KUMAUN UNIVERSITY, NAINITAL

SYLLABUS FOR SIX SEMESTER (THREE YEAR) B.Sc.
Chemistry Course

TWO PAPER SYSTEM

Effective from academic year 2022-23

Papers and distribution of marks for different Semesters

Semester	Paper I	Marks		Paper II	Marks		Practical	
		Ext	Int		Ext	Int	Ext	Int
I	Organic	60	20	Inorganic	60	20	30	10
II	Inorganic	60	20	Physical	60	20	30	10
III	Organic	60	20	Physical	60	20	30	10
IV	Inorganic	60	20	Organic	60	20	30	10
V	Physical	60	20	Inorganic	60	20	30	10
VI	Organic	60	20	Physical	60	20	30	10

Pattern of examination theory papers

A. Theory

Each theory paper shall consist two sections A and B.
***Section A**: (Short answers type with reasoning); 35 marks, eight questions of seven marks each, any five have to be attempted).*
***Section B**: (Long answers type);25 marks, two questions of twelve and half marks with internal choice would be given, both have to be attempted.*

B. Internal assessment

For each theory paper an internal assessment (in the form of class test and or assignment) of 20 marks for each paper which shall be conducted during each semester. The evaluated answer sheets/assignments have to be retained by the Professor In-Charge and a copy of the award list has to be submitted to Head of the Department.

C. Practical

The practical work of the students has to be evaluated periodically. The internal assessment (in the form of lab test, lab record, internal evaluation, assignment/home assignment and attendance) of total 10 marks for each semester shall be conducted during the semester. A minimum of 12 experiments covering all kinds of exercises have to be conducted during a semester. In each semester practical examination of 30 marks has to be conducted by two examiners (External and internal) ***having duration of 4(Four) hours.*** *The total number of students to be examined per batch should not be more than sixty. Marks of the practical have to be submitted tothe Head of the department/ Principal.*

D. Instructions for paper setter

Note to be mentioned in each theory paper*: This question paper consists of two sections Section A consists of eight short answer type questions with logical approach bearing **7** marks each. Attempt any five questions from this section. Section B consists of two long answer type question (with internal choice) carrying 12½ marks each. Attempt both the questions from this section. Questions are to be attempted section wise sequentially as far as possible. If the student attempts more questions, the marks will be allotted sequentially. The question/questions at the last of sequence is/are considered extra/treated cancelled during the evaluation.*

Semester I Paper I (Organic)

S. No.	Contents	Contact Hours/Lectures
1	Structure and Bonding	4 Lectures
2	Mechanism of Organic Reactions	7 Lectures
3	Stereochemistry of Organic Compounds	7 Lectures
4	Alkanes and Cycloalkanes	7 Lectures
5	Alkenes, Cycloalkenes, Dienes and Alkynes	7 Lectures
6	Arenes and Aromaticity	7 Lectures

Semester I Paper II (Inorganic)

S. No.	Contents	Contact Hours/Lectures
1	Atomic Structure	7 Lectures
2	Periodic Properties	5 Lectures
3	Chemical Bonding-I	8 Lectures
4	Ionic Solids	5 Lectures
5	s-Block Elements	6 Lectures
6	p-Block Elements	8 Lectures

Semester II Paper I (Inorganic)

S. No.	Contents	Contact Hours/Lectures
1	Chemical Bonding-II	8 Lectures
2	Redox Reactions	7 Lectures
3	Coordination Chemistry-I	9 Lectures
4	Chemistry of Transition Elements (First Transition Series)	6 Lectures
5	Chemistry of Transition Elements (Second and Third Series)	5 Lectures
6	Metallurgical Processes	4 Lectures

Semester II Paper II (Physical)

S. No.	Contents	Contact Hours/Lectures
1	Gaseous State	12 Lectures
2	Solid State	8 Lectures
3	Colloidal State	8 Lectures
4	Chemical Kinetics and Catalysis	12 Lectures

Semester III Paper I (Organic)

S. No.	Contents	Contact Hours/Lectures
1	Alkyl and Aryl Halides	7 Lectures
2	Alcohols	5 Lectures
3	Phenols	5 Lectures
4	Ethers and Epoxides	5 Lectures

5	Aldehydes and Ketones	7 Lectures
6	Carboxylic Acids; Carboxylic acid derivatives	10 Lectures

Semester III Paper II (Physical)

S. No.	Contents	Contact Hours/Lectures
1	Thermodynamics- I	12 Lectures
2	Chemical Equilibrium	8 Lectures
3	Thermochemistry	12 Lectures
4	Surface Chemistry	8 Lectures

Semester IV Paper I (Inorganic)

S. No.	Contents	Contact Hours/Lectures
1	Chemistry of Lanthanides	7 Lectures
2	Chemistry of Actinides	5 Lectures
3	Acids and Bases	6 Lectures
4	Hard and Soft Acid-Base Theory	7 Lectures
5	Non Aqueous Solvents	6 Lectures
6	Bioinorganic Chemistry	8 Lectures

Semester IV Paper II (Organic)

S. No.	Contents	Contact Hours/Lectures
1	Electromagnetic Spectrum: Absorption Spectroscopy	8 Lectures
2	Nitrogen Containing Organic Compounds	8 Lectures
3	Organic Synthesis via Enolates	5 Lectures
4	Organo-Metallic Compounds	5 Lectures
5	Synthetic Dyes	5 Lectures
6	Heterocyclic Compounds	8 Lectures

Semester V Paper I (Physical)

S. No.	Contents	Contact Hours/Lectures
1	Thermodynamics II	12 Lectures
2	Solutions and Colligative Properties	8 Lectures
3	Photochemistry	8 Lectures
4	Energy and Distribution Law	6 Lectures
5	Thermodynamics III	6 Lectures

Semester V Paper II (Inorganic)

S. No.	Contents	Contact Hours/Lectures
1	Thermodynamic and Kinetic Aspects of Coordination Compounds	5 Lectures
2	Coordination Chemistry-II	8 Lectures
3	Magnetic Properties of Transition Metal Complexes	7 Lectures

4	Electronic Spectra of Transition Metal Complexes	7 Lectures
5	Organometallic Chemistry	7 Lectures
6	Inorganic Polymers of Silicon and Phosphorus	5 Lectures

Semester VI Paper I (Organic)

S. No.	Contents	Contact Hours/Lectures
1	Spectroscopy	8 Lectures
2	Carbohydrates	7 Lectures
3	Amino Acids, Peptides, Proteins and Nucleic Acids	7 Lectures
4	Fats, Oils and Detergents	6 Lectures
5	Synthetic Polymers	6 Lectures
6	Natural Products	5 Lectures

Semester VI Paper II (Physical)

S. No.	Contents	Contact Hours/Lectures
1	Electrochemistry I	10 Lectures
2	Electrochemistry II	8 Lectures
3	Phase Equilibrium	8 Lectures
4	Elementary Quantum Mechanics 8	8 Lectures
5	Spectroscopy	6 Lectures

Semester I Paper I (Organic Chemistry)

Details of Course:

S.No.	Contents	Contact Hours/ Lectures
1	**Structure and Bonding:** Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bond, Van der Waals interactions, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding	4 Lectures
2	**Mechanism of Organic Reactions:** Curved arrow notation, drawing electron movements with arrows, half -headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents- electrophiles and nucleophiles. Types of organic reactions. Energy considerations. Reactive intermediates-carbocations, carbanions, free radicals, carbenes,(with examples).	7 Lectures
3	**Stereochemistry of Organic Compounds** Concepts of isomerism. Types of isomerism-optical isomerism-	7 Lectures

	elements of symmetry, molecular chirality, enantiomers, stereogenic centers, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centre, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequencerules, D & L and R & S systems of nomenclature. Geometrical isomerism: determination of configuration of geometrical isomers, E & Z system of nomenclature, geometrical isomerism in oximes and alicyclic compounds. Conformational isomerism: conformational analysis of ethane and n- butane.	
4	**Alkanes and Cycloalkanes:** IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, sources, methods of formation (with special reference to Wurtz reaction,Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes. Mechanism of free radical halogenationof alkanes: Mechanism of free radical, orientation, reactivity. Cycloalkanes- nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strainin small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring-bent or banana bonds.	7 Lectures
5	**Alkenes, Cycloalkenes, Dienes and Alkynes:**Nomenclature of alkenes , methods of formation, mechanism of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff Rule, Hoffmann Elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes - mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's Rule, hydroboration- oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Nomenclature and classification of dienes; isolated, conjugated and cumulative dienes. Methods of formation, polymerization. Chemical reactions- 1,2 and 1,4 additions. Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration- oxidation, metal- ammonia reduction, oxidation and polymerization.	7 Lectures
6	**Arenes and Aromaticity:** Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Structure of	7 Lectures

	benzene: molecular formula and Kekule structure. Stability and MO picture. Aromaticity –the Hückel rule, aromatic ions. Aromatic electrophilic substitution –Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel- Crafts reaction. Energy profile diagrams. Activating and deactivating substituents and orientation. Side chain reactions of benzene derivatives. Birch reduction.	

Books Recommended:

i. I.L. Finar, Organic Chemistry, Pearson.
ii. E. L. Eliel, Stereochemistry of Organic Compounds, Willey.
iii. Morrison and Boyd, Organic Chemistry, Prentice-Hall, New Delhi.
iv. George S. Zweife and Michael He Nantz, University of California, Davis, New York 2 Edt. 2006.
v. Francis A. Carey and Richard J. Sunderberg, University of Virginia Charlottesville, Virginia, Advanced Organic Chemistry 5Ed, 2007.
vi. Clayden J. Organic Chemistry (Oxford, 2000).
vii. Dr. R. Bruckner and Organic Mechanisms Reactions, Stereochemistry and Synthesis 1st Edt. 2010.
viii. S.M. Mukerji and Singh. Reaction mechanism in Organic Chemistry, Macmillan, Reprint.
ix. Jagdamba Singh. Undergraduate Organic Chemistry Vol.-I, Pragati Prakashan.
x. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi.
xi. G. Marc Loudon, Organic Chemistry, Oxford University Press (Replica press), Kundali, Haryana.

Semester I Paper II (Inorganic Chemistry)

Details of Course:

S. No.	Contents	Contact Hours/ Lectures
1	**Atomic Structure:** Dual nature of matter; de Broglie concept. Heisenberg uncertainty principle and its significance. Atomic orbitals, Schrödinger wave equation (no derivation), significance of ψ and ψ^2. Quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p and d orbitals. Aufbau energy diagram, Pauli's exclusion principle. Hund's ruleof maximum multiplicity. Electronic configuration of elements (s block, p block and first series of d-block elements). Effective nuclear charge.	7 Lectures
2	**Periodic Properties**: Atomic and ionic radii, ionization potential, electron affinity and electronegativity- Definition, methods of determination/evaluation, trends of variation in periodic table and their application in prediction and explaining the chemical behaviour of elements and compounds thereof.	5 Lectures
3	**Chemical Bonding-I**: Ionic bond, covalent bond-Valence Bond Theory and its limitations; directional nature of covalent bond;	8 Lectures

	various types of hybridization and shapes of different inorganic molecules and ions. Valence Shell Electron Pair Repulsion Theory (VSEPR) and shapes of NH_3, H_2O, H_3O^+, SF_4, ClF_3, ICl_2^-, NH_4^+, and other simple molecules/ions. Chemistry of xenon; structure and bonding in xenon compounds with oxygen and fluorine.	
4	**Ionic Solids:** Ionic structures, radius-ratio effects and coordination number. Lattice defects, semiconductors, lattice energy and Borne-Haber cycle. Solvation energy and solubility of ionic solids. Polarizing power and polarizability; Fajan's rule.	5 Lectures
5	**s-Block Elements**: General discussion with respect to all periodic and chemical properties, diagonal relationship, salient features of hydrides, solvation and complexation tendencies, an introduction to their alkyls and aryls. Role of alkali and alkaline earth metalions in bio-systems.	6 Lectures
6	**p-Block Elements**: General discussion and comparative study (all periodic and chemical properties) including diagonal relationship, of groups 13 to 17 elements; chemistry of elements-hydrides, oxides & oxy-acids, and halides (including inter-halogen compounds). Diborane-properties & structure, borohydrides, carbides, fluorocarbons, basic properties of iodine and polyhalides.Inert-pair effect: in heavier elements of 13, 14 & 15 group elements; its consequences in redox properties of their halides.	8 Lectures

Books Recommended:

i. J. D. Lee, Concise Inorganic Chemistry, ELVS.
ii. B. R. Puri, L. R. Sharma and K. C. Kaliya, Principles of Inorganic Chemistry, Milestone Publisher and Distributors.
iii. R. L. Madan, Chemistry for Degree Students, S. Chand & Company, New Delhi.
iv. W. U. Malik, G. D. Tuli and R. D. Madan, Selected Topics in Inorganic Chemistry, S. Chand & Company, New Delhi**.**
v. Sulekh Chandra, Comprehensive Inorganic Chemistry, New Age International Publications.
vi. R. D. Madan and Satya Prakash, Modern Inorganic Chemistry, S. Chand & Company, New Delhi.
vii. B. E. Douglas and D. H. Mc Daniel, Concepts & Models of Inorganic Chemistry, Oxford.
viii. P.W. Atkins and J. Paula, Physical Chemistry, Oxford Press.
ix. M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, ACS Publications.

Semester I
Chemistry Practical

Lab Course: **Max. Marks: 40**

1. Laboratory hazards and safety precautions
2. Mixture analysis: identification of Acid and Basic Radicals including anions in combination and interfering radicals. Home assignments: problems based on Law of mass action, Le Chatelier Principle; common ion effect, solubility product, pH and buffer solutions, mole concept, molar solution, normal solution, molarity, molality and formality, Calculation for the preparation of standard solutions of acids and bases.

3. Volumetric exercise: acid-base titrations; preparation of a solution in normal/molar terms, its standardization using a primary standard solution, determination of the strength of unknown solution. For example: preparation of NaOH solution (secondary standard say N/10), preparation of $(COOH)_2$ solution (primary standard say N/10), standardization of NaOH solution titrating it against $(COOH)_2$ solution using phenolphthalein (indicator) and then determination of the strength of given HCl solution.
   One exercise each from inorganic mixture (qualitative 06 radicals), and volumetric exercise (quantitative) shall be given in the examination.

Distribution of marks shall be as given below:

A.	Inorganic mixture analysis (Acidic and Basic)	15
B.	Volumetric exercise	10
C.	Viva	05
D.	Home assignment/internal assessment, lab record and attendance	10

Note:

- ***The lab work of the student has to be evaluated and assessed carefully and periodically. A minimum of 12 experiments covering all the kind of exercises has to be performed during a semester. The semester record has to be maintained by the department/college as an official record.***
- ***Less than zero mark will not be awarded.***
- ***The total number of students to be examined per batch shall not be more than sixty.***
- ***Duration of the practical examination shall be of 04 (four) hours.***
- ***Marks have to be uploaded onto the University portal and print out of award list from the portal has to be submitted to the Controller Examination, Kumaun University, in a sealed envelope making a copy to the Principal/Head of the department.***

Semester II Paper I (Inorganic Chemistry)

Details of Course:

S. No.	Contents	Contact Hours/ Lectures
1	**Chemical Bonding-II:** Molecular Orbital Theory (MOT) as applied to diatomic homonuclear/heteronuclear inorganic molecules. MO diagrams and bond order of H_2, He_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, Ne_2, CO and NO, difference between VB and MO theories. Multicentre bonding in electron deficient molecules. Polarization of covalent molecules; percentage ionic character from dipole and electronegativity difference. Hydrogen bonding. Weak interactions. Metallic bond- electron pool and MO theories.	8 Lectures
2	**Redox Reactions:** Displacement and redox reactions, oxidation state. Balancing of redox reactions (ion-electron and oxidationstate methods). Computation of equivalent weights (oxidizing and reducing agents). Standard electrode potential, Reference electrode (Standard hydrogen electrode, standard calomel electrode), determination of electrode potential, electrochemical series and its applications, uses of electrode potential data, reaction feasibility and related numerical problems.	7 Lectures
3	**Coordination Chemistry-I:** Introduction of coordination	9 Lectures

	compounds: Concept of single salt, double salt, coordination compounds, ligand, coordination number, coordination sphere, complex ions, counter ion. Nomenclature of coordination compounds (IUPAC system), Werner's theory for coordination compounds; its experimental verification, effective atomic number (EAN) concept, 18 electron rule. Chelates, Valence Bond Theory (VBT) for coordination compounds- Postulates, hybridization and geometry of compounds, octahedral complexes- inner and outer orbital complexes, tetrahedral complexes, square planar complexes, pentagonal bipyramidal complexes, magnetic properties of complex compounds. Isomerism- structural and stereoisomerism.	
4	**Chemistry of Transition Elements (First Transition Series):** Characteristic properties of the elements- Electronic configuration, ionic radii, ionization energy, oxidation states, complex compound formation, catalytic properties, colour and magnetic properties. Their binary compounds, illustrating relative stability of their oxidation states, coordination number and geometry.	6 Lectures
5	**Chemistry of Transition Elements (Second and Third Series):** General characteristics, comparative treatment with their analogues in respect of ionic radii, oxidation state, ionization energy, magnetic behaviour and stereochemistry.	5 Lectures
6	**Metallurgical Processes:** Minerals & ores; general metallurgical processes- Concentration of ores, calcination, roasting, smelting, slag & flux. Extraction and refining of Lithium and Beryllium.	4 Lectures

Books Recommended:

i. J. D. Lee, Concise Inorganic Chemistry, ELVS.
ii. B. R. Puri, L. R. Sharma and K. C. Kaliya, Principles of Inorganic Chemistry, Milestone Publisher and Distributors.
iii. R. L. Madan, Chemistry for Degree Students, S. Chand & Company, New Delhi.
iv. W. U. Malik, G. D. Tuli and R. D. Madan, Selected Topics in Inorganic Chemistry, S. Chand & Company, New Delhi**.**
v. Sulekh Chandra, Comprehensive Inorganic Chemistry, New Age International Publications.
vi. R. D. Madan and Satya Prakash, Modern Inorganic Chemistry, S. Chand & Company, New Delhi.
vii. B. E. Douglas and D. H. Mc Daniel, Concepts & Models of Inorganic Chemistry, Oxford.
viii. P.W. Atkins and J. Paula, Physical Chemistry, Oxford Press.
ix. M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, ACS Publications.

Semester II Paper II (Physical Chemistry)

Details of Course:

S.No.	Contents	Contact Hours/ Lectures

1	**Gaseous State:** Postulates of kinetic theory of gases, Molecular velocities: Root mean square, average and most probable velocities, qualitative discussion of the Maxwell's distribution of molecular velocities (no derivation), collision number, mean free path and collision diameter, Deviation from ideal behavior, van der Waal's equation of states, Critical phenomena – PV isotherms of realgases, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state	12 Lectures

2.	**Solid State:** Definition of space lattice, unit cell, crystal planes, Miller indices, Laws of crystallography – (i) law of constancy of interfacial angles (ii) law of rationality of indices (iii) law of symmetry. Symmetry elements in crystals, X-ray diffraction by crystals. Derivation of Bragg's equation.	8 Lectures
3	**Colloidal State:** Definition of colloids, classification of colloids. Preparation, purification. Properties of colloids – Brownian movement, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number. Sol, gel and emulsions: types and properties. Applications of colloids	8 Lectures
4.	**Chemical Kinetics and Catalysis: R**ate of a reaction, factors influencing the rate of a reaction: Concentration, temperature, pressure, solvent, and catalyst, classification of catalyst with suitable examples. Concept of molecularity and order of reaction, zero order, first order, second order, derivation of integrated rate equation of zero, first and second order (having only one reactant) reactions, pseudo-order reactions with examples, half-life, concept of activation energy.	12 Lectures

Books Recommended:

i. Atkins P.W., Physical Chemistry, Oxford University Press.
ii. D.W. Bell, Physical Chemistry, Thomson Press.
iii. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi
iv. Puri and Sharma and Pathaniya, Principles of Physical Chemistry, Milestone Publisher and Distributors, New Delhi.
v. Bahl and Tuli, Essentials of Physical Chemistry, S. Chand & Company, New Delhi.
vi. Bariyar, Singh and Dwivedi, BSc Chemistry I (combined), Krishna Prakashan Media, Meerut.

SEMESTER II
B. Sc. Chemistry Practical

Lab Course : **Max Marks : 40**

1. Lab Hazards and Safety precautions
2. Determination of surface tension, viscosity, parachor and relative surface tension/viscosity of given liquids.
3. Organic compounds: basic difference between inorganic salts and organic compounds-solubility in water, unsaturation tests; difference between aromatic and aliphatic compounds, determination of MP/BP. Identification of aromatic/aliphatic hydrocarbons, their halogen derivatives, Fusion of organic compound with sodium, preparation of sodium extract- test for the presence of halogens in organic compounds.
4. Home assignments.

One exercise each from organic and physical chemistry experiment shall be given in the examination.

Distribution of marks shall be as given below:

A.	Determination of viscosity and surface tension measurements etc. of given liquids	10
B.	Organic chemistry exercise	15
D.	Viva	05
E.	Home assignment/internal assessment, lab record and attendance	10

Note:

- ***The lab work of the student has to be evaluated and assessed carefully and periodically. A minimum of 12 experiments covering all the kind of exercises has to be performed during a semester. The semester record has to be maintained by the department/college as an official record.***
- ***Less than zero mark will not be awarded.***
- ***The total number of students to be examined per batch shall not be more than sixty.***
- ***Duration of the practical examination shall be of 04 (four) hours.***
- ***Marks have to be uploaded onto the University portal and print out of award list from the portal has to be submitted to the Controller Examination, Kumaun University, Nainital in a sealed envelope making a copy to the Principal/Head of the department.***

Semester III Paper I (Organic Chemistry)

Details of Course:

S.No.	Contents	Contact Hours/ Lectures
1	**Alkyl and Aryl Halides:** Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides, S_N2 and S_N1 reactions with energy profile diagrams. Methods of formation of aryl halides, nuclear and side chain reaction. The addition-elimination mechanism and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivity of alkyl halides vs allyl, vinyl and aryl halides.	7 Lectures
2	**Alcohols:** Classification and nomenclature. Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols. Dihydric alcohols-methods of preparation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol-pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol.	5 Lectures

3	**Phenol:** 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. Mechanism of Fries	5 Lectures
	rearrangement, Claisen rearrangement, Gatterman synthesis and Reimer-Tiemann reaction.	
4	**Ethers and Epoxides:** Nomenclature, methods of preparation. Physical properties. Chemical reactions-cleavage and Ziesel's method. Synthesis of epoxides.	5 Lectures
5	**Aldehydes and Ketones:** Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis from acid chlorides, synthesis using 1,3-dithianes, from nitriles and carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensation. Condensation with ammonia and its derivatives; Oxidation of aldehydes, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions.	7 Lectures
6	**Carboxylic Acids and derivatives:** 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 preparation and chemical reactions of unsaturated monocarboxylic acids. Dicarboxylic acids-methods of preparation and effect ofheat and dehydrating agents.	10 Lectures

Books Recommended:

i. I.L. Finar, Organic Chemistry, Pearson.
ii. E. L. Eliel, Stereochemistry of Organic Compounds, Willey.
iii. Morrison and Boyd, Organic Chemistry, Prentice-Hall, New Delhi.
iv. George S. Zweife and Michael He Nantz, University of California, Davis, New York 2 Edt. 2006.
v. Francis A. Carey and Richard J. Sunderberg, University of Virginia Charlottesville, Virginia, Advanced Organic Chemistry 5Ed, 2007.
vi. Clayden J. Organic Chemistry (Oxford, 2000).
vii. Dr. R. Bruckner and Organic Mechanisms Reactions, Stereochemistry and Synthesis 1st Edt. 2010.
viii. S.M. Mukerji and Singh. Reaction mechanism in Organic Chemistry, Macmillan, Reprint.
ix. Jagdamba Singh. Undergraduate Organic Chemistry Vol.-I, Pragati Prakashan.
x. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi.
xi. G. Marc Loudon, Organic Chemistry, Oxford University Press (Replica press), Kundali, Haryana.

Semester III Paper II (Physical Chemistry)

Details of Course:

S.No.	Contents	Contact Hours/ Lectures
1.	**Thermodynamics I:** Definition of thermodynamic terms, system, surroundings etc. types of systems, intensive and extensive properties, state and path functions and their differentials, thermodynamic process, concept of heat and work, First law of thermodynamics, definition of internal energy and enthalpy. Heat capacity – heat capacities at constant volume and at constant pressure and their relationship, 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 processes, related numerical problems.	12 Lectures
2	**Chemical Equilibrium:** The law of mass action, free energy and equilibrium constant, thermodynamic derivation of law, related numerical problems, factors influencing equilibrium constant, relationship between Kp and Kc. Application of law of mass action to some homogenous and heterogeneous equilibrium, Le-Chatelier's principle.	8 Lectures
3.	**Thermochemistry:** standard state, Standard enthalpy of formation – Hess's law of heat summation and its application, 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, Kirchoff's equation, related numerical problems.	12 lectures
4.	**Surface Chemistry:** Adsorption, absorption and sorption, Definition and difference between Physical and chemical adsorption with suitable examples, Freundlich's and Langmuir's adsorption isotherms and their applications,	8 Lectures

Books Recommended:

i. Atkins P.W., Physical Chemistry, Oxford, 2006
ii. D.W. Bell, Physical Chemistry, Thomson Press, 2007
iii. R. L. Madan, Chemistry for Degree Students, S. Chand & Company, New Delhi.
iv. Puri and Sharma, Principal of Physical Chemistry, Vishal Publications, 2016
v. Essentials of Physical Chemistry, Bahl and Tuli, S. Chand, 2016

SEMESTER III
B. Sc. Chemistry Practical

Lab course: Max Marks: 40

1. Laboratory hazards and safety precautions.
2. Inorganic quantitative analysis-gravimetric estimation of Ba^{2+}, Fe^{3+} Ni^{2+}, Cu^{2+} and Zn^{2+}.
3. Inorganic synthesis – cuprous chloride, potash alum, chrome alum, ferrous oxalate,ferrous ammonium sulphate, tetraamminecopper (II) sulphate and hexaamminenickel (II) chloride. Crystallization of compounds.

4. Organic qualitative analysis- identification of those classes of organic compounds which are being covered in theory classes (alcohols and phenols, difference among pri-, sec- and tertiary alcohols, aldehydes and ketones).
   Home assignments: based on theoretical aspects of the experiments.

   One exercise each from gravimetric estimation, synthesis of compounds and organic chemistry exercise shall be given in the examination.

   Distribution of marks shall be as given below:

A.	Gravimetric estimation	12
B.	Inorganic Synthesis	05
C.	Organic chemistry exercise	08
D.	Viva	05
E.	Home assignment/internal assessment, lab record and attendance	10

   Note:

   - ***The lab work of the student has to be evaluated and assessed carefully and periodically. A minimum of 12 experiments covering all the kind of exercises has to be performed during a semester. The semester record has to be maintained by the department/college as an official record.***
   - ***Less than zero mark will not be awarded.***
   - ***The total number of students to be examined per batch shall not be more than sixty.***
   - ***Duration of the practical examination shall be of 04 (four) hours.***
   - ***Marks have to be uploaded onto the University portal and print out of award list from the portal has to be submitted to the Controller Examination, Kumaun University, in a sealed envelope making a copy to the Principal/Head of the department.***

Semester IV Paper I (Inorganic Chemistry)

Details of Course:

S. No.	Contents	Contact Hours/ Lectures
1	**Chemistry of Lanthanides:** Electronic configuration, ionic radii, spectral and magnetic properties, lanthanide contraction, oxidation states and its consequences, complex formation, methods of separation of lanthanides- Fractional crystallization, fractional precipitation, change in oxidation state, solvent extraction, ion exchange methods.	7 Lectures
2	**Chemistry of Actinides:** Electronic configuration, atomic and ionic radii, oxidation states, ionization potential, complex formation.	5 Lectures
3	**Acids and Bases:** Arrhenius concept, Bronsted-Lowry concept, Lux-Flood and Lewis concept of acids and bases, Factors affecting the relative strength of acids and bases (solvent effect- levelling and differentiating solvent, inductive effect, steric factors, resonance effect, oxidation state of central atom and hydrogen bonding), concept of pH and buffer solution. Acid-base properties in non-aqueous media.	6 Lectures
4	**Hard and Soft Acid-Base Theory:** Classification of acids and bases as hard and soft. Pearson's hard and soft acid base (HSAB) concept, acid base strength and hardness and softness. Applications of HSAB principle. Symbiosis, theoretical basis of	7 Lectures

	hardness and softness, electronegativity and hardness and softness	
5	**Non Aqueous Solvents:** Classification of solvents,their general characteristics, physical properties of the solvents, reaction in non-aqueous solvents-liquid NH_3 and SO_2 (auto-ionization,precipitation reactions, acid-base reaction, oxidation-reduction reactions, salvation and solvolysis, complex formation), merits and demerits.	6 Lectures
6	**Bioinorganic Chemistry:** Role of metal ions in biology, essential and trace elements in biological systems, toxic elements, elementary idea of structure and oxygen binding mechanism in metallo-porphyrins with special reference to haemoglobin and myoglobin. Alkali and alkaline earth metal ions in biological system- Mechanism of transport across cell membrane, biochemistry of magnesium and calcium.	8 Lectures

Books Recommended:

i. J. D. Lee, Concise Inorganic Chemistry, ELVS.
ii. B. R. Puri, L. R. Sharma and K. C. Kaliya, Principles of Inorganic Chemistry, Milestone Publisher and Distributors.
iii. R. L. Madan, Chemistry for Degree Students, S. Chand & Company, New Delhi.
iv. W. U. Malik, G. D. Tuli and R. D. Madan, Selected Topics in Inorganic Chemistry, S. Chand & Company, New Delhi**.**
v. Sulekh Chandra, Comprehensive Inorganic Chemistry, New Age International Publications.
vi. R. D. Madan and Satya Prakash, Modern Inorganic Chemistry, S. Chand & Company, New Delhi.
vii. B. E. Douglas and D. H. Mc Daniel, Concepts & Models of Inorganic Chemistry, Oxford.
viii. P.W. Atkins and J. Paula, Physical Chemistry, Oxford Press.
ix. M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, ACS Publications.

Semester IV Paper II (Organic Chemistry)

Details of Course:

S. No.	Contents	Contact Hours/ Lectures
1	**Electromagnetic Spectrum: Absorption Spectroscopy** Ultraviolet (UV) absorption spectroscopy-absorption laws (Beer-Lambert law), molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation, concept of chromophore and auxochrome. Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated enes and enones. Infra-Red (IR) absorption spectroscopy- molecular vibrations, Hooke's Law, selection rules, intensity and position of IR bands, measurement of IR spectrum, finger print region, characteristic absorptions of various functional groups.	8 Lectures

2	**Nitrogen Containing Organic Compounds:** Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitroarenes and their reduction in acidic, neutral and alkaline medium. Structure and nomenclature of amines. Physical properties. Hinsberg method, Separation of mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Preparation ofalkyl and aryl amines (reduction of nitro compounds, nitriles).Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reaction of amines, electrophilic aromatic substitution in aryl amines, reaction of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.	8 Lectures
3	**Organic Synthesis via Enolate:** Acidity of methylene hydrogen, alkylation of diethylmalonate and ethylacetoacetate. Synthesis of ethylacetoacetate, the Claisen condensation. Keto-enol tautomerism of ethylacetoacetate. Synthetic uses of ethylacetoacetate and diethylmalonate.	5 Lectures
4	**Organo-Metallic Compounds:** Organomagnesium compounds; the Grignard reagent-formation, structure and chemical reactions.	5 Lectures
5	**Synthetic Dyes**: Colour and constitution (electronic concept), classification of dyes. Synthesis and uses of Methyl orange, Phenolphthalein.	5 Lectures
6	**Heterocyclic Compounds:** Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole. Introduction of condensed five- and six membered heterocycles. Preparation and reactions of quinolene, Skraups synthesis and Bischler-Napieralski synthesis.	8 Lectures

Books Recommended:

i. I.L. Finar, Organic Chemistry, Pearson.
ii. E. L. Eliel, Stereochemistry of Organic Compounds, Willey.
iii. Morrison and Boyd, Organic Chemistry, Prentice-Hall, New Delhi.
iv. George S. Zweife and Michael He Nantz, University of California, Davis, New York 2 Edt. 2006.
v. Francis A. Carey and Richard J. Sunderberg, University of Virginia Charlottesville, Virginia, Advanced Organic Chemistry 5Ed, 2007.
vi. Clayden J. Organic Chemistry (Oxford, 2000).
vii. Dr. R. Bruckner and Organic Mechanisms Reactions, Stereochemistry and Synthesis 1st Edt. 2010.

viii. Y.R. Sharma, Elementary Spectroscopy, S. Chand.
ix. Donald L. Pavia, Gary M.Lampman and George S. Kriz, Introduction to Spectroscopy, Thomson learning, U.K.
x. S.M. Mukerji and Singh. Reaction mechanism in Organic Chemistry, Macmillan, Reprint.
xi. Jagdamba Singh. Undergraduate Organic Chemistry Vol.-I, Pragati Prakashan.
xii. R.L. Madan, Chemistry for degree students, S. Chand & Company, New Delhi.
xiii. G. Marc Loudon, Organic Chemistry, Oxford University Press (Replica press), Kundali, Haryana.

SEMESTER IV
B. Sc. Chemistry Practical

Lab Course: **Max Marks:** 40

1. Laboratory hazards and safety precautions.
2. Organic qualitative analysis- identification of organic compounds (acids and their halogen derivatives, nitrogen containing compounds- nitro, amines, amides, difference among pri-, sec- and tertiary amines).
3. Volumetric exercises (double titration)- based on redox reactions involving internal or external indicators.

Home assignments: based on theoretical aspects of the experiments.

One exercise each from identification of compound and redox titration shall be given in the examination.

Distribution of marks shall be as given below:

A. Organic chemistry exercise	12
B. Volumetric exercise	13
C. Viva	05
D. Home assignment/internal assessment, lab record and attendance	10

Note:

- ***The lab work of the student has to be evaluated and assessed carefully and periodically. A minimum of 12 experiments covering all the kind of exercises has to be performed during a semester. The semester record has to be maintained by the department/college as an official record.***
- ***Less than zero mark will not be awarded.***
- ***The total number of students to be examined per batch shall not be more than sixty.***
- ***Duration of the practical examination shall be of 04 (four) hours.***
- ***Marks have to be uploaded onto the University portal and print out of award list from the portal has to be submitted to the Controller Examination, Kumaun University, in a sealed envelope making a copy to the Principal/Head of the department.***

Semester V Paper I (Physical Chemistry)

Details of Course:

S. No.	Contents	Contact Hours/ Lectures
1	**Thermodynamics II:** Second law of thermodynamics, need of the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature. Concept of entropy: entropy as a state function, entropy change in physical and chemical processes, entropy change in reversible and irreversible processes. Gibbs-Helmholtz equation, related numerical problems.	12 Lectures
2	**Solutions and Colligative Properties:** Ideal and non-ideal solutions. Dilute solutions, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular mass determination. Osmosis, law of osmotic pressure, determination of molecular mass from osmotic pressure. Elevation of boiling point and depression in freezing point. Abnormal molar mass, degree of dissociation and association of solutes.	8 Lectures
3.	**Photochemistry:** Difference between thermal and photochemical processes. Laws of photochemistry; Grothuss-Drapper law, Lambert's law, Lambert-Beer's law, Stark-Einstein law, Concept of fluorescence, phosphorescence, quantum yield, Jablonskii diagram.	8 Lectures
4.	**Energy and Distribution Law:** Degrees of freedom, types of energies in linear and non-linear molecules, Applications of Maxwell-Boltzmann distribution law	6 Lectures
5.	**Thermodynamics III:** Statement and concept of residual entropy, third law of thermodynamics, unattainability of absolute zero, Nernst heat theorem. Evaluation of absolute entropy from heat capacity data, related numerical problems.	6 lectures

Books Recommended:

i. Atkins P.W., Physical Chemistry, Oxford Uni, 2006
ii. Bell D.W. Physical Chemistry, Thomson Press, 2007
iii. R. L. Madan, Chemistry for Degree Students, S. Chand & Company, New Delhi.
iv. Puri and Sharma, Principal of Physical Chemistry, Vishal Publications, 2016
v. Essentials of Physical Chemistry, Bahl and Tuli, S. Chand, 2016

Semester V Paper II (Inorganic Chemistry)

Details of Course:

S. No.	**Contents**	**Contact Hours/ Lectures**
1	**Thermodynamic and Kinetic Aspects of Coordination Compounds:** Concept of thermodynamic and kinetic stability of metal complexes, stepwise and overall stability constants and relationship between them. Factors affecting the stability of	5 Lectures

	coordination compounds. Substitution reactions in square planar complexes. *Trans* effect and its applications.	
2	**Coordination Chemistry-II:** Limitations of Valence Bond Theory (VBT), Crystal Field Theory (CFT)- Salient features of CFT, crystal field splitting of octahedral, tetrahedral complexes, Tetragonal (Jahn-Teller) distortion, and crystal field splitting of square planar complexes, Crystal Field Splitting Energy (CFSE)- Concept of CFSE, calculations and applications, spectrochemical series, CFT and magnetic properties of transition metal complexes, CFT and colour of transition metal complexes, factors affecting the crystal-field parameters. Comparison of VBT and CFT.	8 Lectures
3	**Magnetic Properties of Transition Metal Complexes:** Types of magnetic behaviour, methods of determining magnetic susceptibility; Gouy's, Quincke's and Faraday's methods, spin only formula (μ_s), correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.	7 Lectures
4	**Electronic Spectra of Transition Metal Complexes:** Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, Orgel energy level diagram for d^1, $d^4$and d^6, d^9 states, discussion of the electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion.	7 Lectures
5	**Organometallic Chemistry:** Definition, nomenclature, classification, general methods of preparation of organometallic compounds, a brief account of metal-ethylenic complexes. Nature of metal-carbon bond. Metal carbonyls- Mononuclear carbonyls, nature of bonding, structure and preparation. EAN and 18-electron rule. Applications of organometallic compounds- Ziegler-Natta catalyst, Wilkinson catalyst (No mechanism).	7 Lectures
6	**Inorganic Polymers of Silicon and Phosphorus:** Silicones, siloxanes, silicone rubber, polymethylhydrosiloxanes, their applications. Phosphazenes, nature of bonding in triphosphazenes. Zeolites.	5 Lectures

Books Recommended:

i. J. D. Lee, Concise Inorganic Chemistry, ELVS.

ii. B. R. Puri, L. R. Sharma and K. C. Kaliya, Principles of Inorganic Chemistry, Milestone Publisher and Distributors.

iii. R. L. Madan, Chemistry for Degree Students, S. Chand & Company, New Delhi.

iv. W. U. Malik, G. D. Tuli and R. D. Madan, Selected Topics in Inorganic Chemistry, S. Chand & Company, New Delhi**.**

v. Sulekh Chandra, Comprehensive Inorganic Chemistry, New Age International Publications.

vi. R. D. Madan and Satya Prakash, Modern Inorganic Chemistry, S. Chand & Company, New Delhi.

vii. B. E. Douglas and D. H. Mc Daniel, Concepts & Models of Inorganic Chemistry, Oxford.

viii. P.W. Atkins and J. Paula, Physical Chemistry, Oxford Press.

ix. M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, ACS Publications.

SEMESTER V
B. Sc. Chemistry Practical

Lab Course: **Max Marks: 40**

1. Laboratory hazards and safety precautions.
2. Organic qualitative analysis; binary mixture of organic compounds separable by H_2O.
3. Organic synthesis; through nitration, halogenation.
4. Physical chemistry experiments based on solubility and transition temperature.

Home assignments: based on theoretical aspects of the experiments.

One exercise each from organic binary mixture, organic synthesis and physical chemistry experiments shall be given in the examination.

Distribution of marks shall be as given below:

A. Organic qualitative analysis (water separable binary mixture)	12
B. Organic synthesis	05
C. Physical chemistry experiment	08
D. Viva	05
E. Home assignment/internal assessment, semester record and attendance	10

Note:

- ***The lab work of the student has to be evaluated and assessed carefully and periodically. A minimum of 12 experiments covering all the kind of exercises has to be performed during a semester. The semester record has to be maintained by the department/college as an official record.***
- ***Less than zero mark will not be awarded.***
- ***The total number of students to be examined per batch shall not be more than sixty.***
- ***Duration of the practical examination shall be of 04 (four) hours.***
- ***Marks have to be uploaded onto the University portal and print out of award list from the portal has to be submitted to the Controller Examination, Kumaun University, in a sealed envelope making a copy to the Principal/Head of the department*.**

Semester VI Paper I (Organic Chemistry)

Details of Course:

S. No.	Contents	Contact Hours/ Lectures
1	**Spectroscopy:** Nuclear magnetic resonance (NMR) spectroscopy; Proton magnetic resonance (^{1}H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of pmr spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone.	8 Lectures

2	**Carbohydrates:** Classification and nomenclature. Monosaccharides, mechanism of osazone formation, inetrconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Cyclic structure of D(+)-glucose. Mechanism of mutarotation.	7 Lectures
3	**Amino Acids, Peptides, Proteins and Nucleic Acids:** Classification, structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reactions of α -amino acids. Nomenclature of peptides and proteins. Peptide structure determination, end group analysis, Protein denaturation/renaturation. Nucleic acids: introduction, constituents of nucleic acids.	7 Lectures
4	**Fats, Oils and Detergents:** Natural fats and common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponificationvalue, iodine value and acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.	6 Lectures
5	**Synthetic Polymers:** Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step-growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins. Natural and synthetic rubber.	6 Lectures
6	**Natural Products:** Classification, extraction and general methods of structure determination of terpenoids and alkaloids, chemistry of citral and nicotine.	5 Lectures

Books Recommended:

i. I.L. Finar, Organic Chemistry, Pearson.
ii. E. L. Eliel, Sterochemistry of Organic Compounds, Willey.
iii. Morrison and Boyd, Organic Chemistry, Prentice-Hall, New Delhi.
iv. George S. Zweife and Michael He Nantz, University of California, Davis, New York 2 Edt. 2006.
v. Francis A. Carey and Richard J. Sunderberg, University of Virginia Charlottesville, Virginia, Advanced Organic Chemistry 5Ed, 2007.
vi. Clayden J. Organic Chemistry (Oxford, 2000).
vii. Dr. R. Bruckner and Organic Mechanisms Reactions, Stereochemistry and Synthesis 1st Edt. 2010.
viii. S.M. Mukerji and Sing. Reaction mechanism in Organic Chemistry, Macmillan, Reprint.
ix. Jagdamba Singh. Undergraduate Organic Chemistry Vol.-I, Pragati Prakashan.
x. R.L. Madan, Chemistry for Degree Students, S. Chand & Company, New Delhi.
xi. Y.R. Sharma, Elementary Spectroscopy, S. Chand.
xii. Donald L. Pavia, Gary M.Lampman and George S. Kriz, Introduction to Spectroscopy, Thomson learning, U.K.

xiii. G. Marc Loudon, Organic Chemistry, Oxford University Press (Replica press), Kundali, Haryana.
xiv. G. Bhramachari, Natural Products, Chemistry, Biochemistry and Pharmacology, Narosa Publication, 1Ed. 2009.

Semester VI Paper II (Physical Chemistry)

Details of Course:

S.No.	Contents	Contact Hours/ Lectures
1	**Electrochemistry I:** Conductance**,** Specific conductance and equivalent conductance, variation of equivalent and specific conductance with dilution. Weak and strong electrolytes with suitable examples, Concept of Debye-Hückel theory, (no derivation), activity and activity coefficient. Migration of ions, Transport number, definition and determination by Hittorf and moving boundary methods, Kohlrausch's law. Application of conductivity measurements-determination of degree of dissociation, K_a of acids, solubility product of sparingly soluble salts, conductometric titrations, related numerical problems.	10 Lectures
2	**Electrochemistry II:** Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode-reference electrode. Definition of pH and pK_a, determination of pH using hydrogen electrode, by potentiometric Methods, related numerical problems.	8 Lectures
3	**Phase Equilibrium:** Phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component systems- water and sulphur. Phase equilibria of two component systems: solid-liquid equilibra, simple eutectic; Pb-Ag systems, desilverisation of lead.	8 Lectures
4	**Elementary Quantum Mechanics:** Planck's Theory, de Broglie hypothesis, Heisenberg's uncertainty principle, operator concept, Hamiltonian operator, Schrödinger wave equation and its importance, physical interpretation of the wave function.	8 Lectures
5	**Spectroscopy:** Introduction; electromagnetic radiation, regions of the spectrum, physical treatment of microwave and IR spectroscopy.	6 Lectures

Books Recommended:

i. Atkins P.W., Physical Chemistry, Oxford University Press.
ii. D.W. Bell, Physical Chemistry, Thomson Press.
iii. R. L. Madan, Chemistry for Degree Students, S. Chand & Company, New Delhi.
iv. Puri and Sharma, Principal of Physical Chemistry, Vishal Publications.
v. Essentials of Physical Chemistry, Bahl and Tuli, S. Chand.

SEMESTER VI
B. Sc. Chemistry Practical

Lab Course: **Max Marks: 40**

1 Organic qualitative analysis; binary mixture of organic compounds separable by H_2O and $NaHCO_3$.

2 Organic synthesis; through simple oxidation.

3 Physical chemistry experiments: Heat of neutralization and /or critical solution temperature.

Home assignments: based on theoretical aspects of the experiments, provide UV,IR and ^1H NMR data of identified organic compounds.

One exercise each from organic binary mixture, organic synthesis and physical chemistry experiments shall be given in the examination.

Distribution of marks shall be as given below:

A.	Organic qualitative analysis (binary mixture)	12
B.	Organic synthesis	05
C.	Physical chemistry experiment	08
D.	Viva	05
E.	Home assignment/internal assessment, semester record and attendance	10

Note:

- ***The lab work of the student has to be evaluated and assessed carefully and periodically. A minimum of 12 experiments covering all the kind of exercises has to be performed during a semester. The semester record has to be maintained by the department/college as an official record.***
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Prof. Anand B. Melkani
Convener, BoS Chemistry
Department of Chemistry
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25th June, 2022