Syllabus Book

M. Sc. Chemistry

P P Savani University

School of Sciences

Department of Chemistry

Effective From: 2022-23

Authored by: P P Savani University

Sem-1

Course Name: Advances in Inorganic Chemistry-I

Course Code: SSCH7010

Prerequisite: Basics of Inorganic Chemistry

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To enhance the knowledge of main group compounds, metal-ligand bonding, reaction mechanism of transition metal complexes and metal-ligand equilibria in solution.

Course Contents:

Module	Content	Hours	Weightage (%)
	Section-I		
1	**Stereochemistry and Bonding in Main Group Compounds** VSEPR, Walsh diagrams (tri- and penta – atomic molecules, dπ-pπ bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.	12	20
2	**Metal- Ligand Bonding** Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π- bonding and molecular orbital theory	12	20
	Section-II		
3	**Reaction Mechanism of Transition metal complexes** Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism, anation reaction, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reactions, electron transfer reactions, mechanism of one electron transfer reaction, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.	24	40
4	**Metal Ligand Equilibria in Solution** Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of the metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH metry and spectrophotometry	8	20

Learning outcome:

CO-1: Students will be able to visualize the structures in 3-dimensions. The diagrams and hybridization of covalent bonds will be studied.
CO-2: Students will be able to understand various geometry (octahedral, tetrahedral, square planner) of complexes through their molecular orbitals.
CO-3: Through conjugated mechanisms students will be able to understand various hydrolysis (i.e. acid, base) They will be able to learn about different types of reactions.
CO-4: Through metal-ligand interactions stability of the metal complexes can be understood. It can be characterized by pH metry and spectrophotometry

Reference Books:

Title	Authors	Publisher
Advanced Inorganic Chemistry	F.A. Cotton & Wilkinson	John Wiley
Inorganic Chemistry	J. E. Huhey	Harpes& Row.
Chemistry of the elements	N. N. Greenwood and A. Earnshow	Pergamon
Inorganic Electronic Spectroscopy	A. B. P. Lever	Elsevier
Magneto Chemistry	R. L. Carlin	Springer Verlag
Comprehensive Coordination Chemistry	G. Wilkinson, R. D. Gillars and J. A. McCleverty,	Pergamon

Course Evaluation:

Theory:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.
- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Advances in Organic Chemistry-I

Course Code: SSCH7030

Prerequisite: Basics of Organic Chemistry

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To have in-depth knowledge on bonding in organic molecules, stereochemistry of compounds, reaction mechanism and substitution reactions.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Nature of bonding in Organic Molecules** Delocalized chemical bonding-conjugation, cross conjugation, resonance, hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid compounds, alternant and non-alternant hydrocarbons, Huckel's rule, energy level of π- molecular orbitals, annulenes, anti aromaticity, ψ- aromaticity, homo-aromaticity, PMO approach. Bonds weaker than covalent addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.	10	15
2	**Stereochemistry** Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding. Elements of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, sterospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. Stereochemistry of the compounds containing Nitrogen, Sulphur and Phosphorus.	15	25
Section-II			
3	**Reaction Mechanism: Structure and Reactivity** Types of Mechanisms, types of reactions, thermodynamic and kinetic requirements, thermodynamic and kinetic control, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects. Hard and soft acids and bases. Generation, structure, stability and reactivity of carbocations, carboanions, free radicals, carbenes and nitrenes. Effect of structure on reactivity- resonance and field effects, steric effect,	12	20

	quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft equation.		
4	**Aliphatic Nucleophilic Substitution** The SN1, SN2, mixed SN1 and SN2 and SET mechanisms. The neighboring group mechanism, neighbor group participation by π and 6 bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. Applications of NMR spectroscopy in the detection of carbocations. The SN1 mechanism Nucleophilic substitution at an allylic, aliphatic trigonal and vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.	15	25
5	**Aliphatic Electrophilic Substitution** Bimolecular mechanisms- SE2 and SE1. The SE1 mechanism, electrophilic substitution, accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.	8	15

Learning outcome:

CO-1: The students will learn about various bonding phenomenon such as resonance, hyperconjugation, tautomerism and energy level in molecules. Knowledge on crown ether complexes, cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes will be gained.

CO-2: The students are able to understand Conformational analysis, chirality, stereospecific and stereoselective synthesis. They will gain insight on stereochemistry of compounds containing Nitrogen, Sulphur and Phosphorus.

CO-3: The students are able to study different types of mechanism and their thermodynemics and kinetics requirements. They also know about different effects, Hammett equation and Taft equation related to understand reaction mechanism.

CO-4: The students are able to know aliphatic nucleophilic substitution and electrophilic substitution reactions like SN^1, SN^2, mixed, SE^1 and SE^2.

Reference Books:

Title	Authors	Publisher
Advanced organic Chemistry- Reactions, Mechanisms & Structure	Jerry March	John Wiley
Advanced organic Chemistry	F. A. Carey & R. J. Sundberg	Plenum
A guide book to Mechanism in Organic Chemistry	Peter Sykes	Longman
Structure & Mechanism in Organic Chemistry	C. K. Ingold	Cornell University Press
Organic Chemistry	R. T. Morrison & R. N. Boyd	Prentice-Hall
Modern Organic Reactions	H. O. House	Benjamin
Principles of Organic Synthesis	R. O. C. Norman & J. M. Coxon	Blackie Academic & Professional

Pericyclic reactions	S. M. Mukherji	Macmillan, India.
Reaction Mechanism in Organic Chemistry	S. M. Mukherji & S. P. Singh	Macmillan, India.

Course Evaluation:

Theory:

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- The Internal exam consists of 40 marks, which will be converted to 20 marks.
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- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Inorganic & Organic Chemistry Practical-I

Course Code: SSCH7050

Prerequisite: Inorganic & Organic Chemistry Practical-I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	8	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To prepare the exact solutions for quantitative analysis and qualitative analysis for the determination of metals from ores/alloys. To understand different purification techniques in organic chemistry like recrystallization, distillation, steam distillation and extraction and get awareness of safety techniques and handling of chemicals.

Course Contents:

Laboratory Course in Inorganic Chemistry			
Module	**Content**	**Hours**	**Weightage (%)**
1	Chem-Sketch Software (Computer Based experiment): Draw the structure of simple aliphatic, aromatic, heterocyclic organic compounds with substituents. Get the correct IUPAC name.	8	10
2	Separation of Cu-Ni mixture and estimate the amount of Ni gravimetric and Cu volumetric methods from the given binary mixture solution.	8	10
3	Analysis of Alloy: Solder alloy – Estimation of Tin gravimetrically and Lead volumetrically	8	10
4	Preparation of sodium tetratnionate	8	10
5	Preparation of i) Mohr's Salt and ii) Ferrous Oxalate	8	10
Laboratory Course in Organic Chemistry			
1	Preparation of Adipic acid from cyclohexene	8	10
2	Preparation of p-bromo acetanilide to Acetanilide	8	10
3	Preparation of benzophenone oxime from benzophenone	8	10
4	Preparation of dibenzalacetone from benzaldehyde.	8	10
5	Preparation of m-dinitrobenzene from nitrobenzene	8	10

Learning outcome:

CO-1: Students will get the opportunity to learn about chem-sketch software and will be able to draw the chemical structures.

CO-2: Students will also learn to perform gravimetric analysis in proper manner.
CO-3: They will learn the preparation of mohr's salt and ferrous oxalate. Synthesis of various organic compounds is also included.

Reference Books:

Title	Authors	Publisher
Advanced organic Chemistry- Reactions, Mechanisms & Structure	Jerry March	John Wiley
Synthesis & characterization of Inorganic Compounds	W L Jolly	Prentice Hall

Course Evaluation:
Practicals:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.
- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Advances in Physical Chemistry-I

Course Code: SSCH7070

Prerequisite: Physical Chemistry

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To make the student conversant with physical and chemical observations, basic principles of chemical thermodynamics, statistical, advanced concepts in kinetics and electrochemistry and conceptual arguments in Physical Chemistry.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Chemical Thermodynamics** Introduction to terms used in chemical thermodynamics, Partial molar quantities, Chemical potential, Gibbs-Duhem equation, Variation of chemical potential with temperature and pressure, chemical potential for a mixture of ideal gases. Non-ideal solutions, Thermodynamics functions of mixing of non-ideal solutions (i) free energy of mixing (ii) entropy of mixing (iii) volume of mixing and (iv) enthalpy of mixing, Excess functions (μE, GE, SE, HE and VE) for non-ideal solutions and expression for excess thermodynamic functions.	15	25
2	**Statistical Thermodynamics** Basics of Statistical thermodynamics (Assembly, Canonical ensemble, occupation number statistical weight factor, probability), Thermodynamic probability, Probability and entropy, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Lagrange's methods of multipliers, Partition function, Thermodynamic properties in term of partition functions (i) Internal energy (ii) Heat Capacity (iii) Third law of thermodynamics(iv) Helmholtz free energy (v) Enthalpy (vi) Gibb's free energy(vii) Chemical potential (viii) Equilibrium constant Molecular partition functions for an ideal gas, Derivation for Translational, Rotational and Vibrational partition functions.	15	25

Section-II			
3	**Chemical kinetics** Theories of Unimolecular gas reactions: Lindemann and Hinshelwood, Kinetics of some complex reactions (i) Reversible reactions (only first order opposed by first order) (ii) Consecutive reactions(A→B→C); Steady state treatment or approximation, Enzyme catalysed reactions, Kinetics of thermal H_2-Br_2 reaction, Kinetics of photochemical reactions (H_2-$Cl_2$and H_2-Br_2). Kinetics of some organic decomposition (i) decomposition of ethane (ii) decomposition of acetaldehyde, Effect of Ionic strength on rates of ionic reactions (Primary and secondary salt effect).	15	25
4	**Electrochemistry-I** Anamoly of strong electrolytes, Debye-Huckel Theory, The Debye- Huckle limiting law, The Debye-Huckle-Bronsted equation, Thermodynamics of electrified interface, Lippmann equation, Debye-Huckel-Onsager equation and its extension, ion solvent interactions, activity and activity coefficient, activities of electrolytes, ionic strength.	15	25

Learning outcome:

CO-1: The student will acquire knowledge of Chemical Thermodynamics, Kinetics and Electrochemistry.
CO-2: This course aims at to accustom the students the basic concepts of thermodynamics along with the basic Debye Huckel theory.
CO-3: Students will explain statistical chemistry and thermodynamics as logical consequences of the postulates of statistical mechanics.
CO-4: Students will be Familiar with Kinetics of Thermal and photochemical reactions and correlate different kinetic theories.

Reference Books:

Title	Authors	Publisher
Thermodynamics for chemist	Samuel Glasstone	East-West Press Pvt. Ltd.
Principles of Physical Chemistry	Puri B. R., Sharma L. R. and Pathania, M. S.	Vishal Publishing Co. 41th ed.
Chemical Kinetics	Laidler K. J.	TATA McGraw-Hill Publishing Company Ltd.
Kinetics of chemical reactions	S. K. Jain	Vishal Publications
An Introduction to Chemical Thermodynamics	R P Rastogi and R R Mishra	Vikash Publishing House Pvt Ltd. 6th edition
An introduction to Electrochemistry	Samuel Glasstone	East-West Press Pvt. Ltd.
Advanced Physical Chemistry	J N Gurtu and A Gurtu	Pragati Prakashan

Course Evaluation:

Theory:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
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- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Analytical Chemistry & Instrumentation Techniques

Course Code: SSCH7090

Prerequisite: Analytical Chemistry & Instrumentation Techniques

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To Explain Electrical Methods of Analysis like Electrogravimetry, Voltametry , Coulometry as well as provide clear idea about MS and ESR spectroscopy.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Electrical Methods of Analysis** Liquid Junction Potential (LJP), Electric Double layer, Faradic and Non-faradic Current, Mass Transfer in Cells with the Passage of Current, Polarization effect, Different types of polarization, Electrogravimetry, Constant potential and current electrolysis, Factors affecting the quality of deposits, Applications. **Coulometary**: Principle of Coulometry, controlled current coulometry, Instrumentation and application of Controlled potential coulometry, Coulometric titrations (primary and secondary), endpoint detection in coulometry titration, applications and Numerical based on Coulometary	15	25
2	**VOLTAMETRY METHODS OF ANALYSIS** **Rapid Scan Voltammetry**: Principle, Rapid voltage scan at the end of the drop life, Peak current equation, Relation of peak current with the scanning rates, Summit potential equation, Comparison with DC polarography, Limitations. **Hydrodynamic Voltammetry**: Principle and similarity with dc polarography, Types of electrodes used, Applications of the technique in determination of rate constant of the reaction. **Anodic Stripping Voltammetry**: Concentration and stripping steps, Importance of Hanging mercury drop electrode and MTFE, Sensitivity of the	15	25

	technique, Adsorptive stripping, Applications, Cathodic stripping. **Cyclic Voltammetry**: Principle, Forward and reverse scan, cyclic voltamogram, Detection limits, Applications.		
	Section-II		
3	**Mass Spectrometry** What Is Mass Spectrometry?, Mass Spectrometer, Mass Spectrum, Symbols and meaning, Sample introduction, ionisation principle and ion sources (electron ionisation, chemical ionisation, laser-induced desorption, chemical and photon ionisation at atmospheric pressure and electrospray), Mechanism of Ionizations (Protonation, Cationization, Deprotonation, Transfer of a Charged Molecule into the Gas Phase, Electron Ejection, Electron Capture), Calibration (Calibration for FAB, Calibration for MALDI, Calibration for Electrospray), Resolution, Mass Analysers (Quadrupoleanalyser, Mass Analyzer, Time-of-Flight Analyzer,), Tandem Mass Spectrometry (MS/MS with a Triple-Quadrupole Mass Spectrometer, MS/MS with a Time-of-Flight Refiectron Mass Spectrometer, MS/MS with a Fourier Transform-Ion Cyclotron Resonance, MS/MS with an Ion Trap), Ion Detector (Faraday Cup, Electron Multiplier, Photomultiplier Conversion Dynode (Scintillation Counting or Daly Detector), Information received from a chromatogram, determination of molecular weights and molecular formulas, Isotope ratio data, fragmentation pattern of small molecules, Interpretation of spectra, Numericals, Applications	15	25

4	**ESR Electron Spin Resonance Spectroscopy** Introduction, Factors affecting the g-value, Limitations of ESR, Difference between ESR and NMR, Instrumentation, Electron nucleus coupling, Hyperfine interactions-isotropic and anisotropic coupling constants, The spin Hamiltonian, Quantitative analysis, Sensitivity, Choice of solvent, applications of ESR, Study of free radicals, Electronic and Hyperfine splitting, Triplet states- zero field splitting and Krammer's degeneracy, Analytical applications of ESR, Structural determination by ESR, Study of inorganic compounds by ESR, Transition elements, Biological systems	15	25

Learning outcome:

CO-1: The students will learn different Electrical Methods of Analysis like Electrogravimetry, Polarization and Coulometry.
CO-2: The students will get awareness about different voltametry techniques to analyze Samples.
CO-3: The students will gain knowledge related to instrument, mechanism, acceleration, detection and interpretation of spectra.
CO-4: The students will learn about ESR, its principle, application and its limitations.

Reference Books:

Title	Authors	Publisher
Principles of Instrumental Analysis	Douglas A. Skoog, F James Holler, Stanley R. Crouch	Thomson 6th edition
Fundamentals of Analytical Chemistry	Douglas A. S., Donald M. W., Holler H. J., Crouch H. R.	Brooks Cole; 9th edition
Introduction to spectroscopy: A guide for students of organic spectroscopy	Donald L. Pavia, Gary M. Lampman Geroge S. Kriz	Thomson Learning Academic Resource Center
Spectrometric Identification of Organic Compounds	Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce	John Wiley & Sons
Spectroscopy of Organic Compounds	P. S. Kalsi	New Age International Pvt Ltd

Course Evaluation:

Theory:

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- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Physical & Analytical Chemistry Practical-I

Course Code: SSCH7110

Prerequisite: Physical & Analytical Chemistry Practical-I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	8	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To design and carry out scientific experiments safely as well as accurately record and analyze the results of experiments. To understand the principle and handling of pH meter, Potentiometer, conductivity meter, colorimeter, viscometer, etc. along with to Maintain laboratory ethics, safety, cleanliness and understand waste management of the laboratory

Course Contents:

Laboratory Course in Physical Chemistry			
Module	**Content**	**Hours**	**Weightage (%)**
1	Determine the CMC of Tetradecayl trimethyl ammonium bromide using conductometry in different solvent, different solvent mixture, water.	8	10
2	To determine degree of hydrolysis of aniline hydrochloride, and hence hydrolysis constant of the salt	8	10
3	Study the kinetics of the reaction between potassium persulfate and potassium iodide. Determine the rate constant, order of reaction and influence on ionic strength on rate constant	8	10
4	Determine the dissociation constant of tribasic acid solutions.	8	10
5	Calculate the molar absorptivity of each of the given solution (A) and (B) and find out the concentration of supplied of unknown solution colourimetry.	8	10
Laboratory Course in Analytical Chemistry			
1	Constant current Coulometric titration of As_2O_3	8	10
2	Spectrophotometric Determination of Iron in Vitamin Tablets	8	10
3	Determination of the amount of Cd^{2+}/Zn^{2+} present in the unknown solution using cyclic voltammetry	8	10
4	Elecrtogravimetric determination of Cu^{2+} in brass.	8	10

5	Tutorial: Identification of organic molecule using IR, NMR, MS and ESR data.	8	10

Learning outcome:

CO-1: After successfully completing this course, students will be able to: prepare the solution of the desired concentration and the desired volume
CO-2: The students will learn the laboratory skills needed to design, safely conduct and interpret chemical research.
CO-3: Plot accurate graphs of the desired scale for the calculations.

Reference Books:

Title	Authors	Publisher
Polymer Synthesis and Characterization	Stanley R. Sandler, Wolf Karo, JO-anne Bonesteel, Eli M. Pearce	Academic Press
Advance Practical Physical Chemistry	Dr. J. B. Yadav	GOEL Publishing House
Life sciences protocol manual	Dr. P. Hemalatha Reddy, Dr. Suman Govil	Department of Biotechnology
Principles of Instrumental Analysis	Douglas A. Skoog, F James Holler, Stanley R. Crouch	THOMSON 6th edition
Vogel's Textbook of Quantitative Chemical Analysis	G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denney	John Wiley & Sons Inc

Course Evaluation:

Practicals:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.
- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Sem-2

Course Name: Advances in Inorganic Chemistry-II
Course Code: SSCH7020
Prerequisite: Advances in Inorganic Chemistry-II

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To explain in detail about inorganic polymers, Metal cluster, symmetry element and symmetry operations

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Symmetry and Group Theory in Chemistry:** Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroup. Contumacy relation and classes. Point symmetry group. Schoenflies symbols, representations of groups by matrices (representation for the Cn, Cnv, Cnh, Dnh etc. groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables of C2v, C2h, C3v and their use in spectroscopy.	24	54
Section-II			
2	**Metal Clusters** Higher boranes, carboranes, metalloboranes and mettalocarboranes. Metal carbonyl and halide clusters, compounds with metal-metal multiple bonds. **Chains:** Catenation, heterocatenation, intercatenation. **Rings:** Borazines, phosphazines.	18	21
4	**Inorganic polymers:** Introduction, Definition of polymers and their depiction, Types of characteristic of inorganic polymers. Characterization of inorganic polymers (Physical properties): By molecular weights, Number average, Weight average, Molecular weight distribution. Structural features of polymers: backbone bonding, branching and cross-linking, chemical and stereochemical variability Crystallinity: Importance and requirements, Methods for determining percent crystallinity by Dilatometry, crystallography and X-ray diffraction. Classification, types of inorganic polymers, synthesis, properties, structures and uses in following polymers: (i) Polyphosphazenes (ii) Polysiloxanes	15	25

Learning outcome:

CO-1: Student are aware of different type of polymers such as thermoplastics polymers and they will learn how to calculate molecular weight
CO-2: Student will learn to calculate STYX no. and characterize their structure, they will learn to characterize the structure of different type of metal clusters
CO-3: Students will be able to find out point group from different type of symmetry elements.

Reference Books:

Title	Authors	Publisher
Advanced Inorganic Chemistry	F.A. Cotton & Wilkinson	John Wiley
Inorganic Chemistry	Purcell, K.F &Kotz, J.C.	W.B. Saunders Co, 1977.

Course Evaluation:

Theory:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.
- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Advances in Organic Chemistry-II

Course Code: SSCH7040

Prerequisite: Advances in Organic Chemistry-II

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To introduce special mode of cyclic reactions (pericyclic reactions), as well as to enhance the knowledge about electrophilic aromatic substitution, nucleophilic aromatic substitution, addition to carbon-carbon multiple bonds and addition to carbon-hetero multiple bonds.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Pericyclic reactions** Molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrolytic reactions- conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems. Cycloadditions- antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1, 3 dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements- superfacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3,3- and 5, 5- sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements. Fuxionaltautomerism. Ene reaction.	15	33
2	**Aromatic electrophilic substitution** The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Qualitative treatment of reactivity in substrates and electrophiles. Diazonoium coupling, Vilsmeir reaction, Gattermann-Koch reaction.	6	14
3	**Aromatic Nucleophilic Substitution** The SNAr, SN1, benzyne and SRN1 mechanisms. Reactivity- effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet-Hauser, and Smile's rearrangements.	5	13

Section-II			
4	**Addition to Carbon-Carbon Multiple Bonds** Mechanistic and Sterochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, region- and chemo selectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.	7	15
5	**Addition to Carbon-Hetero Multiple Bonds** Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates- Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.	7	15
6	**Elimination reactions** The E2, E1 and E1cB mechanisms and their spectrum. Orientation of the double bond. Reactivity- effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.	5	10

Learning outcome:

CO-1: Students will be able to understand the nature of peripheral electrons, symmetrical elements, co-relation diagrams with three different reactions Cycloaddition, electrocyclic and sigmatropic Modes of interactions of molecular interactions i.e. conrotation, disrotation, supraficial and antraficial could be understood in 3-D
CO-2: Electrophilic reactive intermediates will be studied in-depth with mechanism.
CO-3: Students will be able to understand the mechanism of an important intermediate of chemical reactions which is nucleophiles The new benzyne mechanism will be introduced as well as SN^1 and SN^2 reactions will be elaborated
CO-4: Students will be able to rationalize the addition reaction of carbon-carbon multiple bond and carbon-hetero multiple bond through various intermediates with Hydroboration, Michael reaction, and Sharpless asymmetric epoxidation.

Reference Books:

Title	Authors	Publisher
Advanced organic Chemistry- Reactions, Mechanisms & Structure	Jerry March	John Wiley
Advanced organic Chemistry	F. A. Carey & R. J. Sundberg	Plenum
A guide book to Mechanism in Organic Chemistry	Peter Sykes	Longman
Structure & Mechanism in Organic Chemistry	C. K. Ingold	Cornell University Press
Organic Chemistry	R. T. Morrison & R. N. Boyd	Prentice-Hall
Modern Organic Reactions	H. O. House	Benjamin
Principles of Organic Synthesis	R. O. C. Norman & J. M. Coxon	Blackie Academic & Professional

Pericyclic reactions	S. M. Mukherji	Macmillan, India.
Reaction Mechanism in Organic Chemistry	S. M. Mukherji & S. P. Singh	Macmillan, India.

Course Evaluation:

Theory:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.
- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Inorganic & Organic Chemistry Practical-II

Course Code: SSCH7060

Prerequisite: Inorganic & Organic Chemistry Practical-II

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	8	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To explain how to determine the type and separation of organic binary mixture as well as Inorganic salts and estimating the standard solutions of given compounds.

Course Contents:

Laboratory Course in Inorganic Chemistry			
Module	**Content**	**Hours**	**Weightage (%)**
1	ESTIMATION OF: Silica and iron in hematite ore	8	10
2	ESTIMATION OF: Silica and manganese in pyrolusite	8	10
3	ESTIMATION OF: Ammonia in ammonium salt.	8	10
4	Qualitative analysis of mixture containing eight radicals including two less common Metal from among the following Basic Radicals: **(2 practical)** Ag, Pb, Hg, Bi, Cu, Cd, As, Sb, Sn, Fe, Al, Cr, Zn, Mn, Co, Ni, Ba, Sr, Ca, Mg, Na, K, Ce, Th, Zr, W, Te, Ti, Mo, U, V, Be, Li, Au, Pt. **Acid Radicals:** Carbonate, Sulphite, Sulphide, Nitrite, Nitrate, Acetate, Flouride. Chloride, Bromide, Iodide, Sulphate, Borate, Oxalate, Phosphate, Silicate, Thiosulphate, Ferrocyanide, Ferricyanide, Sulphocyanide, Chromate, Arsenate and Permanganate.	16	20
Laboratory Course in Organic Chemistry			
1	General methods of separation and purification of Organic compound with special Reference To.: Solvent Extraction Fractional Crystallization	8	10
2	Distillation Techniques: Simple distillation, steam distillation, Fractional distillation and distillation under reduced pressure.	8	10

3	Analysis of Organic Binary Mixture: Separation and Identification of organic binary mixtures containing at least one component with two substituents. (A student is expected to analyse at least 03 different binary mixtures.)	24	30

Learning outcome:

CO-1: The students will do type determination and learn how to seperate binary mixture of organic compound of different types such as Acid+Base, Acid + Phenol, Acid + Neutral etc.
CO-2: The students will learn how to separate mixture of Inorganic salts.
CO-3: The students will learn to calculate %purity of respective compound

Reference Books:

Title	Authors	Publisher
Advanced organic Chemistry- Reactions, Mechanisms & Structure	Jerry March	John Wiley
Synthesis & characterization of Inorganic Compounds	W L Jolly	Prentice Hall

Course Evaluation:

Practicals:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.
- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Advances in Physical Chemistry-II

Course Code: SSCH7080

Prerequisite: Basics of Physical Chemistry

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To learn about various double layer theories, the concept of overvoltage , the fundamentals of surface chemistry , Band theory of metal, insulators and semiconductors and deep insight on superconductors as well as Nuclear and radiochemistry.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Electrochemistry-II** Electrical double layer, theories of electrical double layer, Helmoholtz-Perrin theory, Guoy Chapman theory and its limitations, Stern's theory. Overpotential and their types, measurement of overpotential, factors affecting over potential, theories of overpotential, Importance of overpotential.	15	34
2	**Surfactants and solution behavior:** Introduction of liquid surfaces and source of surface tension/interfacial tension. Methods of surface tension measurement Classification of surfactants, micellization, factors influencing CMC. Thermodynamics of micellization. Aggregation number and its determination, micellar solubilization, micro emulsion, reverse micelles, applications of various surfactant organized assemblies	10	22
Section-II			
3	**Electronic Behavior of Materials** Electronic properties and Band theory of solids, band structure of metals, insulators and semiconductors, Intrinsinc and extrinsic semiconductors, doping of semiconductors, Temperature dependence of conductivity, carrier density and carrier mobility in semiconductors, electrically conducting organic solids, Fullerenes, superconductors.	10	22
4	**Nuclear Chemistry** Nuclear reactions – conservation laws, types of nuclear reaction, nuclear chain reaction, condition for controlled chain reaction, principle and types of nuclear reactors (thermal and Breeder reactors). Nuclear fission a source of energy, nuclear chain reaction, condition for controlled chain reaction, Principle of Nuclear reactors and their types, Energy from nuclear fusion, thermonuclear reactions, stellar energy, Biological effects of radiation.	10	22

Learning outcome:

CO-1: Students will be able to apply the Double layer theory on electrochemical reactions and understand the importance of overvoltage.
CO-2: Students will be able to explain the properties of surface active agents and their thermodynamics of micellazation.
CO-3: The students will acquire knowledge of basics of nuclear chemistry and radio analytical techniques.
CO-4: Students will be able to justify the implication of nuclear chemistry and its immense energy generation.

Reference Books:

Title	Authors	Publisher
Physical Chemistry	G.W. Castellan	Addison-Lesley Publishing Co.
Advanced Physical Chemistry	J.N. Gurtu, A. Gurtu	Pragati Prakashan
Physical Chemistry	E.A. Moelwyn Hughes	Pergamon Press.
Solid state Chemistry and its Applications	A.R. West	Plenum.
Nuclear Chemistry	A. H. Arnikar	
Nuclear Chemistry	Dash U. N.	Sultan Chand and Sons

Course Evaluation:

Theory:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.
- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Dyes and Intermediates

Course Code: SSCH7100

Prerequisite: Basics of Dyes and intermediates

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To introduce, classify and synthesis of dyes as well as introduction of unit process in organic chemistry.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Introduction to Dyes:** Important landmark in the history of dyes, Natural colouring matter and their limitations: e. g, Heena, Turmeric, kesar, Chlorolphyll, Indigo, Alizarine from roots of madder plants, Logwood. Tyrian Purple. Synthetic Dyes: Important molestones, i. e. Mauve, Diazotization, aniline Yellow, Congo Red, Synthesis and structure of Indigo, disperse Dye, fluorescent Brighteners, procion reactive Dyes, Remazole Dyes. (Emphasis on Name of the Scientist and dyes and the year of the discovery is required and structure is not expected Defination of dyes, Properties i.e. colour, Chromophore and Auxochrome, Solubility, Linearity, Coplanarity, fastness properties, substantivity, Economic viability Explanation of nomenclature of commercial dyes with atleast one example .suffixes-G, O, R, B, 6B, GK, 3GK, 6GK, L, S Explanation: naming of dyes by colour index (two examples)	10	22
2	**Classification of dyes:** Based on constitution (Examples are mention below with structures) (i) Nitro Dyes-Napyhol yellow S (ii) Nitroso Dye-Gambine Y (iii) Azo Dyes- (a) Monoazo Dyes- Metanil yellow (b) DiazoDyes- Napthol Blue Black (c) Triazodyes -Chloroamine Green B (iv) Diphenymethane Dyes-Auramine G (v) Triphenyl methane Dyes-	15	34

	(a) Malachite Green Series- Naphthalene green V (b) Magenta Series- Acid Magenta (c) RosolicacidSeries-Chrome Violet (vi) Heterocyclic Dyes (a) Xanthene-Rhodamine 6G (b) Acridines-Acriflavine (c) Azines- SafranineB (d) Oxazines-Capri blue (e) Thiazines-Methylene Green (f) Quiolines- Quinoline Yellow (g) Thiazoles-Primuline (vii) Benzoquinones and naphthaquinones, Napthazarin (viii) Anthraquinone Dyes- Indanthrene, Turquoise Blue 3GK (ix) Indigoids-Indigo Caramine (x) Pthacyanines-Sirius Light green FFGL **Classification Based on Application:** Definition, fastness properties & applicability on substrates examples with structures (a) Acid Dyes- Orange II, (b) Basic Dyes-methyl violet, Victoria Blue B (c) Direct cotton Dyes- Benzofast Yellow 5GL (d) Azoic Dyes-Diazo components; Fast yellow G, Fast orange R. Coupling components. Naphtol AS, Naphthol ASG (e) Mordant Dyes-Erichrome Black A, Alizarin. (f) Vat Dyes- Indanthrene brown RRD, Indanthrene Red 5GK. (g) Sulphur Dyes-Sulphur Black T (no structure) (h) Disperse Dyes-Celliton Fast brown 3R, perlon fast blue FFR (i) Reactive Dyes- Cibacron Brillant Red B, procionbriilant Blue HB.		
Section-II			
3	**Synthesis of Specific Dyes and their Uses** (i) Orange IV from sulphanilic acid (ii) Eriochrome Black T from β-naphthol (iii) Eriochrome Red B by using ethyl aceto acetate and 1-amino-2- naphthol-4-sulphonic Acid. (iv) Direct Deep Black EW by using benzidine, H acid, aniline, and m-phenylendiamine. (v) Congo Red from nitrobenzene vi) Diamond Black F by using 5- amino salicylic acid, N.W. acid and α-naphthylamine. (vii) Malachite Green by using benzaldehyde and N, N dimethylaniline. (viii) Auramine O from dimethylaniline (ix) Methylene Blue by using 4- amino-N, N-dimethylaniline and N,N-dimethylaniline (x) Safranine T by using o-toluidine and aniline (xi) Pararosaniline by using p-toluidine and aniline (xii) Alizarine Cyanine Green G by using phthalic anhydride and p-chlorophenol (xiii) Indanthrene from anthraquinone (xiv) Disperse Yellow 6G from benzanthrone (xv) Indigo from aniline (xvi) Eosine by using phthalic anhydride and resorcinol (xvii) Bismark Brown from m-phenylenediamine. Types of Fibers and Classes of Dyes Applicable to them -Introduction to the following types of fibers with structures and classes of dyes applicable to it. Cotton, Wool, Silk, Polyester. Ecology and Toxicity of Dyes -With reference to the textile dyes, food colours, benzidine etc.	10	22
4	**Intermediates** A brief idea of Unit processes, Introduction of primary intermediates	10	22

	Unit processes (a) Nitration (b) Sulphonation (c) Halogenation (d) Diazotization: 3 different methods, importance (e) Ammonolysis (f) Oxidation N.B.: Definition, Reagents Examples with reaction conditions (mechanism is not expected) **Preparation of the following Intermediates.** *Benzene derivatives: Benzenesulphonic acid; 1,3- Benzenedisulphonic acid; phenol; resorcinol; sulphanilic acid; o-, m-, p-chloronitrobenzenes; o-, m-, p-nitroanilines; o-, -m, -p- phenylenediamines; Naphthol ASG. * Naphthalene derivatives: α, β Naphthol's; α, β-Naphthylamines; Schaeffer acid, Tobias acid; Naphthionic acid; N.W. acid; Clev-6-acid; H acid; Naphtholate. *Anthracene derivatives: 1-Nitroanthraquinone; 1-Aminoanthraquinone; 2-Aminoanthraquinone; 2-Methylanthraquinone; anthraquinone-1-sulphonic acid; Anthraquinnone-2-sulphonic acid; 1-Chloroanthraquinone; Chloroanthraquinone; Benzanthrone.		

Learning outcome:

CO-1: Students will be able to understand about natural and synthetic dyes with an industrial aspect.
CO-2: The proper classification of dyes is necessary to understand on the basis of their constitution and applications.
CO-3: Students will be able to understand the synthetic pathway of some selected important dye components with their applications and toxicity.
CO-4: From the utilization and appropriate knowledge of basic unit processes i.e. nitration, sulphonation, halogenation students will understand electronic flow pathway from one organic molecule to the other.

Reference Books:

Title	Authors	Publisher
Fundamental processes of dye chemistry	Hans Eduard Fierz-David and Louis Blangey	Interscience Publishers, Inc., New York
The Chemistry and application of Dyes	David R. Waring and Geoffrey Hallas	Plenum Press- New York & London
Industrial Dyes-Chemistry, Properties and Applications	Klauss Hunger	Wiley-VCH

Course Evaluation:

Theory:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.

- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Physical & Dyes & Intermediates Practical

Course Code: SSCH7120

Prerequisite: Physical & Dyes & Intermediates Practical

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	8	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

To design and carry out scientific experiments safely as well as accurately record and analyse the results of experiments. To understand the principle and handling of pH meter, Potentiometer, conductivitymeter, colorimeter, viscometer,etc. along with the synthesis of different azo dyes.

Course Contents:

Laboratory Course in Physical Chemistry			
Module	**Content**	**Hours**	**Weightage (%)**
1	Determine the equivalent conductivity of a given electrolyte and hence examine the validity of Onsager's equation.	8	10
2	To determine the concentration of given $CuSO_4$ solution by verifying the Beer's law using colorimeter.	8	10
3	[Ka] of weak organic acid [benzoic acid] conductometrically	8	10
4	Preparation of orthophosphate buffer. pH metry	8	10
5	Find out the emf of ferrous sulphate/ferrous ammonium sulphate in given flask potentiometrically using 0.1 N Ferric salt solution.	8	10
Laboratory Course in Dyes & Intermediates			
1	Preparation of Dyes a. Phenyazo- β-napthol b. Magneson II c. Red azo dyes	24	30
2	Estimation of Dyes by reduction method using Titanium chloride a. Indigo Carmine b. Crystal Violet	16	20

Learning outcome:
CO-1: After successfully completing this course, students will be able to: prepare the solution of the desired concentration and the desired volume
CO-2: The students will learn the laboratory skills needed to design, safely conduct and interpret chemical research.
CO-3: Students will learn to plot graphs of the desired scale for the calculations.
CO-4: The students are able to synthesize different dyes under specific conditions.

Reference Books:		
Title	**Authors**	**Publisher**
Handbook of Organic Analysis: Qualitative & Quantitative	H Clark	Adward Arnold
Vogel's Textbook of Practical Organic Chemistry	W L Jolly	Prentice Hall

Course Evaluation:
Practicals:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.
- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Sem-3

Course Name: Chemistry of Natural Products.

Course Code: SSCH8010

Prerequisite: Basic Knowledge of Natural products

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)			Examination Scheme (Marks)			
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course describes the classification, nomenclature, isolation and synthesis of natural products.

Course Contents:

Course Code: SSCH8010			
Course Name: Chemistry of Natural Products.			
Section - I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Alkaloids**: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants, Structure, stereochemistry, synthesis and biosynthesis of the following: Atropine, ajmaline Home assignment stereochemistry, synthesis & biosynthesis of Ephedrine, (+)- coniine, Nicotine, Quinine, Morphine, reserpine, Vinea alkaloids.	15	33
2	**Terpenoids and Carotenoids:** Classification, nomenclature, occurrence, isolation, general methods of structure determination, Isoprene rule, structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules (only two): B-Carotene a-Terpineol, Home assignment: stereochemistry, biosynthesis and synthesis of Citral, Geraniol, Menthol, Farnesol, Zingiberene, Santonin, phytol, and abietic acid.	12	25

3	**Steroids:** Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol and Testosterone, Biosynthesis of steroids, Synthesis of Bile acids, Androsterone, Estrone, Progesterone, Aldosterone, Estradiol.	10	13

Section - II

Module	Content	Hours	Weightage (%)
4	**Prostaglandins and Thromboxanes:** Introduction, nomenclature of Prostaglandins and Thromboxanes; approaches to prostaglandin synthesis; cyclohexane precursors (Woodward synthesis of PGF2a), bi cycloheptane precursors (Corey's synthesis of prostaglandins E and F).	8	9
5	**Pyrethroids, Rotenones and Pheromones:** Synthesis and reactions of pyrethroids, Rotenones and pheromones (For structure elucidation, emphasis is to be placed on the use of spectral parameters wherever possible).	5	10
6	**Natural Pigments & Porphyrins Derivatives:** *Porphyrins*: General structures, Synthesis and Spectral properties. Synthesis of Cryptopyrrole, Phytopyrrole, Opsopyrrole and Hemopyrrole and their carboxylic acid derivatives. Structural elucidation of Hemoglobin and Chlorophyll (Analytical evidences only).	10	10

Learning outcome:

The students will be able to understand

CO-1: To understand the nomenclature, isolation, classification and synthesis of alkaloids.
CO-2: To explain the classification, nomenclature, occurrence, isolation of Terpenoids.
CO-3: To determine the structure and synthesis of steroids.
CO-4: To evaluate the nomenclature and synthetic pathways of Prostaglandins and Thromboxanes.
CO-5: To elucidate the synthesis of Pyrethroids, Rotenones and Pheromones.
CO-6: To describe the structure, synthesis and spectral properties of Natural Pigments & Porphyrins Derivatives.

Reference Books:

Title	Author	Publication
Art in Organic Synthesis, 2nd Edition (1970),	Nitya Anand, J.S. Bindra and S. Ranganathan, Holden Day,	San Francisco.
Chemistry of the Alkaloids	S.W. Pelletier	Van Nostrand Reinhold Co., New York (1970).
The Alkaloids, Vol. I.	K.W. Bentley	Interscience Publishers, New York (1957).
Organic Chemistry, Vol. II, 5th Edition (1975) Reprinted in 1996,	I. L. Finar	ELBS and Longman Ltd, New Delhi

Total Synthesis of Natural Products, Vol. 1-6	J.W. Apsimon,	Wiley-Interscience Publications, New York (Vol. 1, 1973).
Creativity in Organic Synthesis	J.S. Bindra and R. Bindra,	Academic Press, NY (1975). London (1977).
Classics in Total Synthesis of Natural Products, Vol. I (1996) & Vol. II, (2003).	K. C. Nicolaou	Wiley
Organic Chemistry, Chapter 30	J. Clayden, N. Greeves, S. Warren, and P. Wothers,	Oxford University Press, Oxford (2001).
Natural Products: Chemistry and Biological Significance	J. Mann, R.S. Davidson, J. B. Hobbs, D. V. Banthrope and J. B Harborne, Longman, Essex	Wiley-Interscience Publications, New York (Vol. 1, 1973).
Organic Chemistry, Vo. 2.	I. L. Finar, ELBS	Pragati prakashan
New Trends in Natural Product chemistry,	Atta-Ur-Rahman and M. I. Choudhary,	Harwood Academic Publishers

Course Evaluation:

Theory:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.
- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Industrial Chemistry I

Course Code: SSCH8030

Prerequisite: Knowledge of Industrial Chemistry

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)			Examination Scheme (Marks)			
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to improve student's knowledge about Industrial chemistry, basic concept of drug and different unit processes used in industries.

Course Contents:

Course Code: SSCH8030

Course Name: Industrial Chemistry I

Module	Content	Hours	Weightage (%)
1	**Organic Chemistry in Industry** Introduction, Process Chemistry versus Research Chemistry *Pharmaceutical Industry*: Drug Discovery, Drug development, Preclinical and clinical testing, Medicine, Future Problems and Opportunities. *Agrochemical Industry:* Classification, Biodegradable and Persistent Pesticides, Toxicity, Chemical Classification of Pesticides-Herbicides and Insecticides	15	33
2	**Basic Concepts of Dye and Dye Intermediates** Introduction of Dyes and Pigments, Absorption of visible light, colour of wavelength absorbed, complementary colour. Relation between colour and chemical Constitution, Witt's theory, Armstrong's theory, Nietzki's theory, Valence bond theory, Molecular orbital theory, Fastness Properties, Exhaustion and fixation properties. Natural Dyes, Nomenclature of Dye Intermediates, Colour Index Classification of Dyes: Based on structure, based on mode of application to fibers, non – Textile uses of dyes: Dyes in medicine, leather, paper, colour photography and electro photography, food, cosmetics, displays and laser dyes	15	17
3	**Basic Concept of Drugs** Introduction, Classifications: On the basis of their chemical structure and therapeutic action, Nomenclature: Proprietary and Non-proprietary name, Nomenclature of new drugs by WHO, *Names of drugs*: Generic and brand names Theories of drug action: Occupancy theory, Rate theory and induced fit theory Biological defence, chemical defences, Furguson principal	15	25

	Absorption of drugs: Routes of administration, factors that effect on absorption. *Physico-chemical properties*: Solubility, Partition coefficients, Ionization constant, Electronic effect, Steric effect, Stereochemical consideration.		
4	**Unit Processes** **(i)Nitration:** Nitrating agents. Mechanism of aromatic nitration. Industrial chemicals derived from Benzene, Naphthalene, Anthracene using Nitration. **(ii)Sulphonation and Sulfation**: Sulphonating and Sulfating agents. Mechanism of aromatic Sulphonation. Industrial chemicals derived from Benzene, Naphthalene, Anthracene using Sulphonation. **(iii)Amination:** Aminating agents, Amination by reduction, Amination by Ammonolysis. Industrial chemicals derived from Benzene using Amination. **(iv)Alkylation:** Alkylating agents. Industrial important alkyl compounds derived by various routs. **(v)Halogenation:** Halogenating agents. Industrial important halogenated compounds derived by various routs.	15	25

Learning outcome:

CO-1: To understand the basics of pharmaceutical chemistry and agriculture industry.
CO-2: To determine the Nomenclature, classification and uses of Dyes.
CO-3: To explain basic concept of Drugs such as introduction, classification, Nomenclature, and physicochemical properties.
CO-4: To describe unit process such as Nitration, sulphonation and sulfation, Amination, alkylation, Halogination.

Reference Books:

Title	Author	Publication
Organic Chemistry: A Mechanism Approach	Penny Chaloner, Florida Anand, J.S. Bindra and S. Ranganathan	Holden Day
Pharmaceutical Process development: Current Chemical and Engineering Challenges y of the Alkaloids	J. Blacker and M. T. Williams	RSC Cambridge, UK.
Fine Chemicals: The Industry and Its Business	P. Pollak, 2nd Edition	Wiley
The chemistry of synthetic Dyes	Venkataraman, Academic Press	New York.
Chemistry of Synthetic Dyes & Pigments	Lubs	Wiley
Dyes and their intermediates	E. N. Abrahart	Wiley
Handbook of synthetic dyes and pigments	K. M. Shah	Wiley
Industrial Dyes	Klans Hunger, Germany	Wiley-VCH
Development in the Chemistry and technology of Organic Dyes	J. Griffiths, Blackwell Sci.	Oxford, London
Principles of colour Technology	Fred W. Billmeyer and Max Saltzman	John Wiley & Sons

Medicinal Chemistry	G. R. Chatwal	Wiley
A textbook of Pharmaceutical Chemistry	Jayshree Ghosh	Pragati Prakashan

Course Evaluation:

Theory:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.
- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Natural Products and Industrial Chemistry Practicals

Course Code: SSCH8050

Prerequisite: Basic Knowledge of Inorganic & Organic Chemistry Practical-I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)			Examination Scheme (Marks)			
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	8	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

Students will learn the isolation of several Natural compounds. Also, hands on training to learn different types of synthesis and techniques.

Course Contents:

Laboratory Course in Natural Product			
Module	**Content**	**Hours**	**Weightage (%)**
1	Separation of organic mixture by TLC	8	10
2	Isolation of Natural products: Cellulose from cotton	8	10
3	Isolation of Natural products; Eucalyptus oil from leaves (Steam distillation)	8	10
4	Sucrose to ethyl alcohol (Baker's yeast)	8	10
5	Industrial visit (Natural Product) and short report: Sugar Industries. Juggery industries, etc	8	10
Laboratory Course in Industrial Chemistry			
Module	**Content**	**Hours**	**Weightage (%)**
1	Analysis of common raw materials as per the industrial specifications such as phenol, aniline, formaldehyde, hydrogen peroxide, acetone, etc.	8	10
2	Conventional and Green Synthesis in Industrial Chemistry: Acetanilide from aniline	8	10
3	Synthesis of common industrial compounds involving two step reactions, e.g. 4-bromo aniline, 3-nitroaniline, sulphanilamide, 4-amino benzoic acid, 4-nitro benzoic acid, dihalobenzenes, nitrohalobenzenes, paracetamol, oils of winter green.	24	30

Learning outcome:

CO-1: To explain separation of organic mixture by TLC, Isolation of Natural products from respective sources.
CO-2: To prepare common industrial compounds.

Reference Books:

Title	Authors	Publications
Handbook of Organic Analysis: Qualitative & Quantitative	H Clark	Adward Arnol
Isolation, Identification and Characterization of Allelochemicals/ Natural Products	ampietro, Diego A ; Catalan, Cesar A.N.; Vattuone, Marta A.	CRC Press; 1st edition (7 January 2009)
Vogel's Textbook of Practical Organic Chemistry	Vogel	Paperback

Course Evaluation:

Practicals:

- The Continuous Evaluation for practical exam consists of 40 marks and include performance of practical (15 marks), Written Practical (10 marks), Spotting (5 marks), Journal (5 marks) and internal viva.
- End Semester Practical Exam consists of 60 marks covers practical performance (25 marks), Written practical (15 marks), Spotting (5 marks), Journal (10 marks) and Internal viva (5 marks).

Course Name: Rearrangement of Chemicals and Synthesis

Course Code: SSCH8070

Prerequisite: Organic Name reaction

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)			Examination Scheme (Marks)			
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

This course will increase student's knowledge about mechanisms and reagents of Organic reactions to understand their role in the field of sciences.

Course Contents:

Course Code: SSCH8070

Course Name: Rearrangement of Chemicals and Synthesis

Module	Content	Hours	Weightage (%)
1	**Rearrangement involving migration to electron deficient carbon:** (i) Expansion and contraction of rings/Demajnov rearrangement (ii) Benzil-benzilic acid rearrangement, Wagner-Meerwein, (iii) Pinacol-pinacolone, (iv) Wolf (Arndt-Eisterts Synthesis) (v) Rupe and Demjanov rearrangement	17	33
	Rearrangement involving migration to electron rich carbon: (i) Favorskii rearrangement (ii) Neber rearrangement (iii) Witting rearrangement (iv) Steven's rearrangement (v) Sommelet-Houser rearrangement		
	Rearrangement involving migration to electron deficient nitrogen: (i) Schmidt rearrangement (ii) Curtius rearrangement Hofman, Curtius, Lossen and Beckmann rearrangement,		
	Aromatic rearrangements: (i) Migration around the aromatic nucleus: Jacobsen rearrangement (ii) Migration of group from the side chain to the nucleus: Orton rearrangement, Hoffmann-Martius rearrangement, Rearrangement of N-nitrosoanilines (Fischer- Hepp rearrangement). Benzidine rearrangement and Free radical rearrangements		

	Rearrangement involving migration from oxygen to ring (i) Fries rearrangement (ii) Claisen rearrangement **Rearrangement electron deficient oxygen:** (i) Baeyer Villiger rearrangement.		
2	**Oxidation** Introduction, Oxidation with Cr (VI), Mn (VII), Mn (IV), OsO_4, Periodic acid, Peroxy acid. Oxidation of hydrocarbons-alkenes, aromatic rings, saturated C-H group (activated and inactivated), aldehyde and ketones.	13	17
3	**Reduction** Introduction, different reductive processes, hydrocarbons-alkenes, alkynes and aromatic rings, Carbonyl compounds- aldehydes, ketones, ($LiAlH_4$, $NaBH_4$ only for aldehyde and ketone) acids and their derivatives, epoxides, nitro, nitroso, azo and oxime groups, Birch reduction, Shapiro reduction.	15	25
4	**Name Reactions** General nature, method, mechanism and synthetic applications of the following reactions; (1) Ugi reaction (2) Noyori reaction (3) Wittig reaction (4) Peterson olefination reaction (5) Mannich reaction (6) Stille reaction (7) Ene reaction (8) Staudinger reaction (9) Corey-Fuchs reaction (10) Ritter reaction (11) MacMurray reaction (12) Michael addition.	15	25

Learning outcome:

CO-1: To explain rearrangement involving migration to electron-deficient carbon, electron-rich carbon, electron-deficient nitrogen, aromatic rearrangement, rearrangement involving migration from oxygen to ring, Rearrangement electron deficient oxygen.
CO-2: To describe Oxidation with Cr (VI), Mn (VII), Mn (IV), and OsO_4, Oxidation of hydrocarbons-alkenes, aromatic rings, saturated C-H group (activated and inactivated), aldehyde and ketones.
CO-3: To get knowledge of different reduction reactions and reducing reagents ($LiAlH_4$, $NaBH_4$ only for aldehyde and ketone)
CO-4: To describe Name reactions with methods, mechanism and applications.

Reference Books:

Title	Author	Publication
Organic synthesis using transition metals	Roderick Bates	Wiley
Organic chemistry	J. Clayden, N. Greeves, S. Warren and P. Wothers	Oxford Press
Some modern methods of organic synthesis	W. Carruthers	Cambridge
Organic synthesis	Michael B. Smith	Wiley
Advanced organic chemistry, Part B	F. A Carey and R. J. Sundberg, 5th edition (2007)	Wiley
Guidebook to organic synthesis	R K Meckie, D M Smith and R A Atken	Wiley

Organic synthesis	Robert E Ireland	John Wiley & Sons, 1992
Strategic Applications of named reactions in organic synthesis	Laszlo Kurti and Barbara Czako	Wiley
Organic Synthesis	Jagdamba Singh & L.D.S. Yadav, 6th edition,	Pragati Prakashan (2010).
Reaction Mechanism in Organic Chemistry	S. M. Mukherji and S. P. Singh	McMillan India Ltd., 1976
Advance Organic Chemistry, Reaction Mechanism and Structure	Jerry March, 4th ed.	John Wiley & Sons, 1992

Course Evaluation:

Theory:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.
- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Medicinal Chemistry

Course Code: SSCH8090

Prerequisite: Basic Knowledge of drugs.

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)			Examination Scheme (Marks)			
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to enhance the student's knowledge about Medicinal chemistry, types and Mechanism of work for different drugs.

Course Contents:

Course Code: SSCH8090			
Course Name: Medicinal Chemistry			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Drug Design, Pharmacokinetics and Pharmacodynamics** Drugs and Drug Design Introduction, drug targets, procedure for drug design, pro-drug, concepts of lead compounds, lead modification, structure activity relationship (SAR), LD50, ED50, therapeutic index, Concepts of drug receptors, Elementary treatment of drug receptor interactions. Introduction to Pharmaco-kinetic and Pharmacodynamic, Drug administration, Drug absorption, drug distribution, drug Metabolism (general pathway of drug metabolism: Phase-I and Phase-II), elementary treatment of enzyme stimulation, biotransformation, Drug excretion.	15	33
2	**Psychoactive Drugs** (i) General anaesthetics: General classification and Structural variations (ii) Local Anaesthetics: General classification and SAR (iii) Sedatives and Hypnotics: General classification, Structural variations and mode of action Synthesis and therapeutic uses of some drugs.	15	25
3	**Antipyretic, Analgesics and NSAIDs Agents** General classification of Antipyretic Analgesics, Narcotic Analgesics and Non-Steroidal Anti-Inflammatory Drugs Structural variations in Morphine, Morphan and 4-Phenylpiperidine Analogues. Opioid Receptors (Name only), Limitations of Opoids, Synthesis and therapeutic uses of only the following: Meperidine (Pethidine), Ibuprofen, Meclofenamate sodium, Oxyphenbutazone, Diclofenac Sodium, Mefenamic acid.	15	17

4	**(A)Diuretics:** General classification. Structural variation and SAR of Thiazide Diuretics Synthesis and therapeutic uses of only the following: Chlorothiazide, Furosemide, Ethacrynic acid, Triamterene. **(B) Insulin and Oral Hypoglycaemic Agents (Anti-diabetic agents or drugs affecting sugar metabolism):** General classification, Synthesis and therapeutic uses of only the following: Glipizide, Glybomuride Troglitazone, Chlorporpamide, Glibenclamide. **(C) Cardiovascular Drugs:** General introduction of Antiarrythmic agents and Antihypertensive drugs Structure variation in ß-adrenergic blockers and Dihydropyridines, Structure – activity Relationship of ACE Inhibitors. Synthesis and therapeutic uses of only the following: Verapamil, Methyldopa, Atenolol, Lisinopril, Losartan.	15	25

Learning outcome:

CO-1: To understand the Drug Design, SAR, Pharmacokinetics, and Pharmacodynamics.
CO-2: To get knowledge of the general anesthetics, local anesthetics, and sedatives.
CO-3: To define and classify Antipyretic, Analgesics and NSAIDs agents.
CO-4: To describe Diuretics, Anti-diabetic agents and Cardiovascular Drugs.

Reference Books:

Title	Author	Publication
Medicinal Chemistry and Drug Discovery (5/e), 1997, Vol. 1, 2, 3, 4, 5, Edited by Man Fred E. Wolff	Burger	John Wiley & Sons, inc., New York
Principles of Medicinal Chemistry, Vol. I & II (5/e),	S. S. Kadam, K. R. Mahadik, K. G., Bothra	Nirali Prakashan
Principles of Medicinal Chemistry	Lea and Febiyer	William O. Foye (ed.)
Organic Medicinal and Pharmaceutical Chemistry (5/e, 1982) (J. B. Lippincott Company, Philadelphia/Toppan Co. Ltd., Tokyo).	Wilson and Gisvold, Robert F. Doerge	Philadelphia.
Essential of Medicinal Chemistry (2/e)	Andrejus Korolkovas, John Wiley & Sons, Canada).	Wiley Interscience
Medicinal Chemistry	Ashutoshkar	Wiley Eastern Ltd., 1993
The Pharmaceutical Basis of Therapeutics	Goodman and Gilman	The Macmillan Co.
The Organic Chemistry of Drug Synthesis, Vol. I, II & III (1980),	Ed. By D. Lednicer and L. A. Mitscher	John Wiley and Sons, New York
Topics in Medicinal Chemistry, Vol. I & II	Rabinowitz and Myerson (Editor)	Interscience
Adhunik Sanshleshit Aushodhonu Rasayanvighyan,	Dr. Anamik Shah	University Granth Nirman Board
Medicinal Chemistry	D. Sriram and P. Yogeeswari, 1st edi.	Pearson Education

Handbook of pharmaceutical chemicals	Dr. A. R. Shenoy and Dr. V. R. Shenoy	Multitech Publishing Co.
Fundamentals of Medicinal Chemistry	G Thomas	Wiley Interscience

Course Evaluation:

Theory:

- The Continuous Evaluation consists of Maximum 40 marks and include internal exam, Seminar/class test /assignment submission and attendance & discipline.
- The Internal exam consists of 40 marks, which will be converted to 20 marks.
- The seminar/class test/assignment submission conducted will be of 10 marks. The duration of each test shall be one hour.
- The attendance and discipline contain 10 marks during semester.
- End Semester Examination will consist of 60 marks.

Course Name: Medicinal and Analytical Chemistry Practical

Course Code: SSCH8110

Prerequisite: Basic Knowledge of Inorganic & Organic Chemistry Practical-I

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)			Examination Scheme (Marks)			
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	8	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The course is designed to operate software and calculate protein binding value of some drugs. The students are able to take TLC during synthesis of compounds using name reaction, to interpret UV, IR, NMR and Mass Spectra of given drug and organic compounds. The students are able to test drugs with different test and drug delivery via hydrogel beads.

Course Contents:

Laboratory Course in Medicinal and Analytical Chemistry			
Module	**Content**	**Hours**	**Weightage (%)**
1	Study of Drug designing: Software based study	8	10
2	Identification of drugs by TLC	8	10
3	Name reaction Demo: Grignard, Wurtz, Cannizzaro, etc (8 ×3)	24	30
4	Spectroscopic analysis of drugs- UV-visible, IR, NMR and MS structure determination on the basis of data.	8	10
5	Determination of sulphate ash, loss on drying of drugs	8	10
6	Analysis of Caplet and Tablet: Hardness, Friability, % dissolution, disintegration	16	20
7	Drug delivery via hydrogel beads	8	10

Learning outcome:

CO-1: To study software-based drug design.
CO-2: To identify the drug by TLC.
CO-3: To explain the spectra interpretation of drugs.
CO-4: To determine the sulphated ash, loss of drying of drug.

Reference Books:

Title	Authors	Publications
Handbook of Organic Analysis: Qualitative & Quantitative	H Clark	Adward Arnold
Synthesis & characterization of Inorganic Compounds	W L Jolly	Prentice Hall
Vogel's Textbook of Practical Organic Chemistry	Vogel	Paperback

Pharmaceutical Analysis (Practical Book)	Dr. Suresh M. Jain, Dr. Vandana B. Patel	Nirali Prakashan

Course Evaluation:

Practicals:

- The Continuous Evaluation for practical exam consists of 40 marks and include performance of practical (15 marks), Written Practical (10 marks), Spotting (5 marks), Journal (5 marks) and internal viva.
- End Semester Practical Exam consists of 60 marks covers practical performance (25 marks), Written practical (15 marks), Spotting (5 marks), Journal (10 marks) and Internal viva (5 marks).

Sem-4

Considering that some students choose academics and research as their career while others prefer industrial jobs, the students shall get two options to meet their specific need – (i) **Plan A: Research-based curriculum**, and (ii) **Plan B: Industry-based curriculum**.

The program coordinator and placement officer shall conduct an orientation session in semester 3 so that the students can take informed decision to choose between the two options.

PLAN A: Research-based curriculum

Course Name: Dissertation

Course Codee: SSCH8020

Prerequisite: None

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	32	0	16	80	120	200

Objective(s) of the Course:

- To help students learn about the research in state-of-the-art research institutions. This will also provide the students an opportunity to practically use their Biotechnology-based skills in a typical research environment

Course Outline:

Content	Duration
The students shall carry out 4-months dissertation in an academic or research institution of national/international repute. They must prepare a thesis on a specific template provided by the School of Sciences. Upon completion of the dissertation, students are required to present their work before the expert committee. Students must submit four copies of their thesis to the department.	4 months

Course Name: Review Article Writing

Course Codee: SSCH8040

Prerequisite: None

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

Objective(s) of the Course:

- This course will help students learn about the scientific writing skills and also help them develop the ability to comprehend the complex scientific papers.

Course Outline:

Content	Duration
The students shall write a review article on any topic of their choice under the supervision of an allotted faculty mentor. The topic must be from the discipline of Chemical science. Review article must be communicated in UGC care, Scopus indexed, or NAAS rated journals only. During the semester examination, the students must (1) provide the proof-of-submission of their review article, along with a copy of communicated/published full-length article and (2) give an oral presentation on their review article.	4 months

Course Name: Research paper presentation

Course Codee: SSCH8060

Prerequisite: None

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

Objective(s) of the Course:

- This course will expose the students with recent developments in the field of Biotechnology. Research article presentation will not only improve their scientific presentation skills but also improve their ability to infer from complex scientific research papers

Course Outline:

Content	Duration
The students shall be given a recent research paper from journal of national or international repute with impact factor 3 or more by the allotted faculty. The students shall prepare a PowerPoint presentation on the same. In the semester examination, the students must give an oral presentation on their allotted research article before the external examiner. The presentation of review article shall not be considered. The presentation must discuss the hypothesis, objective(s), methods, results, and conclusion(s).	4 months

PLAN B: Industry-based curriculum

Course Name: Dissertation

Course Codee: SSCH8020

Prerequisite: None

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

Objective(s) of the Course:

- To help students learn about the application of Biotechnology in modern Biotech industries. This will also provide the students an opportunity to practically use their Biotechnology-based skills in a life-science industry.

Course Outline:

Content	Duration
The students shall carry out 4-months internship in an industry of national/international repute. They must prepare an internship report on a specific template provided by the School of Sciences. Upon completion of the dissertation, students are required to present their work before the expert committee. Students must submit four copies of their internship report to the department.	4 months

Course Name: Review Article Writing

Course Codee: SSCH8040

Prerequisite: None

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

Objective(s) of the Course:

- This course will help students learn about the scientific writing skills and also help them develop the ability to comprehend the complex scientific papers.

Course Outline:

Content	Duration
The students shall write a review article on any topic of their choice under the supervision of an allotted faculty mentor. The topic must be from the discipline of Chemical sciences. Review article must be communicated in UGC care, Scopus indexed, or NAAS rated journals only. During the semester examination, the students must (1) provide the proof-of-submission of their review article, along with a copy of communicated/published full-length article and (2) give an oral presentation on their review article.	4 months

Course Name: Research paper presentation

Course Codee: SSCH8060

Prerequisite: None

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
2	0	0	2	40	60	100

Objective(s) of the Course:

- This course will expose the students with recent developments in the field of Biotechnology. Research article presentation will not only improve their scientific presentation skills but also improve their ability to infer from complex scientific research papers

Course Outline:

Content	Duration
The students shall find a recent industry-centric applied technology article from journal of national or international repute with impact factor 3 or more by the allotted faculty. The students shall prepare a PowerPoint presentation on the same. In the semester examination, the students must give an oral presentation on their allotted research article before the external examiner. The presentation of review article shall not be considered. The presentation must discuss the hypothesis, objective(s), methods, results, and conclusion(s).	4 months