

# Programme Project Report (PPR)

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## Master of Science in Chemistry [M.Sc. Chemistry] (Non-Semester Pattern)



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School of Science  
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Chennai 60015

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**TAMIL NADU OPEN  
UNIVERSITY SCHOOL OF  
SCIENCE  
M.Sc. CHEMISTRY  
Programme Project Report (PPR)**

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**Programme Mission:**

To provide versatile M.Sc. Chemistry programme to the learners to understand the principles of chemistry and to develop graduates with the key practical skills and interdisciplinary knowledge required to address today's global challenges.

**Programme Objectives (PO):**

While studying the Post Graduate Degree in Chemistry, a student shall able to

**PO1.** Impart knowledge on organic, inorganic, physical, analytical, natural products, pharmaceutical and environmental chemistry.

**PO2.** Motivate critical thinking and analysis skills to solve complex chemical problems, e.g., analysis of data, synthetic logic, spectroscopy, structure and team-based problem solving, etc.

**PO3.** Impart the basic analytical and technical skills to work effectively in the various fields of chemistry.

**PO4.** Present scientific and technical information resulting from laboratory experimentation in both written and oral formats.

**PO5.** Motivate students to go for higher studies and research in chemistry.

**PO6.** Improve the self-employability of the students

**PO7.** Foster a commitment to ethical and social responsibilities.

**Programme Specific Objectives (PSO):**

While studying Post Graduate Degree in Chemistry, a student shall be able to:

**PSO1.** Impart knowledge on all branches of chemistry

**PSO2.** Discuss about the potential uses of industrial chemistry, medicinal chemistry, environmental chemistry and green chemistry.

**PSO3.** Carry out experiments in the area of organic analysis, estimation, separation, derivative process, and inorganic semi micro analysis, and preparation, conductometric and potentiometric analysis.

**PSO4.** Effectively work in teams as well as independently

**PSO5.** Get enormous job opportunities at all level of chemical, pharmaceutical, food products, life oriented material industries

**PSO6.** Appear for discipline specific competitive exams conducted by Government service commissions.

**Relevance of the Programme with HEI's Mission and Vision:** The Programme M.Sc., (Chemistry) is offered to meet current needs of aspiring youths and adult population and

understand the depth knowledge of chemical molecules and make them relevant to society. This Programme aims at creating equity in education by providing opportunity to rural people for whom Higher Education is unreachable.

**Nature of prospective target group of Learners:** The M.Sc. Chemistry programme is meant for students who have completed an Undergraduate Degree Programme in Chemistry from recognized University or graduate teachers (BT assistant) are the target groups. It also targets the rural population to reach their dream of obtaining Higher Education for whom the opportunity was denied due to lack of limited number of seats available in the conventional University system.

**Appropriateness of Programme to be conducted in ODL mode to acquire specific skills and competence:** The M.Sc. Chemistry programme will meet out the present day needs of academic and Research, Institutions and Industries. As Programme outcome of the students may acquire depth knowledge in organic, inorganic, physical, analytical, pharmaceutical and environmental chemistry which will motivate the students to go for higher studies/research in Chemistry. Study materials are given in the SLM format and Practical are being conducted at LSC's.

**Instructional Design:**

**Level:** Post Graduate Degree Programme

**Duration:** 2 years

**Medium:** English Medium and in only TamilNadu.

**Instructional delivery:** The Programme is delivered through the Learner Support Centre (LSC) which is affiliated Arts and Science colleges in the State of Tamil Nadu. The faculties of the LSC act as Academic Counselors of the Programme and handle the Counseling classes for the learners.

**Media of Instruction:** Print material in SLM

**Procedure for admissions, curriculum transaction and evaluation:**

**(i) Eligibility:** A candidate who has passed B.Sc. degree with General Chemistry or Biochemistry or Industrial Chemistry as the main subject in part - III with Physics/Maths/Botany/Zoology as one of the allied papers of any affiliated Institution/University accepted by syndicate shall be permitted to admission for M.Sc., chemistry programme of this University.

Fee: Rs.24000 /- for two years

**(ii) Financial Assistance:** SC/ST Scholarship available as per the norms of the State Government of Tamil Nadu. Complete Admission fee waiver for the physically challenged/ differently abled persons.

**(iii) Policy of Programme delivery:** The Academic Calendar for the Programme will be available for the learners to track down the chronological events/ happenings. The Counselling schedule will be uploaded in the TNOU website and the same will be intimated to the students through SMS.

**(iv) Evaluation System:** Examination to Master Degree Programme in Chemistry is designed to maintain quality of standard. Theory will be conducted by the University in the identified Examination Centres. For the Assignment students may be permitted to write with the help of books/materials for each Course, which will be evaluated by the Evaluators appointed by the University.

(v) **Internal Continuous Assessment:** 1 assignment for 2 credits are to be prepared by the learners. E.g. If a Course is of Credit 6, then 3 number of Assignments are to be written by the learner to complete the continuous assessment of the course. Assignment carries 30 marks, consists of Long Answer Questions (not less than 1000 words) for each Course.

Section-A	One Question out of Three Questions	1 x 30 = 30 Marks
<b>Total</b>		<b>30 Marks</b>

(vi) **Term End Examination:** Students shall normally be allowed to appear for theory examination by completing Practical and Assignment. The Term - End Examination shall Carry 70 marks and has Section: A, B and C will be of duration 3 hours.

Part-A	Answer any Five out of Eight questions [each 5 Marks]	5 x 5 = 25 Marks
Part-B	Answer any Three out of Five questions [each 15 Marks]	3 x 15 = 45 Marks
<b>Total</b>		<b>70 Marks</b>

### Question Pattern

Course Name:

Course Code:

Time: 3 Hours

Maximum Marks: 70

#### **PART - A (5 × 5 = 25 Marks)**

Answer any Five questions out of Eight Questions in 300 words

All questions carry equal marks

1. From Block - I
2. From Block - II
3. From Block - III
4. From Block - IV
5. From Block - V
6. From any Block
7. From any Block
8. From any Block



**PART - B (3 × 15 = 45 Marks)**

Answer any Three questions out of Five Questions in 1000 words.

All questions carry equal marks.

9. From Block - I
10. From Block - II
11. From Block - III
12. From Block - IV
13. From Block - V

**(vii) Passing Minimum:**

For theory examination: The candidate shall be declared to have passed the examination if the candidate secures not less than 32 marks in the Term End Examinations (TEE) of each theory paper and secures not less than 13 marks in the Continuous Internal Assessment (CIA) and overall aggregated marks is 50 in both the external and internal taken together.

Continuous Internal Assessment (CIA)		Term End Examination (TEE)		Overall Aggregated Marks	Maximum Marks
Minimum Mark	Maximum Mark	Minimum Mark	Maximum Mark	CIA + TEE	
13	30	32	70	50	100

For practical examination: The candidate shall be declared to have passed the examination if the candidate secures not less than 50 marks in the University practical examination and the mark distributions on results, record note book, procedure writing and Vivo-voce taken together is required to pass the examinations.

**(viii) Classification of Successful Candidates:**

Candidates who pass all the courses prescribed and who secure

- 75% and above (in first attempt only) will be placed in the *First class with Distinction*.
- 60% and above in the aggregate of marks will be placed in the *FirstClass*.
- 50% and above but below 60% in the aggregate will be placed in the *SecondClass*.

**Requirement of laboratory and Library Resources:** The Programme will be offered through the Learner Support Centre (LSC) maintained by Tamil Nadu Open University. The

LSC's have the required infrastructural facilities to conduct the Counselling for the students who wish clear their doubts and also they are having well equipped laboratory facilities relevant to the Master Degree Programme in Chemistry.

A well-equipped Library is available in the University Headquarters with about 24,000 books and lot of research journals. The Learners Support Centre through which the Degree Programme is to be offered is also equipped with a full-fledged library having books and journals related Chemistry.

**Quality Assurance Mechanism:** The Quality of the Master's Degree Programme in Chemistry is maintained by adopting the curriculum suggested by the UGC. As per UGC guidelines the core courses, three elective courses, three subject specific elective courses, two practical courses are included in the Programme. The Curriculum of Master Degree Programme in Chemistry was approved by the Board of Studies, Academic Council and 41<sup>st</sup> Syndicate of our University held on 03-01-2018 subsequently. As a part of Quality assurance, the curriculum for the Programme will be updated once in three years. Accordingly, the curriculum is updated and approved by Board of Studies held on 18-06-2020. Necessary steps are being taken to obtain feedback from the students and the Academic Counsellors who are part of the Programme for effective delivery of the Programme.

The structure of M.Sc. Chemistry is as follows:

Subject	Title of the Subject	Subject Code	Credit	Examination		
				Mark Distribution		Maximum Marks
				CIA*	TEE#	
<b>I Year</b>						
Core - I (Theory)	Organic Chemistry-I	MCHEN- 11	8	30	70	100
Core -II (Theory)	Inorganic Chemistry-I	MCHEN- 12	8	30	70	100
Core - III (Theory)	Physical Chemistry-I	MCHEN- 13	8	30	70	100
Core - IV (Theory)	Analytical and Environmental Chemistry	MCHEN- 14	8	30	70	100
Core - V (Theory)	Chemistry of Bio-Molecules and Green Chemistry	MCHEN- 15	8	30	70	100
Core-VI (Theory)	Polymer Chemistry	MCHEN- 16	8	30	70	100
<b>Total- A (I year)</b>			<b>48</b>	<b>180</b>	<b>420</b>	<b>600</b>
<b>II Year</b>						
Core -VII (Theory)	Organic Chemistry-II	MCHEN- 21	8	30	70	100
Core -VIII (Theory)	Inorganic Chemistry-II	MCHEN- 22	8	30	70	100
Core - IX (Theory)	Physical Chemistry-II	MCHEN- 23	8	30	70	100
Practical-I (Core)	Organic Chemistry	MCHEN-P1	6	-	100	100

Practical-II (Core)	Inorganic Chemistry	MCHEN-P2	6	-	100	100
Practical-III (Core)	Physical Chemistry	MCHEN-P3	6	-	100	100
<b>Total - B (II year)</b>			<b>42</b>	<b>90</b>	<b>510</b>	<b>600</b>
<b>Total - (A+B)</b>			<b>90</b>	<b>270</b>	<b>930</b>	<b>1200</b>

\* Continuous Internal Assessment (CIA)

#Term End Examination (TEE)

### Programme Outcomes (POC):

On successful completion of Post Graduate Degree in Chemistry, students will be able to:

**POC1.** Demonstrate, solve and an understanding of major concepts in all disciplines of chemistry.

**POC2.** Think critically, systematically, independently to analyze the chemical problems and to draw a logical conclusion.

**POC3.** Make international collaborations for students and faculty exchange and research cooperation.

**POC4.** Familiarize with the emerging areas of Chemistry and their applications in various spheres of Chemical sciences and to apprise the students of its relevance in future studies.

**POC5.** Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.

**POC6.** Design, carry out, record and analyze the results of chemical experiments and are familiar with standard safety practices, equipment, procedures, and techniques common to most working laboratories.

**POC7.** Have the global level research opportunities to pursue Ph.D. programme targeted approach of CSIR - NET examination

### Programme Learning Outcomes (PLO):

**PLO1: Knowledge:** capability of demonstrating comprehensive disciplinary knowledge gained during course of study.

**PLO 2: Research:** Aptitude and Investigation ability of critical thinking, analytical reasoning and research-based knowledge including design of experiments, analysis and interpretation of data to provide conclusions.

**PLO 3: Communication:** ability to communicate effectively on general and scientific topics with the scientific community and with society at large

**PLO 4: Problem Solving:** capability of applying knowledge to solve scientific and other problems using theoretical and practical techniques, skills, and tools.

**PLO 5: Science and Society:** ability to apply reasoning to assess the different issues related to society and the consequent responsibilities relevant to the professional scientific practices.

**PLO 6: Life-Long Learning:** aptitude to apply knowledge and skills that are necessary for participating in learning activities in day-to-day life.

**PLO 7: Modern Tool Usage:** ability to use and learn techniques, skill and modern tools for scientific practices.

**PLO 8: Project Management:** ability to demonstrate knowledge and understanding of the scientific principles and apply these to manage projects.

**PLO 9: Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

## Detailed Syllabi and Curriculum Mapping of M.Sc. Chemistry

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<b>COURSE TITLE</b>	<b>:</b>	<b>ORGANIC CHEMISTRY – I</b>
<b>COURSE CODE</b>	<b>:</b>	<b>MCHEN - 11</b>
<b>COURSE CREDIT</b>	<b>:</b>	<b>8</b>

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### COURSE OBJECTIVES (CO)

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While studying the Organic Chemistry - I course, the student will be able to:

**CO1.** Define the characteristic features and applications of addition and elimination reactions

**CO2.** Explain about the characteristic features and applications of nucleophile and electrophilic substitution reactions

**CO3.** Describe the stereochemistry and conformational analysis of organic molecules

**CO4.** Determine the retro synthetic methods and important organic reagents

**CO5.** Characterize the aromaticity of organic molecules

### COURSE OUTCOMES (COC)

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After completion of the Organic Chemistry - I course, the student will be able to:

**COC1.** Describe the characteristic features and applications of addition and elimination reactions

**COC2.** Define the characteristic features and applications of Nucleophilic and Electrophilic Substitution reactions

**COC3.** Describe the stereochemistry and conformational analysis of organic molecules

**COC4.** Recognize the retro synthetic methods and important organic reagents

**COC5.** Discuss the aromaticity of organic molecules

### **Block I: Addition and Elimination Reactions**

**Unit-1-** Introduction to addition reactions - Electrophilic, Nucleophilic and Free radical additions - Orientation of the addition - Stereochemical factors influencing the addition

**Unit-2-** Syn and Anti, hydroboration - Epoxidation - Ozonolysis - Addition to carbonyl/ conjugated carbonyl systems and carbon-oxygen double bond - Grignard reagents - 1,2-/1,4-additions - Benzoin, Knoevenagel, and Reformatsky reactions

**Unit-3-** Introduction to elimination reactions - E<sub>1</sub>, E<sub>2</sub>, E<sub>1cB</sub> mechanisms - Stereochemistry for elimination reactions

**Unit-4-** Hofmann's and Zaitsev's rules - Pyrolytic cis-elimination - Chugaev reaction - Dehydration,

Dehydrohalogenation - Hofmann degradation- Cope elimination.

## **Block II: Nucleophilic and Electrophilic Substitution Reactions**

**Unit-5-** Introduction to aliphatic nucleophilic substitution reaction -  $S_N1$ ,  $S_N2$ ,  $S_Ni$  mechanisms - Neighbouring Group Participation - non-classical carbocations-Wagner-Meerwein and Dienone-phenol rearrangements

**Unit-6-**Introduction to aromatic nucleophilic substitution reaction: $S_N1$ ,  $S_NAr$ , Benzyne mechanism - Ullmann, Sandmeyer and Chichibabin reactions

**Unit-7-**Introduction to aromatic electrophilic substitution reaction - substitutions in thiophene and pyridine-N-oxide - Hammett equation - Taft equation

**Unit-8-**Introduction to aliphatic electrophilic substitution Reaction:  $S_E2$ ,  $S_{Ei}$  and  $S_{E1}$  mechanisms - Diazonium salts - Diazoniumcoupling reactions

## **Block III: Stereochemistry and Conformational Analysis**

**Unit-9-**Introduction to stereoisomerism - symmetry -Enantiomers and Diastereomers - Optical activity and chirality - Types of molecules exhibiting optical activity - Elements of symmetry

**Unit-10-**Fisher's projection - D,L and R,S configurations -Absolute configuration - Molecules with more than one chiral centres-Atropisomerism-EandZnomenclature

**Unit-11-**Stereochemistry of simple addition and elimination reactions – Stereospecific and stereoselective synthesis

**Unit-12-**Molecular chirality - Allenes, Spiranes, Biphenyls -Conformations of Cyclopentane, Cyclohexane, Cyclohexene and Fused (decalin) and Bridged (norbornane type) ring systems - Anomeric effect in cyclic compounds.

## **Block IV: Synthetic Methodology**

**Unit-13-**Introduction to Reterosynthesis- Disconnections – Synthons- Synthetic equivalent - Target molecules - Protection and deprotection of functional groups (R-OH, -CHO, -C=O, -NH<sub>2</sub>, -COOH) -

**Unit-14-**Applications of Jonesreagent, PCC, PDC, DMP, CAN, Mn(OAc)<sub>3</sub>, NOCl,

**Unit-15-**Reduction: Platinum/nickel/palladium based heterogeneouscatalysts for hydrogenation - Wilkinson's catalyst - reductions using Li/Na in liquid ammonia

**Unit-16-**Applications of BF<sub>3</sub>, NBS, NaBH<sub>4</sub>, LiAlH<sub>4</sub>, Grignard reagent, Organozinc and Organolithium reagent

## **Block V: Aromaticity**

**Unit-17**-Huckel's theory of aromaticity - Concept of homoaromaticity/antiaromaticity - Aromaticity of benzenoid, heterocyclic, and non-benzenoid compounds

**Unit-18**-Aromatic character of Five-, six-, seven-, and eight-membered rings - Electron occupancy in MO's and aromaticity

**Unit-19**-NMR concept of aromaticity and antiaromaticity - Systems with 2,4,8 and 10 electrons - systems of more than 10 electrons (annulenes) - Mobius aromaticity

**Unit-20**-Bonding properties of systems with  $(4n+2)\pi$ -electrons and  $4n\pi$ -electrons, alternant and non-alternant hydrocarbons (azulene type) - Aromaticity in heteroaromatic molecules - Sydnones and fullerenes

### **Text Books:**

1. R.K. Bansal, Organic Reaction Mechanism, I Edition.
2. P. S. Kalsi, Stereochemistry: Conformation and Mechanism, II Edition.
3. V. K. Ahluwalia, Organic Reaction Mechanism, II Edition.
4. S. N. Sanyal, Reactions, Rearrangements and Reagents
5. S.M. Mukherji and S.P. Singh, Organic Reaction Mechanism, MacMillan India Ltd., Chennai (1990) - I Edition.
6. Ernest L. Eliel, Samuel H. Wilen, Stereochemistry of Organic Chemistry, II Edition.

### **Reference Books:**

1. J. Miller, Advanced Organic Chemistry, III Edition
2. J. D. Roberts and M. C. Caserio, Basic principles of Organic chemistry.
3. Stanley Pines, Organic Chemistry, IV Edition
4. R.O.C. Norman and J. M. Coxon.(ELBS) Principle of organic synthesis, II Edition
5. Advanced organic chemistry (McGraw-Hill) J. March.
6. Peter Sykes, A Guide book to mechanism in organic chemistry, Pearson Edn., (2006).

### **Web Links:**

1. <https://youtu.be/AunAQ4EMylA>
2. <https://youtu.be/N06uXaIKDPQ>
3. <https://youtu.be/161qrDk5orM>



4. [https://youtu.be/qbP\\_Ehx87oY](https://youtu.be/qbP_Ehx87oY)
5. <https://youtu.be/zNxPngVqa4o>
6. <https://youtu.be/IaplvqRJL1I>
7. <https://youtu.be/HK2ZVmaO6RA>
8. [https://youtu.be/cNBIYHmW\\_ok](https://youtu.be/cNBIYHmW_ok)
9. <https://youtu.be/q77l5Qpq2YM>
10. <https://youtu.be/8NVHKwuhUd0>
11. <https://youtu.be/DwPhHIwuUk8>
12. [https://youtu.be/SdpXFcf\\_La0](https://youtu.be/SdpXFcf_La0)
13. [https://youtu.be/jzQ\\_xMEjf94](https://youtu.be/jzQ_xMEjf94)
14. [https://youtu.be/3\\_BPUU960s4](https://youtu.be/3_BPUU960s4)
15. [https://youtu.be/iUIzpEEpW\\_Q](https://youtu.be/iUIzpEEpW_Q)
16. <https://youtu.be/Pp0LeL0SkRg>
17. <https://youtu.be/wWmFWQpCiEc>
18. <https://youtu.be/-cn36GY4FOg>
19. <https://youtu.be/yNWGOsa-SEo>
20. <https://youtu.be/ab4WFo0Eq-k>

**COURSE TITLE** : **INORGANIC CHEMISTRY – I**  
**COURSE CODE** : **MCHEN– 12**  
**COURSE CREDIT** : **8**

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### **COURSE OBJECTIVES (CO)**

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While studying the Inorganic Chemistry - I course, the student will be able to:

**CO1.** Describe the theories and characteristic features of covalent and ionic bonding in organic molecules

**CO2.** Explain about the characteristics and applications of coordination chemistry

**CO3.** Determine the stereochemistry of coordination compounds

**CO4.** Interpret the kinetics and reaction mechanism of coordination compounds

**CO5.** Acquire knowledge on the coordination chemistry of lanthanides and actinides

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### **COURSE OUTCOMES (COC)**

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After completion of the Inorganic Chemistry - I course, the student will be able to:

**COC1.** Describe the theories and characteristic features of covalent and ionic bonding in organic molecules

**COC2.** Explain the characteristics and applications of coordination chemistry

**COC3.** Discuss the stereochemistry of coordination compounds

**COC4.** Interpret the kinetics and reaction mechanism of coordination compounds

**COC5.** Recognize the coordination chemistry of lanthanides and actinides

### **Block I: Covalent and Ionic Bonding**

**Unit-1-**V.B. approach to covalent bonding -Heitler, London, Pauling, Slater refinements - Hybridization and structure of molecule - VSEPR theory - Shapes of molecules - M.O. approach to covalent bonding

**Unit-2-**Symmetry and overlap of atomic orbitals - Symmetry of molecular orbitals -Sigma/pi/delta bondings - Bond length, bond order and bond energy

**Unit-3-**Ionic character in a covalent bond -Concept of multi centre bonding - Structure and bonding in fluorine and oxygen compounds of xenon and krypton - Bonding in simple tri atomic molecules/ions

**Unit-4-**Lattice energy and its calculations by Born-Lande and Born-Meyer equations - Determinations by Born-Haber cycle- Properties of ionic compounds.

## **Block II: Coordination chemistry**

**Unit-5**-Classification of complexes based on coordination numbers and possible geometries - Bonding in coordination compounds

**Unit-6**-Crystal field splitting - CFSE - Factors affecting crystal field splitting - Splitting of d orbitals in octahedral, tetrahedral, square planar, square pyramidal and trigonalbipyramidal fields

**Unit-7**-Sigma/pi bonding in coordination compounds - Spectro chemical series - Jahn-Teller distortion- Tanabe-Sugano and Orgel diagrams - Chelate effect - Spinersls--Nephelauxetic effect

**Unit-8**-Ligand field theory - LFSE - M.O energy level diagrams for octahedral and tetrahedral complexes without and with  $\pi$ -bonding

## **Block III: Stereochemistry of Coordination Compounds**

**Unit-9**-Geometrical and optical isomerism in octahedral complexes -Resolution of optically active complexes

**Unit-10**-Determination of absolute configuration of complexes by ORD and Circular Dichroism

**Unit-11**-Stereoselectivity and conformation of chelate rings - Asymmetric synthesis catalyzed by coordination compounds.

**Unit-12**-Linkage isomerism - Electronic and Steric factors affecting linkage isomerism - Symbiosis- Hard and Soft ligands - Prussian blue and related structures–Macrocycles- Crown ethers.

## **Block IV: Kinetics and Reaction mechanism of Coordination compounds**

**Unit-13**- Introduction to Electron transfer reactions –Complementary and non-complementary reaction - Adiabatic and Non adiabatic electron transfer reactions- Atom transfer reactions - Outer and Inner sphere mechanism

**Unit-14**- Marcus-Hush Theory - Reactions of coordinated ligands - Thermodynamic and kinetic stability

**Unit-15**- Kinetics and mechanism of nucleophilic substitution reactions in square planar complexes - Trans effect theory

**Unit-16**- Kinetics and mechanism of octahedral substitution- Water exchange, dissociative and associative mechanisms -Racemisation reactions -Solvolytic reactions (acidic and basic).

## **Block V: Coordination Chemistry of Lanthanides and Actinides**

**Unit-17-**General characteristics of Lanthanides-Electronic configuration, Term symbols for lanthanide ions, Oxidation state

**Unit-18-** Lanthanide contraction - Factors influence the formation of lanthanide complexes

**Unit-19-** Electronic spectra and magnetic properties of lanthanide complexes - Lanthanide complexes as shift reagents

**Unit-20-** General characteristics of Actinides- Difference between 4f and 5f orbitals - Comparative account of coordination chemistry of lanthanides and actinides

### **Text Books:**

1. G. D. Tuli, SathyaPrakas, Basu, R. D. Madhan, Advanced Inorganic Chemistry, I Edition.
2. U. Wahid Malik, G. D. Tuli, R. D. Madhan, Selected Topics in Inorganic Chemistry.
3. J.E. Huheey, Inorganic Chemistry, Harper and Collins, NY, IV Edition, (1993).
4. J. D. Lee, Inorganic Chemistry
5. AshuthoshKar, Advanced Inorganic Chemistry, I Edition.
6. Puri, Sharma, Kalia, Principles of Inorganic Chemistry

### **Reference Books:**

1. F. A. Cotton, G.W. Wilkinson, Advanced Inorganic Chemistry- Acomprehensive Text, John Wiley and Sons, (1988).
2. K.F. Purcell, J.C. Kotz, Inorganic Chemistry WB Saunders Co., USA, (1977).
3. M.C.Shrivers, P.W Atkins, CH. Langford, Inorganic Chemistry, OUP, (1990).
4. N.N. Greenwood and Earnshaw, Chemistry of the Elements, Pergamon Press, New York (1984).
5. N. H. Ray, Inorganic Polymers, Academic Press, (1978).
6. S.F.A. Kettle, Coordination Chemistry, ELBS, (1973).
7. A.B.P. Lever, Inorganic Electronic Spectroscopy, Elsevier, New York, (1984), II Edition.
8. M.C. Day, J. Selbin, Theoretical Inorganic Chemistry, Van Nostrand Co., NY, (1974).

### **Web Links:**

1. <https://youtu.be/DBrq31w8vC4>
2. <https://youtu.be/d3io8p0koOc>
3. <https://youtu.be/7ypHzVcn5dU>
4. <https://youtu.be/5IA156Zi-AM>
5. <https://youtu.be/Hs5JBjX51dc>
6. <https://youtu.be/z9CmSAV1wcY>
7. <https://youtu.be/AxhYojp4Zq0>
8. <https://youtu.be/iT0PpN7y64M>
9. <https://youtu.be/Kde-OdAqTIY>
10. <https://youtu.be/-VHFrocFaCw>
11. <https://youtu.be/vJtw9LiZtbl>
12. <https://youtu.be/6JvRCiTIKe8>
13. <https://youtu.be/vJnzyxxFiVU>
14. <https://youtu.be/MsWDtQ5pjzs>
15. <https://youtu.be/zNxPngVqa4o>
16. <https://youtu.be/Du6Jh1ZyP0U>
17. <https://youtu.be/RlwUKtal0SQ>
18. <https://youtu.be/UVgag7nLC9s>
19. <https://youtu.be/uhEzEOImyWE>
20. <https://youtu.be/coL6arzXuGU>

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**COURSE TITLE** : **PHYSICAL CHEMISTRY - I**  
**COURSE CODE** : **MCHEN - 13**  
**COURSE CREDIT** : **8**

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### **COURSE OBJECTIVES (CO)**

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While studying the Physical Chemistry - I course, the student will be able to:

**CO1.** Explain about the concepts and importance of classical thermodynamics

**CO2.** Describe the theories, terms and applications of quantum chemistry

**CO3.** Interpret the kinetics of chemical reactions

**CO4.** Determine the terms and applications of phase rule

**CO5.** Acquire knowledge on the characteristic features of electrochemistry

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### **COURSE OUTCOMES (COC)**

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After completion of the Physical Chemistry - I course, the student will be able to:

**COC1.** Define the concepts and importance of classical thermodynamics

**COC2.** Describe the theories, terms and applications of quantum chemistry

**COC3.** Analyse the kinetics of chemical reactions

**COC4.** Describe the terms and applications of phase rule

**COC5.** Explain the characteristic features of electrochemistry

### **Block I: Classical Thermodynamics**

**Unit-1-** Thermodynamics concept: Concept of entropy, reversible and irreversible processes, Free energies

**Unit-2-** Fundamental equations for open systems - Partial molar quantities and chemical potential- Variation of Chemical potential with temperature and with pressure

**Unit-3-** Gibbs-Duhem equation - Real gases and Fugacity

**Unit-4-** Thermodynamics of ideal and non-ideal solutions: Liquid-liquid solutions - Liquid-solid solutions

## **Block II: Quantum Chemistry**

**Unit-5-** Quantum Theory: Inadequacy of classical mechanics - Black-body radiation - Planck's distribution - Photoelectric effect

**Unit-6-** Wave-particle duality of material particles and de Broglie's hypothesis -Dynamics of microscopic systems: Born interpretation of the wave function- Normalization - Quantization - Probability density and Uncertainty principle

**Unit-7-** Quantum mechanics: Schrodinger equations - Operator algebra: Operators - Linear and Hermitian - Eigen functions and Eigen values -Application of wave mechanics: Rigid rotor - Harmonic oscillators

**Unit-8-** Particle in a box: One and three-dimensional boxes -Distortions - quantum numbers - Orthogonalization and normality -Tunneling - Perturbation theory

## **Block III: Chemical Kinetics - I**

**Unit-9-** Theories of Reaction Rates: Rate laws and rate constants - reaction order - determination of rate law - reactions approaching equilibrium - temperature dependence of reaction rates

**Unit-10-** Arrhenius parameters - Theories of reaction rates: Collision theory - Steady state hypotheses -Lindmann's theory of unimolecular reaction

**Unit-11-** Transition state theory - Comparison of collisions and transition state theories in simple gas reactions - Steric factor - Transmission coefficient

**Unit-12-** Elementary Reactions in Solutions: Activated complex theory - Bronsted-Bjerrum equation - Primary and secondary salt effects - Kinetic isotope effect - Potential energy surfaces.

## **Block IV: Phase Rule**

**Unit-13-** Introduction to Phase, Component, Degrees of freedom - Gibbs Phase rule

**Unit-14-** Three component systems -Method of plotting three component system - Stokes Roozeboom plot -Method of parallel lines

**Unit-15-**Phase behavior of three liquid components exhibiting partial miscibility - one pair, two pairs and three pairs of partial miscible liquids-Effect of temperature

**Unit-16-**Classification of phase transitions - Phase behavior of solid-liquid, liquid-solid and solid - Vapour boundaries.

## **Block V: Electrochemistry**

**Unit-17-** Concept of activity, activity coefficient, mean ionic activity, mean ionic activity coefficient

**Unit-18-** Debye-Huckel theory - Debye-Huckel theory of strong electrolytes - Debye-Huckel limiting law

**Unit-19-** Polarizable and Non-polarizable interfaces - Lippman Equation - Relating charge density and interfacial tension

**Unit-20-** Different models of double layer - Helmholtz-Perrin model - Gouy-Chapmann diffuse charge model and Stern model - Derivation of Butler-Volmer equation - Tafel equations.

### **Text Books:**

1. B. R. Puri, M. Sharma, S. Pathania, Physical Chemistry, I Edition
2. K.J. Laidler, Chemical Kinetics, II Edition
3. C.N. Banwell, Fundamentals of Molecular Spectroscopy
4. Pearson House, Fundamentals of Chemical Kinetics
5. Pearson House, Fundamentals of Quantum Chemistry
6. R.C. Srivastava, S.K. Saha, A.K. Jain, Thermodynamics, I Edition.

### **Reference Books:**

1. P.W. Atkins Physical Chemistry.
2. A. Frost, G. Pearson, Kinetics and Mechanism of Reaction Rates.
3. H. Eyring, Modern Chemical Kinetics.
4. R. Chang, Basic Principles of Spectroscopy.
5. J.W. Akit, NMR and Chemistry.
6. G.M. Barrow, Introduction to Molecular Spectroscopy.
7. S. Glasstone, Thermodynamics for Chemists.
8. C. Kalidas, Non – equilibrium Thermodynamics.
9. S. Glasstone, Electrochemistry.
10. Electrochemistry: P.H. Reiger
11. J.O'M Bockris, A.K.N. Reddy, Modern Electrochemistry, Vol. I:



## **Web Links:**

1. <https://youtu.be/PXf2KTfjEg>
2. <https://youtu.be/lGuDbdnXrhI>
3. <https://youtu.be/eHeSc45OyZE>
4. <https://youtu.be/HHEk-p0Z64g>
5. <https://youtu.be/DU4bMn6GO-I>
6. [https://youtu.be/WLmHi\\_XFo0g](https://youtu.be/WLmHi_XFo0g)
7. <https://youtu.be/PKKn-rkQLnY>
8. <https://youtu.be/p82enyv3XA0>
9. <https://youtu.be/g7jmTgqOVZ8>
10. <https://youtu.be/fgCrQ1sXDHI>
11. <https://youtu.be/AXapS-Ai3Go>
12. [https://youtu.be/UBlwo\\_1FNrI](https://youtu.be/UBlwo_1FNrI)
13. <https://youtu.be/VojKMD3WY3w>
14. <https://youtu.be/fyJOEGTcHSM>
15. <https://youtu.be/IYbUJpnFdpQ>
16. <https://youtu.be/zU0VCVNoluU>
17. <https://youtu.be/nuYk3K7a9OU>
18. <https://youtu.be/NteoekTHkDU>
19. <https://youtu.be/BT7fFIO9CwE>
20. <https://youtu.be/kamimMzfg3k>

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**COURSE TITLE** : **ANALYTICAL AND ENVIRONMENTAL CHEMISTRY**  
**COURSE CODE** : **MCHEN - 14**  
**COURSE CREDIT** : **8**

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### **COURSE OBJECTIVES (CO)**

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While studying the Analytical and Environmental Chemistry course, the student will be able to:

- CO1.** Describe the principle, instrumentation and applications of NMR Spectroscopy
- CO2.** Explain about the principle, instrumentation and applications of IR Spectroscopy
- CO3.** Determine the principle, instrumentation and applications of UV Vis and Mass Spectroscopy
- CO4.** Discuss the principle and applications ORD/CD/Chromatography/Electro analytical Methods and Thermogravimetry analysis
- CO5.** Interpret the sources and impact of pollution and laboratory hygiene rules

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### **COURSE OUTCOMES (COC)**

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After completion of the Analytical and Environmental Chemistry course, the student will be able to:

- COC1.** Define the principle, instrumentation and applications of NMR Spectroscopy
- COC2.** Explain the principle, instrumentation and applications of IR Spectroscopy
- COC3.** Describe the principle, instrumentation and applications of UV Vis and Mass Spectroscopy
- COC4.** Analyse the principle and applications ORD/CD/Chromatography/Electro analytical Methods and Thermogravimetry analysis
- COC5.** Determine the pollution and laboratory hygiene rules

### **Block I: NMR Spectroscopy**

**Unit-1-**NMR Spectroscopy: Principle - Instrumentation -  $^1\text{H}$  NMR: Chemical shift - Spin-spin coupling - Peak area - Homotopic/enantiotopic/diastereotopic relationships

**Unit-2-** First order/non first order spectra - Factors affecting spin-spin splitting/width of lines - Deuterium substitution - Shift reagents - Double resonance technique

**Unit-3-**  $^{13}\text{C}$  NMR: Basic concepts - Comparison of H and C NMR - Fourier transformation - Chemical shift and its dependence C-C and C-H couplings -

**Unit-4-** Off resonance and broad band decoupling - Application in structural elucidation for some simple molecules.

## **Block II: IR Spectroscopy**

**Unit-5-** IR Spectroscopy: Principle - Instrumentation - Source of IR radiations, Monochromatization, Cell and Prim materials, measuring intensities of IR radiations

**Unit-6-** Sample handling techniques - Stretching vibrations -Hooke's Law -Stretching and bending vibrations

**Unit-7-** Force constants -Fundamentals, overtone and combination bands -Fermi resonance -Effects of substitution/conjugation/bond angle/hydrogen bonding on vibrational frequencies

**Unit-8-** Detecting inter/intra-molecular hydrogen bonding - Frequencies of absorption for nitrate/sulphate/chlorate ions/ammonia/water molecule-shift in frequencies upon coordination

## **Block III: UV- Visible and Mass Spectroscopy**

**Unit-9-** UV- Visible Spectroscopy: Principle - Instrumentation - Electronic excitation  $\sigma\text{-}\sigma^*$ ,  $n\text{-}\sigma^*$ ,  $n\text{-}\pi$  and  $\pi\text{-}\pi^*$  transitions

**Unit-10-** Solvent effect -Factors affecting position/intensity of absorption bands -Woodward -Fieser rules- UV spectra of dienes, polyenes and unsaturated ketones

**Unit-11-** Mass Spectrometry: Principle - Instrumentation- Parent ion, metastable ion & isotopic ions - Base peak

**Unit-12-** General rules of fragmentation -MacLafferty rearrangement -Retro Diels-Alder reaction.

## **Block IV: ORD/CD/Chromatography/Electro analytical Methods and Thermogravimetry**

**Unit-13-** ORD & CD: Principle- Circular birefringence -Circular dichroism -Cotton effect - Types of ORD curves-Applications of Cotton effect curves and plain dispersion curves - Octant rule - Applications for determination of conformation and configuration

**Unit-14-** Chromatography: Definition - Classifications - Principle - Practice of adsorption, partition, paper, Thin-layer, HPLC and Gas chromatographic techniques

**Unit-15-** Potentiometry: Introduction - Electrodes - Types - Reference/ Indicator/Glass/Ion-selective/Liquid membrane/Clark's electrode- Biosensor- Coulometry: Different methods - Coulometric titrations - Conductometric titrations

**Unit-16-Voltammetry:** Principles - Voltammograms - Equation of voltamogram - Modified Voltametric Methods - DPV - Cyclic Voltammetry - Amperometry - Anodic/cathodic stripping voltammetry-Thermogravimetry: TGA/DTA/DSC Instrumentation and Applications.

### **Block V: Pollution and Laboratory Hygiene**

**Unit-17-Pollution:** Air pollution - definition - sources of air pollution - effects of air pollutants - effects of fluorocarbons, ozone layer and green-house effect - Acid rain: Formation theory and control

**Unit-18-** Water pollution: Types - sources - industrial effluents - water sewages - inorganic pollutants - organic pollutants - water pollution control - water treatment

**Unit-19-** Radioactive pollution: Sources - nuclear traces - wastes - effect of radiation - preventive methods

**Unit-20-** Laboratory hygiene and safety rules: Common safety methods - Storage and handling of Carcinogenic chemicals, Poisonous chemicals, Easily vaporizable chemicals and Inflammable Chemicals with examples

### **Text Books:**

1. R.M. Silverstein, G.C. Bassler, Spectroscopic identification of organic compounds, I Edition
2. P.S. Kalsi, Applications of spectroscopic techniques in Organic chemistry, II Edition
3. Y. R. Sharma, Organic Spectroscopy.
4. Pavia, Organic Spectroscopy, I Edition
5. V. Subramanian, A Text book of Environmental chemistry
6. Text book of Environmental chemistry -BalramPhani

### **Reference Books:**

1. D.H. Williams, I. Fleming, Spectroscopic methods in organic chemistry.
2. R. Drago, Physical Methods in Inorganic Chemistry, I Edition
3. D.A. Skoog, D.M. West Fundamentals of Analytical Chemistry (Holt Rinehart and Winston Inc).
4. G. D. Christain(J.W), Analytical Chemistry
5. Bobbit, Introduction to chromatography.
6. H.H. Willard, L.L. Mirrit, J.A. Dean. Instrumental Methods of analysis (CBS).

7. Chatwal, Anand, Instrumental Methods of Analysis:
8. A.I. Vogel, Instrumental Methods of Inorganic Analysis (ELBS).
9. H.A. Strobel, Chemical Instrumentation: A Systematic approach
10. R.A.Horne, Chemistry of our environment
11. A.K.De.Environmental chemistry.
12. L. Iain, Marr, S. Malcom Environmental chemical analysis.

**Web Links:**

1. <https://youtu.be/WJKfl3w52Mk>
2. <https://youtu.be/QIM21sl-TDg>
3. <https://youtu.be/1vEJG0AaELE>
4. <https://youtu.be/awptCdzqXuo>
5. <https://youtu.be/xVNAOcdRuTA>
6. [https://youtu.be/9\\_d8CQrCYUw](https://youtu.be/9_d8CQrCYUw)
7. <https://youtu.be/QwgDxQ9o1XQ>
8. <https://youtu.be/9GYitGryGqs>
9. [https://youtu.be/9YoRq0s\\_ZI0](https://youtu.be/9YoRq0s_ZI0)
10. <https://youtu.be/EWNcpC1V3cQ>
11. <https://youtu.be/SQucmCTpdgg>
12. <https://youtu.be/Xsw7UJQqGWM>
13. <https://youtu.be/-VHFrocFaCw>
14. <https://youtu.be/6lceoAXEWj8>
15. <https://youtu.be/Piwh1BA8cMc>
16. <https://youtu.be/lzeIqQs70pk>
17. <https://youtu.be/q3gc5VXgNeA>
18. <https://youtu.be/UZcCT3Gpr7E>
19. <https://youtu.be/iLwveCNGNLs>
20. [https://youtu.be/dAn\\_OuFwzb4](https://youtu.be/dAn_OuFwzb4)

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**COURSE TITLE** : **CHEMISTRY OF BIOMOLECULES AND GREEN CHEMISTRY**  
**COURSE CODE** : **MCHEN - 15**  
**COURSE CREDIT** : **8**

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### **COURSE OBJECTIVES (CO)**

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While studying the Chemistry of Bio-Molecules and Green Chemistry course, the student will be able to:

- CO1.** Acquire knowledge on the types, structure and applications of protein, enzymes and nucleic acid
- CO2.** Describe the types, structure and applications of carbohydrates, vitamins, hormones and prostoglands
- CO3.** Discuss about the types and applications of antibiotics, pesticides, fertilizers, petrochemicals
- CO4.** Determine the occurrence, classification and isolation of alkaloids, steroids, terpenoids and carotenoids
- CO5.** Interpret the principles and characteristic features of Green chemistry

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### **COURSE OUTCOMES (COC)**

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After completion of the Chemistry of Bio-Molecules and Green Chemistry course, the student will be able to:

- COC1.** Describe the types, structure and applications of protein, enzymes and nucleic acid
- COC2.** Define types, structure and applications of carbohydrates, vitamins, hormones and prostoglands
- COC3.** Determine the types and applications of antibiotics, pesticides, fertilizers, petrochemicals
- COC4.** Explain the occurrence, classification and isolation of alkaloids, steroids, terpenoids and carotenoids
- COC5.** Define the principles and characteristic features of Green chemistry

### **Block I: Protein, Enzymes and Nucleic acid**

**Unit-1-**General introduction proteins and amino acids –Nature, nomenclature and classifications of proteins

**Unit-2-**Structure of peptides - N and C-terminal analysis - Synthesis of peptides by N-protecting groups

**Unit-3-**Enzymes: General introduction - Nature/Nomenclature/classifications of proteins - An

elementary treatment of enzyme - Mechanism of enzyme action - Co-enzymes

**Unit-4-**Nucleic acid: Structure - DNA and RNA - Comparison of DNA and RNA - Secondary structure of DNA - Synthesis of nucleic acid.

## **Block II: Carbohydrates, Vitamins, Hormones and Prostaglandins**

**Unit-5-**Carbohydrates: Introduction to Monosaccharides, Disaccharides and Polysaccharides- Classification, preparation, properties and structures

**Unit-6-** Vitamins: Classification, structure, occurrence and deficiency diseases caused by Vitamin A, B Complex, C, D, E and K

**Unit-7-** Hormones: Definition - Difference between vitamins and hormones - Reproductive Hormones

**Unit-8-** Prostaglandins: Introduction - Structure, stereochemistry and synthesis of PGE<sub>1</sub>.

## **Block III: Antibiotics, Pesticides, Fertilizers, Petrochemicals**

**Unit-9-**Antibiotics: Definition - Applications of Penicillin, Chloromycetin, Streptomycin and Tetracycline - Definitions of analgesics, anaesthetics, antipyretics and anti-inflammatory

**Unit-10-**Pesticides: Definition - Classification - Inorganic pesticides: Lead arsenate, Paris green, Lime, sulphur, hydrocyanic acid - organic pesticides - DDT and Gammexane

**Unit-11-**Fertilizer: Definition - Classification - Role of various elements in plants growth - Natural and Chemical fertilizers - Urea, Super phosphate, Triple super phosphate and Potassium nitrate

**Unit-12-**Petrochemicals: Introduction - Origin - Composition - Chemicals from natural gas, light Naphtha, petroleum, and Kerosene - Synthetic Gasoline.

## **Block IV: Alkaloids, Steroids, Terpenoids and Carotenoids**

**Unit-13-** Alkaloids: Definition - Occurrence - Isolation - Synthesis/biosynthesis of morphine, quinine, Coniine and Nicotine

**Unit-14-** Steroids: Introduction - Occurrence - Nomenclature - Synthesis and stereochemistry of Cholesterol, estrone, progesterone and testosterone

**Unit-15-** Terpenoids: Classification - Occurrence - isoprene rule - Biosynthesis/synthesis of Citral (acyclic),  $\alpha$ -Terpeneol (monocyclic), Santonin (bicyclic)

**Unit-16-** Carotenoids: General methods of structure determination of Carotenes:  $\alpha/\beta/\gamma$ -Carotenes.

## **Block V: Green Chemistry**

**Unit-17-** Green Chemistry: Definition - Need for green chemistry - Principles of green chemistry

**Unit-18-** Green synthesis - Concept of atom economy - Solvent free reactions - Aqueous phase reactions - Reactions in ionic liquids - Solid supported synthesis

**Unit-19-** Green catalysts -Phase transfer catalysts (PTC) and Biocatalysts - Microwave and Ultrasound assisted green synthesis

**Unit-20-** Evaluating the effects of Chemistry: Toxicity to humans, Toxicity to wildlife, Effects on local environment, Global environmental effects- Green chemical synthesis of Paracetamol, Ibuprofen - Applications of green chemistry

### **Textbooks:**

1. I. L. Finar, Organic chemistry Volume 2.
2. Niranjana Das, Natural Products' Chemistry.
3. O. P. Agarwal, Natural Products Chemistry, I Edition.
4. K. AnandSolomon, Chemistry of Natural Products.

### **Reference Books:**

1. J. L.Jain, S.Jain, N.Jain, S. Chand,Fundamentals of Biochemistry (2005).
2. L.Stryer, J. M.Berg, J. L,Tymoczko, W.H. Freeman,Biochemistry(2004) IV Edition.
3. E. E.Conn, F. Stump, Outlines of Biochemistry, John Wiley (2006), V Edition.
4. D. L.Nelson, M.M. Cox, W.H. Freeman,Principles of Biochemistry, (2004),IV Edition.
5. A. L. Lehinger, Principles of Biochemistry, Worth Publications, II Edition.
6. L. Stryer, W. H. Freeman, Biochemistry
7. V. K. Ahluwalia, Green Chemistry,II Edition.
8. P. T. Anastas and J. C. Warner, Green chemistry Theory and Practice; Oxford University Press, New York, 2005.

### **Web Links:**

1. <https://youtu.be/l2NCKYuoWKQ>
2. <https://youtu.be/Kd5FwCLppMA>
3. <https://youtu.be/Ms6tADRvrgY>
4. <https://youtu.be/0lZRAShqft0>
5. [https://youtu.be/7IVm\\_oEPJw4](https://youtu.be/7IVm_oEPJw4)



6. <https://youtu.be/7ZFr9xiAt94>
7. [https://youtu.be/KSclrk\\_Ako](https://youtu.be/KSclrk_Ako)
8. <https://youtu.be/X22bxp7ydg0>
9. <https://youtu.be/DvQHMN6JtW8>
10. <https://youtu.be/x3gbGsUAzDQ>
11. <https://youtu.be/2a5oURbWrek>
12. <https://youtu.be/ji5hqgyhCL4>
13. <https://youtu.be/QSPRtM5MSB4>
14. [https://youtu.be/ii2DNupKG\\_4](https://youtu.be/ii2DNupKG_4)
15. <https://youtu.be/l2LymcI096Q>
16. <https://youtu.be/dRiHWvLdmvE>
17. <https://youtu.be/J9SpYVx8H68>
18. [https://youtu.be/HtiB0Bz\\_CxY](https://youtu.be/HtiB0Bz_CxY)
19. <https://youtu.be/Bbr8Yx7xZ7s>
20. <https://youtu.be/c6lADvpxm2g>

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**COURSE CODE : MCHEN - 16**

**COURSE CREDIT : 8**

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### **COURSE OBJECTIVES (CO)**

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While studying the Polymer Chemistry course, the student will be able to:

**CO1.** Describe the concepts involved in polymer chemistry

**CO2.** Discuss the stereoisomerism occurs in polymer molecules

**CO3.** Interpret the structure and properties of polymer molecules

**CO4.** Explain about the characterization methods of polymer molecules

**CO5.** Determine the types of commercial, natural and speciality polymers

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### **COURSE OUTCOMES (COC)**

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After completion of the Polymer Chemistry course, the student will be able to:

**COC1.** Define the concepts involved in polymer chemistry

**COC2.** Explain the stereoisomerism occurs in polymer molecules

**COC3.** Describe the structure and properties of polymer molecules

**COC4.** Describe the characterization methods of polymer molecules

**COC5.** Acquire knowledge on the types of commercial, natural and speciality polymers

### **Block I: Concepts in Polymers**

**Unit-1-** Introduction to polymers and polymerization - Classification -Linear, branched and cross linked polymers

**Unit-2-** Thermoplastic and thermosetting polymers - Elastomers, Fibers and Resins - Chemical and geometrical structure of polymers

**Unit-3-** Polymerization: Chain polymerization, step growth polymerization, electrochemical, metathetical polymerization, group transfer polymerization

**Unit-4-** Techniques of polymerization - emulsion, bulk, solution and suspension.

### **Block II: Stereoisomerism in Polymers**

**Unit-5-** Types of stereoisomerism in polymers –Monosubstituted ethylenes (Site of steric isomerism, Tacticity)

**Unit-6-** Disubstituted ethylenes (1,1-disubstituted ethylenes, 1,2-disubstituted ethylenes), 1,3-Butadiene and 2-Substituted 1,3-Butadienes (1,2- and 3,4-Polymerizations, 1,4-Polymerizations),

**Unit-7-** Disubstituted ethylenes (1,1-disubstituted ethylenes, 1,2-disubstituted ethylenes), 1,3-Butadiene and 2-Substituted 1,3-Butadienes (1,2- and 3,4-Polymerizations, 1,4-Polymerizations),

**Unit-8-** Stereoregular polymers: Significance of stereoregularity (isotactic, syndiotactic, and atactic polypropenes), Cis- and trans-1,4-poly-1,3-dienes, Cellulose and amylose. Coordination polymerization: Ziegler Natta catalyst.

### **Block III: Structure and Properties of Polymers**

**Unit-9-** Morphology and order in crystalline polymers- Configurations of polymer chains

**Unit-10-** Crystal structures of polymers - Strain-induced morphology

**Unit-11-** Crystalline melting point,  $T_m$ - melting points of homogeneous series, effect of chain flexibility and other steric factor, entropy and heat of fusion

**Unit-12-** The glass transition temperature,  $T_g$ , relationship between  $T_m$  and  $T_g$  - Effect of molecular weight, diluents, chemical structure, chain topology, branching and crosslinking.

### **Block IV: Polymer Characterization**

**Unit-13-** Average molecular weight concept - Number, weight and viscosity average molecular weights

**Unit-14-** Polydispersity and molecular weight distribution - The practical significance of molecular weight

**Unit-15-** Measurement of molecular weights - End group, viscosity, light scattering, osmotic and ultracentrifugation methods

**Unit-16-** Analysis and testing of polymers- Chemical analysis, spectroscopic methods, thermal Analysis, XRD and SEM

### **Block V: Commercial, Natural and Speciality Polymers**

**Unit-17-** Commercial Polymers: Polyethylene, Polyvinyl chloride, Polyamides, Polyesters, Phenolic resins, Epoxy resins and silicone polymers

**Unit-18-** Functional polymers- Fire retarding polymers and electrically conducting polymers- Natural Polymers: Importance of natural polymers - Application and structures of starch, cellulose and chitosin derivatives

**Unit-19-** Speciality Polymers: Bio polymers - Biodegradable polymers - Biomedical polymers - Poly

electrolytes - High temperature and fire retardant polymers - Polymer blend

**Unit-20-** Polymer composites -Polymer nanocomposites- IPN polymers - Electroluminescent polymers.

**Text Books:**

1. V. R. Gowarikar, B. Viswanathan, J. Sridhar, Polymer Science - Wiley Eastern, 1986, I Edition.
2. G. S. Krishenbaum, Polymer Science Study Guide, Gordon Breach Science publishing, New York, 1973, I Edition.
3. P. Bahadur, N. V. Sastry, Principles of Polymer Science, Narosa Publishing House.
4. G. S. Misra – Introduction to Polymer Chemistry, Wiley Eastern Ltd.

**Reference Books:**

1. F. W. Bill Meyer. Text book of polymer science, III Edition, John Wiley and sons, New York.
2. P. J. Flory. Principles of Polymer Chemistry, Cornell Press (recent edition).
3. G. Odian, Principles of Polymerization, McGraw Hill Book Company, New York, 1973.
4. A. Rudin, The Elements of Polymer Science and Engineering. Academic Press, New York, 1973.
5. C. E. H. Brawn, The Chemistry of High Polymers, Butter worth & Co., London, 1948.

**Web Links:**

1. <https://youtu.be/rVjfjLZnoFg>
2. <https://youtu.be/x-Vhelv3rQ8>
3. <https://youtu.be/IE38dGX2YEO>
4. <https://youtu.be/-xbXntt1sZw>
5. <https://youtu.be/5WAWUguAFeQ>
6. <https://youtu.be/AAl6pWkyxO8>
7. <https://youtu.be/AAl6pWkyxO8>
8. <https://youtu.be/5WAWUguAFeQ>
9. <https://youtu.be/4cpH1mpWjGQ>
10. <https://youtu.be/o5chWCtp12E>
11. <https://youtu.be/4lsOcWpaZ8k>

12. <https://youtu.be/5KPmwidovs>
13. <https://youtu.be/Cffz9lKhnt8>
14. <https://youtu.be/T0rKGecWvdQ>
15. <https://youtu.be/FnsfSsFOyYo>
16. <https://youtu.be/OqHO8IBI7ak>
17. <https://youtu.be/8jjPDZxbbe4>
18. <https://youtu.be/nSAvyQajVzE>
19. [https://youtu.be/GV8e8RKN\\_tA](https://youtu.be/GV8e8RKN_tA)
20. <https://youtu.be/t-pVi3IMdOk>

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<b>COURSE TITLE</b>	<b>:</b>	<b>ORGANIC CHEMISTRY - II</b>
<b>COURSE CODE</b>	<b>:</b>	<b>MCHEN – 21</b>
<b>COURSE CREDIT</b>	<b>:</b>	<b>8</b>

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## **COURSE OBJECTIVES (CO)**

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While studying the Organic Chemistry - II course, the student will be able to:

**CO1.** Describe the characteristic features and types of rearrangement and pericyclic Reactions

**CO2.** Acquire knowledge on the synthesis and reactivity of heterocyclic compounds

**CO3.** Determine the chemistry of natural products

**CO4.** Explain about the concepts and applications of photochemistry organic compounds

**CO5.** Determine the principle, terms and applications of NMR, IR and UV-Spectroscopy

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## **COURSE OUTCOMES (COC)**

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After completion of the Organic Chemistry -II course, the student will be able to:

**COC1.** Describe the characteristic features and types of rearrangement and pericyclic Reactions

**COC2.** Define the synthesis and reactivity of heterocyclic compounds

**COC3.** Explain the chemistry of natural products

**COC4.** Discuss about the concepts and applications of photochemistry organic compounds

**COC5.** Describe the principle, terms and applications of NMR, IR and UV-Spectroscopy

### **Block I: Rearrangement and Pericyclic Reactions**

**Unit-1-**Introduction to Rearrangement Reactions – Inter and intra molecular rearrangements - Rearrangement to electron deficient Carbon - 1,2 shift (Wagner-Meerwein and Pinacol-Pinacolone rearrangements)

**Unit-2-**Rearrangements from oxygen to ring carbon (FriesandClaisen rearrangements) - Rearrangements to electron deficient Nitrogen (BeckmannandSchmidt rearrangements) - Rearrangement to electron deficient Oxygen (Baeyer-Villiger)

**Unit-3-**Pericyclic Reactions: Classifications - Concerted reactions - Orbital symmetry and Concerted symmetry - Woodward and Hoffmann rules

**Unit-4-**Selection rules for electrocyclic and cycloaddition reactions - their FMO approach and correlation diagram - Sigmatropic rearrangements - 1,3, 1,5 and 1,7-hydrogen shifts - 1,3-Dipolar cycloaddition reactions - Types of dipoles

### **Block II: Chemistry of Heterocycles**

**Unit-5-**Introduction to heterocyclic compounds - Trivial, systematic and replacement nomenclature

**Unit-6**-Synthesis and reactivity of oxazoles, imidazoles, thiazoles, isooxazoles and aziridines

**Unit-7**-Synthesis and reactivity of oxetanes, triazoles, pyridine, pyrazoles, isothiazoles, pyrimidines, purines, and triazines,

**Unit-8**-Synthesis and reactivity of pyrazines, pyridazines, quinoline, isoquinoline, indole, benzofuran and benzothiophene.

### **Block III: Chemistry of Natural Products**

**Unit-9**-Steroids: Introduction - Partial synthesis of androsterone and testosterone (from Cholesterol)

**Unit-10**-Total synthesis: Johnson's synthesis of progesterone and Vollhardt's synthesis of estrone

**Unit-11**-Terpenoids: Introduction - Biosynthesis of menthol, camphor - Total synthesis: Takasago synthesis of menthol, Corey's synthesis of longifolene

**Unit-12**-Alkaloids: Introduction - biosynthesis of nicotine, camptothecin - Total synthesis: Corey's synthesis of epibatidine - Woodward's synthesis of reserpine.

### **Block IV: Organic Photochemistry**

**Unit-13**-Introduction to organic photochemistry - Basic concepts - Energy transfer - Characteristics of photoreactions

**Unit-14**-Photooxidation - Photo reduction- Photosensitization - Photoreactions of ketones and enones - Norrish Type I and II reactions - Paterno-Buchi reaction

**Unit-15**-Photochemistry of alkenes, dienes and aromatic compounds - di- $\pi$ -methane rearrangement

**Unit-16**-Photochemistry of  $\alpha,\beta$ -unsaturated carbonyl compounds - Photolytic cycloadditions - Photolytic rearrangements - Photo additions - Barton reaction.

### **Block V: NMR, IR and UV-Spectroscopy**

**Unit-17**- Basic concepts and principles of NMR spectroscopy -  $^1\text{H}$  NMR: Chemical shift - Coupling constant - Factors influencing chemical shift/coupling constant -  $^1\text{H}$  NMR spectra of simple organic molecules [ $\text{CH}_3\text{CH}_2\text{OH}$ ,  $\text{CH}_3\text{CH}_2\text{Cl}$ ,  $\text{CH}_3\text{CHO}$  etc.] - AX and AB spin system Nuclear Overhauser effect

**Unit-18**-  $^{13}\text{C}$  NMR: Proton decoupled and off - resonance  $^{13}\text{C}$  NMR spectra - Factors affecting  $^{13}\text{C}$  chemical shift -  $^{13}\text{C}$  NMR spectra of simple organic molecules

**Unit-19**-IR Spectroscopy: Vibrational frequencies - Identification of functional groups - Intra and inter molecular hydrogen bonding - Finger print region - Far IR region

**Unit-20-UV spectroscopy - Electronic transitions - Types - Chromophores and Auxochromes - Factors influencing positions and intensity of absorption bands - Absorption spectra of dienes, unsaturated carbonyl compounds.**

**Text Books:**

1. P. Ramesh, Basic principles of Organic Stereochemistry, Madurai Kamaraj University.
2. P. S. Kalsi, Stereochemistry, II Edition.
3. D. Nasipuri, Stereochemistry of organic compounds.
4. J. D. Coyle, Organic Photochemistry; Wiley, New York, 1998.
5. G. R. Chatwal, Organic Photochemistry; 1st Ed., Himalaya Publications house, Bangalore, 1998.
6. R.R. Gupta, M. Kumar and V. Gupta, Heterocyclic Chemistry Vol. 1-3, , Springer Verlag.
7. P.S. Kalsi, The chemistry of Natural Products.
8. V.M. Parikh, Absorption spectroscopy of organic molecules, I Edition

**Reference Books:**

1. J. Clayden, N. Greeves, S. Warren, and P. Wothers, Organic Chemistry; I Edition, Oxford University Press, UK, 2000.
2. T.L. Gilchrist, Longman Heterocyclic Chemistry.
3. Raymond Chang, Basic Principles of Spectroscopy, McGraw Hill Ltd., New York 1971.
4. R.M. Silverstein, G.C. Bassler Spectroscopic identification of organic compounds.

**Web Links:**

1. <https://youtu.be/QdwzMPwPA3I>
2. [https://youtu.be/fYJ05Xe\\_DVQ](https://youtu.be/fYJ05Xe_DVQ)
3. [https://youtu.be/x\\_pAn8iKQZQ](https://youtu.be/x_pAn8iKQZQ)
4. <https://youtu.be/YnG-CbstGCK>
5. [https://youtu.be/NA38c3\\_YeR8](https://youtu.be/NA38c3_YeR8)
6. [https://youtu.be/Os\\_LYe8xmBQ](https://youtu.be/Os_LYe8xmBQ)
7. <https://youtu.be/PpJOM4Rq76Q>
8. <https://youtu.be/WhJ5EzqACbo>
9. [https://youtu.be/ii2DNupKG\\_4](https://youtu.be/ii2DNupKG_4)
10. <https://youtu.be/ez5GsfTt6z4>



11. <https://youtu.be/fCd5VSMui28>
12. <https://youtu.be/jYngJ0ikgSQ>
13. [https://youtu.be/J\\_b1Y4QhhZc](https://youtu.be/J_b1Y4QhhZc)
14. <https://youtu.be/3l-e-4SRaQ>
15. <https://youtu.be/JNbuLx5Tvdw>
16. <https://youtu.be/g48X4GT-sXE>
17. [https://youtu.be/il2e\\_3vEPzc](https://youtu.be/il2e_3vEPzc)
18. <https://youtu.be/F9H9o1pwwcU>
19. <https://youtu.be/-p2rEi8JAEg>
20. <https://youtu.be/ht8wMEQmMs4>

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**COURSE TITLE : INORGANIC CHEMISTRY - II**  
**COURSE CODE : MCHEN - 22**  
**COURSE CREDIT : 8**

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**COURSE OBJECTIVES (CO)**

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While studying the Inorganic Chemistry -II course, the student will be able to:

**CO1.** Acquire knowledge on the characteristic features and application of organo metallic chemistry

**CO2.** Describe the spectral and magnetic properties of metal complexes

**CO3.** Explain about the applications of nuclear chemistry

**CO4.** Determine the types of mechanism involved in the inorganic reactions

**CO5.** Interpret the non-aqueous solvents and chemistry of solid state molecules

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### **COURSE OUTCOMES (COC)**

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After completion of the Inorganic Chemistry –II course, the student will be able to:

**COC1.** Describe the characteristic features and application of organo metallic chemistry

**COC2.** Analyse the spectral and magnetic properties of metal complexes

**COC3.** Determine the applications of nuclear chemistry

**COC4.** Define the types of mechanism involved in the inorganic reactions

**COC5.** Explain the non-aqueous solvents and chemistry of solid state molecules

### **Block I: OrganoMetallic Chemistry**

**Unit-1-** Carbon donors: Alkyls and aryls metallation -Bonding in carbonyls and nitrosyls -Chain and cyclic donors -Synthesis, structure and bonding of metallocenes

**Unit-2-** Reactions: Association substitution, addition and elimination reactions, ligand protonation, carbonylation, decarboxylation, oxidative addition and fluxionality

**Unit-3-** Catalysis: Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (Oxo process), oxidation of olefins to aldehydes and ketones (Wacker process) polymerization (Ziegler-Natta Catalyst)

**Unit-4-** Cyclooligomerisation of acetylene using nickel catalyst (Reppé's catalyst) -Polymer-bound catalysts.

### **Block II: Spectral and Magnetic Properties of Metal Complexes**

**Unit-5-** UV Visible, IR and Raman spectra of simple inorganic compounds with special reference to coordination sites -NMR: NMR of  $^{31}\text{P}$ ,  $^{19}\text{F}$  -Shift reagents -Mossbauer: Mossbauer spectra of Fe and Sn systems

**Unit-6-** ESR: Introduction - Zeeman equation, g-value, nuclear hyperfine splitting- Anisotropy - g-value and hyperfine splitting constant - ESR of transition metal complexes of copper, manganese and vanadyl

complex

**Unit-7**-Photo Electron Spectroscopy (UV and X-ray) -Koopman's theorem, time structure in PES, chemical shift and correlation with electronic charges

**Unit-8**-Magnetic properties of complexes: Para/Diamagnetic complexes -Molar susceptibility, Gouy method for the determination of magnetic moment of complexes -Spin only magnetic moment

### **Block III: Nuclear Chemistry**

**Unit-9**-Properties of nucleus - Types of nuclear forces - liquid drop/shell model of nucleus

**Unit-10**-Nuclear reactions induced by charged particles - Nuclear Cross-section - Theory of nuclear fission - Conditions for controlled fission chain reaction

**Unit-11**-Nuclear reactor and its components -Production of feed materials for nuclear reactors - Disposal of radioactive wastes

**Unit-12**-Nuclear fusion - Stellar energy - Application of radioisotopes in agriculture, industry and medicine - Neutron activation analysis - Hot atom chemistry.

### **Block IV: Inorganic Reaction Mechanism**

**Unit-13**-Inorganic reaction mechanism: Stabilities of complexes in aqueous solutions

**Unit-14**-Thermodynamic and determination of stability constant by Job's continuous variation method - Labile and inner complexes

**Unit-15**-Stereochemistry of substitution reactions in octahedral coordination compounds

**Unit-16**-Acid hydrolysis - Aquation and Anation reaction - Base hydrolysis -Conjugate base mechanism - Isomerization and racemisation -Trans effect.

### **Block V: Non-aqueous Solvents and Solid State Chemistry**

**Unit-17**-Classification of solvents -Non aqueous solvents -Typical reactions in liquid ammonia, sulphur dioxide, dinitrogen tetroxide, anhydrous hydrogen fluoride, sulphuric acid and acetic acid

**Unit-18**-HSAB concept of acids and bases - Acid, base strength and hardness and softness - Symbiosis - Theories of hardness and softness

**Unit-19**-Solid State Chemistry:Close packing of atoms and ions - FCC, HCP and BCC types of packing- Representative structures of AB and AB<sub>2</sub>, types of compounds- Rock salt, calcium chloride,wurtzite, Zinc blende,rutile, fluorite,antifluorite, and nickel arsenide

**Unit-20-Structure of Graphite and Diamond - Schotky and Frenkel defects-Nonstoichiometric defects.**

**Text Books:**

1. SathyaPrakas, G. D. Tuli, S. K. Basu, R. D. Madhan, Advanced Inorganic Chemistry I
2. Wahid U. Malik, G. D. Tuli, R. D. Madhan, Selected Topics in Inorganic Chemistry
3. J.E. Huheey, Inorganic Chemistry, Harper and Collins, NY, IV Edition, (1993).
4. J. D. Lee, Inorganic Chemistry, I Edition
5. AshuthoshKar, Advanced Inorganic Chemistry
6. Puri, Sharma, Kalia, Principles of Inorganic Chemistry

**Reference Books:**

1. J.M.Hollas, Modern Spectroscopy, John Wiley (1996),III Edition
2. R.C. Mehrotra, A. Singh.Organomettalic Chemistry, A Unified Approach,
3. Chang,R., Basic Principles of Spectroscopy, McGraw-Hill (1971).
4. U.C.Dash,Nuclear Chemistry.
5. B.G.Harvey,Nuclear Chemistry.
6. SamuvelGlastone, Source book of atomic energy.
7. R.H. Crabtree,The Organometallic Chemistry of Transition metals.
8. A. Salzer, VCH, Organometallics by Ch. Elschenbroich, 1995, II Edition.
9. Edberg,Inorganic Reaction Mechanism.
10. BasoloavdPearsor, Inorganic Reaction Mechanism.
11. R. R. Jordan,Reaction Mechanism in Inorganic Chemistry by Oxford Univ.Press, 1998. II Edition.
12. A. R. West, Solid State Chemistry and Its Applications; II Edition, John Wiley and sons, New York, 2014.

**Web Links:**

1. <https://youtu.be/3PmB20gPMOo>
2. <https://youtu.be/Tswc9xcPoow>
3. [https://youtu.be/iUIzpEEpW\\_Q](https://youtu.be/iUIzpEEpW_Q)
4. [https://youtu.be/Uh1RG\\_x1\\_A](https://youtu.be/Uh1RG_x1_A)
5. <https://youtu.be/1sHEWeske4E>

6. <https://youtu.be/LDrHjMFmmCM>
7. [https://youtu.be/bl8wek\\_jvRA](https://youtu.be/bl8wek_jvRA)
8. [https://youtu.be/\\_6d80lX4pSk](https://youtu.be/_6d80lX4pSk)
9. <https://youtu.be/Rd0CJje59bE>
10. <https://youtu.be/R0tdsaFJ4vg>
11. <https://youtu.be/6FH9wO8TXZI>
12. <https://youtu.be/poePf57ILYw>
13. <https://youtu.be/yCijiXm41QY>
14. <https://youtu.be/ZsTmKadPoPs>
15. <https://youtu.be/YqPG1i9CIHw>
16. <https://youtu.be/BBTHPNyapV0>
17. <https://youtu.be/ZZ2ABWw3M-U>
18. <https://youtu.be/eymJJ8Fpdvg>
19. <https://youtu.be/B1JzFAD1GAo>
20. <https://youtu.be/ktXK2yPdwks>

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<b>COURSE TITLE</b>	<b>:</b>	<b>PHYSICAL CHEMISTRY - II</b>
<b>COURSE CODE</b>	<b>:</b>	<b>MCHEN - 23</b>
<b>COURSE CREDIT</b>	<b>:</b>	<b>8</b>

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### **COURSE OBJECTIVES (CO)**

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While studying the Physical Chemistry -II course, the student will be able to:

**CO1.** Discuss about the concepts and characteristic features in statistical thermodynamics

**CO2.** Describe the kinetics of chemical reactions

**CO3.** Determine the types, mechanism and applications of surface reaction

**CO4.** Explain the terms and applications of group theory

**CO5.** Interpret the photochemical reactions and photochemistry of environment

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### **COURSE OUTCOMES (COC)**

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After completion of the Physical Chemistry -II course, the student will be able to:

**COC1.** Describe the concepts and characteristic features in statistical thermodynamics

**COC2.** Explain the kinetics of chemical reactions

**COC3.** Interpret the types, mechanism and applications of surface reaction

**COC4.** Acquire knowledge on the terms and applications of group theory

**COC5.** Explain the photochemical reactions and photochemistry of environment

### **Block I: Statistical Thermodynamics**

**Unit-1-**Concept of ensembles: Canonical ensembles - Grand Canonical ensembles - Thermodynamic quantities - Boltzmann distribution - Bose-Einstein - Fermi-Dirac distributions

**Unit-2-**Partition functions: Molecular, Translational, rotational and vibrational partition functions

**Unit-3-**Ideal mono atomic and diatomic gases - Classical partition functions - Thermodynamic properties and Chemical equilibrium

**Unit-4-**Linear response theory - Irreversible processes - Onsager's law - Entropy production - Non-equilibrium stationary states.

### **Block II: Chemical Kinetics - II**

**Unit-5-**Solution and gas phase kinetics: Chain reactions and its rate laws - Hydrogen-bromine reaction - chain-branching explosion reactions

**Unit-6-** Polymerization kinetics: stepwise and chain polymerizations. Homogeneous catalysis: Features of acid-base catalysis

**Unit-7-**Enzymes: Michaelis-Menten mechanism of enzyme catalysis - Catalytic efficiency of enzymes - Mechanisms of enzyme inhibition

**Unit-8**-Fast reaction kinetics: Relaxation methods (T- and P-jump methods) - Stopped flow methods - Shockwave technique - Flash photolysis.

### **Block III: Surface Reactions**

**Unit-9**-Introduction to surface reactions -Frendlich adsorption isotherm - Langmuir adsorption isotherm - BET

**Unit-10**-Determination of surface area - Adsorption coefficient and its significance - Mechanism of heterogeneous catalysis

**Unit-11**-Unimolecular and bimolecular surface reactions - Langmuir-Hinshelwood mechanism - Langmuir-Rideal mechanism - Catalysis by metals and semiconductor oxides.

### **Block IV: Group Theory**

**Unit-12**-Symmetry elements and symmetry operations - Centre of symmetry - Plane and its types of Symmetry - Proper and Improper axis of Symmetry

**Unit-13**-Principal axis and subsidiary axes - The concept of groups - Assigning Point groups with illustrative examples

**Unit-14**-Symmetry operations and order of a group - Group theoretical rules (Group postulates) - Reducible and irreducible representations

**Unit-15**-Matrix representations of symmetry operations - Construction of Character Tables for  $C_{2v}$  and  $C_{3v}$  point group molecules - Great Orthogonality theorem and its proof.

### **Block V: Photochemistry**

**Unit-16**-Absorption of light and nature of electronic spectra - electronic transition - Frank-Condon principle - Selection rules- Photodissociation, Predissociation

**Unit-17**-Photochemical reactions: Photoreduction, photooxidation, photodimerization, photochemical substitution, photoisomerization

**Unit-18**-Photochemistry of environment: Green-house effect - Joblonski diagram - Photophysical process in electronically excited molecules by different types of pathways

**Unit-19**-Fluorescence - Phosphorescence - Internal conversion- Intersystem crossing

**Unit-20**-Photosensitization -Chemiluminences- Lasers - Fluorescence quenching: Concentration quenching - Stern-Volmer equation - Solar energy storage and conversion.

### **Text Books:**

1. B. R. Puri, M. Sharma, S. Pathania, Physical Chemistry, I Edition.
2. K.J. Laidler, Chemical Kinetics, I Edition.
3. C.N. Banwell, Fundamentals of Molecular Spectroscopy, II Edition.
4. Pearson House, Fundamentals of Chemical Kinetics.
5. Pearson House, Fundamentals of Quantum Chemistry.
6. R.C. Srivastava, S.K. Saha, A.K. Jain, Thermodynamics.
7. N.N. Dass, Symmetry and Group Theory for Chemists, Asian Books Pvt. Ltd (2004).
8. M.S.Gopinathan, V.Ramakrishnan, Group Theory in Chemistry, Vishal Publishers (2006).
9. Veera Reddy, Symmetry and spectroscopy.

### **Reference Books:**

1. Kinetics and Mechanism of Reaction Rates: A.Frost and G. Pearson.
2. Modern Chemical Kinetics: H. Eyring
3. Theories of Reaction Rates: K.J. Laidler, H. Eyring and S. Glasston
4. J.N. Bradly Fast Reactions:
5. CaldinFast Reactions in Solutions:
6. P.W. Atkins, Physical Chemistry, W.H. Freeman (1997) VI Edition.
7. Puri, B.R., Sharma, L.R., and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co. (2011), IV Edition.
8. K.L. Kapoor, A Text Book of Physical Chemistry, Vol. 3, Macmillan India (2005), II Edition.
10. K.J.Laidler, Chemical Kinetics, Dorling Kingsley (2007).

### **Web Links:**

1. <https://youtu.be/2U1SrU9F1hI>
2. <https://youtu.be/n6UxLLtOHb0>
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14. <https://youtu.be/zJUrhVmqI08>
15. [https://youtu.be/g\\_cFd\\_Moymk](https://youtu.be/g_cFd_Moymk)
16. <https://youtu.be/A98KRNQAuiY>
17. <https://youtu.be/5ysuXMazy0o>
18. <https://youtu.be/5KLBrnaulg>
19. <https://youtu.be/MQibi1PpAO0>
20. <https://youtu.be/ExGQnRw75IA>

### **PRACTICAL COURSE SYLLABUS**

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<b>COURSE TITLE</b>	<b>:</b>	<b>ORGANIC ESTIMATION AND SYNTHESIS</b>
<b>COURSE CODE</b>	<b>:</b>	<b>MCHEN - P1</b>
<b>COURSE CREDIT</b>	<b>:</b>	<b>6</b>

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#### **COURSE OBJECTIVES (CO)**

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While studying the Organic Estimation and Synthesis practical course -I, the student will be able to:

**CO1.** Explain about the basic terms and concepts involved in the estimation and synthesis of an organic compound.

**CO2.** Describe the estimation of an organic compound.

**CO3.** Determine the single stage preparation methods involving various types of reactions for the synthesis of organic compounds.

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### **COURSE OUTCOMES (COC)**

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After completion of the Organic Estimation and Synthesis practical course -I, the student will be able to:

**COC1.** Describe the basic terms and concepts involved in the estimation and synthesis of an organic compound.

**COC2.** Estimate the given organic compounds using various methods of estimation.

**COC3.** Synthesize the organic compounds using various types of organic reactions in a single stage method

## **Practical-I: ORGANIC ESTIMATION AND SYNTHESIS**

**I. Organic Estimation:** Estimation of Phenol, Aniline and Glucose.

**II. Organic Synthesis:** One stage preparations involving various types of reactions (Any four synthesis can be selected).

1. Oxidation: Adipic acid by chromic acid oxidation of Cyclohexanol.
2. Aldol condensation: Dibenzal acetone from Benzaldehyde.
3. Sandmeyer reaction: p- Chlorotoulene from p-Toluidine.
4. Cannizzaro reaction: 4-chlorobenzyldehyde as a substrate.
5. Aromatic Electrophilic substitutions:
  - (i) Synthesis of p-Nitroaniline and -
  - (ii) Synthesis of p-Bromoaniline.

### **Text and Reference Books:**

1. N.S. Gnanapragasam and B. Ramamoorthy, "Organic Chemistry Lab Manual" (2006), S.

Visvanathan Printers & Publishers.

2. Experiments and Techniques in Organic Chemistry, D.Pasto, C. Johnson and M.Miller, PrenticeHall.
4. H.Middleton, Adward Arnold, Systematic Qualitative Organic Analysis,
5. H.Clark, AdwardArnold,.Handbook of Organic Analysis-Qualitative and Quantitative,
6. Vogel's Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

**Web Links:**

1. <https://youtu.be/C1tG69O0fXc>
2. <https://youtu.be/PKsWgJdvLec>
3. <https://youtu.be/X9KNf0Xz1fg>
4. <https://youtu.be/Xs6DQySFubc>
5. [https://youtu.be/1pgAFSB\\_E2I](https://youtu.be/1pgAFSB_E2I)

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<b>COURSE TITLE</b>	<b>:</b>	<b>INORGANIC ANALYSIS, ESTIMATION AND PREPARATION</b>
<b>COURSE CODE</b>	<b>:</b>	<b>MCHEN - P2</b>
<b>COURSE CREDIT</b>	<b>:</b>	<b>6</b>

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**COURSE OBJECTIVES (CO)**

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While studying the Inorganic Analysis, Estimation and Preparation practical course -II, the student will

be able to:

**CO1.**Acquire knowledge on the basic terms and concepts involved in the semi-micro qualitative analysis of inorganic ions, estimation and preparation of inorganic compounds.

**CO2.**Describe the analysis of mixture two common cations and less common cations using semi-micro qualitative analysis method.

**CO3.**Explain about the estimation of inorganic metal ions using photoelectric colorimetry method.

**CO4.**Interpret the preparation of inorganic compounds using various synthetic procedures.

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### **COURSE OUTCOMES (COC)**

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After completion of the Inorganic Analysis, Estimation and Preparation practical course -II, the student will be able to:

**COC1.**Describe the basic terms and concepts involved in the semi-micro qualitative analysis of inorganic ions, estimation and preparation of inorganic compounds.

**COC2.**Analyse the mixture two common cations and less common cations using semi-micro qualitative analysis method

**COC3.**Estimate the inorganic metal ions using photoelectric colorimetry method.

**COC4.**Prepare the inorganic compounds using various synthetic procedures.

### **Practical-II: INORGANIC ANALYSIS, ESTIMATION AND PREPARATION**

**I. Semi-micro qualitative analysis:** Analysis of mixture two common cations (Pb, Bi, Ca, Cd, Fe, Cr, Al, Co, Ni, Mn, Zn, Ba, Sr, Ca, Mg,) and two less common cations (W, Tl, Se, Te, Mo, Ce, Th, Zr, Ti, V, U, Li).

**II. Estimation:** Estimation of copper, nickel and Iron ions using photoelectric colorimeter.

**III. Preparation:** Any four preparations from the following:

- Potassium tris (oxalate) aluminate (III) trihydrate
- Potassium tris (oxalato) chromate (III) trihydrate
- Tris (thiourea) copper (I) chloride
- Tris sodium hexanitrocobaltate (III)
- Chloropentammine cobalt (III) chloride
- Bis (acetylacetonato) copper (II)

### **Text and Reference Books:**

1. W. G. Palmer, Experimental Inorganic Chemistry, I Edition.
2. A. I. Vogel, A text book of Quantitative Inorganic Analysis.
3. V. V. Ramanujam, Inorganic Semimicro Qualitative Analysis; III Edition, National Pubs, London, 1988.
4. G. Svehla, Text Book of Macro and Semimicro Qualitative Inorganic Analysis; V Edition, Longman group Ltd, London, 1987.
5. A. I. Vogel, Text Book of Quantitative Inorganic Analysis; VI Edition, Longman, New Delhi, 2000.

### **Web Links:**

1. <https://youtu.be/tnBGR5wfkxo>
2. <https://youtu.be/Jgv9OhWIBYg>
3. [https://youtu.be/nBxKz6HfE\\_w](https://youtu.be/nBxKz6HfE_w)
4. <https://youtu.be/qqAunXcGo8A>
5. <https://youtu.be/OGFWZclzXkk>
6. <https://youtu.be/hJ1fIANSeQk>
7. <https://youtu.be/ykkIP0RJXuk>
8. <https://youtu.be/vVFEyA1SQNU>

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**COURSE TITLE : PHYSICAL CHEMISTRY  
EXPERIMENTS**

**COURSE CODE : MCHEN - P3**

**COURSE CREDIT : 6**

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### **COURSE OBJECTIVES (CO)**

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While studying the Physical chemistry experiments practical course -III, the student will be able to:

**CO1.** Explain about the basic terms, concepts applications of physical chemistry experiments such as conductometric, surface tension adsorption, kinetic, partition-coefficient measurements, potentiometric and redox titrations

**CO2.** Describe the determination of cell constant, verification of Ostwald dilution law for weak acetic acid and conductometric titrations of acids and bases.

**CO3.** Determine the surface tension of the pure solvents

**CO4.** Discuss about the determination of partition – coefficient for the given mixture

**CO5.** Interpret the verification of Freundlich adsorption isotherm for the given mixture

**CO6.** Describe on the kinetics of Hydrolysis and Determination of rate constant for the reaction.

**CO7.** Express the potentiometric titrations of the given acid and base.

**CO8.** Discuss about the redox titrations of the given mixture.

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### **COURSE OUTCOMES (COC)**

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After completion of the Physical chemistry experiments practical course -III, the student will be able to:

**COC1.** Describe the basic terms, concepts applications of physical chemistry experiments such as conductometric, surface tension adsorption, kinetic, partition-coefficient measurements, potentiometric and redox titrations

**COC2.** Determine the cell constant; verify the Ostwald dilution law for weak acetic acid and conductometric titrations of acids and bases.

**COC3.** Measurement the surface tension of the pure solvents

**COC4.** Determine the partition – coefficient for the given mixture

**COC5.** Describe the Freundlich adsorption isotherm for the given mixture

**COC6.** Measurement the kinetics of Hydrolysis and Determination of rate constant for the reaction.

**COC7.** Interpret the potentiometric titrations of the given acid and base.

**COC8.** Determine the redox titrations of the given mixture.

### **Practical-III: PHYSICAL CHEMISTRY EXPERIMENTS**

From experiments provided, any five experiments can be selected.

#### **1. Conductometric Measurements:**

- (i) Determination of cell constant
  - (ii) Verification of Ostwald dilution law for weak acetic acid
  - (iii) Conductometric titrations - strong acid against strong base
  - (iv) Conductometric titrations - weak acid against strong base
2. **Surface Tension Measurements:** Surface tension of pure solvents
  3. **Partition -Coefficient:** Determination of partition – coefficient for  $I_2$  between water and  $CCl_4$
  4. **Adsorption Measurements:** Verification of Freundlich adsorption isotherm for acetic acid on charcoal.
  5. **Kinetic Measurement:**
    - (i) Kinetics of Hydrolysis of Methylacetate in the presence of HCl.
    - (ii) Determination of rate constant for the reaction between potassium persulphate and potassium iodide.
  6. **Potentiometric titrations:** Acid Base titration - Titration of strong acid against strong base.
  7. **Redox titration:** Titration of  $FeSO_4$  against  $K_2Cr_2O_7$ .

**Text and Reference Books:**

1. B.D. Khosla, V.C. Garg and A. Khosla, Senior Practical Physical Chemistry.
2. V. Athawale and P. Mathur, Experimental Physical Chemistry.
3. B. Vishwanathan, P.S. Raghavan, Practical Physical Chemistry.
4. P.S. Sindhu, Practical in Physical Chemistry.

**Web Links:**

1. <https://youtu.be/3ygyHSF-8uc>
2. <https://youtu.be/lxVzjZBHPBE>
3. <https://youtu.be/-GS6uoFf3qQ>
4. <https://youtu.be/Dc4aUdADqY8>
5. <https://youtu.be/6jyoBp2dBAo>
6. <https://youtu.be/TRnkyxfkGf0>
7. <https://youtu.be/E5qbNS0IH9k>
8. <https://youtu.be/6T80JRR4OU8>

9. <https://youtu.be/0DzNtRyIcEM>
10. <https://youtu.be/mSivCc44G3Y>
11. <https://youtu.be/A3rWoLNi6To>

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### Curriculum Mapping of M.Sc. Chemistry

Sl. No		MCHEN-11	MCHEN-12	MCHEN-13	MCHEN-14	MCHEN-15	MCHEN-16	MCHEN-21	MCHEN-22	MCHEN-23	MCHEN-P1	MCHEN-P2	MCHEN-P3
1	Fundamental understanding of the field	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Application of basic Chemistry concepts	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3	Linkages with related disciplines	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4	Procedural knowledge for professional subjects	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	X
5	Skills in related field of specialization	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	Ability to use in Chemistry problem	✓	✓	✓	✓	X	X	✓	✓	✓	X	X	X
7	Skills in Mathematical modeling	-	X	✓	X	X	X	X	X	✓	✓	✓	✓
8	Skills in performing analysis and interpretation of data	✓	✓	✓	X	X	X	✓	✓	✓	✓	✓	✓
9	Develop investigative Skills	X	X	X	X	X	X	X	X	X	✓	✓	✓
10	Skills in problem solving in Chemistry and related Discipline	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11	Develop Technical Communication skills	X	X	X	X	X	X	X	X	X	✓	✓	✓
12	Developing Analytical skills and popular communication	X	X	X	X	✓	X	X	X	X	✓	✓	✓
13	Developing ICT skills	X	X	X	X	X	X	X	X	X	X	X	X
14	Demonstrate Professional behavior with respect to attribute like objectivity, ethical values, self reading, etc	X	X	X	X	X	X	X	X	X	✓	✓	✓

