



# MK UNIVERSITY

PATAN, GUJARAT

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MK University,Patan

Faculty of Science

Department of Chemistry



## M.SC.( CHEMISTRY) SEM-I

SR NO	COURSE TYPE	COURSECODE	CORSENAME	LECTURE (HRS.)/ WEEK	PRACTICAL (HRS.)/ WEEK	CREDITS	EXAMINATION		TOTAL MARKS
							INTERNAL	EXTERNAL	
1	MAJOR	MCHE101UD SC	INORGANIC CHEMISTRY-I	4	0	4	30	70	100
2	MAJOR	MCHE102UD SC	ORGANIC CHEMISTRY-I	4	0	4	30	70	100
3	MAJOR	MCHE103UD SC	PHYSICAL CHEMISTRY-I	4	0	4	30	70	100
4	MINOR	MCHE104UD SC	ANALYTICAL CHEMISTRY-I	4	0	4	30	70	100
5	MINOR	MCHE101UP RA	Chemistry Practical	0	2	2	20	30	50
6	VAC	MCHE101US E	Spectroscopy and Diffraction method	2	0	2	20	30	50
7	IKS	MCHE105UD SC	INDIAN KNOWLEDGE SYSTEM (IKS)	2	0	2	20	30	50
TOTAL				20	2	22	180	370	550



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M.SC.SEM-II									
SR NO .	COURSE TYPE	COURSECODE	CORSE NAME	LECTUR E (HRS.)/ WEEK	PRACTI CAL (HRS.)/ WEEK	CREDIT S	EXAMINATION		TOTAL MARK S
							INTERN AL	EXTERN AL	
1	MAJOR	MCHE201UD SC	INORGANIC CHEMISTRY-II	4	0	4	30	70	100
2	MAJOR	MCHE202UD SC	ORGANIC CHEMISTRY-II	4	0	4	30	70	100
3	MAJOR	MCHE203UD SC	PHYSICAL CHEMISTRY-II	4	0	4	30	70	100
4	MINOR	MCHE204UD SC	ANALYTICAL CHEMISTRY-II	4	0	4	30	70	100
5	MINOR	MCHE201UP RA	CHEMISTRY PRACTICAL	0	2	2	20	30	50
6	SEC	MCHE201US E	Biology for Chemist	2	0	2	20	30	50
7	AVC	MCHE205UDSC	ENVIRONME NTAL STUDIES (EVS)	2	0	2	20	30	50
	TOTAL			20	2	22	180	370	550



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M.SC.SEM-III									
SR NO .	COURSE TYPE	COURSECODE	CORSE NAME	LECTUR E (HRS.)/ WEEK	PRACTI CAL (HRS.)/ WEEK	CREDI TS	EXAMINATION		TOTAL MARK S
							INTERN AL	EXTERN AL	
1	MINOR	MCHE301UD SC	NATURA L PRODUCT S	4	0	4	30	70	100
2	MAJOR	MCHE302UD SC	MEDICINAL CHEMISTRY-I	4	0	4	30	70	100
3	MAJOR	MCHE303UD SC	INDUSTRIA L CHEMISTRY-I	4	0	4	30	70	100
4	MAJOR	MCHE304UD SC	ADVANCED ORGANIC CHEMISTRY-I	4	0	4	30	70	100
5	MINOR	MCHE301UP RA	CHEMISTRY PRACTICAL	0	2	2	20	30	50
6	VAC	MCHE301US E	RESEARCH METHODOLO GY	2	0	2	20	30	50
7	SEC	MCHE305UD SC	BUSINESS COMMUNICA TION	2	0	2	20	30	50
TOTAL				20	2	22	180	370	550



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M.SC.SEM-IV									
SR NO .	COURSE TYPE	COURSECODE	CORSENAME	LECTUR E (HRS.)/ WEEK	PRACTI CAL (HRS.)/ WEEK	CREDI TS	EXAMINATION		TOTA L MAR KS
							INTERN AL	EXTERN AL	
1	MAJOR	MCHE401UD SC	HETEROCYCLI C CHEMISTRY AND ORGANIC REACTION MECHANISM	4	0	4	30	70	100
2	MINOR	MCHE402UD SC	MEDICINAL CHEMISTRY-II	4	0	4	30	70	100
3	MAJOR	MCHE403UD SC	INDUSTRIAL CHEMISTRY-II	4	0	4	30	70	100
4	MAJOR	MCHE404UD SC	ADVANCED ORGANIC CHEMISTRY-II	4	0	4	30	70	100
5	MINOR	MCHE401UP RA	CHEMISTRY PRACTICAL	0	2	2	20	30	50
6	VAC	MCHE401US E	ORGANOMETA LIC COMPOUNDS	2	0	2	20	30	50
7	VAC	MCHE405UD SC	NANO CHEMISTRY	2	0	2	20	30	50
TOTAL				20	2	22	180	370	550



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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:

CO1	Student after learning this course can seek employment in areas of Metallurgy Firms, Hospitals, Educational Institute 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	Stereo chemistry and bonding in main group compounds	1	25 %
	VSEPR, Walsh diagrams (tri and penta - atomic molecules), $d\pi$ - $p\pi$ 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 $\beta$ parameters, charge transfer spectra, spectroscopic Assignment of absolute configuration in optically active metal chelates and their spectrochemical information, an ionic magnetic moment, magnetic exchange coupling and spin crossover.		



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III	Symmetry of Molecules	1	25 %
	Symmetry elements & symmetry operations, multiplications of symmetry operations, multiplication table for $C_{2v}$ , $C_{3v}$ , $C_{2h}$ point groups only, Classifications of Schrodinger point groups, Determination of Schrodinger point groups notations, Symmetry & optical Activity, Symmetry property of orbital's for $C_{2v}$ , $C_{3v}$ , $C_{2h}$ 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, schrodinger symbols, representation of group by matrices, (representation for the $C_n$ , $C_{nv}$ , $C_{nh}$ , $D_n$ etc. group to be worked out 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. Huheey, Harpes & Row.
- Magneto chemistry, F.L. Carlin, Springer Verlag.
- Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
- Chemistry of the Elements, N.N. Greenwood and A. Earnshaw, Pergamon.
- Comprehensive Coordination Chemistry, G. Wilkinson, F.L. Gillard 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=13G8VouhmrFfuhs6rklyTA==>
- <https://nptel.ac.in/courses>

#### Lab Experiments:

Inorganic Qualitative Analysis: (Any Five)

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



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**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, hyper conjugation 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 priority.
- 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:**

CO1	Apply the concepts of bonding, resonance, aromaticity, hyper conjugation and tautomerism to higher organic compounds.
CO2	Predict the products, identify and action in term ediates and propose suitable mechanism for organic reactions
CO3	Identify tereogeniccenters, recognize enantiomers, diastereomers, meso compounds, draw stereo chemical structures, and provide R/S designations of stereo centers
CO4	Draw stable conformations for substituted cyclic compounds, fused and bridge dryings.



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Unit	Content	Hrs.	Weightage
1	Reaction Mechanism: Structure and Reactivity	15	25 %
	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, methods of Determining mechanisms, isotope effects. Hardands of acids And bases, Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes, Effect of structure on reactivity-resonance and fielde ffects, Steric effect, quantitative treatment, the Hammett equation and linear free energy relationship, substituent and reaction constants, Taft equation.		
2	Nature of Bonding in Organic Molecules	15	25 %
	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, crownether complexes and Cryptand, inclusion compounds, cyclodextrins, Catenanes and rotaxanes.		
3	Stereo chemistry	15	25 %
	Conformation alanalysis 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 chiralcenter, threoanderythro isomers, methods of resolution, opticalpurity, 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, Stereo chemistry of the compounds Containing nitrogen, sulphur and phosphorus.		





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4	Aliphatic Nucleophilic Substitution		
	The $S_N2$ , $S_N1$ , mixed $S_N1$ and $S_N2$ and SET mechanisms, the Neighbouring group mechanism, neighbouring group Participation by Pi and sigma bonds, an chimeric assistance, Classical and non-classic carbocations, phenonium ions, norbornyl system, common carbocations rearrangements, Application of NMR spectroscopy in the detection of carbocations, the $S_Ni$ mechanism, Nucleophilic substitution at 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 %

## 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.
- Peri cyclic 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/mscchelp2.pdf>
- [https://chem.libretexts.org/Bookshelves/General\\_Chemistry/](https://chem.libretexts.org/Bookshelves/General_Chemistry/)



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### Lab Experiments:

Organic Preparation : (Any Five)

- Acetylation: Acetylation of cholesterol and separation of cholesterylacetate by column chromatography
- Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol
- Grignard reaction: Synthesis of triphenyl methanol from benzoic acid
- Aldol condensation: Dibenzalacetone 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-Benzoylpropionic 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
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**SUBJECT CODE: MCHE103UDSC**

**SUBJECTNAME: 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:**

CO1	Student after learning this course can be introduced about the Huckel theory of conjugated systems.
CO2	Learn the calculation of scottky and Frenkel defects using statistical method.
CO3	Understand the Nernst 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 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.		



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3	Chemical thermodynamics	15	25%
	Nernst heat theorem and its application to gaseous system, third law of thermodynamics and its application to evaluate absolute entropies of solids, liquids and gases; partial molar quantities and their determination, Gibbs-Duheme equation, chemical potential, chemical potential of ideal gases and solutions, Raoult's law, real solutions, free energy, methods of determination of activity and activity coefficient, 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 Uni molecular reactions. (Lindemann and Hinshelwood theories Of uni molecular reactions.)	15	25%

### Suggested Readings:

1. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum.
2. Modern Electro chemistry Vol. I and Vol. II, J. O. M. Bockris and A. K. N. Fieddy, 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.



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## [C] Chemical Kinetics (Minimum01)

1. Determine the temperature coefficient and energy of activation of their action between  $\text{HBrO}_3$  and  $\text{HI}$ .
2. Flowing clock reactions (Ref: Experiments in Physical Chemistry by Showmaker)
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 (Minimum01)

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  $\text{HAC} + \text{HCl}$  conductometrically.
3. To study the effect of solvent on the conductance of  $\text{AgNO}_3$ /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] Potentiometric/Peltry (Minimum01)

1. Determination of the concentration of  $\text{NaOH}$  and  $\text{NH}_4\text{OH}$  in the given mixture using 0.1 N  $\text{HCl}$  / conductometrically.
2. Determination of the dissociation constant of monobasic/ di basic 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  $\text{KOH}$ .
6. Determine thermodynamic constants,  $\Delta G$ ,  $\Delta S$  and  $\Delta H$  for the reaction by e. m. f. method.  $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + 2\text{H}^+$

## [F] Polarimetry (Minimum01)

1. Determination of rate constant for hydrolysis /inversion of sugar using a Polarimeter.
  2. Enzyme kinetics— inversion of sucrose.
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**SUBJECT CODE: MCHE104UDSC**

**SUBJECTNAME: ANALYTICAL CHEMISTRY**

### Course Objective:

- Errors, statistical treatment of analytical data and use of various computational tools on interpreting experimental data
- Principles, terminologies, types and application 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:

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	11	25%
	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.		
	Volumetric Method of Analysis		



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3	Primary and Secondary standards, Principles of volumetric analysis, Acid-basetitration, 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 F. L. Ho, Wiley Interscience.
- NMR, EPR, EPB And Mossbauer Spectroscopy in Inorganic Chemistry, R. V. Parish.
- Physical Methods in Chemistry, F. L. S. 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. Merritt, 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 textbook of quantitative chemical analysis, 6th Ed., J. H. Vogel, ELBS/Longman, (1989).
- Modern Methods of Chemical Analysis-Pecsok, Shields, Cairns and McWilliams, 2nd Ed., John Wiley and sons (1976).



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SUBJECT CODE: MCHE101USE

SUBJECT NAME: SPECTRO SCOPY & 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:

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	15	50%
	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.		
2.	X-ray Diffraction	15	50%
	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.		

## Reference Books:

1. Inorganic Chemistry, J.E. Huheey, 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>





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M.SC.SEM-II

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**SUBJECT CODE: MCHE201UDSC**  
**SUBJECT NAME: INORGANIC CHEMISTRY-II**

**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:**

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 bio-inorganic compounds and compounds of various block elements.

Unit	Content	Hrs.	Weightage
1	Metal-Lig and Equilibrium solution	12	30%
	Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, $\pi$ -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.		
2	Reaction Mechanism of Transition Metal Complexes	12	30%



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	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), zinc metalloenzymes, 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.
- Magneto chemistry, F.L.L.Carlin, Springer Verlag.
- Inorganic Electronic Spectroscopy, A.B.P.Lever, Elsevier.
- Chemistry of the Elements, N.N.Greenwood and A. Earnshaw, Pergamon.
- Comprehensive Coordination Chemistry eds., G.Wilkinson, F.L.D.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 –



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Oxides, Sulphates and halides.

**SUBJECT CODE: MCHE202UDSC**  
**SUBJECTNAME: ORGANIC CHEMISTRY-**  
**II**

**Course Objective:**

- Stereo chemistry 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:**

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 Electrophilic Substitution	12	25%
	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, Vilsmeier reaction, Gattermann-Koch reaction.		
	(B) Aromatic Nucleophilic Substitution		
	The S <sub>N</sub> Ar, S <sub>N</sub> 1, benzyne and S <sub>RN</sub> 1 mechanism. Reactivity- effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser and Smiles rearrangement.		
	Reagents in Organic Synthesis [Oxidation]		



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2	CrO <sub>3</sub> , MnO <sub>2</sub> , KMnO <sub>4</sub> , SeO <sub>2</sub> , Pb(OAc) <sub>4</sub> , OsO <sub>4</sub> , HIO <sub>4</sub> , DMSO, H <sub>2</sub> O <sub>2</sub> , CH <sub>3</sub> COOAg (Dry & wet), RCOOOH, Ozone, HgO, NBS, K <sub>3</sub> Fe(CN) <sub>6</sub> , DDQ, Al(O-t-Bu) <sub>3</sub> ; Some Miscellaneous Reagents in Organic Synthesis: LDA, Sharpless epoxidation, Wilkinson catalyst, Grignard Reagent and Gilman reagent.	12	25%
3	Reagents in Organic Synthesis [Reduction] Al (O-i-Pr) <sub>3</sub> , Zn/HCl, N <sub>2</sub> H <sub>4</sub> /OH, NaBH <sub>4</sub> , LiAlH <sub>4</sub> , Complex Hydrides, Na/NH <sub>3</sub> , Cat. H <sub>2</sub> , TBTH. Introduction to Green Chemistry, Basic Principles of Green Chemistry, Importance of PTC, ILs, microwave and ultrasonic at ion in green synthesis.	10	25%
4.	Peri cyclic Reaction Molecular orbital symmetry, Frontier orbital of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of Pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions, 4n, 4n+2 and allyl systems Cycloaddition antrafacial and suprafacial addition, 4n, 4n+2 systems, 2+2 addition of ketenes, 1,3 dipolar cyclo additions and cheletropic reactions. Sigmatropic rearrangement – suprafacial and antrafacial shifts of H sigmatropic shifts involving carbon impurities, 3,3 and 5,5-sigmatropic rearrangements. Claisen, cope and azape Rearrangements. 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.
- Stereo chemistry of Organic Compounds, D. Nasipuri, New Age International.
- Stereo chemistry 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.
- Peri cyclic Reactions, S.M. Mukherji, Macmillan, India.



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### 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,  $\text{NaHCO}_3$ ,  $\text{NaOH}$ ,  $\text{HCl}$  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-butylacetoacetate by A.E.E. condensation.
  3. Cannizzaro reaction: 4-Chlorobenzaldehyde as substrate
  4. Friedel Crafts Reaction:  $\beta$ -Benzoylpropionic acid from succinic anhydride and benzene.
  5. Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline.
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**SUBJECT CODE: MCHE203UDSC**

**SUBJECTNAME: 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:**

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	Electro chemistry	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 Over voltage, Butler-Volmer equation, Principle of polarography, Equation of polarographic wave, Ilkovic equation.		
3	Surface Chemistry	15	25%



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	Adsorption Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapor 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 (CMC), Factors affecting the CMC of surfactants, counter ion binding to micelles.		
4	Macromolecules	15	25%
	Polymer – definition, types of polymers, electrically conducting, 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 Mc Graw 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, .Rajaraman and J. Kuriacose, McMillan.

## Suggested Readings:

1. Micelles, Theoretical and Applied Aspects, V. Moroi, Plenum.
2. Modern Electro chemistry 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>



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### 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 their action  $KI + I_2 \rightarrow KI_3$  by distribution method.
4. To determine the formula of the complex formed between the cupric ion and ammonia by distribution method.

5. Chemical Kinetics (Minimum 01) Determine the temperature coefficient and energy of activation of their action between  $HBrO_3$  and  $HI$ .

6. Flowing clock reactions (Ref: Experiments in Physical Chemistry by Showmaker)
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.

#### [C] 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  $HAC + HCl$  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.

#### [D] Potentiometry/pHmetry (Minimum 01)

13. Determination of the concentration of  $NaOH$  and  $NH_4OH$  in the given mixture using 0.1 N  $HCl$  conductometrically.
14. Determination of the dissociation constant of monobasic/ dibasic acid by Albert-Sergeant method.
15. Determination of the valence of mercurous ion 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 thermodynamic constants,  $\Delta G$ ,  $\Delta S$  and  $\Delta H$  for the reaction by .m.f. method.  $Zn + H_2SO_4 \rightarrow ZnSO_4 + 2H^+$

#### [E] Polarimetry (Minimum 01)

19. Determination of rate constant for hydrolysis /inversion of sugar using a Polarimeter.
  20. Enzyme kinetics— inversion of sucrose.
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**SUBJECT CODE: MCHE204UDSC**

**SUBJECTNAME: ANALYTICAL CHEMISTRY**

### Course Objective:

- 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:

CO1	To impart students a broad outline of the methodology of science in general and Chemistry in particular.
CO2	The students will earn 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 Spectro photometry 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- Wood words rule for conjugated dienes and carbonyl compounds, UV spectraofaromatic 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 ofsolventonvibrationalfrequencies,overtones,combinationsbandsand Fermi resonance, FTIR, IR of gaseous, solids and polymeric materials.		



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	Numerical		
3	Fundamental of NMR & CMR Spectroscopy	12	30%
	$^1\text{H}$ 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 FTNMR 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		
4	Examples of UV, IR and NMR Spectroscopy	10	20%
	Numerical		

## Reference Books:

- Modern Spectroscopy, J.M.Hollas, John Wiley.
- Organic Chemistry, Robert Thornton 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, AC Arrington and AD.MacLauchlan, Harper & Row.

## Online Resources:

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



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SUBJECT CODE: MCHE201USE

SUBJECT NAME: BIOLOGY FOR CHEMIST

### Course Objective:

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

### Course Outcomes:

CO1	A student can also become enlightened about food science nano materials, 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	15	50%
	Conformation of monosaccharide, structure and functions of important derivatives of monosaccharide like glycosides, deoxy sugars, myoinositol, amino sugars, N-acetylmuramic acid, Sialic acid, disaccharides and polysaccharides, Structural polysaccharides - cellulose and chitin. Storage polysaccharides - starch and glycogen Structure and biological functions of glucosaminoglycans or mucopolysaccharides. Carbohydrates of glycoprotein and glycolipids. Role of sugars in biological recognition. Blood group substances, Ascorbic acid, Carbohydrate metabolism, Krebs's cycle, glycolysis, glycogenesis and glycolysis, gluconeogenesis, pentose phosphate pathway.		
2	Amino Acids and Nucleic Acids	15	50%
	Amino acid metabolism - degradation and biosynthesis of amino acids, sequence determination: chemical/enzymatic/mass spectral. Racemization/detection, Chemistry of 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		
	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 dinucleoside.		

### Reference Books:

- Organic Chemistry by Francis A. Carey.
- Chemistry of Bio molecules by S.P. Bhutani.



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M.SC.SEM-III

**SUBJECT CODE: MCHE301UDSC**

**SUBJECT NAME: NATURAL PRODUCTS-I**

### Course Objective:

- The objective of the course to impart fundamental knowledge abouts 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:

CO1	The student will be able to relate different kind of naturalvitamins 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	1	25 %
	Details study of chemistry of Thiamine (Vitamin-B1), Pantothenic acid(Vitamin-B2),As corbic acid(Vitamin-C),and To copherol (Vitamin-E), and Pyridoxine (Vitamin-B6), Biological importance of Vitamin		
II	Alkaloids	1	25 %
	General Bio genetic studies of Alkaloids, Chemistry of Reserpine, Colchicines, Strychnine and Narcotine.		
III	Steroids	1	25 %
	General Bio synthetic studies of steroids, chemistry of Ergosterol & Lanosterol, Oestrogens: - Oestrone, Oestriol, Oestradiol, Gestogens:- Progesterone, Adrenocorticalhormones:-Cortisone, Diosgenin and its utility in hormone synthesis, Transformation in steroids molecules.		
IV	Terpenoids	1	25 %
	Chemistry of Camphor, Chemistry of Zingiberene, Chemistry of Carotenes,Bio synthesis study of Tri-Terpenoids and Tetra Terpenoids.		



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### 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/](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.
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**SUBJECT CODE: MCHE302UDSC**

**SUBJECT NAME: MEDICINAL CHEMISTRY-I**

### Course Objective:

- The objective of the course is 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:

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	1	25 %
	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 standards, Modern methods of pharmaceutical Analysis Diagnostic Agents, Pharmaceutical acid: Solvents, Vehicles, Flavors, Suspending agents, Surfactants, Emulsifying agents.		
II	Antibiotics	1	25 %
	Classification of Antibiotics, Synthesis and Activity of: Penicillin, Cephalosporin, Streptomycin, Amoxicillin, Neomycin, Chloroamphenicol.		
III	Sulpha drugs	1	25%
	Chemistry of Sulfonamides, Synthesis and uses: Sulphanilamides, Sulphafurazole, Sulphaguanidine, Sulphathiazole, Sulphamerazine, Sulphalene, Sulphathiadiazole, Trimethoprim.		
IV	Stimulating Agents	1	25 %
	Drugs stimulating or blocking the peripheral nervous system, Cholinergic & Anticholinergic drugs, Histamine and Antihistamine, Local Anesthetics		



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### Reference Books:

1. Medicinal chemistry– AshutoshKar.
2. An introduction to Medicinal chemistry (6th edition)–GrahamL.Patrick.
3. Berger's Medicinal chemistry (Volume1-8), 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/](https://www.advancedmedicinalchemistry-notes.com/articles/basic_concepts/)

### Lab Experiments:

1. Organic Separation:

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



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**SUBJECT CODE: MCHE303UDSC**

**SUBJECTNAME: INDUSTRIAL CHEMISTRY-I**

**Course Objective:**

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

**Course Outcomes:**

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 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 EdwinE.Slosson, Medtech

**Suggested Readings:**

- Introduction To Industrial Chemistry by WhiteHL, John Wiley

**Online Resources:**

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





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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:

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 communications 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	1	25 %
	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 $^1\text{H}$ NMR and $^{13}\text{C}$ NMR spectra.		
II	Name reactions (synthesis of alkene)	1	25 %
	Shapiro reaction, Petersen synthesis, Julia olefination, Curry reaction, Wittig reaction, Corey-Fuchs reaction, Appel reaction, DEAD reagent, Corey-Winter, Tebbe reagent, Eschenmayer fragmentation, Multicomponent reactions: Ugi, Passerini, Biginelli and Mannich reactions, Ring formation reactions: Pausan-Khand, Bergman and Nazarov cyclization.		
III	Photochemistry	1	25%
	Photochemical reactions, Principle of energy transfer, electronic excitation (Jablonski diagram), Photosensitization, Photochemistry of carbonyl compounds, Norrish type-I and II, reaction of cyclic ketones, Perino-Buchi reaction, Di- $\pi$ methane rearrangement, Dinone photochemistry, Cis-trans Isomerization, Photo chemistry of conjugated dienes, photo rearrangement, Barton reaction. Fluorescence chemistry and its application.		
IV	Elimination reactions	1	25 %



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$\alpha$ , $\beta$ and $\gamma$ elimination reaction, region selectivity of the elimination, E1CB mechanism, E2 Mechanism, Hoffmann degradation of quaternary ammonium salt, dehalogenation, E1 mechanism, Chugave reaction, cope elimination, Pyrolysis of selenoxide and sulfoxide, dehydration of aldol.		
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## 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.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.synthesisofalkene-tutorials.ws/>
- [https://www.eliminationreactions-notes.com/articles/basic\\_concepts/](https://www.eliminationreactions-notes.com/articles/basic_concepts/)

## Lab Experiments

### Spectroscopic problems:

Identification of Organic compound by given spectral data. (Combined UV-visible, <sup>1</sup>H NMR, IR)



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**SUBJECT CODE: MCHE301USE**

**SUBJECT NAME: ENVIRONMENTAL CHEMISTRY**

**Course Objective:**

Basic knowledge about the Environment and its various spheres.

Course Outcomes:

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	15	50%
	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, Bio distribution of elements.		
2.	Hydrosphere	15	50%
	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 chlorinedem and, Purification and treatment of water.		



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M.SC.SEM-IV

**SUBJECT CODE: MCHE401UDSC**

**SUBJECT NAME: HETERO CYCLIC 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:**

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)	1	25 %
	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 Hetero cycles with fuse drings, Naming of Bicyclic bridged structures.		
II	Hetero cyclic Compounds(PART-B)	1	25 %
	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.		
III	Rearrangements & Uses of Selective Reagents:	1	25%
	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-isopropylamide, 4. Crownethers,		



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	5. Dicyclohexylcarbodiimide, 6. Cerium ammonium nitrate, 7. Wilkinson's catalyst.		
IV	<p>Synthesis based on Rearrangement and name reactions</p> <p>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) Aceto phenone – Oxime – Acetanilide. c) Phthalic anhydride – o-benzoyl benzoic acid - anthraquinone. d) Aniline- Acetanilide- p-Nitro acetanilide-p-Nitroaniline- pphenylenediamine e) Acetanilide-p-Bromoacetanilide-p-Bromoaniline. Other preparations based on theory.</p>	1	25 %

## Reference Books:

- Hetero cyclic chemistry, K. Bansal.
- Hetero cyclic chemistry, R.R. Gupta, M. Kumar & V. Gupta, Springer.
- Medicinal Chemistry, A. Burger Volume I to VM. 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. Mechanism and S.P. Singh

## Online Resources:

- <https://www.makerspaces.com/heterocyclicchemistry-structure/>
- <https://www.organicchemistry-reactionmechanism-tutorials.ws/>
- [heterocyclicchemistry-notes.com/articles/basic\\_concepts/](https://heterocyclicchemistry-notes.com/articles/basic_concepts/)

## Lab Experiments:

- Organic Separation:-

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



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**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:**

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 Psy-chopharmacological Agents	15	25%
	Antipsychotics, Antidepressant, Antianxiety, Anticonvulsants, Hallucinogenic Drugs, Antiparkinsonism Drugs, Sedative & Hypnotics, General Anesthetics'.		
2	Drugs Acting on the Cardiovascular Haemopoietic and Renal System	15	25%
	Cardiac Drugs, Diuretics, Anti-fungal agents, Antimalarial Drugs.		
3	Anti-Cancer Agents-I	15	25%
	Classification of Cancer, Phase of the cell-cycle, Structural activity relationship, Mechlorethamine, Chlorambucil, Melphalan, Cytosan.		
4	Anti-Cancer Agents-II	15	25%
	Antimetabolites (Methotixate, Purinitol), Antagonist (5-florouracine, Tamoxifen), Antibiotics (Mytomycin-C), Plants products (Paclitaxel, Chamtothesin).		



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### Reference Books:

- Berger's Medicinal Chemistry (Volume 1-8), VII edition—JA Braham, 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/heterocyclicchemistry-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
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**SUBJECT CODE: MCHE403UDSC**

**SUBJECT NAME: INDUSTRIAL CHEMISTRY-II**

**Course Objective:**

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

**Course Outcomes:**

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	15	25%
	Coal, petroleum, natural gas, organic chemicals from coal distillation refining of oil for industrial fuels, Textile fibers classification, Manufacture of important polyamide, Polyester fiber.		
2	Industrial Paint and Varnish & Explosives	15	25%
	Classification of paints, Manufacture of paints, Methods of applying paints, Varnish-Rawmaterials, Manufacture of varnishes, types of varnishes, Types of Explosive, Characteristics of explosive, Industrial explosive.		
3	Industrial Polymers	15	25%
	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, polyacrylonitrile.		
4	Home Products Science	15	25%
	Selected small scale industries, Safety matches, Agarbatties, Naphthalene balls, Carboxylic acid, Cyclohexane, 2-Br- cyclohexanone, 2-Br-4-4-Dimethyl disinfectant, Soap, Detergent.		





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### 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 HL, 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.



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**SUBJECT CODE: MCHE404UDSC**

**SUBJECT NAME: ADVANCED ORGANIC CHEMISTRY-II**

**Course Objective:**

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

**Course Outcomes:**

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 skill through working 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	15	25%
	Classification General method of structural determination, biosynthesis studies of Anthocyanine (cyanin and pelargonidin), Flavones (chrysin), Flavonols (Quercetin), Flavonone (Dihydro Flavones) and isoflavones (Daidzein), Coumarin, Quinones (polyphenolic acid), porphyrins, Chemistry of Haemin and chlorophyll.		
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	15	25%



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	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) heptanes and Bicyclo (2,2,2) octane.		
4	Advances in NMR	15	25%
	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.		

#### Reference Books:

- Fundamental of Enzymology–N.C.Price.L.Stevens, OxfordUni.Press,NY1998.
- Bio genesis of Natural Compounds–P.Bernfield.
- Biochemistry– A.H.Lehninger.

#### Suggested Readings:

- Outline of Biochemistry– Cornand 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:

- Spectro scopic problems:-  
Identification of Organic compound by given spectral data(CombinedUVvisible,HNMR,13CNMR, Mass, IR).



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**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:**

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 organo-metallic 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 carbenes-Synthesis, Nature of bond, Structural characteristics, Nucleophilic and electrophilic reactions on the ligands, Role in Organic synthesis, Transition metal compound with bonds to Hydrogen.	15	
2.	Transition Metal $\pi$ -Complexes	15	50%
	Transition Metal $\pi$ -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.		

**Reference Books:**

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

**Online Resources:**

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