Master of Science Program outcomes (PO)

PO No.	Program Outcome Description
PO1	Advanced Subject Knowledge: Graduates will demonstrate advanced knowledge and expertise in their specialized field, including a comprehensive understanding of advanced concepts and theories.
PO2	Research Proficiency: Students will develop advanced research skills, including the ability to design and conduct independent research, analyze data, and draw meaningful conclusions.
PO3	Critical Analysis and Synthesis: Graduates will demonstrate advanced critical thinking abilities, the capacity to analyze complex scientific problems, synthesize information from diverse sources, and propose innovative solutions.
PO4	Scholarly Communication: Students will possess advanced skills in scientific writing, oral presentation, and effective communication of research findings to scientific and non-scientific audiences.
PO5	Independent Thinking: Graduates will exhibit independent thinking and creativity in problem-solving, research design, and the development of novel approaches in their field of specialization.
PO6	Leadership and Collaboration: Students will develop leadership skills and the ability to collaborate effectively with diverse teams, providing guidance and fostering a collaborative research environment.
PO7	Advanced Technology and Techniques: Graduates will be proficient in utilizing advanced technology, tools, and techniques specific to their discipline to enhance research and analysis capabilities.
PO8	Ethical Research Practices: Students will adhere to high ethical standards in research, ensuring the responsible conduct of research, integrity, and respect for intellectual property rights.
PO9	Continuous Learning and Adaptability: Graduates will demonstrate a commitment to continuous learning, keeping pace with emerging trends and technologies, and adapting to new challenges in their field.
PO10	Contribution to the Field: Students will make significant contributions to their specialized field, actively participating in conferences, publishing research, and advancing scientific knowledge through their research work.

Master of Science Program specific outcomes (PSO)

M.Sc. Chemistry:

PSO No.	Program Specific Outcome Description
PSO1	Advanced Chemical Knowledge and Applications: Graduates of the M.Sc. Chemistry program will acquire advanced knowledge and expertise in the principles and theories of chemistry. They will apply this knowledge to solve complex chemical problems, conduct independent research, and contribute to advancements in chemical science.
PSO2	Advanced Laboratory Skills and Instrumentation: Graduates will possess advanced laboratory skills, including sophisticated instrumentation techniques and data analysis methods. They will demonstrate proficiency in designing and conducting experiments, synthesizing new compounds, and characterizing chemical structures.

M.Sc. Sem - I									
Sr No.	Course Type	Course Code	Corse Name	Lecture (hrs.)	Practical (hrs.)	Credits	Examination		Total Marks
							Internal	External	
1	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE101UDSC	Inorganic Chemistry	4	0	4	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE102UDSC	Organic Chemistry	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE103UDSC	Physical Chemistry	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC	MCHE104UDSC	Analytical Chemistry	4	0	4	30	70	100

	COURSE (DSC)								
5	PRACTICAL COURSE (PRA)	MCHE101UPRA	Chemistry Practical	0	6	6	50	150	200
6	SUBJECT ELECTIVE	MCHE101USE	Spectroscopy and Diffraction method/ Photoinorganic Chemistry	2	0	2	15	35	50
TOTAL				**18**	**6**	**24**	**185**	**465**	**650**

M.Sc. Sem - II									
Sr No.	**Course Type**	**Course Code**	**Corse Name**	**Lecture (hrs.)**	**Practical (hrs.)**	**Credits**	**Examination**		**Total Marks**
							Internal	**External**	
1	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE201UDSC	Inorganic Chemistry	4	0	4	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE202UDSC	Organic Chemistry	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE203UDSC	Physical Chemistry	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE204UDSC	Analytical Chemistry	4	0	4	30	70	100
5	PRACTICAL COURSE (PRA)	MCHE201UPRA	Chemistry Practical	0	6	6	50	150	200

6	SUBJECT ELECTIVE	MCHE201USE	Biology for Chemist/ Computational Chemistry	2	0	2	15	35	50
TOTAL				**18**	**6**	**24**	**185**	**465**	**650**

M.Sc. Sem - III									
Sr No.	**Course Type**	**Course Code**	**Corse Name**	**Lecture (hrs.)**	**Practical (hrs.)**	**Credits**	**Examination**		**Total Marks**
							Internal	**External**	
1	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE301UDSC	Natural Products	4	0	4	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE302UDSC	Medicinal Chemistry-I	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE303UDSC	Industrial Chemistry-I	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE304UDSC	Advanced Organic Chemistry-I	4	0	4	30	70	100
5	PRACTICAL COURSE (PRA)	MCHE301UPRA	Chemistry Practical	0	6	6	50	150	200
6	SUBJECT ELECTIVE	MCHE301USE	Environmental Chemistry/ Research Methodology	2	0	2	15	35	50
TOTAL				**18**	**6**	**24**	**185**	**465**	**650**

M.Sc. Sem - IV									
Sr No.	**Course Type**	**Course Code**	**Corse Name**	**Lecture (hrs.)**	**Practical (hrs.)**	**Credits**	**Examination**		**Total Marks**
							Internal	**External**	
1	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE401UDSC	Heterocyclic Chemistry and Organic Reaction Mechanism	4	0	4	30	70	100
2	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE402UDSC	Medicinal Chemistry-II	4	0	4	30	70	100
3	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE403UDSC	Industrial Chemistry-II	4	0	4	30	70	100
4	DISCIPLINE SPECIFIC COURSE (DSC)	MCHE404UDSC	Advanced Organic Chemistry-II	4	0	4	30	70	100
5	PRACTICAL COURSE (PRA)	MCHE401UPRA	Chemistry Practical	0	6	6	50	150	200
6	SUBJECT ELECTIVE	MCHE401USE	Organometallic Compounds/ Nano Chemistry	2	0	2	15	35	50
TOTAL				**18**	**6**	**24**	**185**	**465**	**650**

M.SC. SEM-I

SUBJECT CODE: MCHE101UDSC
SUBJECT NAME: INORGANIC CHEMISTRY

Course Objective:

- To develop the ability to correlate the chemical and physical properties of elements and their compounds with their positions in the periodic table.
- To acquire expertise in chemistry laboratory in handling of reagents and solvents as well as in analytical techniques.
- To establish the link between theory and laboratory practice by conducting laboratory experiments.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can seek employment in areas of Metallurgy Firms, Hospitals, Educational Institutes etc. as Junior Scientist, Assistant Professor, Content Developer, Process Engineer, Site Engineer, and Researcher etc.
CO2	This course opens a wide range of job opportunities such as in research, development, or production in the chemical process industries or to undertake research or teaching certificates.
CO3	Candidates also hold the opportunity to explore the industrial, pharmaceutical, technological and commercial fields of chemistry as the course basically concentrates on the uses of chemistry in modern society.
CO4	The employment areas of Inorganic Chemistry include Chemicals Manufacturing Companies, Industrial Laboratories, Medical Research, Oil Industry etc.

Unit	Content	Credit	Weightage
I	**Stereochemistry and bonding in main group compounds**	1	25 %
	VSEPR, Walsh diagrams (tri and penta - atomic molecules), dπ-pπ bonds, Bent rule and energetic of hybridization, some simple reactions of covalently bonded molecules.		
II	**Electronic spectra and magnetic properties of transition Metal complexes**	1	25 %
	Spectroscopic ground state, correlation, Tanabe sugano diagram for transition metal complexes(d1-d9) state, calculation of Dq, B and β parameters, charge transfer spectra, spectroscopic assignment of absolute configuration in optically active metal chelates and their spectrochemical information, anomalous		

	magnetic moment, magnetic exchange coupling and spin cross over.		
III	**Symmetry of Molecules**	1	25 %
	Symmetry elements & symmetry operations, multiplications of symmetry operations, multiplication table for C2v, C3v, $C2h$ point groups only, Classifications of schoonflies point groups, Determination of schoonflies point groups notations, Symmetry & optical activity, Symmetry property of orbital's for C2v, C3v, $C2h$ point groups.		
IV	**Group theory and its application**	1	25 %
	Symmetry elements and symmetry operation, definition of group, subgroup, relation between orders of a finite group and its sub groups, Conjugacy relation and classes, point symmetry group, schoonflies symbols, representation of group by matrices, (representation for the Cn, Cnv, Cnh, Dnh etc. group to be workout explicitly Character of a representation, The great orthogonality theorem and its importance, character table and their uses.		

Reference Books :

- Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
- Inorganic Chemistry, J.E. Huhee, Harpes & Row.
- Magneto chemistry, FI.L. Carlin, Springer Verlag.
- Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
- Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
- Comprehensive Coordination Chemistry eds., G. Wilkinson, FLD. Gillars and J.A McCleverty, Pergamon.

Suggested Readings:

- Concise Inorganic Chemistry, J. D. Lee
- Principles of Inorganic Chemistry, Puri, Sharma & Kalia
- Symmetry and Group Theory in Chemistry, H. S. Randhawa and S. K. Dogra

Online Resources:

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
- https://nptel.ac.in/courses

Lab Experiments:

Inorganic Qualitative Analysis: (Any Five)

- Less common metal ions — TI, Mo, W, Ti, Zr, Th, V, U (two metal ions in cationic/anionic forms)
- Insoluble - oxides, sulphates and halides

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**2**	**-**	**-**	**-**	**2**	**-**	**1**	**-**	**2**	**2**
CO2	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**1**
CO3	**3**	**3**	**1**	**-**	**-**	**1**	**2**	**1**	**-**	**1**	**2**	**1**
CO4	**3**	**3**	**3**	**-**	**-**	**2**	**2**	**1**	**-**	**1**	**2**	**1**

SUBJECT CODE: MCHE102UDSC
SUBJECT NAME: ORGANIC CHEMISTRY

Course Objective:
This course aims to impart to the student, knowledge of

- Basic concepts of bonding, structures, resonance, aromaticity, hyperconjugation and tautomerism in organic molecules.
- Generation, structure, stability and reactivity of reactive intermediates.
- Classification of reactions with mechanism, determining reaction mechanism using suitable methods.
- Stereochemistry of organic compounds, isomerism, different projection formulae with nomenclature and prochirality.
- Conformation and stability of substituted cyclic systems, nomenclature and conformations of fused rings and bridged ring systems
- Synthetic molecular receptors, their significance and functions.

Course Outcomes: At the end of the course, students shall be able to

CO1	Apply the concepts of bonding, resonance, aromaticity, hyperconjugation and tautomerism to higher organic compounds.
CO2	Predict the products, identify reaction intermediates and propose suitable mechanism for organic reactions
CO3	Identify stereo genic centers, recognize enantiomers, diastereomers, meso compounds, draw stereochemical structures, and provide R/S designations of stereocenters
CO4	Draw stable conformations for substituted cyclic compounds, fused and bridged rings.

Unit	Content	Hrs.	Weightage
1	**Reaction Mechanism: Structure and Reactivity**		
	Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle, Potential energy diagrams, transition states and intermediates, methodsof determining mechanisms, isotope effects. Hard and soft acids and bases, Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes, Effect of structure on reactivity - resonance and field effects, steric effect, quantitative treatment, the Hammett equation and linear free energy relationship, substituent and reaction constants, Taft equation.	**15**	**25 %**
2	**Nature of Bonding in Organic Molecules**		
	Delocalized chemical bonding: Conjugation, Cross conjugation, resonance, hyper conjugation, bonding in fullerenes, tautomerism, Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons,Huckel's rule, energy level of pi-molecular orbitals, annulenes, anti-aromaticity, homo-aromaticity, PMO approach, Bonds weaker than covalent- addition compounds, crown ether complexes and cryptands, inclusion compounds, cyclodextrins, catenanes and rotaxanes.	**15**	**25 %**
3	**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, stereo specific and stereo selective 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 %**

4	**Aliphatic Nucleophilic Substitution**	**15**	**25 %**
	The SN2, SN1, mixed SN1 and SN2 and SET mechanisms, the neighbouring group mechanism, neighbouring group participation by Pi and sigma bonds, anchimeric assistance, Classical and non- classical carbocations, phenonium ions, norbornyl system, common carbocations rearrangements, Application of NMR spectroscopy in the detection of carbocations, the SNi mechanism, Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon, Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity.		

Reference Books:

- Advanced Organic Chemistry, F. A. Carey and R. J. Sandburg, Plenum.
- A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
- Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
- Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
- Modern Organic Reactions, H. O. House, Benjamin.
- Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
- Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.
- Reaction Mechanism in Organic Chemistry, S. M. Mukherjee and S. P. Singh, Macmillan.
- Pericyclic Reactions, S. M. Mukherjee, Macmillan, India.

Suggested Readings:

- Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
- Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press.
- Principles of Organic Synthesis, R. O. C. Norman and J. M. Coxon, Blackie Academic & Professional.

Online Resources:

- https://study.com/academy/lesson/types-of-reaction-mechanisms-in-organic-chemistry.html
  https://courses.lumenlearning.com/wm-biology1/chapter/reading-types-of-carbohydrates/
- http://mpbou.edu.in/slm/mscche1p2.pdf
- https://www.khanacademy.org/science/organic-chemistry/stereochemistry-topic
- https://chem.libretexts.org/Bookshelves/General_Chemistry/

Lab Experiments:

Organic Preparation: (Any Five)

- Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography
- Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol
- Grignard reaction: Synthesis of triphenylmethanol from benzoic acid
- Aldol condensation: Dibenzal acetone from benzaldehyde
- Sandmeyer reaction: p-Chlorotoluene from p-toluidine
- Acetoacetic ester Condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation.
- Cannizzaro reaction: 4—Chlorobenzaldehyde as substrate
- Friedel Crafts Reaction: B-Benzoyl propionic acid from succinic anhydride and benzene
- Aromatic Electrophilic Substitutions: Synthesis of p-nitroaniline and p-bromoaniline

Quantitative Analysis: (Any two)

- Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method
- Estimation of amines/phenols using bromate bromide solution/or acetylation method
- Determination of Iodine and Saponification values of an oil sample.
- Determination of COD of water sample

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**
CO2	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**2**	**2**
CO3	**3**	**2**	**2**	**-**	**1**	**1**	**1**	**-**	**-**	**1**	**2**	**2**
CO4	**3**	**2**	**2**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**

SUBJECT CODE: MCHE103UDSC
SUBJECT NAME: PHYSICAL CHEMISTRY

Course Objective:

- An advanced knowledge about the electronic structure of atoms and molecular orbital theory.

- An in-depth study of the solid-state chemistry.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can be introduced about the Huckel theory of conjugated systems.
CO2	Learn the calculation of scotty and Frenkel defects using statistical method.
CO3	Understand the Nernst heat theorem and its applications to gaseous system.
CO4	Study the fast reactions by flow method, relaxation method, flash photolysis and nuclear magnetic resonance method.

Unit	Content	Hrs.	Weightage
1	**Electronic Structure of Atoms and Molecular Orbital Theory**	**15**	**25%**
	Electronic configuration, Russell-Saunders terms and coupling schemes, Slater-Condon parameters, term separation energies of the pn configuration, term separation energies for the dn configurations, magnetic effects, spin-orbit coupling, Huckel theory of conjugated systems, Applications to butadiene. Introduction to extended Huckel theory.		
2	**Solid State Chemistry**	**15**	**25%**
	Bonding in solids and electronic structure in solids, bond theory-metals, semiconductors and insulators, defects in crystals, calculation of scottky and Frenkel defects using statistical method, non Stoichiometry, solid electrolytes, diffusion in solids, electrical conductivity in solids, super conductivity, perovskites.		
3	**Chemical thermodynamics**	**15**	**25%**

Reference Books :

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R. McWeeny, ELBS.
5. Chemical Kinetics, K. J. Laidler, McGraw-Hill.
6. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.

	Nernst heat theorem and its applications to gaseous system, third law of thermodynamics and its applications to evaluate absolute entropies of solids, liquids and gases; partial molar quantities and their determination, Gibbs-Duhem equation, chemical potential, chemical potential of idea gases and solutions, Raoult's law, real solutions, free energy, methods of determination of activity and activity co-efficient, fugacity of gases and liquids and methods of its determination, Non equilibrium thermodynamics-basic concepts.		
4	Dynamic Chain (pyrolysis of acetaldehyde, 25% decomposition of ethane), photochemical (hydrogen-chlorine reactions) and oscillatory reactions, homogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and nuclear magnetic resonance method, Dynamics of barrier less chemical reactions in solution, Dynamics of Unimolecular reactions. (Lindemann and Hinshelwood theories of unimolecular reactions.)	**15**	**25%**

Suggested Readings:

1. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenun.
2. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N. Fteddy, Plenum.
3. Introduction to Polymer Science, V.F. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.

Online Resources:

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
2. https://nptel.ac.in/courses

Lab Experiments:

Physical Chemistry

Students are required to perform at least 06 experiments

[A] Adsorption and phase Equilibria (Minimum 01)

1. To study surface tension- concentration relationship for solutions (Gibbs equation).
2. To construct the phase diagram for three component system (e.g. chloroform-acetic acid-water)

[B] Partition coefficient (Minimum 01)

1. To determine equilibrium constant of the reaction $KI+I_2 \rightarrow KI_3$ by distribution method.
2. To determine the formula of the complex formed between the cupric ion and ammonia by distribution method.

[C] Chemical Kinetics (Minimum 01)

1. Determine the temperature coefficient and energy of activation of the reaction between $HBrO_3$ and HI.
2. Flowing clock reactions (Ref: Experiments in Physical Chemistry by Show maker)
3. Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion)
4. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.

[D] Conductometry (Minimum 01)

1. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
2. To determine the amount of acetic acid and hydrochloric acid in given mixture of HAC + HCI conductometrically.
3. To study the effect of solvent on the conductance of $AgNO_3$/acetic acid and to determine the degree of dissociation and equilibrium constant in different solvents and in their mixtures (DMSO, DMF, dioxane, acetone, water) and to test the validity of Debye-Huckel- Onsager theory.
4. Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye Huckel's limiting law.

[E] Potentiometry/pH metry (Minimum 01)

1. Determination of the concentration of NaOH and NH_4OH in the given mixture using 0.1N HCI / conductometrically.
2. Determination of the dissociation constant of monobasic/ dibasic acid by Albert-Sergeant method.
3. Determination of the valence of mercurous ions potentiometrically.
4. Determination of activity and activity coefficient of electrolytes.
5. Determination of the dissociation constant of acetic acid in DMSO /DMF /acetone or dioxane by titrating it with KOH.
6. Determine of thermodynamic constants, ^G, ^S and ^H for the reaction by e.m.f. method. $Zn+H_2SO_4 \rightarrow ZnSO_4 + 2H^+$

[F] Polarimetry (Minimum 01)

1. Determination of rate constant for hydrolysis / inversion of sugar using a Polarimeter.
2. Enzyme kinetics — inversion of sucrose.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**1**	**1**	**1**	**2**	**2**
CO2	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**1**	**1**	**-**	**2**	**2**
CO3	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**1**	**-**	**-**	**2**	**2**
CO4	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**1**	**-**	**-**	**2**	**2**

SUBJECT CODE: MCHE104UDSC
SUBJECT NAME: ANALYTICAL CHEMISTRY

Course Objective:

This course aims to impart to the student, knowledge of

- Errors, statistical treatment of analytical data and use of various computational tools on interpreting experimental data
- Principles, terminologies, types and applications of chromatography.
- Optical and thermal methods of chemical analysis; principle, instrumentation and applications.
- Various concepts of volumetric analysis - equivalence point, theory of indicators, use of chemical equations and equilibrium constants to illustrate the chemical changes that occur during the titration.

Course Outcomes: At the end of the course, students shall be able to

CO1	Organize, analyze and interpret data using the tools learned in an ethically responsible approach and present it systematically.
CO2	Describe and adopt suitable separation techniques.
CO3	Interpret data obtained from optical and thermal methods of chemical analysis.

Unit	Content	Hrs.	Weightage
	Analytical Objectives Data Handling and Good Laboratory Practice (GLP)		

1	Scope of analytical science and its literature, qualitative and quantitative analysis, ways to express accuracy and precision, types of errors and their causes; significant figures, control charts, confidence limit, test of Platinum II complexes, the trans effect, theories of trans effect, significance, rejection of a result- the Q-test. GLP- standard operating procedures, quality assurance and quality control, validation of analytical methods.	**12**	**25%**
2	**Sampling and Calibration Methods** Sampling and sample preparation, general steps in chemical analysis, calibration of glass wares, Finding the best straight line-least square regression, correlation co-efficient, calibration curves, standard addition technique and internal standards, chemical concentrations.	**11**	**25%**
3	**Volumetric Method of Analysis** Primary and Secondary standards, Principles of volumetric analysis, Acid-base titration, Titration in non-aqueous solvents, Complex metric titrations, Precipitation titrations (Mohr's titration, Volhard's titration, adsorption indicators, Fajan's titration), Redox titrations, Theoretical aspects of titration curves and end point evaluation, Choice and suitability of indicator in each case.	**10**	**25%**
4	**Sample Preparation Techniques** Liquid-liquid extraction/solvent extraction-partition co-efficient, Distribution ratio and percent extraction, solvent extraction of metal ions-ion association complexes and metal chelates, multiple batch extraction, Craig's counter-current distribution, accelerated and microwave assisted extraction, protein precipitation and solid phase extraction (SPE).	**12**	**25%**

Reference Books:

- Modern Spectroscopy, J. M. Hollas, John Wiley.
- Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and FL. Ho, Wiley Interscience.
- NMR, NOR, EPB And Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish.
- Physical' Methods in Chemistry, FLS Drago, Saunders College.
- Chemical Applications of Group theory, F. A. Cotton.

- Skoog and West's Fundamentals of Analytical Chemistry, 9th Ed., Holler and Crouch; Cengage Learning, (2014).
- Analytical Chemistry, G.D. Christian, 5th edition, John-Wiley and Sons Inc.,(1946).
- Instrumental Analysis, Skoog, Holler & Crouch, Cengage Learning, (2007).
- Instrumental methods of Chemical Analysis, H.H. Willard, L.L. Merrit, J.A. Dean and F.A. Set, CBS Publishers (1996).
- Quantitative Chemical Analysis, Daniel C. Harris, 8th Ed., W H Freeman & Co. (2010).

Suggested Readings:

- Unified Separation Science, J. Calvin Giddings, Wiley-Blackwell, (1991).
- Instrumental methods of Chemical Analysis, G.W. Ewing, 5th Ed., McGraw-Hill, New York, (1988).
- Vogel's text book of quantitative chemical analysis, 6th Ed., Jaffrey et.al ELBS/Longman, (1989).
- Modern Methods of Chemical Analysis- Pecsok, Shields, Cairns and Mc Williams, 2 nd Ed., John Wiley and sons (1976).
- Vogel's Textbook of Quantitative Inorganic Analysis, Bassett, Denney, Jeffery and Mendham, 4th Ed., ELBS (1989).

Online Resources:

- https://proto.ufsc.br/files/2012/03/glp_trainee_green.pdfhttp://mpbou.edu.in/slm/mscche1p2. pdf
- https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Analytical_Sciences_Digital_Library/Active_Learning/Shorter_Activities/Calibration_Methods_(Harris)
- https://www.diva-portal.org/smash/get/diva2:5262/fulltext01.pdf

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**2**
CO2	**3**	**3**	**2**	**-**	**1**	**1**	**2**	**1**	**-**	**-**	**2**	**2**
CO3	**3**	**3**	**2**	**-**	**1**	**1**	**2**	**1**	**-**	**-**	**2**	**2**

SUBJECT CODE: MCHE101USE
SUBJECT NAME: SPECTROSCOPY & DIFFRACTION METHOD

Course Objective:

- Principles, terminologies, types and applications of chromatography.
- To acquire expertise in chemistry laboratory in handling of reagents and solvents as well as in analytical techniques.

- To establish the link between theory and laboratory practice by conducting laboratory experiments.

Course Outcomes: At the end of the course, students shall be able to

CO1	This course opens a wide range of job opportunities such as in research, development, or production in the chemical process industries or to undertake research or teaching certificates.
CO2	Candidates also hold the opportunity to explore the industrial, pharmaceutical, technological and commercial fields of chemistry as the course basically concentrates on the uses of chemistry in modern society.

Unit	Content	Hrs.	Weightage
1.	**Unifying Principles** Electromagnetic radiation, interaction of electromagnetic radiation with matter – absorption, emission, transmission, reflection, dispersion, polarization and scattering, Uncertainty relation and natural line width and natural line broadening, Transition probability, results of the time dependent perturbation theory, transition moment, selection rules, intensity of spectral lines, Born-Oppenheimer approximation, rotational, vibrational and electric energy levels.	**15**	**50%**
2.	**X-ray Diffraction** Bragg Condition, Miller indices, Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals, index reflections, Identification of unit cells from systematic absences in diffraction pattern, Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem, Description of the procedure for an X-ray structure analysis, absolute configuration of molecules, Ramchandran diagram.	**15**	**50%**

Reference Books :

1. Inorganic Chemistry, J.E. Huhee, Harpes & Row.
2. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.

Online Resources:

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
2. https://nptel.ac.in/courses

CO-PO & CO-PSO Mapping

Course Outcomes	**Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**1**	**1**	**-**	**1**	**1**	**1**	**1**	**-**	**1**	**2**	**2**
CO2	**3**	**1**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**1**	**2**	**2**

M.SC. SEM-II

SUBJECT CODE: MCHE201UDSC
SUBJECT NAME: INORGANIC CHEMISTRY

Course Objective:

- To develop the ability to correlate the chemical and physical properties of elements and their compounds with their positions in the periodic table.
- To establish the link between theory and laboratory practice by conducting laboratory experiments.
- To acquire expertise in chemistry laboratory in handling of reagents and solvents as well as in analytical techniques.

Course Outcomes: At the end of the course, students shall be able to

CO1	To give the students a thorough knowledge of the different theories to explain the bonding in coordination compounds.
CO2	To improve the level of understanding of the chemistry of organometallic compounds, metal carbonyls and metal clusters.
CO3	To give knowledge about some bioinorganic compounds and compounds of various block elements.

Unit	Content	Hrs.	Weightage
1	**Metal-Ligand Equilibrium solution** Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π-bonding and molecular orbital theory. 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 metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.	**12**	**30%**
2	**Reaction Mechanism of Transition Metal Complexes**	**12**	**30%**

	Energy profile of a reaction, reactivity of a metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetic of octahedral substitution, acid hydrolysis, factor affecting the acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favor of conjugated mechanism, anation reaction, reaction without metal ligand bond cleavage. Substitution reaction in square planar complexes, the trans effect. Mechanism of the substitution reaction, redox reaction, electron transfer reaction, mechanism of one electron transfer reaction, outer sphere type reaction, cross reaction and Marcus –Hush theory, inner sphere type reaction.		
3	**Mossbauer Spectroscopy** Basic applications of Mossbauer spectroscopy, hyperfine structure, quadruple splitting, instrumentation and applications of Mossbauer spectroscopy, problems related to Mossbauer spectra.	**10**	**20%**
4	**Bio-inorganic Chemistry** Metalloporphyrins (enzymes) definition, hemoglobin and myoglobin, cytochrome, vitamin B12 (cyanocobalamin), zincmetalloenzymes, nitrogen fixation, essential and trace elements in biological system, biochemistry of non-metals K, Na pump (action of bath ions), toxic metals and their toxicity. Co-ordination compounds in medicine.	**11**	**20%**

Reference Books:

- Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
- Inorganic Chemistry, J.E. Huhey, Harpes &Row.
- Magnetochemistry, FI.L. Carlin, Springer Verlag.
- Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
- Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
- Comprehensive Coordination Chemistry eds., G. Wilkinson, FLD. Gillars and J.A McCleverty, Pergamon.

Online Resources:

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
2. https://nptel.ac.in/courses

Lab Experiments:
Inorganic Chemistry
[A] Quantitative Analysis (Minimum 02)

A separation and Determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. involving Volumetric and gravimetric methods.

[B] Qualitative Analysis (A mixture containing total Eight radicals) (Minimum 04)

1. Less common metal ions – Ti, Mo, W, Ti, Zr, Th, V, U (two metal ions in cationic/ anionic form) Insoluble – Oxides, Sulphates and halides.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**-**	**1**	**2**	**2**	**2**
CO2	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**2**	**2**	**2**
CO3	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**2**	**2**	**2**

SUBJECT CODE: MCHE202UDSC
SUBJECT NAME: ORGANIC CHEMISTRY

Course Objective:

This course aims to impart to the student, knowledge of

- Stereochemistry of organic compounds, isomerism, different projection formulae with nomenclature and prochirality.
- Synthetic molecular receptors, their significance and functions.
- Conformation and stability of substituted cyclic systems, nomenclature and conformations of fused rings and bridged ring systems

Course Outcomes: At the end of the course, students shall be able to

CO1	To impart the student's thorough knowledge about the mechanisms of reactions of some selected functional groups in organic compounds and also to give an outline of applied organic chemistry and the applications of organic chemistry in various spheres of chemical sciences.
CO2	To give an elementary idea of chemotherapy, organic compounds like carbohydrates, dyes and heterocyclic compounds.
CO3	To study the fundamentals of terpenoids, alkaloids, vitamins, lipids and steroids.

Unit	Content	Hrs.	Weightage
1	**(A) Aromatic Electrophillic Substitution** The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrate and electrophiles. Diazonium coupling, Vilsmeir reaction, Gattermann- koch reaction. **(B) Aromatic Nucleophilic Substitution** The SNAr, SN^1, benzyne and SRN1 mechanism. Reactivity- effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser and Smiles rearrangement.	12	25%
2	**Reagents in Organic Synthesis [Oxidation]** CrO_3, MnO_2, $KMnO_4$, SeO_2,$Pb(OAc)_4$, OsO_4, HIO_4, DMSO, H_2O_2, CH_3COOAg (Dry & wet),RCOOOH, Ozone, HgO, NBS, $K_3Fe(CN)_6$, DDQ, $Al(O\text{-}t\text{-}Bu)_3$; Some Miscellaneous Reagents in Organic Synthesis : LDA, Sharp less epoxidation, Wilkinson catalyst, Grignard Reagent and Gilman reagent.	12	25%
3	**Reagents in Organic Synthesis [Reduction]** $Al(O\text{-}iPr)_3$, Zn/HCl, N_2H_4/OH, $NaBH_4$, $LiAlH_4$, Complex Hydrides, Na/NH_3, Cat.H_2 ,TBTH. Introduction to Green Chemistry, Basic Principles of Green Chemistry, Importance of PTC, ILs, microwave and ultrasonication in green synthesis.	10	25%
4.	**Pericyclic Reaction** Molecular orbital symmetry, Frontier orbital of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of Pericyclic reactions. Woodwards-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems Cyclo addition antrafacial and suprafacial addition, 4n, 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cyclo additions and cheleotropic reactions. Sigmatropic rearrangement – suprafacial and antrafacial shifts of H sigmatropic shifts involving carbon impieties, 3, 3 and 5,5- sigmatropic rearrangements. Claisen, cope and azacope rearrangement. Fluxional tautomerism, Ene reaction.	11	25%

Reference Books:

- Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
- Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum
- A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman
- Structure and Mechanism in Organic Chemistry, C. K. Ingold, Cornell University Press
- Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.

Suggested Books :

- Modern Organic Reactions, H. O. House, Benjamin.
- Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
- Stereochemistry of Organic Compounds, P.S. Kalsi, New Age International.
- Reaction Mechanism in Organic Chemistry, S. M. Mukherji and S. P. Singh, Macmillan.
- Principles of Organic Synthesis, R. O. C. Norman and J. M. Coxon, Blackie Academic & Professional.
- Pericyclic Reactions, S. M. Mukherji, Macmillan, India.

Online Resources:

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
2. https://nptel.ac.in/courses

Lab Experiments:

Organic Chemistry

[A] Qualitative Analysis (Minimum 03)

Analysis of an organic mixture containing three components (Solid mixed with liquid) using water, $NaHCO_3$, NaOH, HCl for Separation /or using distillation process for separation and identification with the Preparation of Suitable derivatives.

[B] Organic Preparation (Minimum 03)

1. Sandmeyer reaction: p-Chlorotoluene from p-toluidine.
2. Acetoacetic ester Condensation: Synthesis of ethyl-n-butylaceto acetate by A.E.E. condensation.
3. Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate
4. Friedel Crafts Reaction: β-Benzoyl propionic acid from succinic anhydride and benzene.
5. Aromatic electrophilic substitutions: Synthesis of p-nitro aniline and p-bromoaniline.

CO-PO & CO-PSO Mapping

Course Outcomes	**Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**2**	**2**	**2**
CO2	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**2**	**2**	**2**
CO3	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**2**	**2**	**2**

SUBJECT CODE: MCHE203UDSC
SUBJECT NAME: PHYSICAL CHEMISTRY

Course Objective:

1. An advanced knowledge about the statistical thermodynamics.
2. An in-depth study of the determination of dissociation constant of mono basic acids by conductometry and potentiometry method.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can be introduced about the Electrochemistry.
CO2	Learn the molecular mass determinations (osmometry, viscometry, diffusion and light scattering methods).
CO3	Understand the Concepts of distribution of molecules.
CO4	Study about the Principle of polarography.

Unit	Content	Hrs.	Weightage
1	**Statistical Thermodynamics**	**15**	**25%**
	Concepts of distribution of molecules, thermodynamic probability, permutations and combinations, Boltzmann's most probable distribution, partition function - translational, vibrational, rotational, electronic nuclear partition functions.		
2	**Electrochemistry**	**15**	**25%**
	Debye-Hackle Theory (Mathematical Derivation), Thermodynamics of electrified interfaces Lipmann's Equation, Determination of dissociation constant of mono basic acids by conductometry and potentiometry, Gouy-Chapman Theory, Polarization and Overvoltage, Bulter-Volmer equation, Principle of polarography, Equation of polarographic wave, Ilkovic equation.		
3	**Surface Chemistry**	**15**	**25%**

	Adsorption Surface tension, capillary action, pressure deference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), and surface films on liquids. Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMS), factors affecting the CMC of surfactants, counter ion binding to micelles.		
4	**Macromolecules**	**15**	**25%**
	Polymer – definition, types of polymers, electrically conductiong, fire resistant, liquid crystal polymers, kinetics of free radical chain polymerization, mechanism of polymerization. Molecular mass, number and mass average molecular mass, molecular mass determinations (osmometry, viscometry, diffusion and light scattering methods), size of macromolecules.		

Reference Books :

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R. McWeeny, ELBS.
5. Chemical Kinetics, K. J. Laidler, McGraw-Hill.
6. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.

Suggested Readings:

1. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenun.
2. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N. Fteddy, Plenum.
3. Introduction to Polymer Science, V.F. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.

Online Resources:

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
2. https://nptel.ac.in/courses

Lab Experiments:

Physical Chemistry

Students are required to perform at least 05 experiments

[A] Adsorption and phase equilibria (Minimum 01)

1. To study surface tension- concentration relationship for solutions (Gibbs equation).
2. To construct the phase diagram for three component system (e.g. chloroform-acetic acid-water)

[B] Partition coefficient (Minimum 01)

3. To determine equilibrium constant of the reaction $KI+I_2 \rightarrow KI_3$ by distribution method.
4. To determine the formula of the complex formed between the cupric ion and ammonia by distribution method.

[C] Chemical Kinetics (Minimum 01)

5. Determine the temperature coefficient and energy of activation of the reaction between $HBrO_3$ and HI.
6. Flowing clock reactions (Ref: Experiments in Physical Chemistry by Show maker)
7. Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion)
8. Determination of the rate constant for the oxidation of iodide ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.

[D] Conductometry (Minimum 01)

9. Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.
10. To determine the amount of acetic acid and hydrochloric acid in given mixture of HAC + HCI conductometrically.
11. To study the effect of solvent on the conductance of $AgNO_3$/acetic acid and to determine the degree of dissociation and equilibrium constant in different solvents and in their mixtures (DMSO, DMF, dioxane, acetone, water) and to test the validity of Debye-Huckel- Onsager theory.
12. Determination of the activity coefficient of zinc ions in the solution of 0.002 M zinc sulphate using Debye Huckel's limiting law.

[E] Potentiometry/pH metry (Minimum 01)

13. Determination of the concentration of NaOH and NH_4OH in the given mixture using 0.1N HCI / conductometrically.
14. Determination of the dissociation constant of monobasic/ dibasic acid by Albert-Sergeant method.
15. Determination of the valence of mercurous ions potentiometrically.
16. Determination of activity and activity coefficient of electrolytes.
17. Determination of the dissociation constant of acetic acid in DMSO /DMF /acetone or dioxane by titrating it with KOH.
18. Determine of thermodynamic constants, ^G, ^S and ^H for the reaction by e.m.f. method. $Zn+H_2SO_4 \rightarrow ZnSO_4 + 2H^+$

[F] Polarimetry (Minimum 01)

19. Determination of rate constant for hydrolysis / inversion of sugar using a Polarimeter.
20. Enzyme kinetics — inversion of sucrose.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**1**	**1**	**2**	**2**	**2**
CO2	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**2**	**2**	**2**
CO3	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**2**	**2**	**2**
CO4	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**2**	**2**	**2**

SUBJECT CODE: MCHE204UDSC
SUBJECT NAME: ANALYTICAL CHEMISTRY

Course Objective:

This course aims to impart to the student, knowledge of

- Optical and thermal methods of chemical analysis; principle, instrumentation and applications.
- Various concepts of volumetric analysis - equivalence point, theory of indicators, use of chemical equations and equilibrium constants to illustrate the chemical changes that occur during the titration.

Course Outcomes: At the end of the course, students shall be able to

CO1	To impart students a broad outline of the methodology of science in general and Chemistry in particular.
CO2	The students will learn the important analytical and instrumental tools used for practicing chemistry.
CO3	To develop skills required for the qualitative analysis of organic compounds, determination of physical constants.

Unit	Content	Hrs.	Weightage
1	**Fundamentals of Spectrophotometry and UV-Visible Spectroscopy**	12	25%
	Various electronic transition(185-800nm),Beer-lambert law effect of solvent on electronic transition, Ultraviolet bands of carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Fiesher- Woodwords rule for conjugated dienes and carbonyl compounds, UV spectra of aromatic and heterocyclic compounds, Steric effects in biphenyls.		
	Numerical		
2	**Infrared Spectroscopy**	11	25%
	Instrumentation and sampling, Characteristic vibration frequencies of alkanes, alkenes, alkynes, compounds, alcohols, ethers, phenol and amines. Detailed studies of frequencies of carbonyl compounds. (ketons,aldehydes,esters.acids,amides,anhydrides,lactones,lactams and conjugated carbonyl compounds)effect of hydrogen bonding and effect of solvent on vibrational frequencies, overtones, combinations bands and Fermi resonance, FTIR, IR of gaseous, solids and polymeric materials.		

	Numerical		
3	**Fundamental of NMR & CMR Spectroscopy** 1H NMR Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, de-shielding, spin spin interactions, factors influencing coupling constant 'j'. Classification (ABX, AMX, ABC, A2B2 etc.) spin decoupling; basic ideas about instrument. Advantages of FT NMR use of NMR in medical diagnostics. Principal, basic of NMR (Peak height, Peak signal, Chemical shift) instrumentation and applications of NMR, Criteria for a compound to be NMR active. Basic components of instrumentation of PMR and CMR. Shielding, de-shielding, and splitting. **Numerical**	**12**	**30%**
4	**Examples of UV, IR and NMR Spectroscopy** **Numerical**	**10**	**20%**

Reference Books:

- Modern Spectroscopy, J.M. Hollas, John Wiley.
- Organic Chemistry, Robert Thorton Morrison and Robert Neilson Boyd.
- Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.

Suggested Readings:

- Chemical Thermodynamics by R.P. Rastogi & R.R. Mishra.
- Basic Principles of Spectroscopy, Ft. Chang, McGraw Hill.
- Theory and Applications of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH—Oxford.
- Introduction to Magnetic Resonance, A Carrington and AD. MacLauchlan, Harper & Row.

Online Resources:

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
- https://nptel.ac.in/courses

CO-PO & CO-PSO Mapping

Course Outcomes	**Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**2**	**-**	**1**	**-**	**1**	**1**	**1**	**1**	**2**	**2**
CO2	**3**	**2**	**2**	**-**	**1**	**-**	**1**	**1**	**-**	**1**	**2**	**2**

CO3	**3**	**2**	**2**	**-**	**1**	**-**	**1**	**1**	**-**	**1**	**2**	**2**

SUBJECT CODE: MCHE201USE
SUBJECT NAME: BIOLOGY FOR CHEMIST

Course Objective:

- A basic knowledge about the biological studies.
- An in-depth study of the determination of dissociation constant of mono basic acids.

Course Outcomes: At the end of the course, students shall be able to

CO1	A student can also become enlightened about food science, nanomaterials, drugs, plastics, dyes and paper.
CO2	To give an elementary idea of chemotherapy, organic compounds like carbohydrates, dyes and heterocyclic compounds.
CO3	To study the fundamentals of terpenoids, alkaloids, vitamins, lipids and steroids.

Unit	Content	Hrs.	Weightage
1	**Carbohydrates** Conformation of monosaccharide, structure and functions of important derivatives of monosaccharide like glycosides, deoxy sugars, myoinusitol, amino sugars, N-acetylmuramic acid, Sailic acid, disaccharides and polysaccharides, Structural polysaccharides - cellulose and chitin. Storage polysaccharides - starch and glycogen Structure and biological functions or glucosaminoglyeans or mucopolysaccharides. Carbohydrates of glycoprotein and glycolipids. Role of sugars in biological recognition. Blood group substances, Ascorbic acid, Carbohydrate metabolism, Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway.	**15**	**50%**
2	**Amino Acids and Nucleic Acids** Amino acid metabolism - degradation and biosynthesis of amino acids, sequence determination: chemical/enzymatic/mass spectral. Racemization/detection, Chomistry oxytocin and tryptophan releasing hormone (TRH). Purine and Pyrimidine bases of nucleic acids, base pairing via H-bonding, Structure of Ribonucleic acids (RNA) and Deoxyribonucleic	**15**	**50%**

	acids (DNA), double helix model of DNA and forces responsible for holding it, Chemical and enzymatic hydrolysis of nucleic acids, The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code, Chemical synthesis of mono and tri nucleoside.		

Reference Books:

- Organic Chemistry by Francis A. Careys.
- Chemistry of Biomolecules by S.P.Bhutani.
- Cell Biology and Molecular Biology by H.Arumugan.

CO-PO & CO-PSO Mapping

Course Outcomes	**Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**2**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**
CO2	**2**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**
CO3	**2**	**1**	**-**	**-**	**1**	**-**	**1**	**1**	**1**	**2**	**2**	**2**

M.SC. SEM-III

SUBJECT CODE: MCHE301UDSC
SUBJECT NAME: NATURAL PRODUCTS - I

Course Objective:

- The objective of the course to impart fundamental knowledge about some selected aspects of chemistry. The topics natural vitamins alkaloids steroids and Terpenoids. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of natural vitamins and steroids.
CO2	They will be able to explain alkaloids & Terpenoids of a various group.
CO3	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO4	Apply the various procedures and techniques for the experiments.

Unit	Content	Credit	Weightage
I	**Vitamins** Details study of chemistry of Thiamine (Vitamin-B1), Pantothenic acid (Vitamin-B2), Ascorbic acid (Vitamin-C), and Tocopherol (Vitamin-E), and Pyridoxine (Vitamin-B6), Biological importance of Vitamin	1	25 %
II	**Alkaloids** General Biogenetic studies of Alkaloids, Chemistry of Reserpine, Colchicines, Strychnine and Narcotine.	1	25 %
III	**Steroids** General Biosynthetic studies of steroids, chemistry of Ergosterol & Lanosterol, Oestrogens: - Oestrone, Oestriol, Oestradiol, Gestogens: - Progesterone, Adreno cortical hormones: - Cortisone, Diosgenin and its utility in hormone synthesis, Transformation in steroids molecules.	1	25 %
IV	**Terpenoids** Chemistry of Camphor, Chemistry of Zingiberene, Chemistry of Carotenes, Biosynthesis study of Tri-Terpenoids and Tetra Terpenoids.	1	25 %

Reference Books:

1. The molecules of nature – J.B.Hendrickson.

2. Chemistry of natural products, Volume I to IV – K.W. Bentley.

Suggested Readings

1. Organic chemistry of natural products – Chatwal Volume I & II Himalaya publication.
2. Chemistry of natural products – K. Nakanishi.

Online Resources:

- https://www.makerspaces.com/naturalchemistry-structure/
- https://www.naturalproducts-tutorials.ws/
- https://www.natural-chemisty-notes.com/articles/basic_concepts/

Lab Experiments

Organic Estimation: - (Semi micro methods)

- Estimation of Penicillin.
- Estimation of Amino acid (Glycine).
- Estimation of Sulfa drugs.
- Estimation of Enol Group.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**1**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**
CO2	**3**	**1**	**1**	**-**	**1**	**1**	**-**	**-**	**1**	**1**	**2**	**2**
CO3	**3**	**1**	**1**	**-**	**1**	**1**	**1**	**1**	**-**	**1**	**2**	**2**
CO4	**3**	**1**	**1**	**-**	**1**	**1**	**1**	**1**	**-**	**1**	**2**	**2**

SUBJECT CODE: MCHE302UDSC
SUBJECT NAME: MEDICINAL CHEMISTRY- I

Course Objective:

- The objective of the course to impart fundamental knowledge about Medicinal Chemistry and Antibiotics, Sulpha drugs as well as Stimulating Agents. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of Antibiotics and Sulfa drugs.
CO2	They will be able to explain various Stimulating Agents of a various groups.
CO3	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO4	Apply the various procedures and techniques for the experiments.

Unit	Content	Credit	Weightage
I	**Medicinal Chemistry** Introduction naming of organic medicinal compounds, Literature of medicinal chemistry, Classification of drugs, Drug design, Relation between molecular structure and biological activity(QSAR), Receptor site theory, Pharmacopeias, Indian standers, Modern methods of pharmaceutical Analysis Diagnostic Agents, Pharmaceutical acid: Solvents, Vehicles, Flavors, Suspending agents, Surfactants, Emulsifying agents.	1	25 %
II	**Antibiotics** Classification of Antibiotics, Synthesis and Activity of: Penicillin, Cephalosporin, Streptomycin, Amoxicillin, Neomycin, Chloroamphenicol.	1	25 %
III	**Sulpha drugs** Chemistry of Sulfonamides, Synthesis and uses: Sulphanilamides, Sulphafurazole, Sulphaguanidine, Sulphathiazole, Sulphamerazine, Sulphalene, Sulphathiadiazole, Trimethoprim.	1	25%
IV	**Stimulating Agents** Drugs stimulating or blocking the peripheral nervous system, Cholinergic & Anticholinergic drugs, Histamine and Antihistamine, Local Anesthetics	1	25 %

Reference Books:

1. Medicinal chemistry – Ashutosh Kar.
2. An introduction to Medicinal chemistry (6th edition) – Graham L. Patrick.
3. Berger's Medicinal chemistry (Volume 1-8), VII edition – J. Abraham, Wiley.

Suggested Readings:

1. Synthetic drugs - G.R.Chatwal.
2. Medicinal chemistry principles and practice – F.D.King, RSC, 1994.

Online Resources:

- https://www.makerspaces.com/medicinalchemistry-structure/
- https://www.medicinalchemistry-drugs-tutorials.ws/

- https://www.advancedmedicinalchemistry-notes.com/articles/basic_concepts/

Lab Experiments:

1. **Organic Separation:**

   Separation, Purification and Identification of three compounds (Trinary mixture) from 8 grams organic mixture by semi micro-Method. Preparation of Derivative. (Minimum five mixtures should be done)

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**
CO2	**3**	**2**	**1**	**-**	**1**	**1**	**-**	**-**	**1**	**2**	**2**	**2**
CO3	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**-**	**1**	**2**	**2**
CO4	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**-**	**1**	**2**	**2**

SUBJECT CODE: MCHE303UDSC
SUBJECT NAME: INDUSTRIAL CHEMISTRY- I

Course Objective:

1. An advanced knowledge about the unit process and unit operation
2. An in-depth study of the industrial application of nitration and halogenation.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can be introduced about the agrochemicals.
CO2	Learn the classification of surface-active agents.
CO3	Understand the methods and applications of dyes.
CO4	Study about the soap and detergents with their classification.

Unit	Content	Hrs.	Weightage
1	**Unit Process and Unit Operation**	**15**	**25%**

	Importance of unit process, Other various unit process, Industrial application of Nitration, Industrial application of Halogenation-Chlorination, Bromination, Iodination, Fluorination), Amination, Sulphonation.		
2	**Agrochemicals** Insecticides, Fungicides, Weedicides, Rodenticides, Plant nutrients, plant hormones.	**15**	**25%**
3	**Soap and detergents** Soap and its manufacture, Classification of surface-active agents, Anionic, Cationic, Non-Ionic Detergents, Amphoteric detergents, Miscellaneous compounds.	**15**	**25%**
4	**Dyes** Colour and constitution, Fibers to be dyed, Classification of dyes, Application of the dyes, Methods of dyes, Methods of application.	**15**	**25%**

Reference Books :

- Industrial Chemistry, B.K. Sharma, Goel Publication House, Meerut.
- Chemistry For Chemical Industries by Edwin E. Slosson, Medtech

Suggested Readings:

- Introduction To Industrial Chemistry by White H L , John Wiley

Online Resources:

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
- https://nptel.ac.in/courses

Lab Experiments

- **Organic Preparation: -**

  Two and Three stage preparation from 4 to 5 grams starting material by semi micro method (Minimum five should be done) including name reactions.

CO-PO & CO-PSO Mapping

Course Outcomes	**Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**
CO2	**3**	**2**	**1**	**-**	**1**	**1**	**-**	**-**	**1**	**2**	**2**	**2**
CO3	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**-**	**1**	**2**	**2**
CO4	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**-**	**1**	**2**	**2**

SUBJECT CODE: MCHE304UDSC
SUBJECT NAME: ADVANCED ORGANIC CHEMISTRY- I

Course Objective:

- The objective of the course to impart fundamental knowledge about Instrumental analysis and synthesis of alkene, Photochemistry as well as Elimination reactions. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of Instrumental analysis and Elimination reactions. They will be able to explain various synthesis of alkene of a various group.
CO2	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO3	Apply the various procedures and techniques for the experiments.

Unit	Content	Credit	Weightage
I	**Instrumental analysis** Liquid Chromatography: HPLC Instrumentation, Adsorption Chromatography, Partition Chromatography, Other Types of Liquid Chromatography, Gas Chromatography: Basic Description, Classification of GC Methods, Stationary Phase, Carrier Gas, Detectors, Temperature Programming, Thermal techniques: TGA, DTA, DSC. Application of 1H NMR and 13C NMR spectra.	1	25 %
II	**Name reactions (synthesis of alkene)** Shapiro reaction, Petersen synthesis, Julia olefination, cmurry reaction, Witting reaction, Corey-Fuches reaction, Appel reaction, DEAD reagent, Corey- winter, Tebbe reagent, Eschenmore fragmentation, Multicomponent reactions: Ugi, Passerini, Biginelli and Mannich reactions, Ring formation reactions: Pausan-Khand, Bergman and Nazerov cyclization.	1	25 %
III	**Photochemistry** Photochemical reactions, Principle of energy transfer, electronic excitation (Janlonski diagram), Photosensitization, Photochemistry of carbonyl compounds, Norrish type-I and II, reaction of cyclic ketones, Peterno-Buchi reaction, Di-π methane rearrangement, Dinone photochemistry, Cis-trans Isomerization, Photochemistry of conjugated dienes, photo rearrangement, Barton reaction. Fluorescence chemistry and its application.	1	25%
IV	**Elimination reactions**	1	25 %

	α, β and γ elimination reaction, regioselectivity of the elimination, E_1CB mechanism, E_2 Mechanism, Hoffmann degradation of quaternary ammonium salt,dehalogenation, Ei mechanism, Chugave reaction, cope elimination, Pyrolysis of selenoxiden and sulphoxide, dehydration of aldoxime.		

Reference Books:

- Mechanism in Organic Chemistry: Peter Sykes (Orient Longman).
- Modern Methods of Organic Synthesis: W. Carruthers (Cambridge).
- Organic Reaction Mechanism: V.K. Ahluwalia and R.K. Parashar (Narosa).
- Advanced Organic chemistry reaction mechanism and structure by Jerry March

Suggested Readings:

- Reaction Mechanism in Organic chemistry by S.M. Mechanism and S.P. Singh.
- Principles of organic synthesis R O C Norman and J.M. Coxon. Blackie academic and Professional.
- A Guide book to Mechanism in organic chemistry, Peter Sykes Longman.
- Reaction and mechanism in organic chemistry by P.S. Kalsi, New Age International

Online Resources:

- https://www.makerspaces.com/advancedorganicchemistr-structure/
- https://www.synthesis of alkene-tutorials.ws/
- https://www.eliminationreactions-notes.com/articles/basic_concepts/

Lab Experiments

Spectroscopic problems:

Identification of Organic compound by given spectral data. (Combined UV-visible, HNMR, IR)

CO-PO & CO-PSO Mapping

Course Outcomes	**Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**3**	**2**	**-**	**1**	**-**	**1**	**-**	**1**	**1**	**2**	**2**
CO2	**3**	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**2**	**2**
CO3	**3**	**3**	**2**	**-**	**1**	**-**	**1**	**1**	**1**	**1**	**2**	**2**

SUBJECT CODE: MCHE301USE
SUBJECT NAME: ENVIRONMENTAL CHEMISTRY

Course Objective:
Basic knowledge about the Environment and its various sphere.

Course Outcomes: At the end of the course, students shall be able to

CO1	To create environmental awareness to understand the fragility and sensitivity of environment, in particular the biosphere and the importance of its protection.
CO2	This paper also gives elementary ideas on pesticides and fertilizers.

Unit	Content	Hrs.	Weightage
1.	**Environment** Introduction, Composition of atmosphere, Vertical temperature, Heat budget of the earth atmospheric system, Vertical stability atmosphere, Biogeochemical cycles of C, N, P, S and O, Biodistribution of elements.	15	50%
2.	**Hydrosphere** Chemical composition of water bodies-lakes, streams, rivers and wet lands etc., Hydrological cycle, Aquatic pollution inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants, Water quality parameters-dissolved oxygen, biochemical oxygen demand, solids, metals, content of chloride, sulphate, phosphate, nitrate and micro-organisms, Water quality standards, Analytical methods for measuring BOD, DO, COD, F, Oils, metals(As, Cd, Cr, Hg, Pb, Se, etc.), residual chloride and chlorine demand, Purification and treatment of water.	15	50%

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**1**	**1**	**1**
CO2	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**1**	**-**	**1**	**1**

M.SC. SEM-IV

SUBJECT CODE: MCHE401UDSC

SUBJECT NAME: HETEROCYCLIC CHEMISTRY & ORGANIC REACTION MECHANISM

Course Objective:

- The objective of the course to impart fundamental knowledge about Heterocyclic Chemistry & Antibiotics as well as sulpha drugs can assist a Mechanism of Organic Reaction. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of Antibiotics and Sulfa drugs.
CO2	They will be able to explain various Stimulating Agents of a various groups.
CO3	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO4	Apply the various procedures and techniques for the experiments.

Unit	Content	Credit	Weightage
I	**Heterocyclic Compounds (PART-A)** Introduction of Heterocyclic, Carbocyclic Chemistry, and Nomenclature of heterocyclic compounds, Nomenclature of Heterocyclic compounds Containing partial unsaturation, Compounds having More than one Hetero atom, Nomenclature of Identical system connected by single Bond, Naming of Heterocycles with fused rings, Naming of Bicyclic bridged structures.	1	25 %
II	**Heterocyclic Compounds (PART-B)** Heterocyclic compounds: Properties, Preparation and Chemical Reactions of Imidazole, Properties, Preparation and Chemical reactions of Oxazole, Properties, Preparation and Chemical reactions of Pyrimidine, Properties, Preparation and Chemical Reactions of Indole.	1	25 %
III	**Rearrangements & Uses of Selective Reagents:** Rearrangements: Reaction mechanism–nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements: 1. Baeyer-villager, 2. Wagner Meerwein, 3. Demjanov, 4. Neber, 5. Baker Venkatraman 6. Newman-Kwart. Uses of Selective Reagents: 1. Dess Martin Periodinane, 2. Sodium Cyanoborohydride, 3. Lithium di-isopropyl amide, 4. Crown ethers,	1	25%

	5. Dicyclohexylcarbodiimide, 6. Ceric ammonium nitrate, 7. Wilkinson's catalyst.		
IV	**Synthesis based on Rearrangement and name reactions** Synthesis of compounds using Mannich reaction, Hofmann reaction, benzyl benzylic acid rearrangement, Pinacol-pinacolone rearrangement, reformatsky reaction, benzidine rearrangement etc. Multi steps synthesis: a) Phthalic anhydride – Phthalimide – Anthranilic acid. b) Acetophenone – Oxime – Acetanilide. c) Phthalic anhydride – o-benzoyl benzoic acid -anthraquinone. d) Aniline- Acetanilide- p-Nitro acetanilide-p-Nitroaniline-pphenylenediamine e) Acetanilide – p-Bromo acetanilide – p-Bromoaniline. Other preparations based on theory.	1	25 %

Reference Books:

- Heterocyclic chemistry, K. Bansal.
- Heterocyclic chemistry, R.R. Gupta, M. Kumar & V. Gupta, Springer.
- Medicinal Chemistry, A. Burger Volume. I to V M. E. Wolff, John Wiley (1994).
- Goodman & Gilman. Pharmacological Basis of Therapeutics, McGraw-Hill (2005).

Suggested Readings:

- S. S. Pandeya & J. R. Dimmock. Introduction to Drug Design, New Age International. (2000).
- Warren S. Organic Synthesis: The Disconnection Approach, Wiley Student.
- Organic Reaction Mechanism: V.K. Ahluwalia and R.K. Parashar (Narosa)
- Advanced Organic chemistry reaction mechanism and structure by Jerry March
- Reaction Mechanism in Organic chemistry by S.M. Mechanismand S.P. Singh

Online Resources:

- https://www.makerspaces.com/ heterocyclic chemistry -structure/
- https://www.organicchemistry-reactionmechanism-tutorials.ws/
- heterocyclicchwemistry-notes.com/articles/basic_concepts/

Lab Experiments:

- **Organic Separation: -**

  Separation, Purification and Identification of three compounds (Trinary mixture) from 8 grams organics mixture by semi micro-Method. Preparation of Derivative. (Minimum Five mixtures should be done)

CO-PO & CO-PSO Mapping

Course Outcomes	**Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**-**	**1**	**1**	**2**	**2**

CO2	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**-**	**1**	**1**	**2**	**2**
CO3	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**
CO4	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**

SUBJECT CODE: MCHE402UDSC

SUBJECT NAME: MEDICINAL CHEMISTRY-II

Course Objective:

- The objective of the course to impart fundamental knowledge about Medicinal Chemistry and Anticancer agents, CNS Drugs as well as Psychopharmacological Agents. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of Antibiotics and Sulfa drugs.
CO2	They will be able to explain various Stimulating Agents of a various groups.
CO3	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO4	Apply the various procedures and techniques for the experiments.

Unit	Content	Hrs.	Weightage
1	**CNS Drugs or Psychopharmacological Agents** Antipsychotics, Antidepressant, Antianxiety, Anticonvulsants, Hallucinogenic Drugs, Antiparkinsonism Drugs, Sedative & Hypnotics, General Anesthetics'.	**15**	**25%**
2	**Drugs Acting on the Cardiovascular Haemopoietic and Renal System** Cardiac Drugs, Diuretics, Anti-fungal agents, Antimalarial Drugs.	**15**	**25%**
3	**Anti-Cancer Agents - I** Classification of Cancer, Phase of the cell-cycle, Structural activity relationship, Mechlorethamine, Chlorambucil, Melphalan, Cytoxan.	**15**	**25%**

4	**Anti-Cancer Agents - II** Antimetabolites (Methotixate, Purinitol), Antagonist (5-florouracine, Tamoxifen), Antibiotics (Mytomycin-C), Plants products (Paclitaxel, Chamtothesin).	**15**	**25%**

Reference Books:

- Berger's Medicinal Chemistry (Volume 1-8), VII edition – J Abraham, Wiley.
- Medicinal Chemistry – Ashutosh Kar, New Age International Publishers

Suggested Readings:

- Medicinal Chemistry, an Introduction – G.Thomas, John Wiley.
- Synthetic drugs – G.R.Chatwal

Online Resources:

- https://www.makerspaces.com/ heterocyclic chemistry -structure/
- https://www.organicchemistry-reactionmechanism-tutorials.ws/

Lab Experiments:

- **Organic Estimation: - (Semi micro methods)**

  (A) Estimation of Isoniazid.

  (B) Estimation of Ibuprofen.

  (C) T.L.C. of Drugs

  (D) T.L.C. of Dyes

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**-**	**1**	**1**	**2**	**2**
CO2	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**-**	**1**	**1**	**2**	**-**
CO3	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**2**
CO4	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**

SUBJECT CODE: MCHE403UDSC

SUBJECT NAME: INDUSTRIAL CHEMISTRY- II

Course Objective:

1. An advanced knowledge about the industrial polymers.
2. An in-depth study Industrial explosive.

Course Outcomes: At the end of the course, students shall be able to

CO1	Student after learning this course can be introduced about the Industrial Paint and Varnish & Explosives.
CO2	Learn the classification of paints.
CO3	Understand the Methods of applying paints
CO4	Study about home products science.

Unit	Content	Hrs.	Weightage
1	**Synthetic Industries based on Petroleum** Coal, petroleum, natural gas, organic chemicals from coal distillation refining of oil for industrial fuels, Textile fibers classification, Manufacture of important polyamide, Poly ester fiber.	15	25%
2	**Industrial Paint and Varnish & Explosives** Classification of paints, Manufacture of paints, Methods of applying paints, Varnish- Raw materials, Manufacture of varnishes, types of varnishes, Types of Explosive, Characteristics of explosive, Industrial explosive.	15	25%
3	**Industrial Polymers** Polyethylene – Introduction, Manufacture, Low- and high-density polyethylene, Co-polymers of ethylene and application, Monomers-Dacron, Orlon, Bakelite, Nylone-6,6, Teflon, polymer reaction, Hydrogenation, Addition and substitution aldehyde and ketonic group reaction, Acrylic Polymer Polyacrylated and polymethyl acrylate, poly acrylo nitrile.	15	25%
4	**Home Products Science** Selected small scale industries, Safety matches, Agarbatties, Naphthalene balls, Carboxylic acid, Cyclohexane,2-Br-cyclohexanone, 2-Br-4-4-Dimethyl disinfectant, Soap, Detergent.	15	25%

Reference Books :

- Industrial Chemistry, B.K. Sharma, Goel Publication House, Meerut.
- Chemistry For Chemical Industries by Edwin E. Slosson, Medtech

Suggested Readings:

- Introduction To Industrial Chemistry by White H L , John Wiley

Online Resources:

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
- https://nptel.ac.in/courses

Lab Experiments:

- **Organic Preparation: -**

  Two & Three stage preparations from 4 to 5 grams starting material by semi micro method (Minimum five should be done) including name reactions.

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**-**	**1**	**1**	**2**	**2**
CO2	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**1**	**2**	**2**
CO3	**3**	**2**	**1**	**-**	**1**	**1**	**-**	**1**	**1**	**1**	**2**	**2**
CO4	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**

SUBJECT CODE: MCHE404UDSC

SUBJECT NAME: ADVANCED ORGANIC CHEMISTRY- II

Course Objective:

- The objective of the course to impart fundamental knowledge about Instrumental analysis and synthesis of alkene, Photochemistry as well as Elimination reactions. Some industry relevant topics are also covered under which basic concepts are taught.

Course Outcomes: At the end of the course, students shall be able to

CO1	The student will be able to relate different kind of Instrumental analysis and Elimination reactions. They will be able to explain various synthesis of alkene of a various group.
CO2	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
CO3	Apply the various procedures and techniques for the experiments.

Unit	Content	Hrs.	Weightage

1	**Natural Coloring Matter** Classification General method of structural determination, biosynthesis studies of Anthocyanine (cynin and palargonidin), Flavones (chrysin), Flavonols (Quercetin), Flavonone (Dihydro Flavones) and isoflavones (Daidzein), Coumarin, Quinones (polyporic acid), porphyrins, Chemistry of Haemin and chlorophyll.	**15**	**25%**
2	**Carbohydrates, Purine & Nucleic Acid** Type of Naturally occurring sugars, Amino sugars, Deoxy sugars, General method of structure and ring size determination with reference to starch and cellulose, photosynthesis of carbohydrates, Chemistry of Uric acid, Adenine, Caffeine, Structure of Nucleotides, Nucleosides DNA, RNA and Conformations, protein synthesis, Perbiotic chemistry.		
3	**Conformational Analysis** Conformation of Cyclic System: Monocyclic compounds cyclopropane, cyclopropane 1,2-dicarboxylic acid, 2-OH-Methyl-1-cyclo propane dicarboxylic acid, 1,3-ditertiary butyl cyclohexene, 4-OH cyclohexene carboxylic acid, Cyclohexanone, 2-Br-cyclohexenone, 2-Br-4,4 dimethyl cyclopropane 1,2-dicarboxylic acid, 2-OH-methyl-1-cyclo propane carboxylic acid, Bridge ring system, Bicyclic (1,1,1) Pentane and Bicyclic (2,1,1) hexene, Bicyclo (2,2,1) heptane and Bicyclo (2,2,2) octane.	**15**	**25%**
4	**Advances in NMR** Nuclear over Hauser effect, NMR shift reagents, Correlation Spectroscopy, Theory of H-HCOSY, DQF H: H COSY, H-13C COSY, HET COR, HMBC, HMQC, TOCSY INADEQUATE.	**15**	**25%**

Reference Books :

- Fundamental of Enzymology – N.C.Price. L.Stevens, Oxford Uni. Press, N Y 1998.
- Biogenesis of Natural Compounds – P.Bernfield.
- Biochemistry – A.H.Lehninger.

Suggested Readings:

- Outline of Biochemistry – Corn and Stump.
- Introduction to Modern Bio-chemistry – P.Karlson.

- Organic Spectroscopy – William Kemp, Macmillan Press, London.

Online Resources:

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
- https://nptel.ac.in/courses

Lab Experiments:

- **Spectroscopic problems: -**

  Identification of Organic compound by given spectral data (Combined UV visible, HNMR, 13C NMR, Mass, IR).

CO-PO & CO-PSO Mapping

Course Outcomes	Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**-**	**1**	**1**	**2**	**2**
CO2	**3**	**2**	**1**	**-**	**1**	**-**	**1**	**-**	**1**	**1**	**2**	**2**
CO3	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**

SUBJECT CODE: MCHE401USE

SUBJECT NAME: ORGANOMETALLIC COMPOUNDS

Course Objective:

- To develop the ability to correlate the chemical and physical properties of elements and their compounds with their positions in the periodic table.
- To acquire expertise in chemistry laboratory in handling of reagents and solvents as well as in analytical techniques.

Course Outcomes: At the end of the course, students shall be able to

CO1	To give the students a thorough knowledge of the different theories to explain the bonding in coordination compounds.
CO2	To improve the level of understanding of the chemistry of organometallic compounds, metal carbonyls and metal clusters.

Unit	Content	Hrs.	Weightage
	Compounds of Transition Metal-Carbon Multiple Bonds		**50%**

1.	Alkylidenes, Alkylidynes, Low valent carbenes and carbines- Synthesis, Nature of bond, Structural characteristics, Nucleophilic and electrophilic reactions on the ligands, Role in Organic synthesis, Transition metal compounds with bonds to Hydrogen.	**15**	
2.	**Transition Metal π-Complexes** Transition Metal π-complexes with unsaturated organic molecules, Alkenes, alkynes, allyl, diene, dienyl, arene and thienyl complexes, preparations, properties, nature of bonding and structural features, Important reactions relating to nucleophilic and electrophilic attack on ligands and to organic synthesis.	**15**	**50%**

Reference Books:

- Principles of Organometallic Chemistry – G.E.Coates, M.L.H.Green, P.Powell, K.Wade.
- Organometallic compounds – Indrajit Kumar (Pragati Edition).

Online Resources:

- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
- https://nptel.ac.in/courses

CO-PO & CO-PSO Mapping

Course Outcomes	**Program Outcomes/ Program Specific Outcomes (1- Less Relevant, 2- Mild Relevant, 3- Strong Relevant)**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO1	**3**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**1**	**1**
CO2	**3**	**2**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**-**	**1**	**1**