B.Sc. Physics (Hons.) Syllabus

1st Semester

PAPER CODE	PAPER NAME	INTERNAL	EXTERNAL	TOTAL
BSHPH101	General English	40	60	100
BSHPH102	Mechanics	40	60	100
BSHPH103	Wave and Oscillation	40	60	100
BSHPH104	Physics & Chemistry of Materials	40	60	100
BSHPH105	Computer programming	40	60	100
BSHPH106	Physics Practical Lab	60	40	100
Total		260	340	600

2nd Semester

PAPER CODE	PAPER NAME	INTERNAL	EXTERNAL	TOTAL
BSHPH201	General Hindi	40	60	100
BSHPH202	Electricity and Magnetism	40	60	100
BSHPH203	Optics	40	60	100
BSHPH204	Materials Physics & Engineering	40	60	100
BSHPH205	Computer oriented numerical and mathematical methods	40	60	100
BSHPH206	Physics Practical Lab	60	40	100
Total		260	340	600

3rdSemester

PAPER CODE	PAPER NAME	INTERNAL	EXTERNAL	TOTAL
BSHPH301	Thermal Physics	40	60	100
BSHPH302	Electronics	40	60	100
BSHPH303	Bio-Physics	40	60	100
BSHPH304	Electrical Technology	40	60	100
BSHPH305	Physics Practical Lab	60	40	100
Total		220	280	500

4thSemester

PAPER CODE	PAPER NAME	INTERNAL	EXTERNAL	TOTAL
BSHPH401	Statistical Physics	40	60	100
BSHPH402	Mathematical Physics-I	40	60	100
BSHPH403	Digital Electronics	40	60	100
BSHPH404	Heat Transfer	40	60	100
BSHPH405	Physics Practical Lab	60	40	100
Total		220	280	500

5th Semester

PAPER CODE	PAPER NAME	INTERNAL	EXTERNAL	TOTAL
BSHPH501	Elementary Quantum Mechanics	40	60	100
BSHPH502	Mathematical Physics-II	40	60	100
BSHPH503	Physics of Materials	40	60	100
BSHPH504	Principle of power production	40	60	100
BSHPH505	Physics practical	60	40	100
Total		220	280	500

6thSemester

PAPER CODE	PAPER NAME	INTERNAL	EXTERNAL	TOTAL
BSHPH601	Solid State Physics	40	60	100
BSHPH602	Nuclear & Particle physics	40	60	100
BSHPH603	Elements of spectroscopy	40	60	100
BSHPH 604	Renewable Energy Conversion	40	60	100
BSHPH605	Physics practical	60	40	100
Total		220	280	500

Ist Semester General English

CONTENTS

UnitI: Introduction: **06**

Theory of Communication, Types and modes of Communication, *Mediums and channels ofcommunication,barrierstocommunication,EnglishasaGloballanguage,theLinguaFranca, Social influences on English*

UnitII:LanguageofCommunication: **06**

Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers andStrategiesIntra-personal,Inter-personalandGroupcommunication,*VarietiesofEnglish,Language,Accent, Dialect,Colloquialism, Historical influenceson English*

UnitIII:SpeakingSkills: **06**

MonologueDialogueGroupDiscussionEffectiveCommunication/Mis-CommunicationInterviewPublicSpeech,*RegionalinfluencesonEnglish,Convergenceanddivergence,LinguisticImperialism,*

UnitIV: Reading and Understanding- **06**

Close Reading, *Reading analysis of a text - Audience and purpose, Content and theme, ToneandMood,stylisticdevices,structure*Comprehension-AnalysisandInterpretationTranslation (from IndianlanguagetoEnglishandvice-versa)Literary/KnowledgeTexts

UnitV: Writing Skills **06**

Documenting Report Writing, making notes Letter writing, *Writing tabloids, diary entry, openletters,essays,newsletterandmagazinearticles,skits,shortstories,impersonatingcharacters*

RecommendedReadings:

1. Fluencyin English -Part II, Oxford UniversityPress,2006.

2. BusinessEnglish,Pearson,2008.

3. Language,LiteratureandCreativity,OrientBlackswan,2013.

4. LanguagethroughLiterature(forthcoming)ed.Dr.GauriMishra,DrRanjanaKaul,DrBratiBiswas

Mechanics **I SEMESTER**

Unit 1

Inertial frame of references, Motion and rest, Galilean transformations, transformation of

displacement, velocity and acceleration, Special theory of relativity, Lorentz transformation and rotation in space-time, time like and space like vector, energy-mass relation.

Unit 2

Rotating frame of references, transformation of velocity and acceleration between rotating frames, Coriolis and centrifugal forces, effects of coriolis and centrifugal forces due to Earth's rotation, Foucault's pendulum.

Unit 3

Conservation Laws: Conservative forces, potential energy, Gravitational Potential, electric potential, center of mass and motion of center of mass of a system of particles, two particle system and reduced mass, conservation of linear momentum in Lab and CM system, collision of two bodies in one and two dimensions, slowing down of neutrons in a moderator, motion of a system with varying mass.

Unit 4

Dynamics of rigid body and motion under central forces: Rotational motion of a body, Moment of inertia, inertial coefficients, kinetic energy of rotation and concept of principal axes, Precessional motion of a spinning top and spin precession in constant magnetic field, motion under central forces, general solution under gravitational interaction, cases of elliptical and circular orbits, scattering of charged particles by heavy nucleus, planetary motion, Kepler's Laws.

Unit 5

Hooke's law, three moduli of elasticity, Young's modulus, Bulk modulus and modulus of rigidity, Poison's ratio, Relation between various elastic constants, torsion of a Cylinder, bending of beam, experimental determination of elastic constants by bending of beam and Searle's method, Modulus of rigidity by static and dynamic method and Poisson's ratio for rubber.

Text/Reference Books:

1. Mechanics by M P Saxena, P R Singh, S S Rawat and N S Saxena (4th ed., College Book House, 1999)
2. Mechanics by D S Mathur (S. Chand & Co., 2001)
3. Berkley Physics Course Vol. I, Mc Graw Hill International, New York.
4. Mechanics by P. K. Srivasatava, New Age International Publisher, Delhi

Waves and Oscillations

Unit 1

Oscillations in a potential well, examples of harmonic motion - mass on a spring, torsional oscillators, LC circuit, energy of the oscillator, damping, viscous and solid friction damping, damped harmonic oscillator, power dissipation.

Unit 2
Forced harmonic oscillator with viscous damping, frequency response, phase relation, quality factor, resonance, electrical oscillation, anharmonic oscillator, simple pendulum as an example.

Unit 3
Equation of motion of two coupled simple harmonic oscillators, normal modes, motion in mixed modes, transient behavior, effect of coupling in mechanical systems, electrically coupled circuits, frequency response, reflected impedance, effect of coupling and resistive load.

Unit 4
Dynamics of number of oscillators with near-neighbour interactions, equation of motion for one dimensional monoatomic and diatomic lattices, acoustic and optical mode, dispersion relations, concept of group and phase velocities.

Unit 5
Wave Motion-Wave motion and its parameters, stationary waves, wave velocity and group velocity, production, properties and uses of ultrasonic waves, reverberation time, Sabine's formula.

Text/Reference Books:
1. Oscillations and Waves by M. P. Saxena and S. S. Rawat, College Book House,1997.
2. Berkley Physics Course Vol. I, Mc Graw Hill International, New York.
3. Vibration and Waves by A. P. French, CBS Publications, Delhi, 1987

Physics & Chemistry of Materials

Unit 1
Atomic Structure-Schrodinger wave equation, significance of Ψ, $\Psi^*\Psi$, quantum numbers, shapes of s, p, d orbitals, Aufbau and Pauli principles, Hund's multiplicity rule, exchange energy, pairing energy, symmetrical distribution of charge, extra stability of half-filled and completely-field orbitals, electronic configurations of elements up to atomic No. 71, effective nuclear charge, shielding effect, Slater's rules for evaluation of shielding constant.

Unit 2
Covalent bond:- resonance, valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shell electron pair repulsion (VSEPR) theory with reference to BF_3, BF_4^-, NH_3, H_2O, H_3O^+, PCl_5, SF_4, CIF_3, I_3^-, SF_6, IF_7, ICI_2^-, and $POCl_3$; MO theory, simple LCAO theory, sigma and pi molecular orbitals, homonuclear and heteronuclear (CO and NO) diatomic molecules and their ions, multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Unit 3
Introduction to chemical kinetics, measurement of reaction rate, integration and determination of rate laws, rate constant, unit of rate constant for zero order, first order and second order reactions, order of reaction, molecularity of reaction, difference between order

and molecularity of reaction, chemical kinetics and its scope, factors influencing the rate of a reaction-concentration, temperature, pressure, solvent, light, catalyst; concentration dependence of rates, mathematical characteristics of simple chemical reactions-zero order, first order, second order, pseudo order; half-life and mean life; determination of the order of reaction-differential method, graphical method, method of integration, method of half-life period and isolation method, radioactive decay as a first order phenomenon, applications

Unit 4

Phase Equilibrium-Introduction, terminology: - phase, component, degree of freedom or variance; phase diagram of one-component system: -water system, sulphur system, CO_2 system, phase rule for two-components system: - Pb-Ag system and its applications, reduced phase rule, eutectic point.

Unit 5

Electric transport in electrolytic solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution, migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its uses and limitations, Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only), applications of conductivity measurement: determination of degree of dissociation, determination of K_a of acids, determination of solubility product of sparingly soluble salt, conductometric titrations.

Text/Reference Books:

1. Lee, J. D. "Concise Inorganic Chemistry", Blackwell Publication.
2. Atkins, P. W. "Physical Chemistry", ELBS.
3. Material Science & Engineering, A first course, V Raghavan, PHI, New Delhi.
4. Material Science & Engineering an introduction, William D Callister Jr., John Wiley & Sons.

Computer Programming

Unit 1

C programming: structure of C program, A Simple C program, identifiers, basic data types and sizes, Constants, Operators, variables, expressions, type conversions, conditional expressions, precedence and order of evaluation. Input-output statements, if and switch statements, loops- while, do-while and for statements, break, continue, goto and labels.

Unit 2

Designing structured programs, Functions, basics, parameter passing, storage classes- extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, header files, C preprocessor.

Unit 3

Arrays-concepts, declaration, definition, accessing elements, storing elements, arrays and functions, two-dimensional and multi-dimensional arrays, applications of arrays, pointers-concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory managements functions.

Unit 4

Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bitfields, Input and output - concept of afile, text files and binary files, streams, standard I/o, Formatted I/o, file I/o operations, command line arguments.

Unit 5

FORTRAN programming: Variables, expressions, jumping, branching and looping statements, input/output statement, special statements: COMMON, ENTRY, FORMAT, PAUSE, EQUIVALENCE, programming of simple problems involving use of interpolation differentiation, integration, matrix inversion and least square analysis.

Text/Reference Books:

1. Kochan Stephen G., Programming in C, Pearson Eductaion
2. Wirth N., Algorithms & Data Structures, Prentice Hall

PHYSICS PRACTICAL

1. Study of bending of a beam and determination of Young's modulus.
2. Determine the modulus of rigidity using Maxwell's needle.
3. Determination of the Poisson's ratio of rubber tube.
4. Determination of modulus of rigidity by stattical method.
5. Elastic constant by Searle's method.
6. Low resistance by Carey-Foster' bridge.
7. Study of frequency of energy transfer as a function of coupling strength using coupled oscillator.
8. Study the damping of a compound pendulum and determine the damping coefficient and quality factor.
9. Conversion of a galvanometer in to an ammeter and to calibrate it.
10. Conversion of a galvanometer in to a voltmeter and to calibrate it.
11. Study of charging and discharging of a capacitor through a resistance.
12. Study of temperature variation of surface tension by Jeagger's method.
13. Variation of magnetic field along the axis of circular coil and hence determine the radiusof coil.
14. To study resonance in a series LCR circuit and determine Q of the circuit.
15. Loop Statement using for, while, do–while statement, conditional checking using if statement, nested if statement, switch statement and unconditional goto.
16. Problems based on array data types. Problems on One Dimensional Array-Searching (Linear, Binary), Sorting (Bubble, Selection, Insertion), Merging.
17. Problems on two Dimensional Array-Matrix Operation: Addition, Subtraction, Multiplication etc.
18. Problems based on pointers, Parameter passing in functions, Recursion.
19. Declaration, Reading, Writing and manipulation on struct and union data type, File handling, Command Line Arguments.
20. Any other experiments of the equivalent standard can be set.

II SEMESTER

GENERAL HINDI

1- गद्यसंदेश (Prose)

1- साहित्यकीसाहित्य- महावीरप्रसादद्विवेदी
2- सच्चीवीरता - सरदारपूर्णसिंह
3- मित्रता - आचार्यरामचंद्रशुक्ल

2- कथालोक (Short Stories)

1- मुक्तिधन - मुन्शीप्रेमचंद
2- पुरस्कार - जयशंकरप्रसाद
3- उसनेकहाथा -चन्द्रधरशर्मागुलेरी

3- व्याकरण (Grammar)

1. लिंग,वचन , शब्द. , काल. ,वाच्य. , वाक्योंकीशुद्धि,शब्द- विलोम., संधिविच्छेद , उपसर्ग, संधि, प्रत्यय, समास, मुहावरे / लोकोक्तियाँ, पारिभाषिकशब्दावली,संज्ञा, सर्वनाम, विशेषण, क्रिया, क्रियाविशेषण (व्यावहारिकपक्ष), शब्दयुग्मोंकाअर्थभेद, वाक्यांशकेलिएएकशब्द, पर्यायवाची/विलोमशब्द

2. अंग्रेजी - हिन्दीअनुवाद

4- कार्यालयीन हिन्दी (Official Language)

1- परिपत्र
2- कार्यालय ज्ञापन
3- अधिसूचना
4- शब्दावली
5- वाक्यांशअंग्रेजी- हिन्दीशब्दोंकावाक्यमेंप्रयोग

5- निबंध

6- पत्र- लेखन (Letter Writing)

II SEMESTER

Electricity and Magnetism

Unit 1
Electric potential-Gradient of a scalar function, line integral of vector field, potential difference and potential function. Potential energy of a system, energy required to build a uniformly charged sphere, classical radius of an electron, Potential and field due to a short dipole.

Unit 2
Measurement of charge in motion, invariance of charge, electric field measured in different frames of reference, field of a point charge moving with constant velocity, force on a moving charge, interaction between a moving charge and other moving charges, Magnetic field, Amperes circuital law with applications, Ampere's law in differential form, vector potential, field of a current carrying conductor and deduction of Biot-Savart law.

Unit 3
The moment of a charge distribution, atomic and molecular dipoles, permanent dipole moments, potential and field due to a polarized sphere, dielectric sphere in a uniform field, the field of charge in a dielectric medium and Gauss's law, electric susceptibility and atomic polarizability, polarization in changing fields.

Unit 4
Bohr Magneton, electron spin and magnetic moment, magnetic susceptibility, the magnetic field due to magnetized matter, Faraday's laws in differential form, the displacement current, Maxwell's equations in differential and integral forms.

Unit 5
Maxwell's equations, Electromagnetic waves in isotropic medium, Properties of electromagnetic waves, Energy density, radiation pressure, momentum and poynting vector, radiation resistance of free space, Spectrum of electromagnetic waves.

Text/Reference Books:
1. Electricity and Magnetism by D C Tayal, Himalaya Publishing House, 2005.
2. Electricity and Magnetism by M P Saxena, College Book House, 1997.
3. Elements of Electromagnetics by Mathew N.O. Sadiku, New Delhi, Oxford Univ. Press
4. Berkley Physics Course - Volume 2, Singapore, McGraw Hill International.

Optics

Unit 1
Formation of images, sign convention, position of object and its image formed by refraction on spherical surfaces, lateral, axial and angular magnification, Abbe's sine condition, aplantic points, deviation produced by thin lenses, equivalent focal length, combination of two thin lenses, Abberations: chromatic, Achromatic Combination of lenses, spherical, method of reducing spherical aberrations, Eye-piece: Huygen's, Ramsden's.

Unit 2

Superposition of waves from two point sources, the necessity of coherence, spatial & temporal coherence, Effective size of a point source, Shape of interference fringes, Intensity distribution in space, Fresnel's biprism experiment, Interference by division of amplitude, Interference in thin films, colur of thin films in transmission and reflection, Newton's rings, Michelson's interferometer, fringes of different shapes Determination of λ and $\Delta\lambda$ with Michelson's interferometer.

Unit 3

Fraunhofer diffraction by a single slit, circular aperture, two parallel slits, Plane diffraction grating, transmission and reflection gratings, dispersion by grating, resolving power, Rayleigh's criterion of resolution, Resolving power of a grating, Resolving power of a telescope, Fresnel's diffraction, half-period zones, Fresnel's diffraction by a circular aperture, Straight edge and thin slit, Cornu's (geometrical) spiral to study Fresnel's diffraction, Zone plate.

Unit 4

Polarised light, Production and analysis of plane, circularly and elliptically polarised light, Huygen's theory of double refraction using Fresnel ellipsoidal surfaces (No mathematical derivation), Theory of polarized light, Quarter and half wave plates, Optical activity, Specific rotation, Fresnel's explanation for optical rotation, Biquartz and half shade Polarimeters.

Unit 5

Spontaneous and stimulated emission, Einstein's A and B coefficients, Laser Criterion, Condition for amplification, population inversion, methods of optical pumping, He-Ne Laser, Ruby lasers, Holography, Construction of hologram and reconstruction of the image, Basic characteristics of the optical fiber, total internal reflection, acceptance angle, acceptance cone, numerical aperture.

Text/Reference Books:

1. Optics by Brij Lal and Subrahmanium, S. Chand Publication, 2006.
2. Introduction to Fiber optics - A. Ghatak and K. Thyagarajan, Cambride University Press, Cambridge, 1988.
3. Introduction to Modern Optics- A. K. Ghatak, Tata McGraw Hill.

Materials Physics & Engineering

Unit 1

WATER-Common impurities of water, hardness of water:-determination of hardness by Clark's test and complex metric (EDTA) method, degree of hardness, numerical based on hardness and EDTA method, municipal water supply:-requisites of drinking water, steps involved in purification of water, sedimentation, coagulation, filtration and sterilization, break point chlorination, Water Treatment- Softening of water**:** lime-soda method, zeolite method and deionization or demineralization method, boiler troubles (scale and sludge, priming and foaming), their causes, disadvantages and prevention; boiler corrosion and caustic embrittlement, numerical problems based on lime-soda and zeolite softening methods.

Unit 2
Corrosion-Definition and its significance, mechanisms of corrosion: chemical corrosion and electrochemical corrosion, protection from corrosion: protective coatings, cathodic protection, sacrificial anode and modification in designs, Polymers-Different methods of classification and constituents of polymers, plastics:-thermosets and thermoplasts; preparation, properties and uses of polyethylene, bakelite, terylene and nylon; elastomers:-natural rubber, vulcanization, synthetic rubbers viz. Buna-S, Buna-N, Butyl and neoprene rubbers.

Unit 3
Cement-Definition, composition, basic constituents and their significance, manufacturing of Portland cement by rotary kiln technology, chemistry of setting and hardening of cement and role of gypsum, Glasses-Definition, properties, manufacturing of glass, types of silicate glasses and their commercial uses, importance of annealing in glass making.

Unit 4
Refractories-Definition, classification, properties, requisites of good refractory and manufacturing of refractory, detailed study of silica and fire clay refractory and their uses, Seger's cone test and RUL test.

Unit 5
Fuels-Organic fuels: general aspects of organic fuels; solid fuels:-coal, carbonization of coal, manufacturing of coke by Beehive oven and Otto-Hoffman byproduct oven method; liquid fuels:-advantages and refining of petroleum, cracking, refining, reforming, polymerization and isomerization of refinery products, synthetic petrol:-Berguis and Fischer-Tropsch process, gaseous fuels: composition and calorific value of coal, gas and oil gas, Fuels (Analyses)-calculations of calorific value based on Dulong's formula, combustion and requirement of oxygen/ air in combustion process, flue gas analysis by Orsat's apparatus and its significance.

Text/Reference Books:

1. Senapati, M. "Advanced Engineering Chemistry", Second Edition, Laxmi Publications, New Delhi, 2007.
2. Qanungo, K. "Engineering Chemistry", PHI, New Delhi, 2009.
3. Material Science & Engineering, A first course, V Raghavan, PHI, New Delhi.
4. Material Science & Engineering an introduction, William D Callister Jr., John Wiley & Sons.

Computer Oriented Numerical and Statistical Methods

Unit 1
Computer arithmetic and errors, absolute error, relative error, percentage error, Floating point arithmetic and error estimates, Implication of precision, Illustrations of errors due to round-off.
Solution of non-linear equations: Bisection, Fixed point iteration, Newton - Raphson method, Aitkins process, rate of convergence.

Unit 2
Solution of Linear system of equations: Direct method - matrix inversion method, modified

ordinary differential equations - Taylor's series method, Euler's and modified Euler's method, Runge-methods, Predictro-Corrector method, multistep method.

Unit 3

Interpolation: Newton-Gregory forward and backward interpolations for evenly spaced data, Lagrangian method, divided differences, Gauss central forward and backward interpolation formula, Stirling central interpolation formula, Interpolating with cubic splins, Inverse interpolations, Approximation: Approximation of functions by Taylor's series, Chebysheve polynomials.

Unit 4

Numerical differentiation: Differentiation formula based on interpolating polynomials, formulae for higher derivatives, Extrapolation techniques, Numerical integration: The Trapezoidal, rule, Simpson's 1/3 & 3/8 rule, Weddle's rule, Newton-Cotes integration formulae, Romberg integration, Gaussian quardrature formulae for integration.

Unit 5

Applicable statistics: Curve fitting by principle of least square, linear and non linear curves fitting by least squares approximation, Curve fitting by second order polynomial, Weight least square curve fitting, Chi-square test for goodness of fit, correlation and regression, concept of population and sample.

Text/Reference Books:

1. V. Rajaraman, Computer Oriented Numerical Methods, Prentice Hall, New Delhi
2. R. Govil, Kamputer se sankhyatmak Reetiyan, et.al. Pitamber Publications, New Delhi,
3. S.P. Gupta., Statistical Methods, Sultan Chand Publications
4. S. S. Shastri, Introducing Methods of Numerical Analysis, PHI, New Delhi

PHYSICS PRACTICAL

1. To determine the polarizing angle for the glass prism surface and to determine the refractive index of the material of prism using Brewster's law =tan (i_p).
2. To study the variation of charge and current in RC circuit for different time constants (using DC source).
3. To study the behavior of RC circuit with varying resistance and capacitance using AC as a power source and also determine the impedance and phase relations.
4. To study the rise and decay of current in LR circuit with a source of constant emf.
5. To study the voltage and current behavior of LR circuit with a AC power source also determine power factor, impedance and phase relation.
6. Study of RC / LC transmission line.
7. Measurement of wavelength of monochromatic source of light by Newton's rings.
8. Measurement of wavelength of monochromatic source of light by plane transmission grating. Measurement of wavelength of monochromatic source of light by biprism.
9. Study of specific rotation by polarimeter.
10. Determination of resolving power of a plane transmission grating.
11. Determination of resolving power of telescope.
12. Determination of dispersive power of material of a prism using spectrometer.
13. Perform floating point operations using normalization (addition, subtraction, multiplication, division).

14. Find the roots of equation (bisection method, regula-falsi method, Newton raphson method, secant method, successive approximation method).
15. Find solution of n linear equation (Gauss elimination method (with & without pivoting), Gauss Seidel method, Gauss Jordan method).
16. Generate following difference tables (forward, backward, divided difference).
17. Interpolate value of f(x) at given x (Lagrange's interpolation method, Newton forward interpolation method, Newton's backward interpolation method).
18. Interpolate value of x at given f(x) using Inverse interpolation method.
19. Fitting of different curves (straight line fit (x on y), straight line fit (y on x), parabola, geometric curve, exponential curve).
20. Find order of polynomial.
21. Find derivative of a given tabulated function at given value (Newton's forward method, Newton's backward method).
22. Find Integrated value, (when tabulated function given-Trapezoidal rule (simple & modified), Simpson's 1/3 (simple & modified), Simpson's 3/8 (simple & modified)
23. Find Integrated value, when algebraic expression given (when algebraic expression given-Trapezoidal rule (simple & modified), Simpson's 1/3 (simple & modified), Simpson's 3/8 (simple & modified)
24. Solve differential equation (Euler's method, Runge-Kutta 2^{nd} order method, Runge-kutta 4^{th} order method, Modified Euler's method, Predictor-corrector method.
25. Any other experiments of the equivalent standard can be set.

III SEMESTER

Thermal Physics

Unit 1

General Thermodynamical interaction, Dependence of the number of states of external parameters, General relations in equilibrium, infinitesimal quasistatic process, Entropy of an ideal gas, Equilibrium of an isolated system, Equilibrium of a system in contact with reservoir (Gibb's free energy).

Unit 2

Equilibrium between phases, Clausius-Clapeyron equation, Triple point, Vapour in equilibrium with liquid or solid, equilibrium conditions for a system of fixed volume in contact with heat reservoir (Helmholtz free energy), for a system at constant pressure in contact with a heat reservoir (Enthalpy), Maxwell's relations.

Unit 3

Thermal interactions of macroscopic systems, first law of thermodynamics and infinitesimal general interaction, Concept of temperature and quantitative idea of temperature scale (thermodynamical parameter), Distribution of energy.

Unit 4

Second law of thermodynamics, Claussius and Kelvin's statements, partition function (Z), mean energy of an ideal gas and mean pressure, Heat engine and efficiency of the engine, Carnots cycle, thermodynamical scale as an absolute scale.

Unit 5

Production of Low Temperatures and Application, Joule Thomson expansion and J.T.coefficients for ideal as well as Van-der Waal's gas, Temperature inversions, Regenerative cooling and cooling by adiabatic expansion and demagnetization, Liquid He, He –I and He-II, superfluidity, quest for absolute zero, Nernst heat theorem.

Text/Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger.
6. 1988, Narosa.
7. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford
8. University Press.
9. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

Electronics

Unit 1

Recapitulation of semiconductor, intrinsic and extrinsic semiconductor, charge density of semiconductors generation and recombination of charges, diffusion, the continuity equation, Injected minority carrier charges, potential variation with in a graded, p-n junction, current component volt Ampere characteristic-temperature dependency, space charge, diffusion capacitance.

Unit 2
Rectification and Power Supply, Half-wave, full wave and bridge rectifiers, Ripple factor, efficiency and regulation, Filters-Shunt capacitor, LC and RC filters regulation and stabilization, Zener diode, Voltage multiplier.

Unit 3
Transistor and Transistor Amplifiers:Notations and Volt-ampere relations for bipolar junction transistor, Concept of load line and operating point, Hybrid parameters, Field effect Transistor and their circuit characteristics, Configurations and their equivalent circuits, Analysis of Transistor amplifiers using hybrid parameters and its frequency response, Fixed and emitter bias, bias stability.

Unit 4
Concept of feedback, stabilization of gain by negative feedback, Effect of feedback on output and input resistance, Reduction of nonlinear distortion by negative feedback, Voltage and current feedback circuits, Frequency resonance, Feedback requirements for oscillators, circuit requirement for oscillation, basic oscillators, Colpitt, Hartley, R-C oscillators, Piezo-electric frequency control.

Unit 5
Operational Amplifier: Differential amplifier, DC level shifter, Input and output impedances, Input offset current, Applications : Unit gain buffer, Adder, Subtractor, Integrator and differentiator, Comparator, Idea of wave form generator, Voltage regulator using integrated amplifiers.

Text/Reference Books:

1. Principles of Electronics by V.K. Mehta, S. Chand, 2002.
2. Integrated Electronics: Analog and Digital Circuits and Systems by J. Millman and C.C. Halkias.

Bio-Physics

Unit 1
Basic principle of modern biophysical methods to study macromolecules from the atomic to cellular levels; Basic introduction to molecular spectroscopy, fluorescence, Mass spectrometric technique, NMR spectroscopy, X-ray crystallography, cryo electron microscopy; High resolution light microscopy, Atomic Force Microscopy, Single molecule manipulation.

Unit 2
Introduction to Statistical Mechanics; Statistical thermodynamics, lattice statistics, molecular distribution and correlation functions, molecular dynamics simulation; The problem of protein folding.

Unit 3
Theoretical and experimental approaches to study protein folding; Introduction to Membrane Biophysics. Structure and function of membranes, experimental and theoretical tools for studying biological membrane.

Unit 4

Structure of Proteins and Nucleic Acids**:** Primary and secondary structure, Ramachandran plot, conformational analysis, tertiary structure, structure of a nucleotide chain, the DNA double helix model, polymorphism.

Unit 5

Molecular Forces in Biological Structures: Electrostatic interactions, hydrophobic and hydrophilic forces, hydrogen bonding interactions, ionic interactions, stabilizing forces in proteins and nucleic acids, steric interactions.

Text/Reference Books:

1. Spectroscopy for the Biological Sciences: Gordon G; Wiley-Interscience; 1st edition; 2005.
2. Biophysical Chemistry: Part II: Techniques For The Study Of Biological Structure and Function by Charles R. Cantor and Paul Reinhart Schimmel; pp 503. W H Freeman and Co, Oxford. 1980.
3. Cantor, C. R., and Schimmel, P., Biophysical Chemistry (parts I, II and III), W. H. Freeman, 1980.
4. Serdyuk, I. N., Zaccai, N. R.,and Zaccai, J.,Methods in Molecular Biophysics: Structure, Dynamics, Function, Cambridge, 2007.

Electrical Technology

Unit 1

DC Networks: Node Voltage and Mesh Current Analysis; Source Conversion. Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power Transform, Laplace transforms and inverse Laplace transforms: Basic Theorem and Circuit analysis using Laplace transformations, Initial and final value theorem.

Unit 2

Single Phase AC Circuits:, EMF Equation, Average, RMS and Effective Values. RLC Series, Parallel and Series, Parallel Circuits, Complex Representation of Impedances. Phasor Diagram, Power and Power Factor.

Unit 3

Three Phase A.C. Circuits: Delta-Star and Star-Delta Transformation, Line & Phase Quantities, 3-Phase Balanced Circuits, Phasor diagram, Measurement of Power in Three Phase Balanced Circuits.

Unit 4

Transformer: Magnetic coupled circuits, Dot convention for coupled circuits, coefficient of coupling, mutual inductance, EMF Equation, Voltage & Current, Relationship and Phasor Diagram of Ideal Transformer.

Unit 5

Introduction to principle of DC Machines, synchronous machines and induction motors, single phase and three phase induction motor, dynamo, alternator, inverter.

Text/Reference Books:

1. Valkenburg Van M.E.: Networks and Analysis: PHI Pvt. Ltd. New Delhi, 3rd Edition 1998.
2. Choudhary D Roy: Network and system: New Age International (P) Ltd. 1st Edition 1991.
3. Edminister Joseph A. : Theory and problem of Electrical Circuits in SI Units:

-Laboratory Practices

1. Determine the thermodynamic constant (r=Cp/Cv) using Clement's and Desormes methods.
2. Using platinum resistance thermometer to find the melting point of a given substance.
3. Determine Thermal conductivity of a bad conductor by Lee's method.
4. Study the variation of total thermal radiation with temperature.
5. Determine the resistance per unit length of Carey fosters bridge and find the resistance of a given wire.
6. Determine the self-inductance of a coil using Anderson's bridge.
7. Determine the capacity of a gang condenser by Desauty's bridge and find the dielectric constant of liquid.
8. Determine the self-inductance of a coil using Rayleigh's method.
9. Study Maximum power transfer theorem.
10. Study of power supply using two diodes/ bridge rectifier using various filter circuits.
11. Study of half wave rectifier using L and pi section filters.
12. Characteristics of given transistor PNP/ NPN (common emitter, common base and common collector configurations).
13. Determination of band gap using a junction diode.
14. Determination of power factor of a given coil using CRO.
15. Study of single stage transistor audio amplifier (variation of gain with frequency)
16. Study of diode as integrator with different voltage wave forms.
17. Any other experiments of the equivalent standard can be set.

III SEMESTER

Statistical Physics

Unit 1

Kinetic theory of gases: Distribution of molecular velocities, Energy distribution function, most probable, average & r.m.s. velocities, principle of equipartition of energy, specific heat of gases, classical theory of specific heat capacity, Specific heat of Solids, Einstein's and Debye's Model (No Derivation).

Unit 2

Classical Statistics: Phase space, Micro and Macro states, Thermodynamic probability, Entropy and probability, The Monoatomic ideal gas, Entropy of mixing, Gibb's paradox, Ensembles: canonical, micro canonical and grand canonical,

Unit 3

Quantum Statistics: Failures of Classical statistics (black body radiation and various laws of distribution of radiation, qualitative discussion of Wien's and Rayleigh Jean's (No derivation) laws, postulates of quantum statistics, indistinguishability of wave function and exchange degeneracy, apriorprobability,

Unit 4

Bose-Einstein Statistics: B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas, Bose derivation of Planck's law.

Unit 5

Fermi-Dirac Statistics: Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, Chandrasekhar Mass Limit.

Text/ Reference Books:

1. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford
2. University Press.
3. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
4. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
5. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
6. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
7. An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press

Mathematical Physics-I

Unit 1

Dirac-Delta Function and its properties, Fourier series, computation of Fourier coefficients, applications to simple periodic functions like square wave, saw tooth wave and rectifier out put.

Unit 2
Transformation of covariant, contravariant and mixed tensor, Addition, Multiplication and contraction of tensors, Quotient law, pseudo tensor, Metric tensor, transformation of Tensors.

Unit 3
Four vector formulation, energy-momentum four vectors, relativistic equation of motion, Orthogonality of four forces and four velocities, transformation of four wave vector, longitudinal and transverse Doppler's effect.

Unit 4
Transformation between laboratory and center of mass systems, four momentum conservation, Kinematics of decay products of an unstable particle and reaction thresholds, pair production, inelastic collision of two particles, Compton effect.

Unit 5
Electromagnetic field tensor, transformation of four potentials, four currents, electric and magnetic field between two inertial frames of reference, Lorentz force, equation of continuity, conservation of charge, tensor description of Maxwell's equations.

Text/ Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013,7th Edn., Elsevier.
2. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
3. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
4. Mathematical Physics, Goswami, 1st edition, Cengage Learning
5. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
6. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press

Digital Electronics

Unit 1
Logic Gates : Logic Gates and Boolean Algebra Representation and Simplification of functions by Karnaugh Maps. Combinational Circuits design. Combinational circuits - adder, subtractor, decoder, demultiplexer, encoder, multiplexer, comparator.

Unit 2
Sequential Logic Circuit & Design-flip flop, shift register, asynchronous and synchronous counters, Digital Logic Families and Their Charactersistic : RTL, DTL, TTL, Schotlky TTL, ECL, MOS and CMOS, Fan in, Fan out.

Unit 3
Semiconductor Memories : RAM, ROM, PROM, EPROM, BJTRAM Cell, MOS RAM Cell, Organization of RAM, Charge Coupled devices (CCD), storage of charge and transfer of charge in CCD.

Unit 4
D/A Converter : Weighted resistance D/A, R-2R Ladder Converter. DAC 0800 D/A Chip, D/A Converter specification.

Unit 5
A/D Converter : Analog to Digital Converter, Parallel Comparator Converter, Counting Converter, Successive Approximation Converter, Dual Slop converter A/D converter specification, sampling and hold circuit, ADC 0804 Converter chip.

Text/Reference Books:

1. Digital Principles and Applications by C. P. Malvino and D. P. Leach, Mc-Graw Hill, 1985.
2. Digital logic and computer design by M. M. Mano, Tata Mc-Graw Hill.
3. Digital Integrated Circuits by Taub and Shilling, Tata Mc-Graw Hill
4. Computer Architecture and Organization by J. P. Hayes, Mc-Graw Hill 1988.
5. Digital Fundamentals by Floyd, Mc-Graw Hill.
6. Digital Ic by K. R. Botkar, Mc-Graw Hill.

Heat transfer

Unit 1
Modes of heat transfer- conduction, convection and radiation, steady and unsteady heat transfer, Fourier equation, thermal resistance, thermal conductivity, thermal diffusivity, heat diffusion equation – cartesian, cylindrical, spherical coordinates, initial and boundary conditions

Unit 2
One dimensional steady state conduction, heat conduction through a plane wall, composite wall, cylindrical wall, sphere. Heat flow through surface and surroundings. Shape factor, plane wall with uniform heat generation, heat transfer from extended surface, fin performance, introduction to transient heat conduction, periodic variation.

Unit 3
Radiation fundamentals-processes and properties, Planck's law, Stefan Boltzman law, Wien's displacement law, Kirchoff's law, Gray bodies, selective emitters, Lambert's cosine law, radiation exchange between surfaces, configuration factor, shape factor, view factor, interchange factor, shape factor algebra, electrical network analogy, radiation shields.

Unit 4
Free and forced convection, laminar and turbulent flow, convection rate equation, estimation of convection heat transfer coefficient, dimensional analysis, physical significance of the dimensionless parameters, laminar boundary layer, turbulent boundary layer, empirical relations for free and forced convection heat transfer.

Unit 5
Combined natural and forced convection, boiling and condensation, laminar film condensation on a vertical plate and tube, dropwise condensation. boiling regimes, bubble growth and nucleate boiling, introduction to heat exchangers.

Text/Reference Books:

1. Heat transfer : A practical approach – Yunus A. Cengel
2. Heat transfer – J P Holman, Tata McGraw Hill
3. Heat and Mass transfer- D.S. Kumar, S. K. Kataria & Sons
4. Heat and Mass Transfer – Frank P. Incropera, David P. DeWitt, Wiley
5. Heat Transfer-YVC Rao, Universities Press

Laboratory Practices

1. Verify certain laws of probability distribution.
2. To verify the truth table of various logic gates (AND,OR,NOT,NOR,NAND,XOR)
3. Verify the various theorems of Boolean algebra and D'morgans theorem.
4. Implement the Boolean expression and verify the truth table.
5. Study the various combinational circuits-Half Adder, Half subtractor, Full Adder, Full subtractor, Parity Generator'Parity Checker.
6. Study the advanced combination circuits-Multiplexer, Demultiplexer, Encoder, Decoder.
7. Study the various code converters & verify the truth table-Binary to BCD converter, Binary to Gray codes and Binary to EX-3.
8. Study the flip flops and verify the truth table-R-S,D,J-K, T, Master slave, flip-flop-Serial in Serial out, Serial in Parallel out, Parallel in Parallel out, Parallel in Serial out.
9. Study the various asynchronous /synchronous counters using flip-flop-Binary up, Binary down, Mod-10 .
10. Study the special counters-Ring counter and Twisted ring counter (Johnson counter).
11. To study the A/D converter and also calculate resolution & error percentage.
12. To study the D/A converter and also calculate resolution & error percentage.
13. To Study an Astable Multivibrator using 555 Timer.
14. To Study the Bistable Multivibrator using 555 Timer.
15. To Study the Monostable Multivibrator using 555 Timer.
16. Any other experiments of the equivalent standard can be set.

V SEMESTER

Elementary Quantum Mechanics

Unit 1

Failures of the classical mechanics, black body radiation and spectral distribution of energy, Planck's quantum hypothesis and average energy of Plank oscillator, Plank's radiation law and discussion to obtain Wein's, Rayleigh-Jeans and Stefan-Boltzmann laws using it, photo electric effect, Einstein's explanation, Compton effect, Wave-particle duality, de Broglie waves, Davisson-Germer experiment, group and phase velocities.

Unit 2

Uncertainty principle, formulation and its applications, finite size of atom, non existence of electrons in nucleus, Concept of wave packet, Phase velocity and group velocity, Construction of one dimensional wave packet, Momentum space representation of wave packet (Fourier transform), Bohr's principle of complementarity, wave function, boundary and continuity conditions of wave function, physical significance of wave function (Schrodinger's and Born's interpretation).

Unit 3

Schrodinger's equation, Its need and justification, time dependent and time independent forms, probability current density, Postulates of Quantum mechanics, operators in quantum mechanics, Definition of an operator, linear and Hermition Operator, Properties of Hermitian operators, Expectation values of dynamical variables -position, momentum, energy, Eigen functions & eigen values, degeneracy, orthogonality of eigen function, ehrenfest theorem, Commutation relations, parity-symmetric and antisymmetric wave functions.

Unit 4

Particle in a one-dimensional box, eigen functions and eigen values, Discrete energy levels, generalization to three dimensions and degeneracy of levels, Potential step and rectangular potential barrier, calculation of reflection and transmission coefficients, alpha decay,

Unit 5

Square well potential problem, calculation of transmission and reflection coefficients, Particle in one dimensional infinite potential well, Particle in a one-dimensional finite depth potential well, Energy eigen values and eigen functions, simple harmonic oscillator (One dimensional case), Zero point energy.

Text/Reference Books:

1. Elementary Quantum Mechanics and Spectroscopy - S. L. Kakani, C. Hemrajni and T.C. Bansal, College Book Centre, Jaipur, 1995.
2. Quantum Mechanics-Theory & Applications by A. K. Ghatak & S. Loknathan, McMillan, 1977
3. Perspectives of Modern Physics- Arthur Beiser, McGraw Hill, Auckland,1995.
4. Introduction to Atomic Spectra - H E. White, Tata McGgraw Hill International Edition

Mathematical Physics-II

Unit 1
Orthogonal Curvilinear coordinate system, scale factors, expression for gradient, divergence and curl and their applications to Cartesian, cylindrical and spherical polar coordinate systems, Coordinate transformation and Jacobian.

Unit 2
Matrices**:** Addition and Multiplication of Matrices, Types of Matrices (Null, Diagonal, Scalar and Unit, Upper-Triangular and Lower-Triangular), Transpose of a Matrix, Symmetric and Skew-Symmetric Matrices, Hermitian and Skew-Hermitian Matrices, Singular and Non-Singular matrices, Conjugate of a Matrix.

Unit 3
Matrices**:** Adjoint of a Matrix, Inverse of a Matrix by Adjoint Method, Trace of a Matrix, Eigen-values and Eigenvectors, Cayley- Hamiliton Theorem, Diagonalization of Matrices, Solutions of Coupled Linear Ordinary Differential Equations.

Unit 4
The second order linear differential equation with variable coefficient and singular points, series solution method and its application in the Bessel's, Hermite's, Legendre's and Laguerre's differential equations, Basic properties like orthogonality, recurrence relations, graphical representation and generating function of Bessel, Hermite, Legendre Laguerre and Associated Legendre functions.

Unit 5
Technique of separation of variables and its application to following boundary value problems: Laplace equation in three dimension Cartesian, Coordinate system-line charge between two earthed parallel plates, Wave equation in spherical polar coordinates the vibration of circular membrane, Diffusion equation in two dimensional Cartesian coordinate system-heat conduction in thin rectangular plate, Laplace equation in spherical coordinate system-Electric Potential about a spherical surface.

Text/Reference Books:
1. Matrices and Tensors in Physics by A.W.Joshi.(New Age Int.Pub., 1995).
2. Vector Spaces and Matrices in Physics by M. C. Jain (Alpha Science International Ltd, 2007).
3. Mathematical Physics by B.S. Rajput, Pragati Prakashan (2011).

Physics of Materials

Unit 1
Elementary Lattice Dynamics - Lattice vibrations and phonons, vibrations of crystals with monoatomic basis, two atoms per primitive basis, quantization of elastic waves, Inelastic neutron scattering by phonons, phonon momentum, Thermal Conductivity of insulators.

Unit 2
Drude-Lorentz Theory of Electrical Conductivity, Boltzman Transport Equation, Sommerfield Theory of Electrical Conductivity, Mathiessen's Rule, Thermal Conductivity,

Boltzmann equation and mean free path, relaxation time and scattering processes, Hall Effect.

Unit 3

Dielectric Properties of Materials - Polarization. Local Electric Field at an Atom. Depolarization Field. Dielectric Constant. Electric Susceptibility. Polarizability. Classical Theory of Electric Polarizability. Clausius- Mosotti Equation. Normal and Anomalous Dispersion. Complex Dielectric Constant.

Unit 4

Magnetic properties of solids: Magnetic susceptibility, Classification of magnetic materials, Origin of atomic Magnetism, Classical theories of diamagnetism and paramagnetism, Quantum theory of paramagnetism, Weiss molecular fields theory of ferromagnetism, Origin of magnetic domain and domain walls, Heisenberg exchange interaction.

Unit 5

Superconductivity: Basic properties of Superconductors, Meissoner effect, isotope effect, type-I and type-II superconductors, Superconducting tunneling, Josephson junction, application of superconductivity, Cooper pairs, Frohlich interaction, BCS theory of superconductivity, High temperature superconductivity in cuprates.

Text/Reference Books:

1. Charles Kittel, Introduction to Solid State Physics, 7th Edition, John Wiley and Sons, Inc.
2. A J Dekkar, Solid State Physics, Macmillan India Limited, 2000.
3. J. S. Blackmore, Solid State Physics, Cambridge University Press, Cambridge.
4. N. W. Ascroft and N. D. Mermin, Solid State Physics, (Harcourt Asia, Singapore, 2003).
5. M. Ali Omar, Elementary solid state physics: principles and applications, (PearsonEducation, 1999)

Principles of Power Production

Unit 1

Introduction to energy resources, classification of energy sources-renewable, non-renewable, commercial, non-commercial, conventional, non-conventional, primary and secondary sources, impacts on environment due to use of conventional and nonconventional sources of energy, climate change, global warming, CO_2 emissions, green house gases. Power scenario – India and World, installed capacity of power plants in India, power generation status, power losses, electrification status, effect of availability of power on development of country and quality of life.

Unit 2

Coal based thermal power plants-Types of coal, properties of coal, coal production and processing, principle, working and components of coal based thermal power plant,

introduction to basics of combustion, boiler, steam generation, turbine, generator, cooling tower, demineralization of water, transmission system. Advantages and disadvantages of coal based power plants.

Unit 3

Nuclear Fission based thermal Power Plants- Introduction to fission and fusion based on binding energy and nuclear stability, nuclear fission reaction, thermal neutrons, fissile material, critical energy of fission, energy released in fission, types of nuclear fission reactors- pressurised water

reactor, light water reactor, boiling water reactor, gas cooled reactor, pressurized heavy water reactor, control rods, moderator, neutron poisons, control of chain reaction and reactor safety.

Unit 4

Hydroelectric power plants-Principles of conversion of hydel energy to electricity, classification and types of hydroelectric power plants, construction and system components - dam, barrage, reservoir, screens, penstock, turbine and generator, head and flow of water, impulse and reaction turbine, energy conversion chain, efficiency and losses.

Unit 5

Concepts of Bio-energy: Photosynthesis process, biomass, biofuel, importance, production and applications of bio-fuels, biomass combustors, gasifiers, anaerobic digestion, organic waste to energy conversion process, production of biogas, composition of biogas and its applications.

Text/Reference Books:

1. Nuclear Energy 6th Edition: An introduction to the Concepts, Systems and Applications ofNuclear Processes- Raymond LeRoy Murray (Elsevier).
2. Nuclear Energy in the 21st Century: World Nuclear University Press- Ian Hore-Lacy.
3. Energy Science: Principles, technologies and impacts – John Andrews & Nick Jelly(Oxford).
4. Energy Management Handbook, W.C. Turner, S. Doty, CRC Press, 2006.
5. Power Plant Engineering, P. K. Nag, Tata McGraw Hill.
6. The Physics of Nuclear Reactions :W.M.Gibson,Pergamon Press.
7. Non-conventional Energy Resources, B. H. Khan, Tata McGraw Hill, 2006
8. Non-Conventional Energy Sources, G D Rai, Khanna Publishers.
9. Electrical Power Generation: Conventional and Renewable, Tanmay Deb, KhannaPublishers, 2018.
10. Reports of Ministry of Power and Central Electricity Authority, India.

Laboratory Practices

1. Determine the electric charge (e/m) using Millikan's oil drop method.
2. Determine the specific charge (e/m) using Thomson method.

3. Determine the specific charge (e/m) using helical method.
4. Determine ballistic constant using constant deflection method.
5. Determine ballistic constant using condenser method.
6. Determine high resistance by leakage method.
7. Determine the magnetic field using ballistic galvanometer and search coil.
8. Determine the mechanical equivalent of heat (J) by using calendar and barn's constantflow calorimeter
9. Determine the thermal conductivity of a bad conductor using lee's disc method.
10. Determine the melting point of given material using platinum resistance thermometer.
11. Plot thermo emf vs temperature graph and find the inversion and neutral temperature.
12. Determine the thermodynamic constant (Cp/Cv) using Clement and Desorme'smethod.
13. Study of variation of total thermal radiation with temperature and verify the Stefan'slaw.
14. Determine the value of Stefan's constant.
15. Design a Zener regulated power supply and studies the regulation with various loads.
16. Study the characteristic of field effect transistor (FET) and design andstudy amplifi
17. Applications of operational amplifier as(minimum two of the following exercises) : (i)Inverter (ii) Non-Inverter (iii) Differentiator (iv) Integrator.
18. Study of polarization by reflection from a glass plate with the help of Nicolprism and photo cell and verification of Brewster's law of Malus.
19. Any other experiments of the equivalent standard can be set.

VI SEMESTER

Solid State Physics

Unit 1

Crystal structure : Symmetry elements in crystal, fundamental lattice systems and types, Miller indices and direction indices, Spacing of planes in Crystal Lattice, crystal structures of simple cubic, Face centered cubic structure, Body concerted cubic structure, Hexagonal closed packed structure, diamond and Zinc blend structure, Pervoskite structure, reciprocal lattice, Brilloin zones.

Unit 2

Crystal bonding, ionic bond, binding energy of ionic crystal, determination of the repulsive exponent, covalent bonding, metallic bonding, molecular or Vander Waal's bonding, hydrogen bonding, Crystal Diffraction: Bragg's law, X-ray and neutron diffraction, rotating crystal and powder methods, Lave equation.

Unit 3

Electrical and Thermal Properties of Solids: Phonon, Lattice Specific heat, Various theories of specific heat – Classical theory, Einstein's theory and theory, Quantum theory of electrical and Thermal conductivity, Weidmann-Franz law, light propagation in conducting media, Fermi Dirac distribution function, density of states.

Unit 4

Semiconductor, Law of mass action, Calculation of impurity conductivity, Introduction of band structure, Ellipsoidal energy surfaces in Si and Ge, Hall effect, recombination mechanism, Shockley Read theory, excitons, photoconductivity, photo luminescence.

Unit 5

Band theory of solids: Formation of bands, Wave Function in a periodic lattice and Bloch theorem, Kronig Penny Model, Effective mass of an electron moving in a crystal, Physical origin of effective mass, difference between conductors, insulators, semiconductors.

Text Reference Books:

1. Solid State Physics by S. O. Pillai, New Age International, 2005.
2. Introduction to Solid state Physics by C. Kittel, (John Wiley), VII Ed.,1995.
3. Solid State Physics by A. J. Dekker, (Macmilam), London, 1965.
4. Solid state physics by S. O. Pillai, (New Age International Publishers), 2005.
6. Intermediate Quantum theory of solids- A.D.E.Animalu,(Prentice Hall).

Nuclear & Particle

PhysicsUnit 1

Nuclear Properties: Mass, radius, angular momentum, magnetic moment, electric quadrupole moment, parity, estimation of mass, basic concepts of mass spectrographs, Bainbridge Jordan double focussing spectrograph, Coulomb scattering of a charged particle by a nucleus, Electron scattering by a nucleus, variation of nuclear radius with mass number A.

Unit 2

Nuclear Binding : Constituents of the nucleus, properties of nuclear forces, Binding energy, mass defect, variation of binding energy with mass number A. Liquid drop model, Semi- empirical mass formula, origin of various terms, stable nucleus and conditions for stability.

Unit 3

Nuclear Fission: Energy release in nuclear fission (using BE curve) spontaneous fission and potential barrier, liquid drop model, self sustaining chain reaction, neutron balance in a nuclear reactor, classification of reactors, uncontrolled reaction and atomic bomb, Nuclear Fusion: Energy released in nuclear fusion in stars, carbon-nitrogen and proton-proton cycle, problems of controlled fusion.

Unit 4

Particle Accelerator: Linear accelerator, cyclotron, synchrocyclotron, betatron, synchrotron, Electron Synchrotron, proton synchrotron, Nuclear detectors: Ionisation chamber, Proportional counter, GM counter, scintillation counters, solid state detectors, neutron detector.

Unit 5

Subatomic Particles: Properties of particles, classification into leptons, mesons and baryons, matter and antimatter, conservation laws, fundamental interactions, quark model for thestructure of matter.

Text/Reference Books:

1. Nuclear physics by Irving Kaplan, Oxford & IBH Pub., 1962.
2. Introduction to experimental Nuclear Physics by R. M. Singru, Wiley Eastern Pvt. Ltd.
3. Nuclear Physics by S. N. Ghoshal, S. Chand, 2006.

Elements of Spectroscopy

Unit 1

Hydrogen Atom : Particle in spherically symmetric potential, Schrodinger's equation for one electron atom in spherical coordinates, separation of variables, orbital angular momentum and its quantization, spherical harmonics, Energy levels of hydrogen atom, calculation of average radius, hydrogen atom spectrum, probability density distribution.

Unit 2

Magnetic dipole in external magnetic field, Space quantization, effect of spin, relativistic and spin orbit corrections to energy levels of hydrogen, Hamiltonian including all corrections and term shifts, fine structure, the Lamb shift (only an qualitative description)

Unit 3

Systems with Identical Particles: Indistinguishability and exchange symmetry, many particle wave functions and Pauli's exclusion principle, spectroscopic terms for atoms, Vector representation and Coupling of angular momenta, interaction energies, LS-Russel Saunders coupling, jj coupling, their interaction energies.

Unit 4

Atom in a weak uniform external electric field, Linear Stark effect for H-atom levels, calculation of the polarizability of the H-atom, spin-orbit interaction, Normal and anomalous Zeeman Effect, Splitting of levels, Paschen Back effect.

Unit 5

Spectroscopy (qualitative) : Born-Oppenheimer approximation, rotational and vibrational spectra of a molecule, anharmonic oscillator, isotope effect, molecule as vibrating rotator, general features of electronic spectra, fine structure of electronic bands, Franck-Condon's principle, classical and quantum theory of Raman effect, Raman spectra for rotational and vibrational transitions, comparison with infra red spectra.

Text/Reference books:

1. Introduction to Atomic Spectra by H. E. White
2. Spectra of diatomic molecules by G. Herdetzberg
3. Spectroscopy Vol. I, II, & III by Walker & Straughen
4. Atomic Spectra by Kuhn.
5. Molecular Spectroscopy By C. N. Bennwell, Tata McGraw Hill Publication.
6. Elementary Atomic Structure: G.R.Woodgate
7. Quantum Physics (atoms, molecules…) R. Eisberg and R. Resnick (J. Wiley),2005

Renewable Energy

Conservation

Unit 1

Solar spectrum – Electromagnetic spectrum, Physics of the Sun, solar constant, spectral distribution and variation of extraterrestrial radiation, beam, diffuse and global solar radiation, basics of conversion of solar radiation to thermal energy, property of glass and green house effect, applications of solar thermal energy in solar devices- solar cookers, solar dryers, solar distillation stills, solar water heaters and power generation.

Unit 2

Introduction to Solar Photovoltaics- solar radiation to electrical energy conversion, semiconductors, p-n junction, photovoltaic effect, photovoltaic cell, current-voltage characteristics, equivalent circuit, fill factor, efficiency, power curve, maximum power point, effect of irradiation and temperature on efficiency of solar cells.

Unit 3

Wind Power Generation: Physical principles for conversion of kinetic energy of wind to electricity, lift and drag forces, maximum theoretical efficiency of horizontal wind turbine, Betz limit, wind turbine components, horizontal and vertical axis wind turbines, description of generation system, energy conversion, losses and characteristic power curve, cut in speed, cut out speed, rated power.

Unit 4

Geothermal Energy conversion: Geothermal energy resources, geothermal energy for power production- dry steam, single flash steam, double flash steam and binary cycle power plants, production well and injection well, potential, advantages and

disadvantages.

Unit 5

Ocean, tidal and wave energy: Wave power, Wells turbine for conversion of wave energy, principle of operation of oscillating water column wave energy converter, concept of ocean thermal energy conversion, closed cycle OTEC, open cycle OTEC, occurrence of tides and principle of tidal power.

Text/Reference books:

1. Renewable Energy Engineering and Technology: Principles and Practice, Edited by V VN Kishore, The Energy and Resources Institute, New Delhi.
2. Energy Science: Principles, technologies and impacts – John Andrews & Nick Jelly(Oxford).
3. Non-conventional Energy Resources, B. H. Khan, Tata McGraw Hill, 2006
4. Non-Conventional Energy Sources, G D Rai, Khanna Publishers.
5. Solar Energy: Principles of Thermal Collection and Storage, Sukhatme S.P. TataMcGraw Hill Pub., New Delhi
6. Solar Energy Fundamentals and Applications, Garg H.P., Prakash J., Tata McGraw-Hill,2005.
7. Solar Photovoltaic: Fundamentals,Technologies and Application, Chetan Singh SolankiPHI Learning Pvt Ltd., 2009.
8. Wind Energy: Theory and Practice, Siraj Ahmed, PHI, 2013
9. Renewable Energy: Power for sustainable future, Godfrey Boyle, Oxford UniversityPress, 2004.

Laboratory Practices

1. Determine the value of Plank's constant using photocell.
2. Determine the value of Plank's constant using solar cell.
3. Work function of Tungsten, Richardson's equation.
4. Study the absorption spectrum of iodine molecule.
5. Study the Franck Hertz experiment and determine the ionization potential of inert gas.
6. Study the hyperfine structure of spectral lines and Zeeman effect by constant deviation spectrograph.
7. Determine hall voltage, mobility, carrier concentration and hall coefficient in a givensemiconductor.
8. Determine the band gap in a semiconductor using four-probe method.
9. Determine the magnetic susceptibility of a paramagnetic salt by Quinck's method.
10. Determine the power factor of a coil using CRO.
11. Determine hysterisis loss using CRO.
12. Study the dynamics of a lattice using electrical analogue.
13. Study the characteristics of a G.M counter and verify the inverse square law.
14. Study of β- absorption in aluminium foil using G.M counter.
15. Determine the g- factor by ESR- step up.
16. Study of variation of modulus of rigidity of a given specimen as a function of

temperature.

17. Any other experiments of the equivalent standard can be set.