BSc Physics / Integrated MSc Physics Syllabus

JIS University

First Semester

S.No	Subject Code	Subject Name	L	T	P	Credit	Hours /Week
1	BPY101	Mathematical Physics I	2	1	0	3	3
2	BPY102	Acoustics and General Properties of Matter	2	1	0	3	3
3	BCH101	Inorganic Chemistry I	2	1	0	3	3
4	BCH102	Physical Chemistry I	2	1	0	3	3
5	BMTH101	Mathematics I	3	1	0	4	4
6	BPY191	Physics Laboratory	0	0	3	2	3
7	BCH191	Chemistry Laboratory	0	0	3	2	3
8	BHU 101	English	3	0	0	3	3
9	BSD181	Project and Seminar	0	0	0	1	-
10	BSD182	Skill Development	0	0	0	1	-
Total			14	5	6	25	25

Second Semester

S.No	Subject Code	Subject Name	L	T	P	Credit	Hours /Week
1	BPY 201	Classical Mechanics I	2	1	0	3	3
2	BPY 202	Thermal Physics	2	1	0	3	3
3	BCS 201	Computer Applications in Physics & Chemistry	2	0	2	3	4
4	BCH201	Organic Chemistry I	2	1	0	3	3
5	BCH202	Physical Chemistry II	2	1	0	3	3
6	BMTH201	Mathematics II	3	1	0	4	4
7	BPY291	Physics Laboratory	0	0	3	2	3
8	BCH291	Chemistry Laboratory	0	0	3	2	3
9	BSD281	Project and Seminar	0	0	0	1	-
Total			11	4	8	24	26

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Third Semester

S.No	Subject Code	Subject Name	L	T	P	Credit	Hours /Week
1	BPY 301	Mathematical Physics II	2	1	0	3	3
2	BPY 302	Electricity and Magnetism	2	1	0	3	3
3	BPY 303	Optics I	2	1	0	3	3
4	BCH301/ BCH 302/ BCH303	Organic Chemistry II / Inorganic Chemistry II / Physical Chemistry III	2	1	0	3	3
5	BMTH301	Mathematics III	3	1	0	4	4
6	BPY391	Physics Laboratory	0	0	6	4	6
7	BCH391	Chemistry Laboratory	0	0	6	4	6
7	BSD381	Project and Seminar	0	0	0	1	-
8	BSD382	Skill Development	0	0	0	1	-
Total			11	5	12	26	28

Fourth Semester

S.No	Subject Code	Subject Name	L	T	P	Credit	Hours /Week
1	BPY 401	Quantum Mechanics I	2	1	0	3	3
2	BPY 402	Statistical Physics	2	1	0	3	3
3	BPY 403	Electronics I	2	1	0	3	3
4	BPY404	Electromagnetic Theory	2	1	0	3	3
5	BCH401/ BCH 402/ BCH403	Organic Chemistry III / Inorganic Chemistry III / Physical Chemistry IV	2	1	0	3	3
6	BMTH401	Mathematics IV	3	1	0	4	4
7	BPY491	Physics Laboratory	0	0	6	4	6
8	BSD481	Project and Seminar	0	0	0	1	-
Total			13	6	12	24	25

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Fifth Semester

S.No	Subject Code	Subject Name	L	T	P	Credit	Hours /Week
1	BPY 501	Optics II	2	1	0	3	3
2	BPY 502	Quantum Mechanics II	2	1	0	3	3
3	BPY 503	Solid State Physics	2	1	0	3	3
4	BPY 504	Atomic and Nuclear Physics	2	1	0	3	3
5	BPD 591	Project I	0	0	6	4	6*
6	BPY591	Physics Laboratory	0	0	6	4	6
7	BSD581	Project and Seminar	0	0	0	1	-
8	BSD582	Skill Development	0	0	0	1	-
Total			8	4	12	22	24

Sixth Semester

S.No	Subject Code	Subject Name	L	T	P	Credit	Hours /Week
1	BPY 601	Classical Mechanics II	2	1	0	3	3
2	BPY 602	Electronics II	2	1	0	3	3
3	BPY ***	Departmental Elective	2	1	0	3	3
4	***	Open Elective	2	1	0	3	3
6	BPV691	Grand Viva	0	0	0	1	3
7	BPD691	Project II	0	0	9	6	9*
9	BSD682	Project and Seminar	0	0	0	1	-
Total			10	5	9	20	24

BPY101 Mathematical Physics I (2-1-0)

1. Preliminary Topics

Infinite sequences and series - convergence and divergence, conditional and absolute convergence, ratio test for convergence. Functions of several real variables - partial differentiation, Taylor's series, multiple integrals.

Random variables and probabilities - statistical expectation value, variance; Analysis of random errors: Probability distribution functions (Binomial, Gaussian, and Poisson)

2. Vector Analysis

Transformation properties of vectors; Differentiation and integration of vectors; Line integral, volume integral and surface integral involving vector fields; Gradient, divergence and curl of a vector field (Physical significance); Gauss' divergence theorem, Stokes' theorem, Green's theorem (Green's theorem) - application to simple problems; Orthogonal curvilinear co-ordinate systems, unit vectors in such systems, illustration by plane, spherical and cylindrical co-ordinate systems only.

3. Matrices

Hermitian adjoint and inverse of a matrix; Hermitian, orthogonal, and unitary matrices; Eigenvalue and eigenvector (for both degenerate and non-degenerate cases); Similarity transformation; diagonalisation of real symmetric matrices.

4.(i) Basic ideas of Probability & Statistics

(ii) Error analysis, significant figures, limits of accuracy of an Experiment-associated choice of equipments.

Recommended Books:

1. Mathematical Methods for Physicists – Arfken, Weber Harris (Elsevier).
2. Higher Engineering Mathematics, B S Grewal, (Khanna Publishers).
3. Vector Analysis - M. R. Spiegel, (Schaum's Outline Series) (Tata McGraw-Hill).
4. Mathematical Physics – A.K. Saxena (Narosa)
5. Mathematical Physics – P.K. Chattopadhyay (Wiley Eastern)

BPY102 Acoustics and General Properties of Matter (2-1-0)

1. Linear Harmonic Oscillator

LHO. Free and forced vibrations. Damping. Resonance. Sharpness of resonance. Acoustic, optical, and electrical resonances: LCR circuit as an example of the resonance condition. A pair of linearly coupled harmonic oscillators --- eigen frequencies and normal modes.

2. Waves

Plane progressive wave in 1-d and 3-d. Plane wave and spherical wave solutions. Dispersion: phase velocity and group velocity.

3. *Gravitation:* Newton's law, Gravitational potential and intensity due to spherical and other symmetrical bodies, Self energy.

4. *Elasticity:*

Elastic constant, Poisson's ratio- inter realations, bending of uniform beams Torsional rigidity.

5. *Surface tension.*

Capillary rise. Excess pressure. Shape of liquid drops. Vapor-pressure over a curved surface. Surface tension and evaporation.

6. *Fluid motion*. Euler's method of describing fluid motion. Path line and Stream line, Viscous flow through a capillary tube, Poiseuilli's formula. Stokes law. Reynolds's number. Euler's equation of incompressible fluid. Bernoulli's fluid. Bernoulli's theorem. Velocity of efflux of a liquid. Pilot tube, Venturimeter

Recommended Books:
1. Principles of acoustics, Basudev Ghosh, Sreedhar Publishers,
2. Advanced Acoustics - D. P. Ray Chaudhuri (Chayan – Kolkata).
3. Waves and Oscillations - Rathin N. Chaudhury (New Age Publ.).
4. Waves- J R Crawford (Tata McGraw Hill)
5. A treatise on general properties of matter, Sengupta and Chatterjee, Central Publishers
6. Newman & Searle – General Properties Matter
7. C. J. Smith – General Properties of Matter

BPY201 Classical Mechanics I (2-1-0)

1. Mechanics of a Single Particle
Velocity and acceleration of a particle in (i) plane polar coordinates - radial and cross-radial 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 momentum.
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.
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. Rotating frames of reference - Coriolis and centrifugal forces, simple examples.
4. Special Theory of Relativity
Galilean transformation and invariance of Newton's laws of motion, non-invariance of Maxwell's equations. Michelson-Morley experiment and explanation of the null result. Concept of inertial frame. Postulates of special theory; simultaneity; Lorentz transformation along one of the axes – length contraction, time dilatation and velocity addition theorem, Four /vectors. Relativistic dynamics : variation of mass with velocity; energy momentum relationship. Concept of space-time, Space like, time-like and light like four vectors.

Recommended Books:
1. Theoretical Mechanics - M. R. Spiegel, (Schaum's Outline Series) (McGraw-Hill).
2. Mechanics - K. R. Symon (Addison-Wesley).
3. Classical Mechanics, A. K Saxena, CBS, New Delhi (2010)
4.Introduction to Classical Mechanics - R. G. Takwale and P. S. Puranik (Tata McGraw-Hill).
5. Classical Mechanics – N. C. Rana and P. S. Joag (Tata McGraw-Hill).
6. Mechanics and General Properties of Matter – D. P. Roychaudhuri and S. N. Maiti (Book

Syndicate).
7. The Feynman Lectures on Physics – Vol I (Addison-Wesley).
8.An Introduction to Mechanics – D. Keppner and R.J. Kolenkow (Tata McGraw-Hill).
9.Mechanics – H. S. Hans and S. P. Puri (Tata McGraw-Hill).
10. Classical Mechanics – J. Goldstein (Narosa Publ. House).
11. Classical Mechanics – A. K. Roychaudhuri (O. U. P., Calcutta).
12. Introduction to Special Theory of Relativity - R. Resnick (Wiley Eastern).
13. Special Theory of Relativity - A. P. French (ELBS).
14. Special Theory of Relativity, Puri, (Pearson).
15. Theory of Relativity – Nikhilendu Bandyopadhyay (Academic Publishers)

BPY202 Thermal Physics (2-1-0)

1.Kinetic Theory of Gases

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).

2. Transport Phenomena

Viscosity, thermal conduction and diffusion in gases. Brownian motion: Einstein's theory, Perrin's work, determination of Avogadro number.

3. Real Gases

Nature of intermolecular interaction: isotherms of real gases. van der Waals equation of state, Other equations of state (mention only), critical constants of a gas, law of corresponding states; Virial Coefficients, Boyle temperature.

4. Basic Concepts of Thermodynamics: Microscopic and macroscopic points of view : thermodynamic variables of a system, State function, exact and inexact differentials.

5. First Law of Thermodynamics

Thermal equilibrium, Zeroth law and the concept of temperature. Thermodynamic equilibrium, internal energy, external work, quasistatic process, first law of thermodynamics and its applications, specific heats and their ratio, isothermal and adiabatic changes in perfect and real gases.

6. 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. Otto and Diesel engines.

7. Thermodynamic Functions

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

8. 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.

Recommended Books:
1. Heat and thermodynamics - Zemansky and Ditman (Mc Graw Hill, Kugakusha).
2. Kinetic theory of gases - Loeb (Radha Publ. House).
3. Thermodynamics – F. Fermi (Dover)
4. An introduction to Thermodynamics and Statistical Mechanics, A.K Saxena (Narosa).
5. A Treatise on Heat - Saha and Sribastava (The Indian Press Ltd).
6. Thermal Physics – S. Garg, R. M. Bansal, C. K. Ghosh (Tata Mc Graw Hill).
7. Heat and Thermodynamics – H. P. Roy and A. B. Gupta (New Central Book Agency).

BPY301 Mathematical Physics II (2-1-0)

1.Ordinary Differential Equations
Solution of second order linear differential equations with constant coefficients and variable coefficients by Frobenius' method (singularity analysis not required); Solution of Legendre and Hermite equations about x=0; Legendre and Hermite polynomials - orthonormality properties.
2. *Partial Differential Equations*
Solution by the method of separation of variables; Laplace's equation and its solution in Cartesian, spherical polar (axially symmetric problems), and cylindrical polar (`infinite cylinder' problems) coordinate systems.
3. 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. Applications: Conduction of Heat: Thermal conductivity, diffusivity. Fourier's equation for heat conduction – its solution for rectilinear and radial (spherical and cylindrical) flow of heat. Vibration of stretched strings- plucked and struck cases.
Recommended Books:
1. Introduction to Mathematical Physics - C. Harper (Prentice-Hall of India).
2. Mathematical Methods - M. C. Potter and J. Goldberg (Prentice-Hall of India).
3. Higher Engineering Mathematics, B S Grewal, (Khanna Publishers).
4. Mathematical Physics – A.K. Saxena (Narosa)
5. Mathematical Physics – P.K. Chattopadhyay (Wiley Eastern)

BPY302 Optics I (2-1-0)

1. Fermat's principle
Fermat's principle and its application on plane and curved surfaces.
2. Cardinal points of an optical system
Two thin lenses separated by a distance, equivalent lens, different types of magnification: Helmholtz and Lagrange's equations, paraxial approximation, introduction to matrix methods in paraxial optics – simple application.
3. Interference of light waves

Huygen's principle; 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. Multiple beam interference – reflected and transmitted pattern. Fabry-Perot interferometer.

4. 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 aperture (qualitative). Plane diffraction grating (transmission). Rayleigh criterion of resolution; resolving power of prism, telescope, microscope and transmission grating.

5. Polarisation

Different states of polarisation; double refraction, 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.

Recommended Books:

1. A Text book on Light, Ghosh and Mazumdar, Sreedhar Publishers
2. Fundamentals of Optics - F. A. Jenkins and H. E. White (Mc Graw Hill, Kogakusha).
3. Optics – A. K. Ghatak (Tata Mc Graw Hill).
4. Optics – Hecht and Zajac (Addison-Wesley)
5. Optics – B. K. Mathur.
6. Geometrical and Physical Optics - B. S. Longhurst (Orient Longmans).

BPY303 Electricity and Magnetism (2-1-0)

1. *Units and dimensions*:CGS, Gaussian and SI units; conversion between Gaussian and SI units.

2. *Gauss' law*: Coulomb's law of electrostatics, intensity and potential; Gauss' theorem – its application; Poisson and Laplace's equations; Superposition theorem (statement only). Application of Laplace's equation to simple cases of symmetric charge distribution.

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

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 non-uniform.

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.

6. *Steady Direct Current (dc)*: Charge-particles in motion-electric current (drift, diffusion and connection); current density and equation of continuity; potential difference and electromotive force, electric energy sources – voltage source and current source; metallic conduction and Ohm's law, conductance and resistance as parameters. Network: Thevenin Theorem, Norton theorem, Maximum power transfer theorem, Superposition principle, T and Π networks.

7. *Magnetic effect of steady current Lorentz force and concept of magnetic induction*; force on linear current element; Biot-Savart's law. ∇. 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 – simple illustrations; force between long parallel current carrying conductors; ∇xB = μJ; comparison between static electric and magnetic fields.
8. *Field and magnetic materials:* Free current and bound current; surface and volume density of current distribution; magnetisation; nonuniform magnetisation of matter; $J_b = \nabla$xM ; 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.
9. *Electromagnetic induction:* Faraday's and Lenz's law; motional e.m.f.-simple problems; inductances in series and parallel; reciprocity theorem LR, CR and LCR circuits- transient and sinusoidal emf cases, calculation of self and mutual inductance in simple cases.

Recommended Books:
1. Introduction to Electrodynamics – D. J. Griffith, (Prentice Hall, India Pvt. Ltd).
2. Foundation of Electricity & Magnetism, Basudev Ghosh, Books & Allied
3. Berkeley Series Vol II (Electricity and Magnetism) E.M. Purcell (Tata McGraw-Hill).
3. The Feynman Lectures on Physics – Vol. II (Addison – Wesley).
4. Electricity and Magnetism - J. H. Fewkes and J. Yarwood (Oxford Univ. Press, Calcutta).
5. Electricity and Magnetism – Chatterjee and Rakshit.
6. Electricity and Magnetism – A. S. Mahajan and A. A. Rangwala (Tata McGraw-Hill).
7. Classical Electrodynamics – J.D. Jackson (Wiley India)

BCS 301 COMPUTER APPLICATIONS IN PHYSICS & CHEMISTRY (3-0-2)

MS Office, Programming in MathCAD, MATLAB, Mathematica. Use of Origin, Curve Fitting, Extrapolation. Error analysis. Basics of Simulation techniques, Elements of C Programming Language: Algorithms and flowchart; Structure of a high level language program; Features of C language; constants and variables; expressions; Input and output statements; conditional statements and loop statements; arrays; functions; character strings; structures; pointer data type. Numerical Methods: Roots of Polynomials, Solution of Linear simultaneous equations, matrix multiplication and inversion. Numerical integration. Statistical treatment of data, variance and correlations.

Books Recommended: 1. Balaguruswamy, ANSI C. TMH. 2. Gottfried, Programming with C. Schaum series. 3. Tanenbaum, Operating system. Prentice Hall.

BPY401 Quantum Mechanics I (2-1-0)

1. Old quantum theory
Planck's formula of black-body radiation. Photoelectric effect. Compton effect
2. Basic quantum mechanics
de Broglie hypothesis. Electron double-slit experiment. Compton effect, Davisson-Germer experiment, Heisenberg's uncertainty principle (statement) with illustrations. Concept of wave function as describing the dynamical state of a single particle. Group and phase velocities, classical velocity of a particle and the group velocity of the wave representing the particle. Principle of superposition. Schrodinger equation. Probabilistic interpretation; equation of continuity, probability current density. Boundary conditions on the wave function.
3. Basic postulates of quantum mechanics
Dynamical variables as linear hermitian operators and eigenvalue equations, Momentum, energy and angular momentum operators. Measurement of observables, expectation values. Commutation relations between operators. Compatible observables and simultaneous measurements, Ehrenfest theorem.

Recommended Books:
1. Quantum Mechanics – J. L. Powell and B. Crasemonn, (Oxford, Delhi).
2. Quantum Mechanics – F. Schwabl (Narosa).
3. Quantum Mechanics – A. K. Ghatak and S. Lokenathan (Macmillan, Delhi).
4. Introductory Quantum Mechanics - S. N. Ghoshal (Calcutta Book House).
5. A Textbook of Quantum Mechanics – P. M. Mathews and K. Venkatesan (Tata McGraw Hill).
6. Modern Quantum Mechanics – Sakurai (Persian Education)

BPY402 Statistical Physics (2-1-0)

1.Microstates and macrostates
Classical description in terms of phase space and quantum description in terms of wave functions. Hypothesis of equal *a priori* probability for microstates of an isolated system in equilibrium. Interactions between two systems – thermal, mechanical and diffusive. Statistical definition of temperature, pressure, entropy and chemical potential. Partition function of a system in thermal equilibrium with a heat bath.
2. Classical statistical mechanics
Maxwell-Boltzmann distribution law. Calculation of thermodynamic quantities for ideal monoatomic gases.
3. Motivations for quantum statistics
Gibbs' paradox. Identical particle and symmetry requirement. Derivation of MB, FD and BE statistics as the most probable distributions (micro-canonical ensemble). Classical limit of quantum statistics.
4. Quantum statistical mechanics
Bose-Einstein statistics: Application to radiation – Planck's law, Radiation: Spectral emissive and absorptive powers, Kirchoff's law, blackbody radiation, energy density, radiation pressure.

Stefan-Boltzmann law, Newton's law of cooling, Planck's law. Rayleigh Jeans and Wien laws as limiting cases, Stefan's law. Fermi-Dirac statistics: Fermi distribution at zero and non-zero temperatures. Fermi energy and its expression in terms of particle density. Degenerate and non-degenerate Fermi gas. Electron specific heat of metals at low temperature. Saha equation for thermal ionization and its application to astrophysics.

Recommended Books:
1. Statistical Physics, F. Mandle (ELBS).
2. Fundamentals of Statistical and Thermal Physics, F. Reif, (Mc Graw Hill).
3. Laser Principles and Applications – A. K. Ghatak and K. Tyagrajan (Tata – Mc Graw Hill).

BPY403 Electronics I (2-1-0)

1. Semiconductor diodes:
Zener diode and its applications, optoelectronic diodes: LED, photo diodes.
2. Bipolar junction transistors (BJT)
pnp and npn structures; CE, CB,and CC modes, characteristics of BJT in CE
configuration α and β of a transistor and their interrelation, Two port analysis of a transistor, h-parameter model, transistor biasing and stability of biasing, transistor as amplifier-its analysis by using h parameter model (CE only)
3. Field effect transistors (FET)
FETs, construction, drain characteristics, biasing, operating region, pinch-off voltage. MOSFET: construction of enhancement and depletion type, principle of operation and characteristics. Elementary ideas of CMOS and NMOS.
4. Digital electronics
Boolean theorem, Boolean identities, OR, AND, NOT, NAND, NOR gates, Ex-OR, Ex-NOR gates, universal gate, de-Morgan's theorem, 1's and 2's complement, binary number addition, subtraction and multiplication, functional completeness, S-O-P and P-O-S representation, Karnaugh map.

Recommended Books:
1. Integrated Electronics – J. Millman and C. C. Halkias (Mc Graw Hill).
2. Fundamental Principles of Electronics, Basudev Ghosh, (Books & Allied)
3. Electronic Fundamentals and Applications – D. Chattopadhyay and P. C. Rakshit (New Age International)
4. Electronic Device and Circuit Theory – R. Boylestad and L. Nashelsky (Prentice – Hall).
5. Electronics Fundamentals and Applications – J. D. Ryder (PHI Pvt. Ltd).
6. Digital Logic and Computer Design – M. Moris Mano, (PHI (Pvt.) Ltd.).
7. Electronics – R.K. Kar (Books and Allied (P) Ltd.).
8. Digital Electronics – D. Ray Chaudhuri (Platinum Publishers)
9. Basic Electronics – K. K. Ghosh (Platinum Publishers)

BPY404 Electromagnetic Theory (2-1-0)

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

Recommended Books:
1. Introduction to Electrodynamics – D. J. Griffith, (Prentice Hall, India Pvt. Ltd).
2. Foundation of Electricity & Magnetism, Basudev Ghosh, Books & Allied
3. The Feynman Lectures on Physics, Vol I (Addison – Wesley).
4. The Feynman Lectures on Physics – Vol. II (Addison – Wesley).
5. Electricity and Magnetism - J. H. Fewkes and J. Yarwood (Oxford Univ. Press, Calcutta).
6. Electricity and Magnetism – Chatterjee and Rakshit.
7. Electricity and Magnetism – A. S. Mahajan and A. A. Rangwala (Tata McGraw-Hill).
8. Classical Electrodynamics – J.D. Jackson (Wiley India)
9. Electromagnetic Theory and Applications, A.K.Saxena, (Narosa)
10. Berkeley Series Vol II (Electricity and Magnetism) E.M. Purcell (Tata McGraw-Hill).
11. A Text book on Light, Ghosh and Mazumdar, Sreedhar Publishers.

BPY501 Quantum Mechanics II (2-1-0)

1. Time dependent and time independent Schrodinger equation
Eigenstates, normalization and orthonormality.

2. Simple applications of Quantum Mechanics
One dimensional potential well and barrier, boundary conditions, bound and unbound states. Reflection and transmission coefficients for a rectangular barrier in one dimension – explanation of alpha decay. Free particle in one dimensional box, box normalization, momentum eigenfunctions of a free particle. Linear harmonic oscillator, energy eigenvalues from Hermite differential equation, wave function for ground state, parity of wave function.
3. Schrodinger equation in spherical polar coordinates
Angular momentum operators and their commutation relations; eigenvalues and eigenfunctions of L2 and Lz; theorem of addition of angular momenta [statement with examples]. The hydrogen atom problem – stationary state wavefunctions as simultaneous eigenfunctions of H, L2, and Lz;radial Schrodinger equation and energy eigenvalues [Laguerre polynomial solutions to be assumed]; degeneracy of the energy eigenvalues.

Recommended Books:
1. Quantum Mechanics – J. L. Powell and B. Crasemonn, (Oxford, Delhi).
2. Quantum Mechanics – F. Schwabl (Narosa).
3. Quantum Mechanics – A. K. Ghatak and S. Lokenathan (Macmillan, Delhi).
4. Introductory Quantum Mechanics - S. N. Ghoshal (Calcutta Book House).
5. A Textbook of Quantum Mechanics – P. M. Mathews and K. Venkatesan (Tata Mc Graw Hill).
6. Modern Quantum Mechanics – Sakurai (Persian Education)
7. Quantum Mechanics, A.K.Saxena, CBS,

BPY502 Solid State Physics (2-1-0)

1. Crystal Structure
Crystalline and amorphous solids, translational symmetry. Elementary ideas about crystal structure, lattice and bases, unit cell, reciprocal lattice, fundamental types of lattices, Miller indices, lattice planes, simple cubic, f.c.c. and b.c.c. lattices. Laue and Bragg equations. Determination of crystal structure with X-rays.
2. Structure of solids
Different types of bonding- ionic, covalent, metallic, van der Waals and hydrogen. Band theory of solids, Periodic potential and Bloch theorem, Kronig-Penny model, energy band structure. Band structure in conductors, direct and indirect semiconductors and insulators (qualitative discussions); free electron theory of metals, effective mass, drift current, mobility and conductivity, Wiedemann-Franz law. Hall effect in metals : Phenomenology and implication.
3. Dielectric properties of materials
Electronic, ionic and dipolar polarizability, local fields, induced and oriented polarization – molecular field in a dielectric; Clausius-Mosotti relation.
4. Magnetic properties of materials
Dia, para and ferro-magnetic properties of solids. Langevin's theory of diamagnetism and paramagnetism. Quantum theory of paramagnetism, Curie's law. Ferromagnetism : spontaneous magnetization and domain structure; temperature dependence of spontaneous magnetisation; Curie-Weiss law, explanation of hysteresis.

5. Lattice vibrations
Elastic and atomic force constants; Dynamics of a chain of similar atoms and chain of two types of atoms; optical and acoustic modes; interaction of light with ionic crystals. Einstein's and Debye's theories of specific heats of solids.
6. Superconductivity
Introduction (Kamerlingh-Onnes experiment), effect of magnetic field, Type-I and type-II superconductors, Isotope effect. Meissner effect. Heat capacity. Energy gap. Ideas about High-Tc superconductors.

Recommended Books:
1. Introduction to Solid State Physics, C. Kittel (Wiley Eastern).
2. Elementary Solid State Physics – M. Ali Omar (Pearson Education)
4. Solid State Physics – A. J. Dekker (Mc. Millan)
5. Solid State Physics, A.K. Saxena, Macmillan India
6. Solid State Physics – S. O. Pillai (New Age International)
7. Elements of Solid State Physics – J. P. Srivastava (Prentice Hall)
8. An Introduction to Solid State Physics and Application – R.J. Elliot and A.F. Gibson (McMillan)
9. Solid State Physics – D.W. Snoke (Person Education)
10. High Temperature Superconductors, A.K.Saxena, Springer

BPY503 Atomic and Nuclear Physics (2-1-0)

1. Atomic Spectrum
Quantum numbers, Stern-Gerlach experiment and spin as an intrinsic quantum number.
2. Vector atom model
Magnetic moment of the electron, Lande g factor. Vector model – space quantization. Zeeman effect. Explanation from vector atom model.
3. Many electron model
Pauli exclusion principle, shell structure. Hund's rule, spectroscopic terms of many electron atoms in the ground state.
4. Molecular spectroscopy
Diatomic molecules – rotational and vibrational energy levels. Basic ideas about molecular spectra. Raman effect and its application to molecular spectroscopy (qualitative discussion only).
5.Bulk properties of nuclei
Nuclear mass, charge, size, binding energy, spin and magnetic moment. Isobars, isotopes and isotones;
6. Nuclear structure
Nature of forces between nucleons, nuclear stability and nuclear binding, the liquid drop model (descriptive) and the Bethe-Weizsacker mass formula, application to stability considerations, extreme single particle shell model (qualitative discussion with emphasis on phenomenology with examples).
7. Unstable nuclei
(a) Alpha decay: alpha particle spectra – velocity and energy of alpha particles. Geiger-Nuttal law. Gammow's theory.

(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, Kurie plot.
(c)Gamma decay: gamma ray spectra and nuclear energy levels, isomeric states. Gamma absorption in matter – photoelectric process, Compton scattering, pair production (qualitative).
1. Nuclear reactions
Conservation principles in nuclear reactions. Q-values and thresholds, nuclear reaction cross-sections, examples of different types of reactions and their characteristics. Bohr's postulate of compound nuclear reaction.
2. Nuclear fission and fusion
Discovery and characteristics, explanation in terms of liquid drop model, fission products and energy release, spontaneous and induced fission, transuranic elements. Chain reaction and basic principle of nuclear reactors. Nuclear fusion: as a source of energy.
3. Elementary particles
(a) Four basic interactions in nature and their relative strengths, examples of different types of interactions. Quantum numbers – mass, charge, spin, isotopic spin, intrinsic parity, hypercharge. Charge conjugation. Conservation laws.
(b) Classifications of elementary particles – hadrons and leptons, baryons and mesons, elementary ideas about quark structure of hadrons – octet and decuplet families.
4. Particle Accelerator and Detector
Cyclotron – basic theory, GM counter, cloud chamber.
5. Nuclear Astrophysics
Primordial nucleosynthesis, energy production in stars, pp chain, CNO cycle. Production of elements (qualitative discussion)

Recommended Books:
1 Optics and Atomic Physics – B. P. Khandelwal (Siblal Agarwala).
3. Physics of Atoms and Molecules – B. H. Bransden and C. J. Joachain(Pearson Education)
4. Atomic and Nuclear Physics – S. K. Sharma (Pearson Education).
5. Nuclear Physics – Cottingham and Greenwood (Cambridge University Press).
6. Concepts of Nuclear Physcics – R. Cohen (Tata-Mc Graw Hill).
7.Fundamentals of Molecular Spectroscopy, Banwell, and McCash , (Tata – Mc Graw Hill)
8. Atomic and Nuclear Physics – S. N. Ghoshal (S. Chand).
9. Nuclear Physics – S. B. Patel (New Age).
10. Principles of Modern Physics , A.K. Saxena, Narosa
11.Nuclear Physics: Principles and applications – J.S. Lilley (Willey Eastern).
12. Fundamentals in Nuclear Physics: from Nuclear Structure to Cosmology – J. Basdevant, J. Rich and M. Spiro (Springer).
13. Particle Physics – Seiden (Persian Education)
14.Atomic and Molecular Spectra and Lasers, A K Saxena, CBS

BPY504 Advanced Optics (2-1-0)

Laser: Basic principle of lasers. Spontaeneous and stimulated emission, Population inversion, Einstein's A and B coefficients; 3-level and 4-level systems. He-Ne laser, Ruby laser, Semiconductor laser.

Optical Fiber: Acceptance Angle and Numerical Aperture of optical fiber, Sources of signal attenuation and dispersion, Step and graded index multimode fibers, Classification, Construction, Step Index and Graded Index Fiber, Dispersion in Step index fiber.

Holography: Recording and Reconstruction, in-line and off-axis holography; Reflection, white light, rainbow and wave guide holograms; Recording medium for holograms: silver halides, dichromatic gelatin, photoresistor, phoconductor, photorefractive crystals, etc.; Applications : microscopy; interferometry,

BPY601 Electronics II (2-1-0)

1. Amplifier
Voltage and current gain, principle of feedback, positive and negative feedback, advantages of negative feedback, multistage amplifier, frequency response of a two stage R-C coupled amplifier, gain and band width and their product, operating point of class A, amplifier, analysis of single tuned voltage amplifier, requirement of power amplifiers
2. Oscillators
Barkhausen criterion for sustained oscillation, L-C, Weinbridge and crystal oscillators, relaxation oscillators- monostable, bistable and astable multivibrators.
3. Operational amplifier
Properties of ideal OP-AMP, differential amplifiers, CMRR, inverting and non-inverting amplifiers, mathematical operations.
4. Combinational logic
Half adder, full adder, digital comparator, decoder, encoder (ROM), multiplexure
5. Sequential logic
Flip-flops- RS, D, JK, JKMS flip-flops, edge triggering. Shift register, ripple counter(binary and decade).
6. Communication principles
Modulation and demodulation – elementary theory of AM, FM and PM, demodulation of AM (diode detector) and FM (slope detector) waves.

Recommended Books:
1. Integrated Electronics – J. Millman and C. C. Halkias (Mc Graw Hill).
2. Fundamental Principles of Electronics, Basudev Ghosh, (Books & Allied)
3. Electronic Fundamentals and Applications – D. Chattopadhyay and P. C. Rakshit (New Age International)
4. Electronic Device and Circuit Theory – R. Boylestad and L. Nashelsky (Prentice – Hall).
5. Electronics Fundamentals and Applications – J. D. Ryder (PHI Pvt. Ltd).

6. Digital Logic and Computer Design – M. Moris Mano, (PHI (Pvt.) Ltd.).
7. Electronics – R.K. Kar (Books and Allied (P) Ltd.).
8. Digital Electronics – D. Ray Chaudhuri (Platinum Publishers)
9. Basic Electronics – K. K. Ghosh (Platinum Publishers)

BPY602 Classical Mechanics II (2-1-0)

1. Central force problem
Motion under central force; Nature of orbits in an attractive inverse square field; Kepler's laws of planetary motion. Rutherford scattering as an example of repulsive potential.
2. *Mechanics of Ideal Fluids*
Streamlines and flowlines; Equation of continuity; Euler's equation of motion; Streamline motion -Bernoulli's equation and its applications. Definition of Newtonian and non-Newtonian fluids.
3. Lagrangian and Hamiltonian formulation of Classical Mechanics
Generalised coordinates, constraints and degrees of freedom; D'Alembart's principle; Lagrange's equation for conservative systems (from D'Alembert's principle; variational principle not required) and its application to simple cases; Generalised momentum; Idea of cyclic coordinates, its relation with conservation principles; Definition of Hamiltonian, Hamilton's equation (derivation by Legendre transformation) and its application to simple cases.
4.Rotation of rigid bodies: Force free motion of rigid bodies - free spherical top and free symmetric top.
*5. Basic Perturbation Techniques: S*imple problems.

Recommended Books:
1. Theoretical Mechanics - M. R. Spiegel, (Schaum's Outline Series) (McGraw-Hill).
2. Mechanics - K. R. Symon (Addison-Wesley).
3. Introduction to Classical Mechanics - R. G. Takwale and P. S. Puranik (Tata McGraw-Hill).
4. Classical Mechanics – N. C. Rana and P. S. Joag (Tata McGraw-Hill).
5. Mechanics and General Properties of Matter – D. P. Roychaudhuri and S. N. Maiti (Book Syndicate).
6. Classical Mechanics – G. Aruldhas (PHI)
7. The Feynman Lectures on Physics – Vol I (Addison-Wesley).
8.An Introduction to Mechanics – D. Keppner and R.J. Kolenkow (Tata McGraw-Hill).
9.Mechanics – H. S. Hans and S. P. Puri (Tata McGraw-Hill).
10. Classical Mechanics – J. Goldstein (Narosa Publ. House).
11. Classical Mechanics – A. K. Roychaudhuri (O. U. P., Calcutta).

DEPARTMENTAL ELECTIVES

BPY001 Group Theory (3-0-0)

1. Abstract group theory: Definition. Group postulates. Finite and infinite groups, order of a group, subgroup; rearrangement theorem, multiplication table. Cosets, Lagrange's theorem. Order of an element.. Conjugate elements and classes. Invariant subgroups, factor groups. Generators. Isomorphism and homomorphism. Cyclic and other distinct groups. Permutation and

alternating groups. Cayley's theorem. 2. Representation theory: Definition of representation. Faithful and unfaithful representations. Invariant subspaces and reducible representations. Reducible and irreducible representations. Schur's lemmas, great orthogonality theorem and its geometrical interpretation. Character. First and second orthogonality theorems of characters and its geometrical interpretation. Regular representation, celebrated theorem and its implication. Projection operators; determination of basis functions. Direct product groups and their representations Direct product representations and their reduction. Construction of character tables of simple groups. 3. Continuous group: Infinite groups. Discrete and continuous groups, mixed continuous group. Topological and Lie groups. Axial rotation group SO(2). Rotation group SO(3). Special Unitary groups SU(2) and SU(3) and their application in Physics. 4. Application in Physics Group of Schrodinger equation. Reduction due to symmetry. Perturbation and level splitting. Selection rules. Zeeman effect.

BPY002 Laser Physics (3-0-0)

Introduction. Physics of interaction between Radiation and Atomic systems including: stimulated emission, emission line shapes and dispersion effects. Gain saturation in laser media and theory of FabryPerot laser. Techniques for the control of laser output employing Qswitching, mode-locking and mode-dumping. Optical cavity design and laser stability criteria. Description of common types of conventional lasers. Physics of semiconducting optical materials, degenerate semiconductors and their Homojunctions and Hetrojunctions. Light emitting diodes (LED's),

BPY003 Fiber Optics and Wave guides (3-0-0)

Fiber numerical aperture, Sources of signal attenuation and dispersion, Step and graded index multimode fibers, including plastic fibers LP modes in optical fibers: Single-mode fibers, mode cutoff and mode field diameter, Pulse dispersion in single-mode fibers: dispersion-tailored and dispersion-compensating fibers. Birefringent fibers and polarization mode dispersion. Fiber bandwidth and dispersion management, Erbiumdoped fiber amplifiers and lasers; Isolators, Fiber fabrication techniques. Fiber characterization techniques including OTDR, Connectors, splices and fiber cable.

BPY004 Applied Optics (3-0-0)

Interferometry, Laser Speckles, Basics of Fourier transformation (FT) operation, definition of spatial frequency, Transmittance functions, FT operation, Definition of spatial frequency, Transmittance functions, FT by diffraction and by lens, Spatial filtering-basics, Types of filters, Abbe-Porter experiment, Phase contrast microscope, Matched filter,

BPY005 Holography: Theory and Applications (3-0-0)

Basics of holography, in-line and off-axis holography; Reflection, white light, rainbow and wave guide holograms; Theory of plane holograms, magnification, aberrations, effects of non-linearity,

band-width and source size; Volume holograms: coupled wave theory, wavelength and angular selectivity, diffraction efficiency; Recording medium for holograms: silver halides, dichromatic gelatin, photoresistor, phoconductor, photorefractive crystals, etc.; Applications : microscopy; interferometry,

BPY006 Plasma Physics (3-0-0)

Introduction to plasma, Debye shielding, Single particle motion in E and B fields, Mirror confinement, Plasma oscillations, Waves in unmagnetized plasmas, Solitons, Two stream instability, Rayleigh Taylor instability, Vlasov equation and Landau damping, Waves in magnetized plasmas (fluid theory), Plasma production & characterization, Plasma processing of materials, Laser driven fusion, Cerenkov free electron laser, Applications to astrophysics and astronomy.

BPY007 Basic Properties of Materials (3-0-0)

Drude and Sommerfeld theories of metals, Effect of periodic lattice potential, Magnetic behaviour-exchange interaction and magnetic domains, Ferrimagnetic order, ferrites and garnets, hard and soft magnets, single domain magnets, spin waves, surface magnetism, dielectric constants of solids and liquids, Claussius-Mossoti relation, dielectric dispersion and losses, piezo, ferro-and pyroelectricity, optical constants, atomistic theory of optical properties, quantum mechanical treatment, band transitions, dispersion, plasma oscillations.

BPY008 Science & Technology of Thin Films (3-0-0)

Physical Vapor Deposition - Hertz Knudsen equation; mass evaporation rate; Knudsen cell, Directional distribution of evaporating species Evaporation of elements, compounds, alloys, Raoult's law; e-beam, pulsed laser and ion beam evaporation, Glow Discharge and Plasma, Sputtering–mechanisms and yield, dc and rf sputtering, Bias sputtering, magnetically enhanced sputtering systems, reactive sputtering, Hybrid and Modified PVD- Ion plating, reactive evaporation, ion beam assisted deposition, Chemical Vapor Deposition - reaction chemistry and thermody-namics of CVD; Thermal CVD, laser & plasma enhanced CVD, Chemical Techniques - Spray Pyrolysis, Electrodeposition, SolGel and LB Techniques, Nucleation & Growth: capillarity theory, atomistic and kinetic models of nucleation, basic modes of thin film growth, stages of film growth & mechanisms, amorphous thin films, Epitaxy–homo, hetero and coherent epilayers, lattice misfit and imperfections, epitaxy of compound semiconductors, scope of devices and applications.

BPY009 Physics of Nanomaterials (3-0-0)

Physics of low-dimensional materials, 1D, 2D and 3D confinement, Density of states, Excitons, Coulomb blockade, Surface plasmon, Size and surface dependence of physical, electronic, optical, luminescence, thermo-dynamical, magnetic, catalysis, gas sensing and mechanical properties. Physical and chemical techniques for nanomaterial synthesis, Assembling and self

organization of nanostructures, Nanoscale manipulation, Nanotube and wire formation, Importance of size distribution control, size measurement and size selection.

MPY010 Biophysics (3-0-0)

General Biophysics PH Meter: Standardization of pH meter, Preparation of Buffers, pH titration curve of acid-base . Determination values of Iso-electric point: Amino acids, proteins, phosphoric acids. Viscosity: Determination of viscosity of biofluids and chemicals. Colorimeter: Verification of Beer'sLambert law, determiantion of absorption maxima of color compounds, determination of molecular extinction coefficient. Estimation of percent purities of dyes and inorganic compound

MPY011 Astrophysics and Cosmology (3-0-0)

Introduction to Astrophysics and Astronomy, Celestial coordinate systems (Sun-Earth system, Galactic Coordinate system). Stellar Structure and Evolution: i) Star formation, Stellar Magnitudes, Classification of stars, H-D classification, Saha Equation of ionization, Hertzsprung-Russel (H-R) diagram. ii) Gravitational energy, Virial theorem, Equations of stellar structure and evolution. iii) Pre-main sequence evolution, Jeans criteria for star formation, fragmentation and adiabatic contraction, Evolution on the main sequence, Post main sequence evolution, Polytropic Models: Lane-Emden equation, simple stellar models: Eddington's model and Homologous model, Convective and Radiative stars, Pre-main sequence contraction: Hayashi and Henyey tracks. Nuclear Astrophysics: Thermonuclear reactions in stars, pp chains and CNO cycle, Solar Neutrino problem, subsequent thermonuclear reactions, Helium burning and onwards, nucleosynthesis beyond iron, r- and s- processes. Stellar Objects & Stellar Explosions: Qualitative discussions on: Galaxies, Nabulae, Quasars, Brown dwarfs, Red Giant Stars, Nova, Supernova. Gravitational Collapse and relativistic Astrophysics: Newtonian theory of stellar equilibrium, White Dwarfs, Electron degeneracy and equation of States, Chandrasekhar Limit, Mass-Radius relation of WD. Neutron Stars, Spherically symmetric distribution of perfect fluid in equilibrium. Tolman-Oppenheimer-Volkoff (TOF) equation, Mass-Radius relations of NS. Pulsars, Magnetars, Gamma ray bursts. Black holes, Collapse to a black hole (Oppenheimer and Snyder), event horizon, singularity. Accretion disks: Formation of Accretion Disks, Differentially rotation systems in Astrophysics, Disk dynamics, Steady Disks, Disk formation in close binary systems through mass transfer, Accretion onto compact objects (Black Holes and Neutron Stars).

LABORATORY PAPERS

BPY 191

1. Determination of moment of inertia of metallic cylinder / rectangular bar about an axis passing through its C.G. and to determine the rigidity modulus of the material of the suspension wire.
2. Determination of refractive index of a liquid by using travelling microscope.
3. To study the nature of dependence of dipolar field of a short bar magnet on distance with the help of a deflection magnetometer and to determine the horizontal component of the Earth's magnetic field.
4. To determine the coefficient of viscosity by Poisseuli's methods.
5.To determine the surface tension of a liquid by capillary rise method.
6. To convert a given ammeter into a voltmeter and a given voltmeter into an ammeter and hence to calibrate the device and measure the internal resistance in each case.
7. To measure the resistance per unit length of the wire of a bridge and to determine an unknown resistance by Carey Fosters bridge.
8. To measure the current flowing in a circuit by measuring the drop of potential across a known resistance in the circuit using a potentiometer (by measuring the resistance of the potentiometer with a P.O. Box).
9. To determine the time period of Kater's pendulum

BPY 291

1. Adjustment of the Spectrometer for parallel rays by Schusters method and to determine the refractive index of the material of a prism by spectrometer from (i-δ) curve.
2. To study the variation of refractive index (μ) of the material of a prism with wave length and to verify Cauchy's dispersion formula and to find the dispersive power of the material of the prism by spectrometer.
3. To determine the specific heat capacity of a liquid by continuous flow (Callender and Barnes) method.
4. Determination of thermal conductivity of a bad conductor of heat by Lee's and Chorlton's method.
5. To verify truth tables of different gates using discrete components and I.C's
6. To estimate the temperature of a torch bulb filament from resistance measurement and to verify Stefan's law.
7. To determine the boiling opoint of a liquid using a platinum resistance thermometer.
8. To calibrate a thermocouple with the help of potentiometer and hence (i) to measure the thermoelectric power at a particular temperature, (ii) to measure an unknown temperature.
9. Verification of Thevenin, Norton and Maximum power transfer theorems using a resistive Wheatstone bridge, d.c. source and d.c. meters.

BPY 391

1. To calibrate a polarimeter and hence to determine the concentration of sugar solution.

2. To study the variation of mutual inductance of a given pair of co-axial coils by using a ballistic galvanometer.
3. To measure the voltage across the inductance (L), capacitance (C) and resistance(R) of a series LCR circuit for different frequencies of the input voltage with the help of an A.C millivoltmeter. Hence (i) to study the variation of impedance of L and C with frequency of the impressed voltage, (ii) to draw the resonance curve of the series LCR circuit and to determine the Q-factor of the circuit.
4. To determine Fourier spectrum of (i) square, (ii) triangular and (iii) half sinusoidal waveform by C.R.O.
5. To determine the wavelength of a monochromatic light by Fresnel's biprism
6. To study the diffraction pattern of a crossed grating with the help of a LASER source.
7. To find the number of lines per centimeter of the transmission grating and hence to measure the wavelength of an unknown spectral line and to measure the wavelength difference between D1 and D2 lines of sodium using a slit of adjustable width
8. To draw the B-H loop for the material of an anchor ring by ballistic galvanometer and to estimate the energy loss per cycle of magnetisation.
9. To determine the wavelength of a monochromatic light by Newton's ring method.
10. Measurement of the slit width and the separation between the slits of a double slit by observing the diffraction and interference fringes.

BPY 491

1. To draw the forward and reverse characteristics of a Zener diode and to study its regulation characteristics. Estimate the a.c. resistances of the diode for different diode currents in both forward and reverse bias conditions.
2. To draw the regulation characteristics of a bridge rectifier (i) without using any filter and (ii) using a filter. Determine the ripple factor in both cases by measuring the ripple voltage with the help of an ac meter.
3. To execute half adders and full adders with basic gates and hence to verify addition of binary numbers.
4. To calibrate a Hall probe with the help of a Ballistic Galvanometer and use the probe to study the variation of magnetic field of an electromagnet with (i) the magnetizing current and (ii) position in a transverse direction.
5.To determine the band gap energy of a given semiconductor by four-probe method.
6. To draw the characteristics of a transistor in C-E mode and hence to determine the hybrid parameters using dc and ac sources .
7. Verification of Fresnel's equation of reflection of electromagnetic waves with the help of prism and two polaroids.
8. a)To draw the characteristics of a JFET and hence to determine the relevant parameters and b) to design an amplifier using JFET.
9. (a) To measure the self inductance of two coils by Anderson bridge .To find the total inductance of the above two coils connected in series and hence estimate the coefficient of coupling between the coils. (b)To study the variation of inductance of two coils in series with angle between their planes by Anderson bridge.

BPY 591

Electronics Designing Experiments (USE OF PREFABRICATED CIRCUIT PROHIBITED**)**

1. To construct a regulated power supply on a bread board, using
(i) a power transistor as pass element,
(ii) a second transistor as a feedback amplifier and
(iii) a zener diode as a reference voltage source and to study its operational characteristics.
2. To design and draw the output waveform of an astable multivibrator and hence to verify the time period of oscillation.
3. To construct and study the frequency response of a voltage amplifier using a transistor in CE mode and to find its bandwidth.
4. To design and test the following circuits using an OPAMP
(i) Inverting and non inverting amplifier
(ii) Differential amplifier
(iii) Schmitt trigger
(iv) Integrator
(v) Differentiator.
5. To construct Wein Bridge oscillator on a bread board using OPAMP and to study the wave form of the oscillator and calibrate it using CRO.
6. To design and fabricate a temperature controller and to study its performance characteristics.
7. To design and verify the following digital circuits using basic gates:
i) S-R flip-flops, ii) J-K flip-flops, iii) 4 input multiplexer iv) 7-segment demultiplexer v) Mod-5 and decade counters.