आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश

IFTM University, Moradabad, Uttar Pradesh

NAAC ACCREDITED

SCHOOL OF SCIENCES

DEPARTMENT OF CHEMISTRY

MASTER OF SCIENCE (CHEMISTRY)

TWO YEAR PROGRAMME

[W. E. F. ACADEMIC SESSION: 2020 - 21]

IFTM UNIVERSITY
N.H.-24, Lodhipur Rajput, Delhi Road, Moradabad, Uttar Pradesh-244001
www.iftmuniversity.ac.in

आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश

IFTM University, Moradabad, Uttar Pradesh

NAAC ACCREDITED

Website: www.iftmuniversity.ac.in

SCHOOL OF SCIENCES
DEPARTMENT OF CHEMISTRY

Study & Evaluation Scheme of
Master of Science (Chemistry)
[Session 2020-21]

Programme	**:**	Master of Science (Chemistry)
Course Level	**:**	PG Course
Duration	**:**	Two Year (Four Semester) Full Time
Medium of Instruction	**:**	English
Minimum Required Attendance	**:**	75%
Maximum Credits	**:**	80

Programme Outcomes (POs):

1. To provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.
2. To provide students with the skills required to succeed in graduate school, the chemical industry or professional school.
3. To expose the students to learn the experimental techniques using modern instrumentation.
4. The student will understand the importance of the elements, how it came to be, and its role in organizing chemical information and formulation.
5. The student will understand the interdisciplinary nature of chemistry and to integrate knowledge of mathematics, physics, biochemistry, computational chemistry, synthetic chemistry and other disciplines of life sciences to a wide variety of chemical problems.
6. The student will learn the different chemical process to enhance their laboratory skills needed to design the chemical compounds, new molecules, safely conduct and interpret chemical research.
7. The student will acquire the sufficient depth of knowledge to enable them to understand and critically interpret the primary chemical literature.
8. The student will develop the ability to effectively communicate scientific information and research inferences in different written formats.
9. The student will learn professionalism, including the ability to work in teams and apply basic ethical principles.
10. The Department of Chemistry is committed in preparing competitive and professional post graduates and researchers, having good knowledge of basics and emerging branches of chemistry for the betterment of society.

Course Structure
Master of Science (Chemistry) Programme

S. N.	Semester 1.	Course code	Theory Course Name	Periods			EVALUATION SCHEME (Marks)				Total Marks	Credits
							Mid semester Exam			End semester Exam		
				L	T	P	MS 1+2	AS +AT	Total			
	THEORY											
1.		MCH-101	Inorganic chemistry- I	3	1	0	10+ 10	5+5	30	70	100	4
2.		MCH-102	organic chemistry- I	3	1	0	10+ 10	5+5	30	70	100	4
3.		MCH-103	Physical chemistry- I	3	1	0	10+ 10	5+5	30	70	100	4
4.		MCH-104	Analytical methods	3	1	0	10+ 10	5+5	30	70	100	4
5.		MCH-151	Inorganic Chemistry Practical	-	-	4x2 x3= 24	-	-	30	70	100	2
6.		MCH-152	Physical Chemistry Practical	-	-	4x2 x3= 24	-	-	30	70	100	2
7.			TOTAL	12	4	48	x	X	x	x	600	20
S. N.	Semester 2.	Course Code	Theory course Name	Periods			EVALUATION SCHEME				Total Marks	Credits
							Mid semester Exam			End semester Exam		
				L	T	P	MS 1+2	AS +AT	Total			
	THEORY											
1.		MCH-201	Inorganic chemistry- II	3	1	0	10+ 10	5+5	30	70	100	4
2.		MCH-202	organic chemistry- II	3	1	0	10+ 10	5+5	30	70	100	4
3.		MCH-203	Physical chemistry- II	3	1	0	10+ 10	5+5	30	70	100	4
4.		MCH-204	Polymer Science	3	1	0	10+ 10	5+5	30	70	100	4
5.		MCH-251	Analytical Chemistry Practical	-	-	4x2 x3= 24	-	-	30	70	100	2
6.		MCH-252	Organic Chemistry Practical	-	-	4x2 x3= 24	-	-	30	70	100	2
7.			TOTAL	12	4	48	x	X	x	x	600	20

Course Structure
Master of Science (Chemistry) Programme

S.N.	Semester 3.	Course code	Theory Course (Name Of The Paper)	Periods			EVALUATION SCHEME (Marks)				Total Marks	Credits
							Mid semester Exam			End semester Exam		
				L	T	P	MS 1+2	AS +AT	Total			
	THEORY											
1.		MCH-301	Organic Synthesis-I	3	1	0	10+ 10	5+5	30	70	100	4
2.		MCH-302	Chemistry of Natural Products -I	3	1	0	10+ 10	5+5	30	70	100	4
3.		MCH-303	Heterocyclic Chemistry	3	1	0	10+ 10	5+5	30	70	100	4
4.		MCH-304	Instrumental Methods In Chemical Analysis	3	1	0	10+ 10	5+5	30	70	100	4
5.		MCH-351	Organic Chemistry Practical	-	-	4x2x 3= 24	-	-	30	70	100	4
			TOTAL	12	4	24	X	X	x	x	500	20

S.N.	Semester 4.	Course Code	Theory Course (Name Of The Paper)	Periods			EVALUATION SCHEME				Total Marks	Credits
							Mid semester Exam			End semester Exam		
				L	T	P	MS 1+2	AS +AT	Total			
	THEORY											
1.		MCH-401	Organic Synthesis-II	3	1	0	10+ 10	5+5	30	70	100	4
2.		MCH -402	Chemistry of Natural Products- II	3	1	0	10+ 10	5+5	30	70	100	4
3.		MCH-403	Applications Of Spectroscopy In Organic Chemistry	3	1	0	10+ 10	5+5	30	70	100	4
		MCH-404	ELECTIVE PAPER (MEDICINAL CHEMISTRY)	3	1	0	10+ 10	5+5	30	70	100	4
4.		MCH-451	Organic Chemistry Practical	-	-	4x2 x3= 24			30	70	100	4
5.		MCH-PRJ-452	Project	-	-		-	-	30	70	100	4
6.			Total	9	3	24	x	x	x	x	500(as medicinal chemistry is an optional subject paper in lieu of project	20 (as medicinal chemistry is an optional subject paper in lieu of project)

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) I Year (I Semester)
MCH-101: INORGANIC CHEMISTRY – I

Objectives: The students will be able to describe wave mechanics and origin of quantum theory. They will learn how to give the systematic names of simple coordination compounds.
The students will be able to explain the preparation of Sulphur, Nitrogen and Phosphorus compounds.

UNIT-I

(09 Sessions)

Wave mechanics:
Origin of quantum theory, black body radiation, atomic spectra, photoelectric effect, and matter waves, wave nature of the electron, the wave equation, the theory of hydrogen atom,

UNIT-II

(09 Sessions)

Metal π complexes and Metal Clustres:
Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls ,Compounds with metal- metal multiple bonds, Boranes ,Carboranes, Wade's rule.

UNIT-III

(09 Sessions)

Sulphur, Nitrogen and Phosphorus:
Sulphur-Nitrogen compounds: Tetra sulphur tetra nitride, disulphur dinitride and polythiazyl. S_xN_y compounds. S-N cations and anions .Other S-N compounds. Sulphur-phosphorus compounds: Molecular sulphides such as P_2S_3, P_4S_7, P_4S_9 and P_3S_{10}. Phosphorus-nitrogen compounds: Phosphazenes. Cyclo and linear Phosphazenes.Other P-N compounds. Boron-nitrogen compounds: Borazine, substituted borazines and boron nitride.

UNIT-IV

(09 Sessions)

Chemistry of transition elements:
General characteristic properties of transition elements, nomenclature of coordination compounds, Werner's theory, splitting of d -orbitals in low and high symmetry environments, Jahn- Teller effect , metal clusters, sandwich compounds.

Course Outcomes:
Students completing this course will able to:

- To explain atomic structure based on quantum mechanics
- Able to explaining the theory of the determination of the electron structure of d-metal complexes and explain the properties of these complexes.
- Students should be able to explain the structure and bonding in molecules and predict the structure of molecules.

Suggested Readings:

1. Inorganic Chemistry by J.E.Huheey
2. Basic Inorganic Chemistry by Cotton and Wilkinson

3. 4. Organic Chemistry by Morrisson and Boyd
4. Concise Inorganic Chemistry by J.D.Lee
5. The Organometallic Chemsitry Of Transition Metals: John Willey

Web Sources:

- https://bookboon.com/en/chemistry-ebooks
- https://www.pdfdrive.com/msc-inorganic-chemistry-e11145894.html
- https://ocw.mit.edu/courses/chemistry/5-12-organic-chemistry-i-spring-2003/lecture-handouts/

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) I Year (I Semester)
MCH-102: ORGANIC CHEMISTRY – I

Objective: The main objective of this course is to understand the difference between structure and reactivity .To understand the reagents used in organic synthesis. Also to know the stereochemistry of biphenyls , allenes and spirans.

UNIT-I

(09 Sessions)

Structure and reactivity:
Properties of organic molecules – concept of Aromaticity – Types – Huckle and Craig's rules – Benzenoid and non benzenoid compounds – annulenes – Hetero annulenes – fullerenes (C- 60) – Types of organic reactions – mechanisms – Energy and Kinetic aspects –reactive intermediates – their formation and stability – Aromatic substitution reactions (electrophilic, nucleophilic and through benzynes) – radical substitution of arynes . Nucleophilic substitution at a saturated carbon atom –SN-1, SN-2 and SN i reactions.

UNIT-II

(09 Sessions)

Reagents in Organic Synthesis:
$NaBH_4$, LAH , Lithium disopropylamide (LDA)- dicyclohexyl carbodimmide (DCC), 1,3 – Dithiane (reactivity umpolung), OsO_4, SeO_2, Wilkinson's catalyst and 2,3 – dichloro – 5,6 – dicyano – 1,4,- benzo quinone (DDQ).

UNIT-III

(09 Sessions)

Stereochemistry:
Conformational isomerism– cyclohexanes and decalins – optical isomerism – optical activity – molecular asymmetry and dissymmetry . Enantio and diastereo selective synthesis . Chirality – optical isomerism in biphenyls, allenes and spirans – optical isomerism in Nitrogen compounds . Geometrical isomerism – acylic and cyclic compounds.

UNIT-IV

(09 sessions)

Pericylic reactions and chemistry of heterocyclic compounds
Definition – classification selection rules and stereochemistry of electrocyclic reactions, cycloaddition and sigmatropic shifts, Sommelet – Hauser , Diels – Alder reaction.
Synthesis and reactivity of Indole, Pyrimidine, Pyrazine, Oxazole**.**

Course outcomes:

Students completing this course will able to:

- To recognize either molecule is aromatic, non-aromatic or antiaromatic.
- Able to describe mechanism of different electrocyclic ,aliphatic nucleophillic substitution reactions.
- Able to draw potential energy diagrams.
- Able to assign R and S to given molecules.

Suggested readings:

1. Biochemistry : L. Steyer, Freeman And Co.; New York
2. Organic Synthesis: M.B. Smith: Mc Graw Hill, New York

3. Advanced Organic Chemistry Reaction, Mechanism And Structure, M.B. Smith And J. March: John Willey And Sons, New York.
4. Symmetry and Spectroscopy Of Molecules, K.Veera Reddy, Newage International Pvt Ltd, New Delhi.

Web sources:

- https://www.organic-chemistry.org/
- https://www.organic-chemistry.org/namedreactions/
- https://www.internetchemistry.com/chemistry/organic_chemistry.htm

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) I Year (I Semester)
MCH -103: PHYSICAL CHEMISTRY – I

Objectives: This course will impart the knowledge on design and development of materials with pre-required properties. To give understanding the structure of solids in its influence on physical-chemical properties, also to give understanding of phase relations, chemical synthesis, reaction kinetics as well as characterization methods.

UNIT-I

(09 Sessions)

Solid State Chemistry – I

Introduction, classification, laws of crystallography, crystallographic systems, space lattice, types of lattices, Bragg's Equation, X-ray spectrometer, Rotating crystal method, Powder method, Neutron Diffraction, Heat capacities of solids, Molar heat capacities, application, quantum theories of specific heats (Einstein Equation, Debye equation) Born Haber cycle, cohesive energy Ionic crystal. Properties of solids

UNIT-II

(09 Sessions)

Solid state chemistry – 1

Defects in solids-point defects- linear defect- Frenkel & Schotkey defect (Mathematical derivations). Band theory of solids semiconductors – Extrinsic & Intrinsic non stochiometric ,organic semiconductors, p-n junction, rectifiers, transistors, metal purification by zone refining, preparation of single crystals of Si & Ge (Czochralski crystal pulling method) doping, Integrated circuits.

UNIT-III

(09 Sessions)

Chemical kinetics:

zeroth order , first order, second order, third order rate equations (with suitable gaseous phase and liquid phase reaction, determination of order of reactions (method of integration, fractional life period method, differential method, isolation method) opposing reactions, Hydrogen-bromine, hydrogen- chlorine reactions, consecutive reactions photolysis of acetaldehyde. Theories of reaction rates-(collision and transition state theory). Primary and secondary salt effects, effect of dielectric constant of solvent, ion – ion interaction.

UNIT-IV

(09 Sessions)

Thermodynamics:

Concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties and partial molar free energy, Partial molar volume and partial molar heat content and their significances. Concept of fugacity , Non ideal systems: Excess functions for non – ideal solutions. Activity, activity coefficients. Determination of activity and activity coefficients, ionic strength.

Course Outcomes:

Students completing this course will able to:

- Describe the principles concerning *solid state* structures.
- Describe specific crystal structures by applying basic crystallographic concepts.

- Give an account of the generation of X-ray radiation and its effects of matter. Describe the experimental use of the diffraction phenomenon.
- Describe basic concepts of Thermodynamics.
- Restate definition of system, surrounding, closed and open system, extensive and intensive properties.
- Distinguish heat transfer by conduction, convection and radiation and calculated the amount of heat energy transferred.

Suggested Readings

1. Text Book of Physical Chemistry By S Glasstone
2. .Advanced Physical Chemistry By Gurudeep Raj
3. Modern Electrochemistry J.O.M. Bockris And A.K .M. Reddy: Plenium Press New York.
4. Physical Chemistry: Atkins, Oxford Universiyt Press, New York.
5. Physical Chemistry, I.N.Livine: Tata Mc Graw Hill Publication New Delhi**.**

Web Sources

- https://edujournal.in/physical-chemistry-handwritten-notes-download-free-notes/
- https://www.internetchemistry.com/chemistry/physical_chemistry.htm
- http://www.freebookcentre.net/Chemistry/Physical-Chemistry-Books.html

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) I Year (I Semester)
MCH -104: ANALYTICAL METHODS

Objectives: Students will learn intermediate theory and laboratory techniques in analytical and physical chemistry. They will know the applications of electrochemistry and liquid chromatography. They will learn modern theoretical and experimental methods used to study problems of molecular structure and bonding; emphasis on spectroscopic techniques.

UNIT-I

(09 Sessions)

Treatment of Analytical Data:

Errors in Quantitative Analysis –Standard deviation-Variance –regression analysis- statistical design of experiments and sampling. Quality control- standards of purity. Basic components of computers -comparison of micro, main frame and super computers. Synopsis of software Packages in Chemistry.

Applications :

1. Standard deviation and variance of universate data.
2. Roots of quadratic – equation and application to hydrogen ion concentration of strong acid .
3. Determination of rate constant of first order reaction or Beer's law using least square method (Derivation not needed).

UNIT-II

(09 Sessions)

Conventional Separation Methods :

Precipitation methods- Nucleation and crystal growth- purity of precipitate-co precipitation & post precipitation – homogeneous precipitation (methods) techniques and its advantages. Use of organic reagents as precipitants . Separation by hydroxide and sulphide precipitation.

UNIT-III

(09 sessions)

Modern Separation Methods :

Solvent extraction- general principles – classification of extraction systems and applications to chemical analysis. Chromatography – adsorption – liquid partition – column – TLC- HPLC-GLC Basic principles and typical applications to organic and inorganic analysis. Ion exchange methods. Cation and anion exchangers – ion exchange chromatography – Ion exchange separations. Zone Refining technique and preparation of ultrapure compounds.

UNIT-IV

(09 Sessions)

Electroanalytical Techniques:

Polarography: Introduction, Instrumentation, Ilkovic equation and its verification. Derivation of wave equation , Determination of half wave potential, qualitative and quantitative applications. Amperometry: Basic principles, instrumentation, nature of titration curves, and analytical applications.

Course Outcomes:

Students completing this course will able to:

- To understand the principles defining analytical chemistry from the point of view of the "problem solving" approach.

- ❖ Furthermore, he will acquire knowledge about the chemical equilibria in solution ,carrying out simple qualitative tests and of defining the optimal conditions for a reaction to proceed.
- ❖ volumetric and gravimetric quantitative determinations; standard analysis procedures, understanding and development of a SOP

Suggested Readings:

1. Chemical Instrumentation: A. Schematic Approach, Strovel, Addision Wesley Reading Mass.
2. Analytical Chemistry by Skoog and Miller
3. A textbook of qualitative inorganic analysis by A.I. Vogel
4. Nanochemistry by Geoffrey Ozin and Andre Arsenault
5. Stereochemistry by D. Nasipuri5. Organic Chemistry by Claiden.
6. Organic Analytical Chemistry: Theory And Practice: Jagmohan , Narosa Publishing House New Delhi.

Web Sources:

https://freebookcentre.net/
http://www.chemguide.co.uk/

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) I Year (I Semester)
MCH -151: INORGANIC CHEMISTRY PRACTICAL

Objectives: Students will be able to understand the objective of their chemical experiments, properly carry out the experiments, and appropriately record and analyze the results.
Students will be able to use standard laboratory equipment, modern instrumentation, and classical techniques to carry out experiments. Students will know and follow the proper procedures and regulations for safe handling and use of chemicals.

(20 Sessions)

[1] Quantative separation of following pairs of metal ions using gravimetric and volumetric methods:
i) Ag^{+}(gravimetrically) and Cu^{2+}(volumetrically)
ii) Cu^{2+}(gravimetrically) and Zn^{2+}(volumetrically)
iii) Fe^{3+}(gravimetrically) and Ca^{2+}(volumetrically)
iv) Mg^{2+}(gravimetrically) and Ca^{2+}(volumetrically)
[2] Separation of a mixture of cations/anions by paper chromatographic technique using aqueous/non-aqueous media
i) Pb^{2+} and Ag^{+} (aqueous and non-aqueous media)
ii) Co^{2+} and Cu^{2+} (non-aqueous medium)
iii)Cl^{-} and I^{-} (aqueous-acetone medium)
iv) Br^{-} and I^{-} (aqueous-acetone medium)
[3] Determination of chromium (VI)present in a sample of potassium dichromate.
[4] Preparation of tetrammine copper(II)sulphate monohydrate, $[Cu(NH_3)_4]SO_4.H_2O$
[5] Preparation of tris(thiourea)copper(I)sulphate.
[6] Preparation of cis-potassium dioxalate diaqua chromate(III).
[7] Preparation of trans-potassium dioxalate diaqua chromate(III).
[8] Preparation of bis[dimethylglyoximato nickel(II)].
[9] Preparation of hexamine nickel(II)chloride.
[10] Preparation of sodium trioxalato ferrate(III).

Course outcomes:

Students completing this course will able to:

- Students will demonstrate safe laboratory practices through the use of appropriate personal protective equipment and appropriate handling of all chemicals, including proper disposal of waste.
- Students will critically assess the progress and success of their experiments, and be able to adjust experimental procedures when necessary.

Suggested Readings:

1. Practical Chemistry - Giri, Bajpai And Pandey, S. Chand & Co. Ltd., New Delhi.
2. Laboratory Manual In Organic Chemistry, R.K. Bansal, Willey Eastern.
3. Experimental Organic Chemistry, Vol. I And II, P.R. Singh, D.S. Gupta And K.S. Bajpai, Tata Mc Graw Hill.
4. Method Of Chemical Analysis G.W. Ewing Mc Graw Hill.
5. Experiments In General Chemistry, N.R. Rado And U.C. Agarwal, Eastern Press.

Web Sources:

- https://www.acs.org/content/acs/en/education/students/highschool/chemistryclubs/activities/simulations.html
- http://www.chem.ox.ac.uk/vrchemistry/

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) I Year (I Semester)
MCH -152: PHYSICAL CHEMISTRY PRACTICAL

Objectives: This practical course will give scientific reasoning and quantitative analysis laboratory practice and safety practices to the post graduate students. They will learn the ability to perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations and draw reasonable, accurate conclusions.

(20 Sessions)

[1] Conductometric titration of mixture of strong acid with sodium hydroxide.

[2] Conductometric titration of mixture of weak acid with sodium hydroxide.

[3] Equilibrium constant of KI $+I_2$-------KI_3.

[4] Hydrolysis of an ester – A Kinetic study.

[5] Determination of solubility product of a sparingly soluble salt by conductometric method.

[6] Heat of Neutralization.

[7] Heat of solution.

[8] A study of the adsorption of oxalic acid on charcoal.

[9] Determination of dissociation constant of acetic acid and verification of ostwald's dilution law.

[10] Rate constant of acid catalyzed hydrolysis of sucrose by chemical method.

Course outcomes:
Students completing this course will able to:

- Understand the principles defining physical chemistry from the point of view of the "problem solving" approach.
- Furthermore, he will acquired knowledge about equilibrium and dissociation constant, Heat of Neutralization of the given sample and carrying out simple qualitative tests and can defining the optimal conditions for a reaction to proceed.

Suggested Readings:

1. Experimental physical chemistry by Frederick A. Bettelheim
2. Experimental physical chemistry by G. Peter Matthews
3. Experimental physical chemistry by Farrington Daniels
4. Experimental physical chemistry by Halpern and McBane
5. Experiments in Physical Chemistry by Shoemaker, Garland and Nible

Web Sources

- https://www.labster.com/chemistry-virtual-labs/
- https://digitallearning.ucf.edu/ilab/remote-labs/college-of-sciences-remote-lab-resources/

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) I Year (II Semester)
MCH -201: INORGANIC CHEMISTRY – II

Objectives: To make the students conversant with the nomenclature of co ordination compounds. They will learn isomerism in co ordination compounds, bonding theories of co- ordination compounds..

UNIT-I

(09 Sessions)

Spectroscopic properties of complexes: ground states, co-relation, Orgel Diagrams for transition metal complexes (d^1-d^9 states), calculations of Dq, B & β parameters, and charge transfer spectra.

UNIT-II

(09 Sessions)

Co-ordination chemistry of metal complexes, Isomerism in coordination compounds, valence bond theory of complex compounds –Inner and outer orbital complexes, Introduction to Molecular orbital theory, Electro neutrality principle and back bonding, Crystal Field Theory (CFT), Crystal Field Stabilization Energy, crystal field splitting of d-orbitals in tetrahedral and square planar complexes, Nephelauxetic effect.

UNIT-III

(09 Sessions)

Inorganic reaction mechanisms- concept of hard and soft acids and bases, Mechanism of redox reactions-outer sphere and Inner sphere mechanisms, Octahedral and square planar substitution reaction mechanism in co-ordination compounds.

UNIT-IV

(09 Sessions)

Mossbauer spectroscopy- basic principles, spectral parameters- isomer shift, chemical applications of Fe (II) and Fe(iii) compounds and Sn(II) and Sn(IV) compounds only, Nature of M-L bond.

Course Outcomes:

Students completing this course will able to:

- Understand to analyze the spectra of transition metal ions.
- Can analyze Orgel Diagrams for transition metal
- Can interpret the stability of complexes.
- Can understand the substitution reactions in transition metal complexes.

Suggested Readings:

1. Inorganic Chemistry by J.E.Huheey
2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. 4. Organic Chemistry by Morrisson and Boyd
4. Concise Inorganic Chemistry by J.D.Lee
5. The Organometallic Chemsitry Of Transition Metals: John Willey

Web Sources:

- https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry

- https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Modules_and_Websites_(Inorganic_Chemistry)

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) I Year (II Semester)
MCH -202 : ORGANIC CHEMISTRY – II

Objectives: To impart the knowledge of the increasingly important role played by organic and transition metals reagents and catalysts with their corresponding proposed reaction mechanisms. Knowledge for rational mechanism-based design of synthetic strategies for new and novel organic reactions will be given to students.

UNIT-I

(09 Sessions)

Chemistry of Natural Products:
Classification, isolation , synthesis and structural elucidation of terpenoids, general methods of sdtructure determination of citral, α- terpineol, phytol and zingiberene

UNIT-II

(09 Sessions)

Photochemistry :
Jablonski diagram-cis- trans isomerism, paterno- Buchi reaction, Norrish Type I and II reactions, Barton reaction, di-pi methane rearrangement.

UNIT-III

(09 Sessions)

Mechanisms of some typical name reactions:
Aldol, Perkin, Benzoin, Cannizaro, Wittig, Reformatsky reactions. Hofmann, Curtius, Beckmann, Oppenauer Oxidation- Clemmenson, Wolf-Kishner, Meerwein-Pondorf-Verley and Birch reductions , pinacol- pinacolone rearrangement

UNIT-IV

(09 Sessions)

Organic Spectroscopy:
Basic principles, instrumentation of UV – visible, IR and ^{1}H & ^{13}C NMR spectroscopy. Determination of structure of simple organic compounds by spectroscopic methods (like Ethyl alcohol, p-methoxy Benzyl alcohol, p-cresol, acetic acid, Cinnamic acid , Acetophenone, cyclopentanone, salicylaldehyde, Benzamide, N,N- Dimethyl aniline, 1,3,5- trimethyl benzene).

Course Outcomes:

Students completing this course will able to:

- Understand synthesis and structural elucidation of terpenoids
- Can understand principles involved in photo chemistry.
- They will have the knowledge of spectroscopy of organic compounds.

Suggested Readings:

1. Biochemistry : L. Steyer, Freeman And Co.; New York
2. Organic Synthesis: M.B. Smith: Mc Graw Hill, New York
3. Advanced Organic Chemistry Reaction, Mechanism And Structure, M.B. Smith And J. March: John Willey And Sons, New York.
4. Symmetry And Spectroscopy Of Molecules, K.Veera Reddy, Newage International Pvt Ltd, New Delhi.

Web sources:

- https://rmg.mit.edu/

- https://libguides.lib.rochester.edu/c.php?g=201104&p=4256071
- http://www.freebookcentre.net/Chemistry/Organic-Chemistry-Books.html

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) I Year (II Semester)
MCH -203 : PHYSICAL CHEMISTRY – II

Objectives: Objective of this course is to learn about the phenomenon of fluorescence, phosphorescence and sensitized fluorescence**.** They will learn fundamentals of electro chemistry, colloids and their properties and the mechanism of catalysis.

UNIT-I

(10 Sessions)

Photo Chemistry:

Consequences of light absorption –quantum yield and its determinations – fluorescence , phosphorescence and sensitized fluorescence – photolysis of aldehydes and ketones photochemical reactions between hydrogen and halogens – photosynthesis – flash photolysis **.**

UNIT-II

(08 Sessions)

Electro Chemistry:

Interionic attraction theory of Debye and Huckle – Onsagor's modification - determination of activity coefficients from EMF of reversible cells – concentration cells with and with out transference, liquid junction potentials – applicability to hydration numbers – determination of thermodynamic data from EMF measurements – primary cells fuel cells – photo electrochemical cells.

UNIT-III

(10 Sessions)

Surface Chemistry & Colloids:

Adsorption of gases by solids –Langmuir, Freundlich and B.E.T theory of multi molecular adsorption – applications to heterogeneous catalysis–determination of surface area of adsorbents. Electro kinetic phenomena – Donnam membrane equilibrium – emulsions , stability of colloids, factors affecting, determination of Avogadro's Number, origin of charge on colloidal particles – electrical double layer theory, theories of coagulation , kinetics of coagulation, size of colloidal particles-methods of measurement.

UNIT-IV

(08 Sessions)

Catalysis:

Acid – base catalysis, Michaelis – Menten catalysis, chain reactions, parallel reactions involving unimolecular steps only , oscillating reactions, auto catalysis , chemical chaos.

Course Outcomes:

Students completing this course will able to:

- Understand photolysis of aldehydes and ketones photochemical reactions between hydrogen and halogens.
- Can understand the kinetics of coagulation.
- Can determine the thermodynamic data from EMF measurements .

Suggested Readings:

1. Text Book of Physical Chemistry By S Glasstone
2. .Advanced Physical Chemistry By Gurudeep Raj
3. Modern Electrochemistry J.O.M. Bockris And A.K .M. Reddy: Plenium Press New York.

4. Physical Chemistry: Atkins, Oxford Universiyt Press, New York.
5. Physical Chemistry, I.N.Livine: Tata Mc Graw Hill Publication New Delhi.

Web sources:

- http://www.freebookcentre.net/Chemistry/ElectroChemistry-Books-Download
- https://www.ise-online.org/books.php
- https://ncert.nic.in/ncerts/l/lech103.pdf

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) I Year (II Semester)
MCH-204: POLYMER SCIENCE

Objectives: To explain the relationship between polymer properties (thermal, rheological, mechanical), and calculation of polymer molecular weight. Students will relate polymer properties , processing and uses. The course will explain significance of polymer solubility, melting point and glass transition temperature, different types of polymerisation methods, and the importance in each of: initiation, propagation, termination, branching; and, for co polymerization , reactivity ratios and monomer ratio.

UNIT-I

(09 Sessions)

Introduction:
Basic concepts: monomer repeat units, degree of polymerization, Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, Carother's theory addition: radical, chain-ionic and co-ordination and co- polymerization Importance of polymers

UNIT-II

(10 Sessions)

Polymers (Degradation & Kinetics)
Polymer degradation – Types of degradation – thermal, mechanical, ultrasonic waves, photo-degradation, oxidative degradation (rubber and phenol-fermaldehyde) and hydrolytic degradation. Kinetics of polymer reaction – addition – Free-radical, cationic and Anionic polymerization. Condensation polymerization – acid catalysed condensation reactions.

UNIT-III

(10 Sessions)

Rheology and mechanical properties of polymers:-
Introduction to Rheology: Newton's and Hooks laws, rheological response of materials, the ideal fluidS, non - Newtonian Fluids, time dependent fluids, power law models. Viscous flow , Relationship between stresses and strains, viscoelasticity.

UNIT-IV

(08 Sessions)

Commercial Polymers:
Polyethylene, polyvinyl chloride, polyamides, polyesters, epoxy resins and silicon polymers. Functional polymers- electrically conducting polymers. Biomedical polymers- contact lense, dental polymers, artificial heart & kidney.

Course Outcomes:

Students completing this course will able to:

- Understand Different kind of polymers and their properties
- Can calculate the ratio of monomer types in co-polymerisation and predict the type of sequence obtained.
- Can Determine the data required for the design of polymerisation .
- May know the different kind of polymers and their properties

Suggested Readings:

1. Text Book of Polymer Science, F.W. Billmeyer, Willey Science New York.
2 .Principles of Polymeriszation, J. Odien, John Willey, Singapore
3.Principles of Polymer Science, P. Bahadur And N. V. Shashtri , Narosa Publishing House New Delhi.
4. Polymer Sciences, V.R. Gowarikar and J. Sridhar, Willey Eastern New Delhi.

Web Sources:

- https://www.wiley.com/en-us/materialssciencebooks
- http://www.freebookcentre.net/Chemistry/Polymer-Chemistry-Books.html
- https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Polymers

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) I Year (II Semester)
MCH -251: ANALYTICAL CHEMISTRY PRACTICAL

Objectives: The students will learn the basics of inorganic chemistry practical such as spectrophotometric determination of various ions. They will learn the estimation of various ions by titrimetry and spectral techniques

(20 Sessions)

Exercises:

[1] Determination of copper (II) present in a brass sample (iodometric method)
[2] Determination of calcium hardness and magnesium hardness of hardwater sample.
[3] Determination of chloride in a sample of water (silver nitrate method).
[4] Estimation of copper and nickel from the given solution gravimetrically.
[5] Determination of ferrous content in the supplied sample of iron ore by titrimetric analysis.
[6] Determination of partition coefficient of benzene between water and benzoic acid.
[7] Spectrophotometric verification of Beer's law.
[8] Determination of concentration of amino acid spectrophotometrically.
[9] Spectrophotometric determination (in ppm) of Fe(II) or Fe(III) using 1,10 phenanthroline as coloring agent.
[10] Preparation of buffer solution of known ionic strength.

Course outcomes:

Students completing this course will able to:

- Learn about the Systematic preparation of simple inorganic compounds.
- Can determination the spectrophotometric concentration of amino acid.

Suggested Readings:

1. Separation methods in chemical analysis by James M. Moller (Wiely Interscience 1975)
2. Introduction to separation science By Kargar, Synder and Horwath (willy Interscience 1975).

Web sources:

- http://chemcollective.org/vlabs
- http://chemcollective.org/physical
- https://www.vlab.co.in/broad-area-chemical-sciences

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) I Year (II Semester)
MCH -252: ORGANIC CHEMISTRY PRACTICAL

Objectives: Lab will provide hands-on opportunities to develop and apply this knowledge to learn the synthesis of organic compounds.

(20 Sessions)

1. Synthesis and purification of following organic compounds involving one or two Stages.
   i) Iodoform
   ii) Picric acid
   iii) m-dinitrobenzene
   iv) Aspirin
   v) Acetanilide
   vi) p-nitroacetanilide
2. Systematic identification of about eight simple organic compounds having one or two functional groups by functional group analysis, chemical reaction and derivatisation.
3. Separation and identification of the constituents of organic compounds by the given binary organic mixture.

Course outcomes:

Students completing this course will able to:

- Learn about the Systematic identification of simple organic compounds.
- Can separate the constituents of organic compounds by the given binary organic mixture

Suggested readings:

1. A text book of practical Organic chemistry by A.I. Vogel, ELBS and Longman group.
2. Practical Organic chemistry by Mann and Saunders, ELBS and Longman group

Web Sources:

- http://chemcollective.org/vlabs
- http://chemcollective.org/physical
- https://www.vlab.co.in/broad-area-chemical-sciences

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) II Year (III Semester)
MCH- 301: ORGANIC SYNTHESIS -I

Objectives: This course will provide an introduction to the synthesis of complex organic molecules. Transformations for C-X and C-C bond-formation, functional group reactivity, chemoselectivity, regioselectivity, and the strategy of multistep synthesis will be the core topics that are covered also including the concepts /strategy/retro synthesis stereochemistry, enolates and other carbonyl chemistry, alkene synthesis, and reduction/oxidation (introductory) etc.

UNIT -I

(10 Sessions)

Molecular Rearrangements:
General mechanistic considerations– nature of migration, migratory aptitude, memory effects.
A detailed study of the following:
Hofmann –Martius Rearrangement, Benzidine Rearrangement, cope rearrangement,stobee condensation, Stevens Rearrangement, Dakin Reaction, Darzen glysidic ester condensation, , Dieckmann Reaction, Arndt eistert Synthesis, Knoevenagel Reaction, Perkin Reaction, Ullmann biaryl Reaction .

UNIT -II

(10 Sessions)

Heterocyclic Synthesis:
Principles of heterocyclic synthesis involving cyclization reaction and cycloaddition reaction. Three-membered and four-membered heterocyclics- synthesis and reactions of Aziridines, Oxiranes, Thiranes, Azetidines, Oxetanes Thietanes.

UNIT -III

(08 Sessions)

Reduction : Introduction : Different reductive processes. Hydrocarbons - alkanes, alkenes, alkynes and aromatic rings. Carbonyl compounds-aldehydes , ketones, acids and their derivatives,
Epoxides , Nitro, Nitroso, Azo and Oxime Groups. Hydrogenolysis .

UNIT -IV

(08 Sessions)

Oxidation : Introduction, Different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and inactivated). Alcohols, diols, aldehydes, and sulphides. Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and Thallium (iii) nitrate.

Course Outcomes:

Students completing this course will able to:

- To identify, classify, explain, and apply fundamental organic reactions like SN2, SN1, E2, E1, alkene addition, electrophilic aromatic substitution, 1,2/1,4-additions, ring-opening, and radical halogenation.
- Be able to apply concepts associated with these general reaction types to product prediction, synthesis design, and reaction mechanism.

- ❖ Can predict, explain, and rank the relative speeds of different chemical reactions by applying structure-dependent patterns in stability combined with application of mechanism recognition.

Suggested readings:

1. Organic Synthesis: M.B. Smith: Mcgraw New York
2. Organo metalklic Reagents In Synthesis: P.R. Jenkins; Oxford Science Publishing House
3. Modern Synthetic Reaction, H.O. House; Benjamin Publishing Company , California
4. Reagents For Organic Synthesis: L.F. Fieser, Willey Inter science New York

Web Sources:

- ❖ http://www.freebookcentre.net/Chemistry/Organic-Chemistry-Books.html
- ❖ https://chemistrynotes.com/pages/full-course-organic-chemistry-notes

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) II Year (III Semester)
MCH- 302: CHEMISTRY OF NATURAL PRODUCTS-I

Objectives: This course provides a survey of natural products chemistry including biogenesis by enzyme-mediated pathways, structure determination, medicinal and biochemical significance and synthesis. Theme of this course is to recognize the chemical building blocks in nature that enable student to link structures to biosynthetic hypotheses. It Provide an overview of the field of natural product chemistry. Also discuss the use of natural products as starting materials for medicines.

UNIT-I **(09 Sessions)**

Amino acids and proteins:
Introduction of amino acids, classification , general synthetic methods for the preparation of amino acids , peptide synthesis, classification of proteins, primary , secondary ,tertiary and quaternary structure of proteins.

UNIT-II

(09 Sessions)

Alkaloids:
Occurrence, functions, nomenclature of alkaloids, structure and synthesis of coniine, piperine, atropine, cocaine, quinine, morphine

UNIT-III

(09 Sessions)

Carotinoids and plant pigments:
introduction , classification and structure of β- carotene
Classification of plant pigments, structure determination of anthocyanin and flavones

UNIT-IV

(09 Sessions)

Purines and pyrimidines: Constitution and synthesis of uric acid, caffeine , adenine, guanine, uracil, thymine.

Course Outcomes:
Students completing this course will able to:

1. Identify and characterize various classes of natural products by their structures.
2. Appreciate the biogenesis of many natural products of importance
3. Have some knowledge of some of the plants around them and their pharmaceutical importance.

Suggested Readings:

1. Chemistry of Alkaloids: S.W. Pelytier.
2. Chemistry of Natural Products: Gurudeep Raj.
3. Total Synthesis of Natural Products, K.C. Nicolaou Vol I, Vol II

Web Sources:

- https://www.rsc.org/journals-books-databases/about-journals/npr/
- http://pubs.rsc.org/lus/natural-product-updates
- https://www.pdfdrive.com/chemistry-of-natural-products-books.html

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) II Year (III Semester)
MCH- 303: HETEROCYCLIC CHEMISTRY

Objectives: The main goal is to design and develop chemical transformations that facilitate rapid synthesis of heterocyclic compounds with economic, eco-friendly with desired properties and excellent yield. Due to main importance in biology, heterocyclic compounds find wide applications in diverse areas such as in dyes, photosensitizers, coordination compounds, polymeric materials and many more to mention. Purines as the main part of biological system, can be explored as key factors for transformations.

UNIT- I

(09 Sessions)

Nomenclature of Heterocyclic compounds:
Classification, Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic , fused and bridged heterocyclic. Importance of heterocyclic compounds, applications of heterocycles in medicines

UNIT -II

(09 Sessions)

Synthesis of ring fluorinated heterocycles, electrophilic fluorination, Balz-Schiemann reaction, Halex reaction, isotopically labeled heterocycles, bioprocess in heterocyclic chemistry

UNIT -III

(09 Sessions)

Six- Membered Heterocyclic compounds with One Heteroatom-
Synthesis and reaction of pyrylium salts and pyrones , Synthesis and reaction of and benzopyrylium salts, coumarin and chromones.

UNIT- IV

(09 Sessions)

Purines: Reaction and synthesis, reaction with electrophilic reagents , reaction with radicals, oxidizing agents, reducing reagents, reaction with nucleophilic reagents, direct ring C-metallation, metal halogen exchange, oxy and amino purines, purines carboxylic acids, ring synthesis of purines.

Course outcomes:

Students completing this course will able to:

- Understand methods for the preparation of specific groups of heterocyclic systems. The students will be made familiar with particular properties, reactions, and applications of the most important as well as less common heterocycles.

Suggested Readings:

1. Heterocyclic Chemistry, T.L.Gillchrist: Addison Wesley, Ltd England.
2. Heterocyclic Chemistry Synthesis Reaction And Mechanism, R.K. Bansal, Newage International Publisher, New Delhi.
3. Hetrocylic Chemistry, Vol I,II,III, R. Gupta, Springer Verler Berlin
4. Aromatic Heterocyclic Chemistry David. T. Davies, Oxford Universioty Press

Web Sources:

- https://www.wiley.com/en-us/materialssciencebooks
- http://www.freebookcentre.net/Chemistry/Polymer-Chemistry-Books.html
- https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Polymers

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) II Year (III Semester)
MCH-304: INSTRUMENTAL METHODS IN CHEMICAL ANALYSIS

Objectives: To impart the knowledge about radio analytical methods of analysis and their principles and applications. Students will know about thermal methods of analysis like TGA, DTA and DSC. They will understand about structure identification, topology, morphology, composition and crystallographic information by using XRD and SEM.

UNIT – I

(10 Sessions)

Radioactive methods:
Nuclear reactions and radiation, radioactive decay measurements, ionization chamber, proportional counter, Geiger-Muller counter, scintillation counter, semi-conductor detectors, pulse height discrimination counting equipments, activation analysis application of radio nuclides.

UNIT – II

(10 Sessions)

Thermal and Calorimetric methods of analysis:
Thermo gravimetric analysis, apparatus, methodology, application, differential thermal analysis, apparatus, methodology, differential scanning calorimetry, instrumentation, methodology. Comparative study of TGA and DTA .Thermometric titrimetry and applications to acid-base and complexometric titrations.

UNIT – III

(08 Sessions)

X-ray Methods:
Production of x-rays, x-ray spectra, absorption methods of x-ray, determination of molecular structure by X-ray diffraction, crystal morphology, lattice and unit cells, kinds, space lattice, planes or faces of cubic systems, labeling the planes, the Miller indices.

UNIT-IV

(08 Sessions)

Scanning Electron Microscopy:Basic Concepts, Instrumentation and its applications.

Course outcomes:
Students completing this course will able to:

- Understand the capability of treatment and evaluation of the results of analysis.
- Knowledge of temperature controlled analysis.
- Capability of sample analysis by percentage weight loss.
- Capability of differentiation between endothermic or exothermic reactions.
- Ability to analyze topography, morphology, composition and size of the sample

Suggested Readings:

1. Analytical Chemistry, G.D. Christian, J. Wiley.

2. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West and F.J. Holler, W.B. Sauders.
3. Analytical Chemistry-Principles, J.H. Kennedy, W.B. Saunders.
4. Analytical Chemistry-Principles and Techniques, L.G. Hargis, Prentice Hall.
5. Principles of Instrumental Analysis, D.A. Skoog and J.L. Loary, W.B. Saunders.
6. Principles of Instrumental Analysis, D.A. Skoog, W.B. Saunders.
7. Quantitative Analysis, R.A. Day, Jr. and A.L.Underwood, Prentice Hall.
8. Environmental Solution Analysis, S.M. Khopkar, Wiley Eastem.
9. Basic Concepts of Analytical Chemistry, S.M. Khopkar, Wiley Easterm.
10. Handbook of Instrumental Techniques for Anlytica Chemistry, F. Settle, Prentice Hall.

Web Sources:

- https://www.wiley.com/en-us/materialssciencebooks
- http://www.freebookcentre.net/Chemistry/Polymer-Chemistry-Books.html
- https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Polymers

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) II Year (III Semester)
MCH-351: ORGANIC CHEMISTRY PRACTICAL-1

Objectives: To learn the quantitative analysis of elements like sulphur in the given organic compound**.** Stu8dents will know the method of synthesis of various name reactions of industrial application.

(20 Sessions)

1. Quantitative Analysis

Estimation of element:

Estimation of sulphur in an organic compound by Messenger's Method.

2) Organic Synthesis:

i) Beckmann Rearrangement-

Preparation of benzinilide from benzophenone oxime.

ii) Benzilic Acid Rearrangement-

Preparation of benzilic acid from benzil.

iii) Benzoine condensation-

Preparation of benzoin from benzal chloride.

iv) Cannizzaro's reaction-

Preparation of benzyl alcohol and benzoic acid togather from benzaldehyde.

v) Claisen Schmidt reaction-

Preparation of dibenzal acetone from benzaldehyde.

vi) Clemmensen reaction-

Preparation of 2,4-dihydroxy ethyl benzene from 2,4-dihydroxy acetophenone.

vii) Reformatsky reaction-

Preparation of β,β' diphenyl propionate from benzophenone.

3. Extraction of Organic Compounds from Natural Sources

i). Isolation of caffeine from tea leaves.

ii). Isolation of casein from milk (the students are required to try some typical colour reaction of protein.

iii). Isolation of lactose from milk (purity of sugar should be checked and Rf value reported).

iv). Isolation of nicotine dipicrate from tobacco.

v). Isolation of cinchonine from cinchona bark.

4. Paper Chromatography:

Separation and identification of the sugar present in the given mixture of glucose, fructose and sucrose by paper chromatography.

5. Viva voce

6. Record

Course outcomes:

Students completing this course will able to:

- Demonstrate mastery of basic organic chemistry laboratory techniques, including Distillation , recrystallization, melting point determination, liquid-liquid extraction, gravity and liquid filtration, and chromatography.

- Students will demonstrate the ability to safely and effectively perform synthetic organic reactions, using proper glassware set-up, handling of hazardous chemicals, and following the prescribed experimental procedures.

Suggested Readings:

1. Separation methods in chemical analysis by James M. Moller (Wiely Interscience 1975)
2. Introduction to separation science By Kargar, Synder and Horwath (willy Interscience 1975).

Web sources:

- http://chemcollective.org/vlabs
- http://chemcollective.org/physical
- https://www.vlab.co.in/broad-area-chemical-sciences

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) II Year (IV Semester)
MCH-401: -ORGANIC SYNTHESIS –II

Objectives: To provide an introduction to the synthesis of complex organic molecules. Transformations for C-X and C-C bond-formation, functional group reactivity, chemoselectivity, regioselectivity, and the strategy of multistep synthesis will be the core topics that are covered.

UNIT -I

(09 Sessions)

Basic concept of disconnections, types of synthesis, types of transforms, polarity and retro-synthetic analysis

UNIT- II

(09 Sessions)

Carbon – halogen (C-X) Disconnection:
Strategy of C-X Disconnection, one group C-X Disconnection, two group C-X Disconnection, synthesis of amines by using C-X Disconnection , useful chemical reactions using C-X Disconnection

UNIT -III

(09 Sessions)

Carbon – carbon (C-C) Disconnection:
Useful chemical reactions using C-C Disconnection, one group and α- carbonyl C-C Disconnection , generation of enolates, chemo selectivity , region-selectivity , stereo selectivity and kinetics of enolate formation, chemical reactions of enolates.

UNIT -IV

(**09 Sessions)**

Protecting groups in organic synthesis :
Protecting strategy, Protecting Groups -Principle of protection of carbonyl and carboxyl alcoholic and amino groups

Course Outcomes:

Students completing this course will able to:

- To identify, classify, explain, and apply fundamental organic reactions like SN2, SN1, E2, E1, alkene addition, electrophilic aromatic substitution, 1,2/1,4-additions, ring-opening, and radical halogenation.
- Be able to apply concepts associated with these general reaction types to product prediction, synthesis design, and reaction mechanism.
- Can predict, explain, and rank the relative speeds of different chemical reactions by applying structure-dependent patterns in stability combined with application of mechanism recognition.

Suggested Readings:

1. Designing Organic Synthesis, S. Warren, Wiley.
2. Organic Synthesis-Concept, Methods And Starting Materials, J.Fuhrhop And G.Penzilin, Verlage Vch.
3. Some Modern Methods Of Organic Synthesis. W. Carruthers, Cambridge Univ. Press.
4. Modern Synthetic Reactions, H.O. House, W.A. Benjamin,

5. Advanced Organic Chemistry: Reactions, Mechanisms And Structure, J. March, Wiley.
6. Principles Of Organic Synthesis, R.Norman And J.M.Coxon, Blackie Academic & Professional.
7. Advanced Organic Chemistry Part B, F.A. Carey And R.J.Sundbergy, Plenum Press.
8. Medicinal Chemistry, A. Burger,3rd Edn ., Wiley, 1970.
9. Chemistry Of Pesticides, N.M. Melnikov, Residue Reviews, Vol.36, Springer Verlag, New York , .
10. Future For Insecticides , R.C. Netealr, J.J.Mckalvery, Jr. John Wiley &Sons, New York,
11. Pesticide Processes Encyclopedia, Marshal Sitting Hoyes Data Corporation, U.S.A.., 1977.

Web Sources:

- http://www.freebookcentre.net/Chemistry/Organic-Chemistry-Books.html
- https://chemistrynotes.com/pages/full-course-organic-chemistry-notes

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) II Year (IV Semester)
MCH-402: CHEMISTRY OF NATURAL PRODUCTS-II

Objectives: To learn about the molecular structure present in different types of vitamins. Students will know about the chemistry of lipids, constitution of steroids and their physiological importance and the chemistry behind the genetic materials like DNA and RNA.

UNIT-I

(09 Sessions)

Chemistry and biochemical action of vitamins:
Occurrence, biological functions, constitution and synthesis of-
(Vitamin-A), Thiamin (Vitamin--B1), Riboflavin (Vitamin--B2), Nicotinamide (Vitamin--B5), Cynocobalamine (Vitamin--B12), Ascorbic Acid (Vitamin--C), Tocopherols (Vitamin--E)

UNIT-II

(09 Sessions)

Lipids:
Occurrence, biological functions, classification, analysis of fats and oils, chemical properties of fats, rancidity, brief idea about phospholipids, glycolipids , derived lipids, waxes

UNIT-III

(09 Sessions)

Steroids:
Introduction, nomenclature of steroids, stereochemistry and absolute configuration of steroids, constitution and synthesis of cholesterol, ergosterol, stigmasterol , brief idea about steroidal hormones.

UNIT-IV

(09 Sessions)

Nucleic acids:
Introduction, classification, relation among nucleic acids, nucleotides and nucleosides, isolation of nucleic acids, components of nucleic acid, structure of nucleosides, structure of RNA and DNA.

Course Outcomes:
Students completing this course will able to:

- Identify and characterize various classes of natural products by their structures.
- Appreciate the biogenesis of many natural products of importance
- Have some knowledge of some of the plants around them and their pharmaceutical importance.
- Pharmaceuticals are derived; have acquired the skills to isolate and purify simple products that are derived from plants.

Suggested Readings:

1. Natural Products: Chemistry and Biological Significance, J.Mann. R.S.Davidson, J.B.Hobbs, D.V. Banthrope and J. B. Harborne. Longman, Essex.
2. Organic Chemistry, Vol 2, I.L. Finar, ElBS
3. Stereo selective Synthesis: A Practical Approach, M. Nogradi, VCH.
4. Rodd's Chemistry of Carbon Compounds, Ed.S. Coffey, Elsevier.

5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed.Kurt Hostettmann. M. P. Gupta and A . Marston. Harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm, Harwood Academic Publishers
7. Synthetic Organic Chemistry, O.P. Agarwal ,10th edition , Publishing House, Meerut, 1994.

Web Sources:

1. https://www.rsc.org/journals-books-databases/about-journals/npr/
2. http://pubs.rsc.org/lus/natural-product-updates
3. https://www.pdfdrive.com/chemistry-of-natural-products-books.html

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) II Year (IV Semester)
MCH- 403: APPLICATIONS OF SPECTROSCOPY IN ORGANIC CHEMISTRY

Objectives: To know about various electronic transitions occurs in ultra violet spectroscopy. Students will learn about methods of analysis of functional groups in I R spectroscopy, about structure identification by NMR spectroscopy and mass spectra of different organic compounds.

UNIT -I

(09 Sessions)

Ultraviolet and Visible Spectroscopy:
Various electronic transitions (185-800nm), Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

UNIT- II

(09 Sessions)

Infra-Red Spectroscopy:
Instrumentation and sample handing. Characteristic vibration frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibration frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi Resonance.

UNIT -III

(09 Sessions)

Nuclear Magnetic Resonance Spectroscopy:
General introduction and definition, chemical shift, spin-spin interaction, shielding & deshielding effects, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), complex spin-spin interaction between two, three, four and five nuclei (first order spectra), vicinal coupling, contact shift reagents, solvent effects. Fourier transform technique, nuclear Overhauser effect (NOE), 2D-NMR spectroscopy-COSY, NOESY techniques.

UNIT -IV

(09 Sessions)

Mass Spectroscopy
Introduction,ion production,factors affecting fragmentation,ion analysis, ion abundance,Mass spectral fragmentation of organic compounds,common functional groups,molecular ion peaks.

Course Outcomes:
Students completing this course will able to:

- Very well understand the structure determination by spectroscopic methods.
- They will understand the importance of mass spectra in organic compound structure determination.

Suggested Readings:

1. Modern Spectroscopy, J.M.Hollas, John Wiley.
2. Applied Electron Spectroscopy for Chemical Analysis Ed. H.Windalwl and F.L.Ho.Wiley Insterscience.
3. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V.Parish, Ellis Harwood.;
4. Physical Methods in Chemistry, R.S. Drago, Saunders College.
5. Chemical Applications of Group Theory, F.A.Cotton.
6. Introduction to Molecular Spectroscopy, G.M. Barrow. McGraw Hill.
7. Basic principles of spectroscopy, R.Chang. McGarw Hill.
8. Theory and Applications of UV Spectroscopy, H.H. Jaffe and M.Orchin, IBH-Oxford.
9. Introduction to Photoelectron Spectroscopy, P.K.Ghosh, John Wiley.
10. Introduction to Magnetic Resonance, A, Carrington and A.D. Maclachalan, Harper & Row

Web Sources:

- https://www.wiley.com/en-us/materialssciencebooks
- http://www.freebookcentre.net/Chemistry/Polymer-Chemistry-Books.html
- https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Polymers

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) II Year (IV Semester)

Elective paper in- lieu of project

MCH-404: MEDICINAL CHEMISTRY

Objectives: This course provides an introduction to the chemical principles behind the design and production of pharmaceutical agents. Focus is on explaining and predicting how small organic molecules bind to biological receptors, inhibit enzymes and get metabolized. This course draws on and expands upon material covered in introductory organic chemistry such as proposing reasonable arrow-pushing mechanisms for organic reactions and predicting the reactivity of organic molecules with particular reagents

UNIT-I

(10 Sessions)

Characteristics of Synthetic Drugs: Relationship between chemical structure and biological activity (SAR). Assay of drugs: chemical assay, biological assay, immunological assay, absorption of drugs, isosterism.

Receptor Site Theory, Approaches to drug design. Introduction to combinatorial synthesis in drug discovery.

UNIT-II

(08 Sessions)

Antibiotics, Antiviral and antibacterials: introduction, pharmacodynamics, anti-viral strategy

Synthesis of followings-

Broad spectrum antibiotics - Norfloxacin, Ciprofloxacin

Antibiotic β-Lactam type - Cephalosporins , Penicillins

Antineoplastic drugs –Classification, alkylating agents (busulphan,mefalan), antimetabolites(methotrxate,mercaptopurine ,flurouracil) ,natural products (vinibastine, vinicristine

Antifungal – polyenes

Antiviral – Acyclovir

UNIT-III

(08 Sessions)

Antimalarials: Chloroquine, Chloroguanide and Mefloquine, Atovaquone, Primaquine, Artemisinin and derivatives, Halofantrine

antimalarial drug combination therepy

UNIT-IV

(08 Sessions)

a.) Non-steroidal Anti-inflammatory Drugs (NSAIDs) : introduction, mechanism of action, classification, synthesis and action of

b.)Diclofenac Sodium, Ibuprofen and Nefopam

Antihistaminic and antiasthmatic agents : Terfenadine, Cinnarizine, Salbutamol

Course outcomes:

Students completing this course will able to:

- Understand the chemical principles behind the design and production of pharmaceutical agents.
- Can Focus is on explaining and predicting how small organic molecules bind to biological receptors, inhibit enzymes and get metabolized.
- Can cover in introductory organic chemistry such as proposing reasonable mechanisms for organic reactions and predicting the reactivity of organic molecules with particular reagents

Suggested Readings:

1. A. Burger, Medicinal Chemistry, Vol. I-III, (1995) Wiley Interscience Publications, New York.
2. W. O. Foye, Principles of Medicinal Chemistry, 3rd Edition (1989), Lea & Febiger/ Varghese Publishing House, Bombay.
3. D. Lednicer and L. A. Mitscher, The Organic Chemistry of Drug Synthesis, Vol. I-III, Wiley Interscience.
4. A. Kar, Medicinal Chemistry, (1993) Wiley Eastern Ltd., New Delhi.
5. N. K. Terrett, Combinatorial Chemistry, (1998) Oxford Univ. Press, Oxford.
6. O.P.AGARWAL, Synthetic Organic Chemistry, Goel Publication House, Merrut.

Web Sources:

- https://www.wiley.com/en-us/materialssciencebooks
- http://www.freebookcentre.net/Chemistry/Polymer-Chemistry-Books.html

Note: Latest edition of all the suggested readings must be used.

IFTM University, Moradabad
Master of Science (Chemistry) Programme
M.Sc. (Chemistry) II Year (IV Semester)
MCH-451: ORGANIC CHEMISTRY PRACTICAL-2

(20 Sessions)

Objectives: To learn the quantitative analysis of different functional groups like phenolic , in the given organic compound**.** Also to know the method of synthesis of various name reactions of industrial applications.

A. Quantitative Analysis:

a) Estimation of Functional Groups-

1. Estimation of phenolic group

Determine the strength of the given phenol solution by brominating method.

2. Estimation of amine :

Determine the strength of the given aniline solution by brominating method.

3. Estimation of carbohydrate:

Determine the strength of the given glucose solution by Fehling's solution method OR iodometrically.

4. Estimation of oil and fats:

a) Determine the saponification value of the given oil OR fat.

B. Organic Synthesis :

i) Sandmayer's reaction-

a) Preparation of o-chloro benzoic acid from anthranilic acid.

ii) Wurtz Fittig Reaction-

Preparation of di benzyl from benzyl chloride.

iii) Friedel Craft Reaction-

Preparation of benzophenone from benzoyl chloride and benzene.

iv) Hoesch Reaction-

Preparation of 2 , 4 di- hydroxyl acetophenone from resorcinol.

v) Pechmann Reaction-

Preparation of 7- hydroxyl -4-methyl coumarin from resorcinol.

vi) Perkin's Reaction-

Preparation of cinnamic acid from benzaldehyde.

vii) pinacol-Pinacolone Rearrangement-

Preparation of benzopinacolone from benzophenone.

C). Extraction of Organic Compounds from Natural Sources

i). Isolation of Piperine from black pepper.

ii). Isolation of lycopene from tomatoes.

iii). Isolation of □ □ □ □ carotene from carrots.

vi). Isolation of limonene from citrus fruits

4. Viva voce

5. Record

Course outcomes:

Students completing this course will able to:

.

- Demonstrate the ability to safely and effectively perform synthetic organic reactions, using proper glassware set-up, handling of hazardous chemicals, and following the prescribed experimental procedures.

Suggested Readings:

1. Experimental Organic Chemistry Vol I&II, P.R. Singh, D.S. Gupta and K.S. Bajpai, Tata McGaw Hill.
2. Laboratory Manual in Organic Chemistry, R.K. Bansal, Wiley Eastern.
3. Vogel's Textbook of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith and A.R. Tatchell. ELBS
4. Experiments in General Chemistry, C.N.R. Rao and U.C. Agarwal, East-West Press.

Web sources:

- http://chemcollective.org/vlabs
- http://chemcollective.org/physical
- https://www.vlab.co.in/broad-area-chemical-sciences

Note: Latest edition of all the suggested readings must be used.