in subjects other than physics.
3. The need for a major revision of the list of experiments prescribed for the laboratory classes is felt. Since this shall require a considerable exercise over a period of time, no revision is undertaken.
4. An effort is made to prescribe master textbooks wherever possible.

After due deliberations and discussions, the Committee prepared a draft syllabus for the B.Sc. (Physics) Course. A copy of the syllabus along with a CD containing a PDF file is also enclosed herewith.

Sd/-

(Th. Jekendra Singh)
Chairman, Syllabus Drafting Committee (Physics)

SEMESTER STRUCTURE OF UNDERGRADUATE COURSE: B.Sc. (Physics)

Semester – I

Paper	Course	Marks
FC – 1	Foundation Course (General English)	100
PHY – 101	Mechanics	75
	Laboratory	25
E_2 – 101		100
E_3 – 101		100

Semester – II

Paper	Course	Marks
FC – 2	Foundation Course (General English)	100
PHY – 202	Thermal Physics and Optics	75
	Laboratory	25
E_2 – 202		100
E_3 – 202		100

Semester – III

Paper	Course	Marks
FC – 3	Foundation Course (Environmental Studies)	100
PHY – 303	Electricity and Magnetism	75
	Laboratory	25
E_2 – 303		100
E_3 – 303		100

Semester – IV

Paper	Course	Marks
FC – 4	Foundation Course (Environmental Studies)	100
PHY – 404	Atomic and Nuclear Physics	75
	Laboratory	25
E_2 – 404		100
E_3 – 404		100

Semester – V

Paper	Course	Marks
PHY – 505	Electronics	100
PHY – 506	Mathematical Physics	100
PHY – 507	Laboratory	100

Semester – VI

Paper	Course	Marks
PHY – 608	Quantum Mechanics	100
PHY – 609	Physics of Materials	100
PHY – 610	Laboratory	100

MANIPUR UNIVERSITY
Syllabus of B.Sc. (Physics)

Semester – I

PHY-101: MECHANICS Marks: 75

Fundamentals of Dynamics:
Dynamics of a single particle, Dynamics of a system of particles, Centre of mass, Conservation of momentum, Idea of conservation of momentum from Newton's third law, Impulse, Momentum of variable mass system, Motion of rocket, Work-Energy theorem, Potential Energy, Energy diagram, Stable and Unstable equilibrium, Conservative and Non-conservative forces, Force as a gradient of potential energy. 10 Marks

Rotational Dynamics:
Angular momentum of a particle and system of particles, Torque, Conservation of angular momentum, Rotation about a fixed axis, Moment of inertia – its calculation for rectangular, spherical and cylindrical bodies, Kinetic energy of rotation. 15 Marks

Gravitational and Central Force Motion:
Law of gravitation, Inertial and Gravitational mass and their equivalence, Potential energy and field due to spherical shell and solid sphere, Self energy, Motion of a particle under central force field, Angular Momentum conservation, one body problem, two body problem and its reduction to one body problem and its solution, The energy equation and energy diagram. 15 Marks

Oscillatory Motion:
Motion of a simple and compound pendulum, Loaded spring, Energy considerations, Time average of energy, Damped Harmonic Oscillator, Resonance in a lightly damped system, Free oscillations of system with one degree of freedom, Linearity and superposition principle, Superposition principle, Superposition of (i) two and (ii) N collinear harmonic oscillations; beats. 15 Marks

Special theory of Relativity:
Michelson-Morley experiment and its outcome, Postulates of special theory of relativity, Lorentz transformations, Simultaneity and order of events, Lorentz contraction and time dilation, Relativistic transformation of velocity, frequency and wave number, Velocity dependence of mass and equivalence of mass and energy, Relativistic Doppler effect, Relativistic kinematics, Transformation of energy and momentum. 20 Marks

Suggested Books:

1. An introduction to Mechanics by Daniel Kleppner, Robert J. Kolenkow (McGraw-Hill,1973)
2. Berkeley Physics Course Vol 1 Mechanics: Charles Kittel, Walter Knight, Malvin Ruderman, Carl Helmholz.Burton Moyer. (Tata MvOraw-Hill, 2007)
4. Mechanics: D S Mathur (S. Chand & Company Limited, 2000)
5. The physics of waves and oscillations: N.K. Bajaj (Tata McGraw-Hill, 1988)
6. Berkeley Physics Course Vol 3Waves: Franks Crawford (Tata McGraw-Hill, 2007)

Laboratory: **Marks: 25**

1. Determination of 'g' by using a compound pendulum (bar with holes)
2. Determination of moment of inertia of a body using a torsion pendulum
3. Determination of frequency of a tuning fork by means of a sonometer
4. Determination of 'g' by Kater's pendulum
5. Determination of surface tension of a given liquid by capillary rise method and verification of the Jurin's law
6. Determination of coefficient of viscosity of water by Poiseuille's method
7. Verification of Stoke's Law and determination of coefficient of viscosity of a liquid
8. Determination of Young's modulus by Searle's method
9. Determination of rigidity modulus by statical method

Semester – II

PHY-202: THERMAL PHYSICS AND OPTICS **Marks: 75**

Thermodynamics:
First and second laws of thermodynamics, Carnot theorem, Thermodynamic scale of temperature, Entropy, Entropy of a mixture. Third law of thermodynamics, Thermodynamic potentials: Enthalpy, Gibbs and Helrnholtz functions, First- and second- order phase transitions, Chemical potential, Maxwell relations and their applications, Clausius-Clapeyron's equation, Ehrenfest's equation, Joule- Thomson effect and its theory, Magnetic cooling by adiabatic demagnetization, approach to absolute zero. 15 Marks

Kinetic Theory of Gases and Radiation:
Derivation of Maxwell's law of distribution of velocities, Mean free path, Transport phenomena, viscosity, conduction, diffusion and Brownian motion Equation of state for 'ideal gases, Equation of state for real gases, Deviations from the ideal gas equation, The virial equation, Derivation of Van-der-Waal' s equation, Critical constants and law of corresponding states.

Blackbody radiation, Wien's displacement law, Rayleigh-Jeans' law and ultraviolet catastrophe, derivation of Planck's radiation law 20 Marks

Interference and Diffraction:
Interference in thin films, Fringes of equal thickness and equal inclination, Theory of Newton's rings. Michelson's interferometer and Fabry-Perot interferometer, Difference between Interference and diffraction, Theory of Plane diffraction grating, Resolving power and dispersive power of a plane diffraction grating, Fresnel's integrals, Cornu's spiral, Fresnel diffraction pattern at a straight edge.
20 Marks

Polarization:
Polarization by reflection, Double refraction, wave surfaces at uniaxial crystal, production and detection of elliptically and circularly polarized light, Babinet's compensator- theory and uses, optical activity and polarimeter. 10 Marks

Elements of Quantum Optics:
Stimulated emission, population inversion, spontaneous and stimulated emission, Einstein's coefficients, Threshold condition for laser action, He-Ne laser, Ruby laser, Application of lasers, Elements of second harmonic generation
10 Marks

Suggested Books:

1. A Treatise on Heat: including kinetic theory of gases, thermodynamics and recent advances in statistical thermodynamics: Meghnad Saha, B. N. Srivastava (Indian Press, 1958)
3. Heat and Thermodynamics: an intermediate textbook: Mark Waldo Zemansky, Richard Dittman (McGraw- Hill, 1981)
4. Thermodynamics, Kinetic theory and statistical thermodynamics: Francis W. Sears & Gerhard L. Salinger (Narosa, 18986)
5. Fundamentals of optics: Francis Arthur Jenkins and Harvey Elliot White (McGraw-Hill, 1976)
6. Optics: Ajoy Ghatak (Tata McGraw Hill, 2008)
7. A Textbook of Light: B. Ghosh and K.G. Mazumdar (5^{th} Edition), Sreedhar Publishers, Kolkata
8. Thermal Physics: P K Chakrabarti, New Central Book Agency, Kolkata

Laboratory: **Marks: 25**

1. To construct a thermocouple with the elements supplied and to determine the melting point of the given substance and the thermoelectric power.
2. Determination of 'J' by Callender and Barnes method.
3. Determination of co-efficient of linear expansion of a metallic rod by optical lever method.
4. Verification of Newton's law of cooling.
5. Determination of apparent expansion of a liquid by weight thermometer method.
6. Determination of frequency of a tuning fork by Melde's method.
7. Determination of thermal conductivity of a metallic rod by Searle's method.
8. Determination of the refractive index of the given liquid with the help of a plane mirror, convex lens and a spherometer.
9. Determination of the refractive index of a given liquid by travelling microscope method.

Semester – III

PHY-303: ELECTRICITY AND MAGNETISM **Marks: 75**

Vector and scalar fields:
Fields- scalar and vector, examples, directional derivative and gradient of a vector field, flux and divergence of a vector field, circulation and curl of vector field, algebra of the del operator and Laplacian operator, Gauss's theorem, Stoke's theorem and Green's theorem. 15 Marks

Electric Field:
Electric field and electric lines, Gauss's Law and applications, electrostatics of conductor, Electric potential, multipole moments and multipole expansion, force, torque and energy of a dipole in an external electric field, Poisson's and Laplace's equations, uniqueness theorem, solutions to Laplace 's equations in spherical coordinates, zonal harmonics, conducting sphere in uniform electric field.

Electrostatic energy, system of point charges, system of continuous charge distribution, spherically symmetric charge distributions, charged capacitors.

Dielectric properties of matter, polarization, electric field caused by polarised matter, Gauss's law in a dielectric, boundary conditions on **E** and **D**, capacitors filled with dielectric, dielectric sphere in a uniform electric field, Clausius- Mosseti equation. 20 Marks

Magnetic field:
Magnetic field, magnetic force between currents and definition of **B**, divergence and curl of **B**, Ampere's circuital law, magnetic scalar and vector potentials, calculation of B for a straight wire, a circular loop, and a solenoid, field of a dipole, force, torque and energy of a dipole in an external field, magnetic moment, Lorentz force, magnetic field energy.

Magnetic properties of matter, magnetization, magnetic field caused by magnetized matter, field equations in a magnetized matter, Ampere's law in a magnetized matter, boundary conditions on **B** and **H**, magnetic shell, magnetic circuits, hysteresis and **B-H** curve. 20 Marks

Electromagnetic induction:
Electromagnetic induction, Faraday's laws of induction, curl E, self and mutual inductance, reciprocity theorem, energy stored in a coil,

Alternating current and transient phenomena, AC circuit, mean value of current and voltage, skin effect, power factor, AC in L-R, C-R, L-C-R circuits, series and parallel resonance, transient growth and decay of currents in L-R, C-R, L-C-R circuits, and oscillatory discharge.

Maxwell's equations, the equations and their physical meanings and the respaective laws, equation of continuity, wave equations for E and B, plane wave solutions, transverse nature of electromagnetic wave, flow of electromagnetic power and the Poynting theorem. 20 Marks

Suggested Books:

1. Introduction to Electrodynamics: David J. Griffiths, 3rd edition, (Benjamin Cummings, 1998).
2. Elements of Electromagnetics: Mathew N.O. Sadiku (Oxford University Press)
3. Electricity and magnetism: Edward M. Purcell (McGraw-Hill Education, 1986)
4. Electricity and magnetism: D C Tayal (Hirnalaya Publishing House, 1988)
5. Electricity and Magnetism: D Chattopadhyay and P Rakshit

Laboratory: **Marks: 25**

1. Determination of the horizontal component of earth's magnetic field and the magnetic moment of the magnet with the help of a deflection magnetometer.
2. Determination of self inductance by Rayleigh's method.
3. Determination of frequency of the A.C. mains with the help of sonometer.
4. Determination of capacitance by de Sauty's bridge.
5. Determination of refractive index of a prism by using a spectrometer.
6. Determination of capacitance by using ballistic galvanometer.
7. Determination of ECE of copper.
8. To convert the given galvanometer into an ammeter and calibrate it with the help of copper voltameter.

Semester – IV

PRY-404: ATOMIC AND NUCLEAR PHYSICS **Marks: 75**

Mass spectrographs and X-ray:
Atomic masses: Bainbridge and Aston mass spectrograph,
X-rays: continuous and characteristic X-rays; Mosley's law; absorption of X-ray and absorption spectra, X-ray diffraction and Bragg's law; measurement of X-ray wave length. 10 Marks

Atomic spectra:
Hydrogen spectrum, Bohr's theory, Sommerfeld's modification of Bohr's' theory and relativistic correction, vector model of atom, electron spin, Pauli's exclusion principle, periodic table of elements; spin-orbit interaction - fine structure of hydrogen, spectra of alkali elements, selection rules, L-S and j-j coupling schemes, Zeeman Effect. 20 Marks

Radioactivity:
Law of radio-active decay and half-life, radio-active series; theory of successive transformations; secular and transient equilibrium; Carbon dating, artificial radioactivity; radio-isotopes and their uses; radiation hazards; theory of alpha decay; beta decay and neutrino hypothesis; gamma decay. 10 Marks

Particle accelerator: Linear accelerator, Cyclotron; Betatron; Synchrotron.

Nuclear detectors: Proportional counter, G.M. counter, cloud chamber, bubble chamber, scintillation counter, nuclear emulsion. 10 Marks

Nuclei and their properties: Rutherford's theory of alpha particle scattering and its experimental verification; Charge mass, size, constituents, spin and parity of nuclei; nuclear stability and binding energy; nuclear moments- electric dipole moment, electric quadrupole moment and magnetic moment, nuclear forces.
5 Marks

Nuclear models: Liquid drop model, Semi-empirical mass formula and its applications, shell model. 10 Marks

Nuclear reactions: Q-value of a reaction; kinematics of nuclear reactions; types of nuclear reactions; cross sections for nuclear reactions; nuclear fission-elementary theory of nuclear fission, energy and mass distribution of fission fragments, fission neutrons, four factor formula, nuclear reactor and its types, breeder reactor; nuclear fusion reaction in the sun; controlled nuclear fusion. 10 Marks

Suggested Books:

I. Atomic and Nuclear Physics: Gopalakrishnan (McMillanJ
2. Concepts of Modern Physics: A Beiser
3. Concepts of Nuclear Physics: Bernard L Cohen
4. Nuclear Physics: S N Ghosal
5. Nuclear Physics: D C Tayal

Laboratory: **Marks: 25**

1. To draw the (i-D) curve for a prism using a spectrometer and to find the minimum deviation using sodium light.
2. To draw the (i-D) curve for a prism using a spectrometer and to find the refractive index of the prism using sodium light (angle of prism given).
3. Determination of radius of curvature of a convex lens by Newton's ring method.
4. Determination of dispersive power of a prism for sodium light using a spectrometer.
5. Determination of width of a single slit from a diffraction pattern and verification of the value by means of a travelling microscope.
6. Determination of wavelength of sodium light using a plane transmission grating.
7. Determination of internal resistance of a cell using potentiometer.
8. To measure current in an external circuit with the help of a potentiometer.
9. Calibration of an ammeter with the help of potentiometer

Semester – V
(Honours Course)

PHY-505: ELECTRONICS **Marks: 100**

Basic Circuit Analysis:
Circuit models, Kirchhoffs law, single equation loops, single node pair circuit, voltage and current divider riles, principle of superposition, Thevenin and Norton's theorems, two-port analysis of an electrical network. 10 Marks

Semiconductor diodes:
p-n junction diode, I-V characteristics, application in rectifiers, clippers and limiters, Zener diode and its applications. 10 Marks

Bi-polar junction transistors (BJT):
p-n-p and n-p-n structures. active and saturation regions, characteristics of BJT, common - emitter configuration, input and output characteristics, z and h parameters, common-base configuration. output characteristics, two-port analysis of a transistor using z and h parameters, load line concept, emitter follower, biasing methods, stability factor, low frequency model

Derivation of current gain, input resistance, voltage gain and output resistance of the CB, CE amplifier configurations (for small signals) and the CE configuration with an emitter resistor (also for small signals), bypassing of the emitter resistor with a bypass capacitor. 30 Marks

Field effect transistor (FET):
Classification of various types of FETS, constructional details of junction field-effect ansistor, drain characteristics of JFET, biasing of JFET, operating regions, pinch-off voltage, idea of metal-oxide-semiconductor-field-effect-transistor (MOSFET).
10 Marks

Amplifiers:
Resistance- capacitance and transformer coupled amplifiers, power amplifiers-class A, B, AB and C operations, Concept of negative and positive feedback, representation of a single - loop negative feedback amplifier, transfer gain with feedback, merits and demerits of negative feedback, Differential amplifiers, principles of operational amplifiers, transfer characteristics, offset parameters, differential gain, CMR, inverting and non-inverting operational amplifier, operational amplifier adder, differentiator, integrator, applications of operational amplifiers.
25 Marks

Oscillators:
Wave-form generators: Barkhausen criterion, RC oscillator, Wien Bridge oscillator, phase shift oscillator. 5 Marks

Digital circuits:
Binary system, Boolean algebra, NOR, NAND gates, half and full adders, minimization of Boolean expressions using K –map. 10 Marks

Suggested Books:

1. Digital principles and applications: Donald P. Leach & Albert Paul Malvino, (Glencoe, 1995).
2. Electronic Principles: Albert Paul Malvino (Tata McGraw Hill).
3. Basic Electronics and Linear Circuits: N.N. Bhargava, D.C. Kulshreshtha and S.C. Gupta (Tata McGraw Hill, 2006).
4. Integrated Electronics: Millman and Halkias
5. Electronics: D Chattopadhyay and PC Rakshit

PHY-506: MATHEMATICAL PHYSICS **Marks: 100**

Complex variables and functions of a complex variable:
Complex numbers and their graphical representation, modulus and argument of a complex number, function of a complex variable, continuity and derivative, Cauchy-Riemann condition, analytic functions, integration of a function of a complex variable, Cauchy's theorem, Cauchy 's integral formula, Taylor's series for an analytic function, Laurent series, singularities and their classification, residue and the residue theorem, evaluation of definite integrals. 35 Marks

Special functions:
Gamma functions, recurrence relations, Beta function and recurrence relations, relation between gamma and beta function

Legendre, Hermite and Laguerre polynomials and associated Legendre functions, differential equations and series solutions, generating functions, recurrence relations, orthogonality relations

Bessel Differential equation, generating function, recurrence relation, zeroes of the Bessel function, orthogonality relation, series expansion of a function in terms of a complete set of orthogonal functions. 30 Marks

Partial differential equations:

Vibrations of stretched string, derivation of the equation and its solution under various initial conditions, vibration of rectangular and circular membranes, heat conduction, derivation of the equation, solution for the temperature in a finite rod, semi-infinite rod, the classical wave equation and the Laplace equation. 20 Marks

Fourier series:

Orthogonality of the sine and cosine functions, Fourier series of a function, Fourier series expansion of a periodic function, Parseval's theorem, sine and cosine series 15 Marks

Suggested Books:

1. Advanced Engineering Mathematics: by Erwin Kreyszig
2. Mathematical Methods for Physicists: by G. Arfken and Weber
3. Mathematical Physics: by A. K. Ghatak, I Goyal and Chu
4. Applied Mathematics for Engineers and Physicists: by L. A. Pipes and L. R. Harvell
5. Complex Variables (Schaurn Series): M Spiegel

PHY -507(P): Laboratory **Marks: 100**

1. To draw the characteristics of a transistor in the CE and CB configurations.
2. To draw the resonance curve of series and parallel LCR circuit and to determine the Q-factor.
3. Determination of the constant of a ballistic galvanometer by using a standard capacitor.
4. To construct two input OR and AND logic gates using p-n junction/transistor and to verify their truth tables.
5. To study the performance of NOT circuit using transistors.
6. To draw the characteristic of a Zener diode and to study its use as a voltage regulator.
7. To study solid state half- wave and full- wave rectifiers and to determine the ripple factor and p.c. of regulation and different types of filters.
8. To plot the frequency response of an R.C.-coupled amplifier (i) without feedback and (ii) with negative feedback and to determine the bandwidth in each case

9. Determination of self inductance by Anderson' s method.
10. Determination of mutual inductance by using a ballistic galvanometer and to draw the M.O. curve.
11. Determination of the band gap of a p-n j unction diode (germanium).

Semester – VI
(Honours Course)

PHY -608: QUANTUM MECHANICS **Marks: 100**

Origin of the Quantum theory:

Blackbody-radiation spectrum and Planck's hypothesis, Einstein's idea and the photoelectric effect, Compton Effect, Franck- Hertz experiment

Stability of the atom, Bohr's postulate of angular momentum quantization and the Bohr atom model, Bohr- Sommerfeld quantization rule

De Broglie wave and wave particle duality, Davisson Germer experiment, electron diffraction and neutron diffraction

Developement of Quantum mechanics: Wave behaviour of matter. two-slit experiment with electron (thought experiment), superposition, description in terms of probability and need for probability amplitude, Wave packet, Heisenbergs uncertainty principle (thought experiment and applications), Bohr's complimentary principle, Bohr's correspondence principle. 30 Marks

Basic postulates and formalism:

Schrodinger equation, wave function as probability amplitude and dynamical variables as operators, probability conservation and normalization of wave function, conditions for physical acceptance of wave function, equation of continuity (differential probability conservation)

Eigenvalues and eigenfunction of a dynamical variable, Hermiticity and reality of eigenvalues, physical meaning of eigenvalues of a dynamical variable, superposition of of wave functions and the expansion postulate, expectation value and Ehrenfest's theorem, the commutator and the quantum analogue of the classical equation of motion, constants of motion

The fundamental commutators, commutator algebra, precise definition of uncertainty and the uncertainty relation (statement) 30 Marks

Stationary states and Energy eigen-states:
Stationary states, time independent Schrodinger equation, the stationary state wave functions, free particle and plane wave

Particle in a one-dimensional box:
Energy eigenvalues and eigenfunctions, graphical illustrations, nodes as the energy quantum number, calculation of expectation values, qualitative estimation of the ground state energy from the uncertainty principle

Linear harmonic oscillator:
Solution of the Schrodinger equation for energy eigenvalues and eigenfunctions, calculation of expectation values and matrix elements, parity of eigenfunctions, the varial theorem

One dimensional potential barrier:
One-dimensional finite potential step, stationary solutions, reflection and transmission coefficients, phenomenon of barrier penetration

Hydrogen atom:
Solution for the energy spectrum and the eigenfunctions, the quantum numbers n, 1, m, degeneracy, expectation values, the virial theorem 40 Marks

Suggested Books:

1. Quantum Mechanics: B H Bransden and C J Joachain (Pearson, 2008)
2. Quantum Mechanics: L. I. Schiff (McGraw Hill Book Co., New York, 1968).
3. Quantum Mechanics: E. Merzbacher, (John Wiley & Sons, Inc 1997)
4. Quantum Mechanics: J.L. Powell & B. Crasemann (Addison-Wesley Publs. Co., 1965)
5. Quantum Mechanics: Theory and Applications: A. Ghatak & S. Lokanathan 5th Edition, (Macmillan India: 2004)

PRY -609: PHYSICS OF MATERIALS **Marks: 100**

Crystal structure:
Crystalline and amorphous materials, lattice and unit cell, lattice translational vectors, lattice with a basis- central and noncentral unit cell, reciprocal lattice, Bravais lattice types, Brillouin zones of sc, bcc, fcc lattices, X-ray diffraction: Braggs Law, X-ray scattering, atomic structure factor and geometric structure factor 20 Marks

Electrical Properties of Materials:
Free electron model and its limitation, elementary band theory: Bloch theorem, Kronig Penney model, effective mass, concept of hole, band gaps, classification of solids, intrinsic and extrinsic semiconductors, p-type and n-type semiconductors, conductivity of semiconductors, concentration of charge carriers, Femi level and its temperature dependence, classical Hall effect 20 Marks

Magnetic properties of Materials:
Types of magnetic materials, classical theory of diamagnetism and paramagnetism, quantum mechanical treatment of paramagnetism, Curies law, Weiss' theory of ferromagnetism, magnetic domains, soft and hard magnetic materials. 20 Marks

Lattice Dynamics:
Lattice vibrations, monatomic and diatomic lattice vibrations, acoustic and optic modes, Einstein's' theory of specific heat, Density of states, Debye's theory of specific heat 20 Marks

Superconductivity:
Experimental properties, Meissner effect, London's theory and penetration depth, isotope effect, type I and type II superconductors, elementary idea of high T_c superconductivity 15 Marks

Physics of low dimension:
Density of states in low dimension, different types of nanomaterials, Blue Shifting, quantum wells, wires and application of nanoscience 10 Marks

Suggested Books:

1. Solid State Physics: - A J Dekkar
2. Introduction to Solid State Physics: - C Kittel
3. Solid State Physics: - A R Verma and 0 N Srivastava
4. Introduction to Nanoscience: - Poole etal
5. Solid State Physics: - Keer

PRY -610: Laboratory **Marks: 100**

1. Determination of wavelength of monochromatic light source by using Fresnel's biprism
2. To draw the (μ-λ) curve for the material of it prism by using spectrometer and verification of dispersion formula
3. To draw the (μ-λ) curve for the material of a prism by using spectrometer and determine the wavelength of the given source
4. To draw the (D-λ) curve for a given spectrometer and hence to determine the wavelength of the unknown source
5. Determination of the grating constant by using sodium light and hence to determine the wavelength of the unknown radiation
6. To calibrate a polarimeter and to determine the concentration of a given solution
7. Determination of electronic charge by Millikan's experiment
8. To study the hydrogen spectrum and to determine the Rydberg's constant with the given grating and spectrometer
9. Determination of e/m of electron by Thomson's method
10. To study the B-H curve and hysteresis loss by anchor ring method
11. To determine Planck's constant using a photocell

Suggested Books:

1. A Handbook of Advanced Practical Physics: C R Dasgupta
2. Advanced Practical Physics: K G Mazumdar
3. Practical Physics: D Chattopadhyay and P C Rakshit
4. A Textbook of Advanced Practical Physics: S K Ghosh

Semester – V
(General Course)

E-505: Mathematical Physics and Electronics (Pass Course) **Marks: 75**

Fourier Series:
Fourier series of a function, Dirichlet condition (statement only), expansion of a periodic function, square wave, triangular wave

Series Solution:
Regular and singular solutions, Fuch's theorem, Frobenius solution, Legendre differential equation, generating function, recurrence relation and orthogonality theorem 25 Marks

Network Analysis:
Thevenin and Norton's theorems, two-port analysis of an electrical network

Semiconductor diodes:
p-n junction diode, I-V characteristics, rectifiers, Filters- capacitance, inductance and pi-section, Zener diode and as a voltage regulator 15 Marks

Bi-polar junction transistors (BJT):
p-n-p and n-p-n structures, characteristics of BJT, common-emitter configuration, input and output characteristics, common-base configuration, output-characteristics, two-port analysis of a transistor using h parameters, load line concept, low frequency model, transistor amplifying action. 15 Marks

Transistor Amplifier:
Resistance- capacitance coupled amplifiers, concept of negative and positive feedback, representation of a single - loop negative feedback amplifier, transfer gain with feedback, merits and demerits of negative feedback 10 Marks

Oscillators:
Barkhausen criterion, Wien Bridge oscillator, phase shift oscillator,
Digital circuits:
Binary system, Boolean algebra, basic (AND, NOT, OR) and universal (NOR, NAND) logic gates. 10 Marks

Semester V: Laboratory Course **25 Marks**

1. To draw the static characteristics of a P n junction diode and determine its internal resistance (forward biased case)
2. To draw the static characteristics of a triode and determine its amplification factor
3. To determine the resistance of a galvanometer by half deflection method
4. To draw the characteristics of a Zener diode and determine breakdown voltage
5. To draw the characteristics of a transistor in the CE- and CB- configurations
6. To plot the frequency response of an R.C.- coupled amplifier (a) without feedback and (b) with negative feedback and to determine the band width in each case
7. Determination of self-inductance by Anderson's method
8. To compare the capacitances of two given condensers with the help of a ballistic galvanometer
9. To compare two given low resistances using a potentiometer
10. To construct a two input OR and AND logic gates using p-n junction diodes and to verify truth tables

Semester – VI
(General Course)

E-606: Quantum Physics and Solid State Physics (Pass Course) **75 Marks**

Quantum Physics:
De Broglie wave and wave particle duality, Davisson Germer's experiment, electron diffraction, Wave behaviour of matter, superposition, uncertainty principle, Schrodinger equation, wave function, probability amplitude, Particle in a one-dimensional box, energy eigenvalues and eigenfunctions, calculation of expectation values, qualitative estimation of the state energy from the uncertainty principle, one dimensional potential step. 25 Marks

Crystal Structure:
Crystalline and amorphous state solid; space lattice, primitive and non-primitive unit cells; crystal symmetry, Bravais lattice; Miller indices; study of crystal structures
10 Marks

Thermal and magnetic properties of solid:
Breakdown of the classical theory of specific heat of solid; Einstein's theory of specific heat, Debye's theory of specific heat of solid; Langevin diamagnetism; classical theory of paramagnetism and the Curie's law, Theory of ferromagnetism and Curie- Weiss Law 20 Marks

Free electron theory of metal:
Difficulties of the free electron theory of metals, density of states, Fermi energy, Sommerfield's electrical conductivity

Band theory of solids:
Bloch theorem; Kronig-Penny model (No derivation), origin of energy bands in solids, motion of electrons in solids and effective mass, classification of solids
20 Marks

Semester VI: Laboratory Course (Pass Course) **25: Marks**

I. To draw the (D-λ) curve for the material of a prism by using spectrometer and verification of dispersion formula.
2. To draw the dynamic characteristic curve of a triode and determine μ.
3. Determination of the wavelength of a monochromatic light source by Newton's ring method.
4. To determine Planck constant h by using a photocell.
5. To determine electronic charge from the rectifier equation after drawing characteristic curve of a p-n junction diode.
6. To determine the constant of a ballistic galvanometer by using a standard capacitor.
7. To determine the dip of a place using an earth inductor.
8. To determine the specific charge (e/m) of electron by Thomson method.
9. To study Fourier spectrum analysis of a given signal by using CRO.
10. To calibrate a polarimeter and to determine the concentration of a given solution.