B.Sc. – III (Physics)

Paper – I Elements of Relativistic, Classical & Statistical Mechanics:

Unit – I

Relativistic Mechanics:

Earth as a reference frame, Galilean transformation, Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformations, Lorentz contraction and time dilation, Law of addition of velocities, variation of mass with velocity, Principle of equivalence of mass and energy.

Unit – II

Classical Mechanics:

Mechanics of a system of particles, generalized co-ordinates, D'Alembert's principle. The Lagrangian formulation and Lagrange's equations of motion. Calculus of variation and it's applications. The Hamiltonian formulation and Hamilton's equation of Motion.

Unit – III

Classical Mechanics & Statistical Mechanics:

The rigid body motion, Force-free motion of symmetrical rigid body. Two – body central force problem, reduction to equivalent one-body problem, the equation on motion and first integrals, Classification of orbits, Orbit for integrable power-law potentials, Inverse square law-Kepler problem. Inadequacy of Classical Mechanics, phase space, Liouville's theorem, connection between statistical and thermodynamic quantities.

Unit – IV

Statistical Mechanics:

Ensembles, the microcanonical, the canonical and grand canonical ensembles, Maxwell-Boltzmann statistics, Partition function, Maxwell Velocity distribution and mean values, equipartition theorem, Statistics of interacting systems, Van der Waal's gas, Statistics of identical particles, Fermi-Dirac and Bose-Einstein Statistics, simple applications, electron gas and Planck's oscillator.

Paper – II – Solid State and Nuclear Physics:

Unit – I

Crystal Structure:

Lattice translation vectors and lattice, Symmetry operations, Basis and crystal structure, Primitive Lattice cell, Two-dimensional lattice types, systems. Number of lattices. Point groups and plane groups, Three dimensional lattice types, System, Number of Lattices, Points groups and space groups, Index system for crystal planes-Miller indices, Simple crystal structures, Nacl, cs cl, diamond, Cubic

ZnS and hexagonal ZnS, Occurrence of nonideal crysal structures, random stacking of polytyprism, glasses.

Crystal Diffraction and Reciprocal Lattice:

Incident beam, Bragg law, Experimental diffraction method, Laue method, Rotating-crystal method, Powder method Derivation of scattered wave amplitude, Fourier analysis, Reciprocal lattice vectors, Diffraction conditions, Ewald method, Brillouin zones, Reciprocal lattice to sc, bcc and fcc lattices, Fourier analysis of the basis and atomic form factor.

Unit – II

Crystal Bindings:

Crystal of inert gases, Van der Walls-London interaction repulsive interaction, Equilibrium lattice constants, Cohesive energy, compressibility and bulk modulus, Ionic crystal, Madelung energy evaluation of Madelung constant, Covalent crystals, Hydrogen-bonded crystals, Atomic radii.

Lattice Vibrations:

Lattice Heat capacity, Einstein model, Vibrations of monatomic lattice, derivation of dispersion relation, First brillouin zone, group velocity, continuum limit, Force constants, Lattice with two atoms per primitive cell, derivation of dispersion relation, Acoustic and optical modes, Phonon momentum.

Free electron theory, Fermi energy, density of states, Heat capacity of electron gas, Paramagnetic susceptibility of conduction electrons, Hall effect in metals.

Origin of band theory, Qualitative idea of Bloch theorem, Kronig-Penney model, Number of orbitals in a band, conductor, Semi-conductor and insulators, Effective mass, Concept of holes.

Unit – III

Nuclear Physics:

1. **General Properties of Nucleus:**
   Brief survey of general Properties of the Nucleus, Mass defect and binding energy, charges, Size, Spin and Magnetic moment, Bainbridge mass spectrograph.

2. **Nuclear Forces:**
   Saturation phenomena and Exchange forces, Deutron ground state properties.

3. **Nuclear Models:**
   Liquid drop model and bethe Weiszacher mass formula, Single particle shell model (only the level scheme in the context of reproduction of magic numbers).

4. **Natural Radioactivity:**

Fundamental laws of radioactivity, Soddy-Fajan's displacement law and law of radioactive disintegration, Basic ideas about α, β and γ decay.

Unit – IV

1. **Nuclear Reactions:**
   Nuclear reactions and their conservation laws, Cross section of nuclear reactions, Theory of fission (Qualitative), Nuclear reactors and Nuclear fusion.

2. **Accelerators and detectors:**
   Vande Graff, Cyclotron and Synchrotron, Interaction of charged particles and gamma rays with matter (qualitative), GM counter, Scintillation counter and neutron detectors.

3. **Elementary Particles:**
   Basic classification based on rest mass, Spin and half life, particle interactions (gravitational, Electromagnetic, week and strong Interactions).

Paper – III – Electronics:

Unit – I

Network Theorems and Circuit Analysis:

Thevenin, Norton and superposition theorems and their applications, T and ∏ Network characteristics Interactive and image impedances, Constant K and derived-m type filters. Transmission lines. Characteristics impedances and attenuations Reflection coefficients.

Diodes:

Diffusion of minority carrier in semiconductor, work function in metals and semiconductors. Junctions between metal and semiconductors, Semiconductor and semiconductor; p.n. Junction, Depletion layer, Junction Potential Width of depletion layer, Field and Capacitance of depletion layer, Forward A.c. And D.C. resistance of junction Reverse Breakdown.

UNIT – II

Diode:

Zener and Avalanche diodes, Tunnel diodes, Point contact diode. Their importance at High frequencies, LED photodiodes, Effect of temperature on Junction diode Thermistors.

Transistors:

Transistors parameters, base width modulation transit time and life-time of minority carriers base. Emitter resestance Collector conductance, Base spreading resistance, Difusion capacitance, Reverse

feedback ratio, Equivalent circuit for transistors, Basic Model, hybrid model and Y parameter equivalent circuit Input and output impedances.

UNIT – III

Current and Voltage gain, Biasing formulae for transistors, Base bias, emitter bias and mixed type bias and mixed type biasing for small and large signal operation.

Transistor circuit application at law frequencies, their AC and DC equivalent for three different modes of operation, Large signal operation of transistors, Transistor Power amplifiers, Class A and B operation. Maximum power output. Effect of temperature. Heat sinks, thermal resistance Distorsion in amplifiers, cascading of stages, Frequency response, Negative and positive feedback in transistor amplifiers.

UNIT – IV

Field effect transistors and their characteristics biasing of FET, use in preamplifiers MOSFET and their simple uses.

Power Supplies:

Electronically regulated low and high voltage power supplies, Inverters for battery operated equipments.

Miscellaneous:

Basic linear integrated circuits phototransistors, Silicon Controlled rectifiers, Unijunction transistor and their simple uses.

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Physical Chemistry

Semester III **Paper 4** **Max Marks: 100 (80 + 20)**

UNIT I

I. Thermodynamics-1

a. Definition of thermodynamic terms: System, surroundings etc. Types of systems, intensive andextensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

b. First Law of Thermodynamics: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law - Joule-Thomson coefficient and inversion temperature. Calculation of w,q, dU&dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

II. Thermochemistry: Standard state, standard enthalpy of formation - Hess's Law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy,effect of temperature on enthalpy of reaction, Kirchhoff s equation.

UNIT II

III. Thermodynamics - II

a. Second law of thermodynamics: statements of second law of thermodynamics, Carnot's cycle and its efficiency, Carnot's theorem. Thermodynamic scale of temperature, Le Chatelierôs principle, reaction isotherm and reaction isochore, Clapeyron-Clausius equation and its applications

b. Concept of entropy: Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, criteria of spontaneity and equilibrium change in ideal gases and mixing of gases.

IV. Gibbs and Helmholtz free energy functions and their definitions

UNIT III

V. Electrochemistry -1:

a. Electrical transport - Conduction in metals and in electrolyte solutions, specific conductance, equivalent conductance, experimental determination of equivalent conductance and specific conductance, variation of equivalent and specific conductance with dilution. Kohlrausch's law, weak and strong electrolyte, Arrhenius theory of electrolyte dissociation and its limitations. Ostwald's dilution law its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and its determination by Hittorfs method and moving boundary method.

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Physical Chemistry

Semester III **Paper 4** **Max Marks: 100 (80 + 20)**

VI. Applications of conductivity measurements: Determination of degree of dissociation, determination of Ka of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

UNIT IV

VII. Electrochemistry - II:

a. Types of reversible electrodes- Gas-metal ion, metal-ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, single electrode potential, standard electrode potential. Reference electrode: standard hydrogen electrode and calomel electrode, Nernst equation, derivation of cell E.M.F., electrochemical series and its significance.

b. Electrolytic and Galvanic cells- Reversible and irreversible cells, conventional representation of electrochemical cells.

c. EMF of a cell and its measurements- Calculation of cell EMF. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K)

d. Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

VIII. Definition of pH and pKa, determination of pH using quinhydrone and glass electrodes by potentiometric methods. Buffers - Mechanism of buffer action, Henderson-Hazel equation. Hydrolysis of salts.

Books Suggested (Theory Courses)

a. Physical Chemistry. G.M. Barrow. International Student Edition, McGraw Hill.
b. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.
c. The Elements of Physical Chemistry, P.W. Atkins, Oxford.
d. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.
e. Graduate physical Chemistry,VolumeI-III By L.R.sharma and M.s..Pathania
f. Principles of Physical Chemistry by B.R.Puri,L.P Sharma and M.S.Pathania,V ishal publication ,Jallandhar.

Department of Chemistry
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Chemistry

Semester III **Practical** **Max Marks: 100**

Physical Chemistry

1. Chemical Kinetics
    a. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at room temperature.
2. Distribution Law
    a. To study the distribution of iodine between water and CCI4.
3. Colloids
    a. To prepare arsenious sulphide sol and compare the precipitating power of mono-, bi- and trivalent anions.
4. Viscosity, Surface Tension
    a. To determine the percentage composition of a given binary mixture (non interacting systems) by viscosity method.
    b. To determine the percentage composition of a given binary mixture (non interacting systems) by surface tension method (acetone & ethyl methyl ketone).
5. Phase Equilibrium
    a. To construct the phase diagram of two component (e.g. diphenylamine benzophenone) system by cooling curve method.
6. Thermochemistry
    a. To determine the solubility of benzoic acid at different temperatures and to determine æH of the dissolution process.
    b. To determine the enthalpy of neutralisation of a week acid/weak base versus strong base/strong acid and determine the enthalpy of ionisation of the weak acid/weak base.

Organic Chemistry

a. Sublimation
b. Crystallization
c. Identification of organic compounds with derivatives (solid compounds of all functional groups and liquid compounds.

Record and Viva

Books Recommended

(a) Chemistry Practical by S.Giri, D.N. Bajpai and O.P.Shukla,S.Chand Publication.
(b) Practical Chemistry Volume 1-3 by Fateh Bahadur, Vishal Publication
(c) Advanced Physical Chemistry by J.B.Yadav, Goel Publication

B.A./B.Sc. II (Semester III)
Mathematics
(Applicable from July 2019)

Paper I (Algebra)

Unit I

Equivalence relations and partitions, Congruence modulo n, Definition of a group with examples and simple properties, Subgroups, Generators of a group, Cyclic groups.

Unit II

Permutation groups, Even and odd permutations, The alternating group, Cayley's theorem, Direct products, Coset decomposition, Lagrange's theorem and its consequences, Fermat and Euler theorems

Unit III

Normal subgroups, Quotient groups, Homomorphism and isomorphism, Fundamental theorem of homomorphism, Theorems on isomorphism.

Unit IV

Rings, Subrings, Integral domains and fields, Characteristic of a ring, Ideal and quotient rings, Ring homomorphism, Field of quotient of an integral domain.

Paper II: Mathematical Methods

Unit I

Limit and Continuity of functions of two variables, Differentiation of function of two variables, Necessary and sufficient condition for differentiability of functions two variables, Schwarz's and Young theorem, Taylor's theorem for functions of two variables with examples, Maxima and minima for functions of two variables, Lagrange multiplier method, Jacobians.

Unit II

Existence theorems for Laplace transforms, Linearity of Laplace transform and their properties, Laplace transform of the derivatives and integrals of a function, Convolution theorem, inverse Laplace transforms, Solution of the differential equations using Laplace transforms.

Unit III

Fourier series, Fourier expansion of piecewise monotonic functions, Half and full range expansions, Fourier transforms (finite and infinite), Fourier integral.

Unit IV

Calculus of variations-Variational problems with fixed boundaries- Euler's equation for functionals containing first order derivative and one independent variable, Extremals, Functionals dependent on higher order derivatives, Functionals dependent on more than one independent variable, Variational problems in parametric form.