Chemistry Syllabus & Evaluation Scheme For II Year

B.Sc.(PCM/CBZ/Microbiology)

Dev Bhoomi Institute of Management Studies, Dehradun

Affiliated to

Sri Dev Suman Uttarakhand University, Badshahithol, Tehri, Uttrakhand

B.Sc. Second Year

Paper	Paper code	Course	Max. Marks	Work Hrs
I	CH-201	Inorganic Chemistry	50	60
II	CH-202	Organic Chemistry	50	60
III	CH-203	Physical Chemistry	50	60
	CH-204	Laboratory Practical	50	60
Grand Total			200	180

Note: Examiner should follow the below given pattern covering all the units for each section compulsorily:

a) Twelve compulsory objective type questions of one mark each, 12 x 1 = 12 Marks

b) Examinees to solve six short answer questions out of ten question (3 mark each) 3x6=18 Marks.

c) Examinees to solve four long answer questions out of seven (5 mark each) 4x5=20 Marks

Distribution of marks for Practical exam will be as follows:

B.Sc. (SECOND YEAR)

(i)	**Inorganic Experiment**	**15**
(ii)	**Organic Experiment**	**12**
(iii)	**Physical Chemistry Experiment**	**10**
(iv)	**Viva-voce****	**05**
(v)	**Annual record**	**08**
	Total	**50**

	Dev Bhoomi Institute Of Management Studies		YEAR: II
	Department of Applied Science		
	Total Contact Hours: 60	LTP -2-0-0	External Marks: 50
Course Title: Inorganic Chemistry		Course Code: CH-201	Duration of External Exam: 3 Hours

Pre – Requisite: Knowledge of basic concepts of Inorganic Chemistry.

Objective: In coordination complex consists of a central atom or ion, which is usually metallic and is called the coordination center and a surrounding array of bounded atom. In electrochemistry students studies the relationship between electricity as a measurable and quantitative phenomenon.

B.Sc. – II Chemistry
Paper-I Inorganic Chemistry

Unit – I

I. Chemistry of Elements of First Transition Series:
Characteristic properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry.

II. Chemistry of Elements of Second and Third Transition Series:
General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.

Unit – II

III. Coordination Compounds
Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

Unit – III

IV. Chemistry of Lanthanide Elements
Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, ceric ammonium sulphate and its analytical uses.

V. Chemistry of Actinides
Electronic configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.

Unit – IV

VI. Oxidation and Reduction
Electrode potential, electrochemical series and its applications, Principles involved in the extraction of the elements.

Unit – V

VII. Acids and Bases

Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concept of acids and bases.

VIII. Non-aqueous Solvents

Physical properties of a solvent, types of solvents and their general characteristics, Reactions in non-aqueous solvents with reference to liquid NH_3 and Liquid SO_2.

Books Suggested:

1. J.D Lee Concise, Inorganic Chemistry, RI.VS>
2. Puri, Sharma and Kaliya, Principles of Inorganic Chemistry, Milestone publisher and distributors
3. R.I Madan, Chemistry, Malik Tuli and Madan, S.Chand

Course Outcome	Description
CO1	Students learn about I,II,III Transition Series Elements
CO2	Student gets to know about compound containing coordinate bonds
CO3	Students learn about Lanthanides & Actinides
CO4	Students learn about Oxidation & Reduction Process.
CO5	Students gets to know about Acid Base concept in Detail & different types of Solutions.

	Dev Bhoomi Institute Of Management Studies		**YEAR: II**
	Department of Applied Science		
	Total Contact Hours: 60	**LTP -2-0-0**	**External Marks : 50**
Course Title: Organic Chemistry		**Course Code: CH-202**	**Duration of External Exam: 3 Hours**

Pre – Requisite: Knowledge of basic concepts of Organic Chemistry.
Objective: Chemistry is a central subject of science. It is also closely related to daily life. So students get to know about things which are important for their day to day life.

B.Sc. – II Chemistry
Paper-II Organic Chemistry

Unit – I

I. Electromagnetic Spectrum Absorption Spectra

Ultraviolet (UV) absorption spectroscopy – absorption laws (Beer-Lambert law), molar absroptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. U.V. spectra of conjugated enes and enones.

Infrared (I.R.) absorption spectroscopy – molecular vibrations, Hooke's law, selection rules, intensity and position of I.R. bands, measurement of I.R. spectrum, finger print region, characteristic absorptions of various functional groups and interpretation of I.R. spectra of simple organic compounds.

Unit – II

II. Alcohols

Classification and nomenclature, Monohydric alcohols – nomenclature, methods of formation by reduction of Aldehydes, Ketones, Carboxylic acids and Esters, Hydrogen bonding, Acidic nature, Reactions of alcohols.

Dihydric alcohols - – nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol- pinacolone rearrangement.

Trihydric alcohols - nomenclature, methods of formation, chemical reactions of glycerol.

III. Phenols :

Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of

phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman syntheis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

Unit – III

IV. Ethers and Epoxides

Nomenclature of ethers and methods of their formation, physical properties, Chemical

reactions – cleavage and autoxidation, Ziesel's method.

Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organo lithium reagents with epoxides.

V. Aldehydes and Ketones:

Nomenclature and structure of the carbonyl groups, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones uses 1, 3-dithianes, synthesis of ketones from nitrites and from carboxylic acids, Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction.

Use of acetals as protecting group, Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions. Halogenation of enolizable ketones, An introduction to O, P unsaturated aldehydes and Ketones.

Unit – IV

VI. Carboxylic Acids:

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength, Preparation of carboxylic acids, Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction, Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids, Mechanism of decarboxylation. Methods of formation and chemical reactions of halo acids, Hydroxy acids: malic, trartaric and citric acids. Methods of formation and chemical reactions of unsaturated monocarboxylic acids. Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.

VII. Carboxylic Acid Derivatives

Structure and nomenclature of acid chlorides, esters, amides (urea) and acidanyhydrides. Relative stability of acyl derivatives, Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reaction. Mechanisms of esterificaton and hydrolysis (acidic and basic)

Unit - V

VIII. Organic Compounds of Nitrogen:

Preparation of nitroalkanes and nitroarenes, Chemical reactions of nitroalkanes. Mechanisms of nuclephilc substitution in nitroarenes and their reductions in acidic, neutral and alkaline media, Picric acid.

Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties, Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts, Preparation of alkyl and aryl amines (reduction of nitro compounds, nitrities), reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction, Hofmann-bromamide reaction. Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryldiazonium salts, azo coupling.

Books Suggested:

Organic Chemistry

1 F.L Eliel. Stereochemistry of organic Compounds Willey.

2 Jagdamba Singh, Undergraduate Organic Chemistry Voi-1, Pragati Prakashan

Mechanisms of esterfication and hydrolysis (acidic and Basic).

Course Outcome	Description
CO1	Student get to know about Alcohol & Phenol family.
CO2	Student get to know about Ether & Epoxides.
CO3	Students got to know about Carbonyl Compounds.
CO4	Students got to know about Carboxylic Acid Derivatives,

	Dev Bhoomi Institute Of Management Studies		YEAR: II
	Department of Applied Science		
	Total Contact Hours: 60	**LTP -2-0-0**	**External Marks : 50**
Course Title: Physical Chemistry		**Course Code: CH-203**	**Duration of External Exam: 3 Hours**

Pre – Requisite: Knowledge of basic concepts of Physical Chemistry.

Objective: Detail study of important topics of Physical Chemistry. In Thermodynamics students deals with the relation between heat and other forms of energy. In electrochemistry students studies the relationship between electricity as a measurable and quantitative phenomenon.

B.Sc. – II Chemistry
Physical Chemistry

Unit – I

I. Thermodynamics – I

Definitions of thermodynamic terms: System, surroundings etc. types of systems, intensive and extensive properties, State and path functions and their differentials, Thermodynamic processes, concept of heat and work.

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, ΔU & ΔH for the expansion of ideal gases under isotheral and adiabatic conditions for reversible process.

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 and its calculation from thermochemical data, temperature dependence of enthalpy, Kirchhoff's equation

Unit – II

II. Thermodynamics – II

Second Law of Thermodynamics: Need for the law, different statements of the law, Cornot's cycle and its efficiency, Carnot's theorem. Thermodynamic scale of temperature.

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, clausius inequality, entropy as a criteria of spontaneity and equilibrium, Equilibrium change in ideal gases and mixing of gases.

Gibbs and Helmholtz functions: Gibbs function (G) and Helmhotz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity,

their advantage over entropy change, Variation of G and A with P, V and T.

Third Law of Thermodynamics: Nernst heat theorem, statement and concept of residual entropy. Nernst distribution law – thermodynamic derivation, applications.

Unit - III

III. Chemical Equilibrium

Equilibrium constant and free energy, Thermodynamic derivation of law of mass action, Le Chatelier's principle. Reaction isotherm and reaction isochore – Clapeyron-clausius equation and its applications.

Unit – IV

IV. Electrochemistry – I:

Electrical transport: Conduction in metals and in electrolyte solutions, specific conductance molar and equivalent conductance, measurement of equivalent conductance, variation of molar equivalent and specific conductance with dilution.

Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law its uses and limitations, Debye-Huckel-Onsager's equation for strong electrolytes(elementary treatment only),

Transport number, definition and determination by Hittorf's method and moving boundary method.

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

V. Solutions:

Liquid – Liquid mixtures- Ideal liquid mixtures, Raoult's and Henry's law, Non-ideal system-azeotropes – HCl-H_2O and ethanol – water systems.

Partially miscible liquids- Phenol – water, trimethylamine – water, nicotine-water systems, Immiscible liquids, steam distillation.

Unit – V

VI. Electrochemistry – II:

Types of reversible electrodes – gas-metal ion, metal-ion, metal-insoluble salt anion and redox electrodes, Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, strandard hydrogen electrode-reference electrodes and their applications, standard electrode potential, sign conventions, electrochemical series and its significance.

Electrolytic and Galvanic cells–reversible and irreversible cells, conventional representation of electrochemical cells, EMF of a cell and its measurements, Computation of cell EMF, Calculation of thermodynamic quantities of cell reactions (QG, QH and K) Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

Definition of pH and pK_a, determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods, Buffers – Mechanism of buffer action, Henderson- Hazel equation, application of buffer solution, Hydrolysis of salts

VII. Phase Equilibrium:

Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibb's phase rule, phase equilibria of one component system-water, 'CO_2' and 'S' systems Phase equilibria of two component system – solid liquid equilibria simple eutectic – Bi-Cd, Pb-Ag systems, desilverisation of lead.

Solid solutions – compound formation with congruent melting point (Mg-Zn) and incongruent melting point, ($FeCl_3$-H_2O) and ($CuSO_4$-H_2O) system.

Books Suggested:

1. J.D Lee Concise, Physical Chemistry, RI.VS>

2. Puri, Sharma and Kaliya, Principles of Physical Chemistry, Milestone publisher and distributors
3. R.I Madan, Chemistry, Malik Tuli and Madan, S.Chand

Course Outcome	Description
CO1	Student gets to know relationship between heat & other forms of energy and by extension of the relationships between all forms of energy.
CO2	Student get to know about
CO3	Students got to know about chemical equilibrium
CO4	Students got to know about Electrochemistry
CO5	Students learn about Electrochemistry II and Phase Equillibrium

	Dev Bhoomi Institute Of Management Studies	**YeaR: II**
	Department of Applied Science	
	Total Contact Hours: **LTP --2-0**	**External Marks:50**
Course Title: Chemistry Practical (Lab Course)	**Course Code: CH-204**	**Duration of External Exam: 3 Hours**

B.Sc. – II (Laboratory Practical) 180 hrs. (6 hrs/week)

Atleast three practicals from each specialization should be carried out.

Inorganic Chemistry:

I. Calibration of fractional weights, pipettes and burettes, Preparation of standard solutions, Dilution – 0.1 M to 0.001 M solutions.

Quantitative Analysis:

II. Volumetric Analysis:

(a) Determination of acetic acid in commercial vinegar using NaOH. (b) Determination of alkali content – antacid tablet using HCl.

(c) Estimation of calcium content in chalk as calcium oxalate by permanganometry.
(d) Estimation of hardness of water by EDTA.
(e) Estimation of ferrous and ferric by dichromate method.
(f) Estimation of copper using thiosulphate.

III. Gravimetric Analysis:

Analysis of Cu as CuSCN and Ni as Ni (dimethylgloxime).

Organic Chemistry

Laboratory Techniques

IV. A. Thin Layer Chromatography

Determination of R*f* values and identification of organic compounds:
(a) Separation of green leaf pigments (spinach leaves may be used).
(b) Preparation of separation of 2, 4-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2, and 3-one using toluene and light petroleum (40:60)
(c) Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5).

V. B. Paper Chromatography: Ascending and Circular

Determination of R*f* values and identification of organic compounds:
(a) Separation of a mixture of phenylalanine and glycine, Alanine and aspartic acid, Leucine and glutamic acid, Spray reagent – ninhydrin.
(b) Separation of a mixture of D, L – alanine, glycine, and L-Leucine using *n*-butanol: acetic acid:water (4:1:5), Spray reagent – ninhydrin.
(c) Separation of monosaccharide – a mixture of D-galactose and D-fructose using n-butanol:acetone:water (4:5:1), spray reagent – aniline hydrogen phthalate.

VI. Qualitative Analysis:

Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

Physical Chemistry

VII. Transition Temperature

1. Determination of the transition temperature of the given substance by thermometric /dialometric method (e.g. $MnCl_2.4H_2O$/$SrBr_2.2H_2O$).

VIII. Phase Equilibrium

2. To study the effect of a solute (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol-water system.

3. To construct the phase diagram of two component (e.g. diphenylamine – benzophenone)
system by cooling curve method.

IX. Thermochemistry

1. To determine the solubility of benzoic acid at different temperatures and to determine QH of the dissolution process.
2. To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base.
3. To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber Cycle.