TAMIL NADU OPEN UNIVERSITY

Regulations and Syllabi for

M.Sc. CHEMISTRY (Non-Semester Pattern)

[w.e.f. Academic Year 2020-21]

Department of Chemistry

School of Science

Saidapet, Chennai – 600 015

Tamil Nadu, INDIA.

Master of Science in Chemistry

Regulations

1. Programme Objectives (PO):

Chemistry, being a central science and a pervasive subject, encompasses the synthesis and study of molecules and materials, the exploration of their properties and the development of ways to use them in real life. Our Master of Science programme is a versatile degree which has been designed 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.

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

PO1. Impart knowledge 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.

2. Programme Specific Objectives (PSO):

While studyingPost 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.

3. 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

4. Eligibility for admission:

A candidatewho 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.

5. Medium: English

6. Duration of the Course:

The minimum duration for pursuing the degree of Master of Science in Chemistry is TWOyears. The maximum duration shall be adhering as per TNOU regulations time to time.

7. Admission:

The candidate's admission for the degree of Master of Science in Chemistry will be taken in Academic year only.

8. Course of Study:

The course of study shall comprise the instruction in the following courses according to the syllabus.

Year	Course	Credit
I	Core Theory - I	6
	Core Theory- II	6
	Core Theory- III	6
	Core Theory- IV	6
	Core Theory - V	6
	Core Theory - VI	6
II	Core Theory - VII	6
	Core Theory-VIII	6
	Core Theory- IX	6
	Core Practical -I	6
	Core Practical - II	6
	Core Practical - III	6
Total Credits		**72**

9. Examinations:

The examination for the M.Sc. Degree shall consist of theory and practical papers.

(ii) Theory Examinations: The theory examination shall be of three hours duration to each paper and conducted at the end of each year. The candidates who failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examinations.

(i) Practical Examinations: The practical examinations shall be of four hours duration to each practical and conducted at the end of second year. The candidates who failing in any practical(s) will be permitted to appear for each failed practical(s) in the subsequent examinations.

(Note:Those who fail in the practical examination should appear only for practical examinations not

need to appear for the practical counselling classes again. The marks once awarded for records will remain the same and will be declared to have passed in that course.)

10. Scheme of Examinations:

The scheme of examinations for two years shall be as follows:

Subject	Title of the Subject	Subject Code	Credit	Examination		
				Mark Distribution		Maximum Marks
				CIA*	TEE#	
I Year						
Core - I (Theory)	Organic Chemistry-I	MCHEN-11	6	30	70	100
Core - II (Theory)	Inorganic Chemistry-I	MCHEN-12	6	30	70	100
Core - III (Theory)	Physical Chemistry-I	MCHEN-13	6	30	70	100
Core - IV (Theory)	Analytical and Environmental Chemistry	MCHEN-14	6	30	70	100
Core - V (Theory)	Chemistry of Bio-Molecules and Green Chemistry	MCHEN-15	6	30	70	100
Core - VI (Theory)	Polymer Chemistry	MCHEN-16	6	30	70	100
II Year						
Core -VII (Theory)	Organic Chemistry-II	MCHEN-21	6	30	70	100
Core -VIII (Theory)	Inorganic Chemistry-II	MCHEN-22	6	30	70	100
Core - IX (Theory)	Physical Chemistry-II	MCHEN-23	6	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
Total Credits = 72				**Total Marks = 1200**		

***** *Continuous Internal Assessment (CIA)*

#Term End Examination (TEE)

11. Question Pattern:

Max. Marks: 70 Time: 3 hours

PART - A (5 × 2 = 10 marks)

Answer all FIVE questions in 50 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

PART - B (4 × 5 = 20 marks)

Answer any FOUR questions out of Seven questions in 150 words

All questions carry equal marks

6. From Block - I
7. From Block - II
8. From Block - III
9. From Block - IV
10. From Block- V
11. From any Block
12. From any Block

PART - C (4 × 10 = 40 marks)

Answer any FOUR questions out of Seven questions in 400 words

[All questions carry equal marks]

13. From Block - I
14. From Block - II
15. From Block - III
16. From Block - IV
17. From Block - V
18. From any Block
19. From any Block

12. 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)[The mark distributions will be adhere as per TNOU norms time to time]and overall aggregated marks is 50 in both the external and internal taken together.The Candidate must secure the minimum aggregated total of 50 marks for passing in the each course.

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 will be based on the results, record note book, procedure writing and Vivo-voce taken together is required to pass the examinations.

13. 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 ***First Class***.
- 50% and above but below 60% in the aggregate will be placed in the ***Second Class***.

COURSE TITLE	**:**	**ORGANIC CHEMISTRY – I**
COURSE CODE	**:**	**MCHEN - 11**
COURSE CREDIT	**:**	**6**

COURSE OBJECTIVES (CO)

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. Describethe stereochemistry and conformational analysis of organic molecules

CO4. Determine the retro synthetic methods and important organic reagents

CO5. Characterize thearomaticity of organic molecules

COURSE OUTCOMES (COC)

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. Recognizethe 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_1, E_2, E_1cB mechanisms - Stereochemistry for elimination reactions

Unit-4-Hofmann's and Zaitsev's rules - Pyrolyticcis-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_2, -COOH) -

Unit-14-Applications of Jonesreagent, PCC, PDC, DMP, CAN, $Mn(OAc)_3$, 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_3, NBS, $NaBH_4$, $LiAlH_4$, 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)π-electrons and 4nπ-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
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8. https://youtu.be/cNBlYHmW_ok
9. https://youtu.be/q77l5Qpq2YM
10. https://youtu.be/8NVHKwuhUd0
11. https://youtu.be/DwPhHIwuUk8
12. https://youtu.be/SdpXFcf_La0
13. https://youtu.be/jzQ_xMEjf94
14. https://youtu.be/3_BPUU960s4
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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	**:**	**6**

COURSE OBJECTIVES (CO)

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

COURSE OUTCOMES (COC)

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 triagonalbipyramidal fields

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

Unit-8-Ligand field theory - LFSE - M.O energy level diagrams for octahedral and tetrahedral complexes without and with π-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 toElectron 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-OdAqTlY
10. https://youtu.be/-VHFrocFaCw
11. https://youtu.be/vJtw9LiZtbI
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

COURSE TITLE	**:**	**PHYSICAL CHEMISTRY - I**
COURSE CODE	**:**	**MCHEN - 13**
COURSE CREDIT	**:**	**6**

COURSE OBJECTIVES (CO)

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

COURSE OUTCOMES (COC)

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 thecharacteristic 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 - Orthogonization 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,ModernElectrochemistry,Vol. I:

Web Links:

1. https://youtu.be/PXf2KTfjfEg
2. https://youtu.be/lGuDbdnXrhI
3. https://youtu.be/eHeSc45OyZE
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5. https://youtu.be/DU4bMn6GO-I
6. 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
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/BT7fFlO9CwE
20. https://youtu.be/kamimMzfg3k

COURSE TITLE	**:**	**ANALYTICAL AND ENVIRONMENTAL CHEMISTRY**
COURSE CODE	**:**	**MCHEN - 14**
COURSE CREDIT	**:**	**6**

COURSE OBJECTIVES (CO)

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

COURSE OUTCOMES (COC)

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 he 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-NMRSpectroscopy: Principle - Instrumentation - ^{1}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 - Dueterium substitution - Shift reagents - Double resonance technique

Unit-3- ^{13}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 bondingon vibrational frequencies

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

Block III: UV- Visible and Mass Spectroscopy

Unit-9- UV- Visible Spectroscopy**:** Principle **-** Instrumentation - Electronic excitation σ-σ*, n- σ*, n-π and π-π*transitions

Unit-10- Solvent effect -Factors affecting position/intensity ofabsorption 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 Methodsand 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/QlM21sl-TDg
3. https://youtu.be/1vEJG0AaELE
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8. https://youtu.be/9GYitGryGqs
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11. https://youtu.be/SQucmCTpdgg
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14. https://youtu.be/6lceoAXEWj8
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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

COURSE TITLE	**:**	**CHEMISTRY OF BIOMOLECULES AND GREEN CHEMISTRY**
COURSE CODE	**:**	**MCHEN – 15**
COURSE CREDIT	**:**	**6**

COURSE OBJECTIVES (CO)

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, harmones and prostoglands

CO3. Discuss about the types and applications of antibiotics, pesticides, fertilizers, petrochemicals

CO4. Determine the occurrence, classification and isolation of alkoloids, steroids, terpenoids and carotenoids

CO5. Interpret the principles and characteristic features of Green chemistry

COURSE OUTCOMES (COC)

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, harmones and prostoglands

COC3. Determine the types and applications of antibiotics, pesticides, fertilizers, petrochemicals

COC4. Explain theoccurrence, classification and isolation of alkoloids, 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, Harmones and Prostoglands

Unit-5-Carbohydrates: Introduction to Monosaccharides, Disaccahaides 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 harmones - Reproductive Hormones

Unit-8- Prostoglands: Introduction - Structure, stereochemistry and synthesis of PGE1.

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: Alkoloids, Steroids, TerpenoidsandCarotenoids

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), α-Terpeneol (monocyclic), Santonin (bicyclic)

Unit-16- Carotenoids:General methods of structure determination of Carotenes: α/β/γ-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. Niranjan Das, Natural Products' Chemistry.
3. O. P. Agarwal, Natural Products Chemistry, I Edition.
4. K. AnandSolamon, 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
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COURSE TITLE	**:**	**POLYMER CHEMISTRY**
COURSE CODE	**:**	**MCHEN – 16**
COURSE CREDIT	**:**	**6**

COURSE OBJECTIVES (CO)

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. Interpretthestructure and properties of polymer molecules

CO4. Explain about the characterization methods of polymer molecules

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

COURSE OUTCOMES (COC)

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 –Monosubstitutedethylenes(Site of steric isomerism, Tacticity)

Unit-6- Disubstitutedethylenes (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- Disubstitutedethylenes (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 ofstereoregularity (isotactic, syndiotactic, and atacticpolypropenes), 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- Configurationsof polymer chains

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

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

Unit-12- The glass transition temperature, Tg, relationship between Tm and Tg - 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 viscosityaverage molecular weights

Unit-14- Polydispersity and molecular weight distribution - The practicalsignificance of molecular weight

Unit-15- Measurement of molecular weights - End group, viscosity, lightscattering, 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, Phenolicresins, Epoxy resins and silicone polymers

Unit-18- Functional polymers-Fire retarding polymers andelectrically 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.

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COURSE TITLE : ORGANIC CHEMISTRY - II

COURSE CODE : MCHEN – 21

COURSE CREDIT : 6

COURSE OBJECTIVES (CO)

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

COURSE OUTCOMES (COC)

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 ofoxetanes, triazoles, pyridine, pyrazoles, isothiazoles, pyrimidines, purines, and triazines,

Unit-8-Synthesis and reactivity ofpyrazines, 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-π-methane rearrangement

Unit-16-Photochemistry of α,β-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}H NMR: Chemical shift - Coupling constant - Factors influencing chemical shift/coupling constant - ^{1}H NMR spectra of simple organic

molecules [CH_3CH_2OH, CH_3CH_2Cl, CH_3CHO etc.] - AX and AB spin system Nuclear Overhauser effect

Unit-18- ^{13}C NMR: Proton decoupled and off - resonance ^{13}C NMR spectra - Factors affecting ^{13}C chemical shift - ^{13}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 Phtochemistry; 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.BasslerSpectroscopic identification of organic compounds.

Web Links:

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5. https://youtu.be/NA38c3_YeR8
6. https://youtu.be/Os_LYe8xmBQ
7. https://youtu.be/PpJOM4Rq76Q
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9. 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
14. https://youtu.be/3l-_e-4SRaQ
15. https://youtu.be/JNbuLx5Tvdw
16. https://youtu.be/g48X4GT-sXE
17. https://youtu.be/il2e_3vEPzc
18. https://youtu.be/F9H9o1pwwcU
19. https://youtu.be/-p2rEi8JAEg
20. https://youtu.be/ht8wMEQmMs4

COURSE TITLE : INORGANIC CHEMISTRY - II

COURSE CODE : MCHEN - 22

COURSE CREDIT : 6

COURSE OBJECTIVES (CO)

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

COURSE OUTCOMES (COC)

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

COC1. Describe thecharacteristic features and application of organo metallic chemistry

COC2. Analyse thespectral 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 ofmetallocenes

Unit-2- Reactions: Association substitution, addition and elimination reactions, ligand protonation, carbonylation, decorboxylation, 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 (Zeigler-Natta Catalyst)

Unit-4- Cyclooligomerisation of acetylene using nickel catalyst (Reppe'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}P, ^{19}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., 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-Nonstochiometric 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.

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20. https://youtu.be/ktXK2yPdwks

COURSE TITLE : PHYSICAL CHEMISTRY - II

COURSE CODE : MCHEN - 23

COURSE CREDIT : 6

COURSE OBJECTIVES (CO)

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

CO1. Discussabout 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

COURSE OUTCOMES (COC)

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).

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19. https://youtu.be/MQibi1PpAO0
20. https://youtu.be/ExGQnRw75lA

PRACTICAL COURSE SYLLABUS

COURSE TITLE : ORGANIC ESTIMATION AND SYNTHESIS

COURSE CODE : MCHEN - P1

COURSE CREDIT : 6

COURSE OBJECTIVES (CO)

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.

COURSE OUTCOMES (COC)

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:

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5. https://youtu.be/1pgAFSB_E2I

COURSE TITLE	**:**	**INORGANIC ANALYSIS, ESTIMATION AND PREPARATION**
COURSE CODE	**:**	**MCHEN - P2**
COURSE CREDIT	**:**	**6**

COURSE OBJECTIVES (CO)

While studying the Inorganic Analysis, Estimation and Preparationpractical 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.

COURSE OUTCOMES (COC)

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 theinorganicmetal 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: Anyfour 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,NationalPubs, London, 1988.
4. G. Svehla, Text Book of Macro and Semimicro Qualitative InorganicAnalysis; V Edition, Longman group Ltd, London, 1987.
5. A. I. Vogel, Text Book of Quantitative Inorganic Analysis; VI Edition,Longman,New Delhi, 2000.

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7. https://youtu.be/ykkIP0RJXuk
8. https://youtu.be/vVFEyA1SQNU

COURSE TITLE	**:**	**PHYSICAL CHEMISTRY EXPERIMENTS**
COURSE CODE	**:**	**MCHEN - P3**
COURSE CREDIT	**:**	**6**

COURSE OBJECTIVES (CO)

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 andconductometric titrations ofacids 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 forthe 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.

COURSE OUTCOMES (COC)

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 andconductometric 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 forthe 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:

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