



आईएफटीएम विश्वविद्यालय, मुरादाबाद, उत्तर प्रदेश
IFTM University, Moradabad, Uttar Pradesh
NAAC ACCREDITED

SCHOOL OF SCIENCES
DEPARTMENT OF CHEMISTRY

Bachelor of Science (Honors Chemistry)

THREE 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



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SCHOOL OF SCIENCES
DEPARTMENT OF CHEMISTRY

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

Programme	:	Bachelor of Science (Honors Chemistry)
Course Level	:	UG Course
Duration	:	Three Year (Six Semester) Full Time
Medium of Instruction	:	English
Minimum Required Attendance	:	75%
Maximum Credits	:	96

Programme Outcomes (POs):

Students completing this course will be able to understand:

1. Systematic and coherent understanding of the fundamental concepts in Physical chemistry, Organic Chemistry, Inorganic Chemistry, Analytical Chemistry and all other related allied chemistry subjects.
2. Students will be able to use the evidence based comparative chemistry approach to explain the chemical synthesis and analysis.
3. Students will be able to understand the basic principle of equipments, instruments used in the chemistry laboratory.
4. The student will understand good laboratory practices and safety.
5. Students will be able to demonstrate the experimental techniques and methods in different areas of Chemistry.
6. The chemistry graduates are expected to know the fundamental concepts of chemistry and applied chemistry and its new emerging branches.
7. These fundamental concepts would reflect the latest understanding of the field, and therefore, are dynamic in nature and require frequent and time-bound revisions.
8. Applying subject knowledge for solving societal problems related to application of chemistry in day to day life.
9. Identifying chemistry related problems, analysis and application of data using appropriate methodologies.
10. Finding opportunity to apply subject-related skill for acquiring jobs and self-employment.

COURSE STRUCTURE
B. SC. - I Year (H) (I Semester)
(Chemistry)

S. No.	Course Code	Course Titles	EVALUATION SCHEME							Course Total (Marks)	Credits
			Internal Exam						External Exam		
			L	T	P	CT	AS+AT	Total			
1.	BPHY-101	Mechanics	3	1	0	20	10	30	70	100	4
2.	BPHY-102	Thermal Physics	3	1	0	20	10	30	70	100	4
3.	BCHE-101	Inorganic Chemistry	3	1	0	20	10	30	70	100	4
4.	BCHE-102	Organic Chemistry	3	1	0	20	10	30	70	100	4
5.	BMAT-101	Matrices and Trigonometry	3	1	0	20	10	30	70	100	4
6.	BMAT-102	Calculus	3	1	0	20	10	30	70	100	4
7.	BPHY-151	Physics Lab-1	-	-	4	-	-	30	70	100	2
8.	BCHE-151	Chemistry Lab -1	-	-	4	-	-	30	70	100	2
TOTAL			18	6	4	-	-	-	-	800	28

Semester – II

S. No.	Course Code	Course Titles	EVALUATION SCHEME							Course Total (Marks)	Credits
			Internal Exam						External Exam		
			L	T	P	CT	AS+AT	Total			
1.	BPHY-201	Waves & Oscillations	3	1	0	20	10	30	70	100	4
2.	BPHY-202	Optics	3	1	0	20	10	30	70	100	4
3.	BCHE-201	Physical Chemistry	3	1	0	20	10	30	70	100	4
4.	BCHE-202	Basic of Analytical Chemistry	3	1	0	20	10	30	70	100	4
5.	BMAT-201	Vector Calculus and Co-ordinate geometry	3	1	0	20	10	30	70	100	4
6.	BMAT-202	Differential equations and Integral Transforms	3	1	0	20	10	30	70	100	4
7.	BPHY-251	Physics lab-2	-	-	4	--	--	30	70	100	2
8.	BCHE-251	Chemistry lab-2	-	-	4	-	-	30	70	100	2
9.	AECC* Audit course	Environmental Science	3	0	0	20	10	30	70	100	3*
TOTAL			18	6	4	-	-	-	-	800	28

Semester-III

S. No.	Course Code	Course Titles	Periods			EVALUATION SCHEME				Course Total (Marks)	Credits
			L	T	P	Internal Exam			External Exam		
						CT	AS+AT	Total			
1.	BPHY-301	Electricity and Magnetism	3	1	0	20	10	30	70	100	4
2.	BPHY-302	Circuit fundamental and Basic Electronics	3	1	0	20	10	30	70	100	4
3.	BCHE-301	Inorganic Chemistry	3	1	0	20	10	30	70	100	4
4.	BCHE-302	Organic chemistry	3	1	0	20	10	30	70	100	4
5.	BMAT-301	Mechanics	3	1	0	20	10	30	70	100	4
6.	BMAT-302	Numerical Methods	3	1	0	20	10	30	70	100	4
7.	BPHY-351	Physics Lab -3	-	-	4	-	-	30	70	100	2
8.	BCHE-351	Chemistry Lab -3	-	-	4	-	-	30	70	100	2
9.	UDM* Audit course	Disaster Management	3	0	0	20	10	30	70	100	03*
TOTAL			18	6	8	-	-	-	-	800	28

Semester -IV

S. No.	Course Code	Course Titles	Periods			EVALUATION SCHEME				Course Total (Marks)	Credits
			L	T	P	Internal Exam			External Exam		
						CT	AS+AT	Total			
1.	BPHY-401	Atomic and Laser Physics	3	1	0	20	10	30	70	100	4
2.	BPHY-402	Classical and Statistical Mechanics	3	1	0	20	10	30	70	100	4
3.	BCHE-401	Physical Chemistry	3	1	0	20	10	30	70	100	4
4.	BCHE-402	Environmental Chemistry	3	1	0	20	10	30	70	100	4
5.	BMAT-401	Discrete Structures	3	1	0	20	10	30	70	100	4
6.	BMAT-402	Real Analysis	3	1	0	20	10	30	70	100	4
7.	BPHY-451	Physics Lab- 4	-	-	4	-	-	30	70	100	2
8.	BCHE-451	Chemistry Lab-4	-	-	4	-	-	30	70	100	2
TOTAL			18	6	8	-	-	-	-	800	28

Course Structure and Evaluation Scheme
B. Sc. (ZBC) I Year

S. No.	Subject Code	Subject Title	Periods			EVALUATION SCHEME				Total	Credi t
						Internal Exam			Extern al Exam		
			L	T	P	MSE	AS+ AT	Total			
Semester-I											
1.	BBO-101	DIVERSITY OF MICROBES	3	1	0	10+10	5+5	30	70	100	4
2.	BBO-102	ALGAE AND BRYOPHYTES	3	1	0	10+10	5+5	30	70	100	4
3.	BBO-151	BOTANY LAB-1	-	-	4	-	-	30	70	100	2
4.	BZO-101	LOWER NON-CHORADATA	3	1	0	10+10	5+5	30	70	100	4
5.	BZO-102	HIGHER NON-CHORDATA	3	1	0	10+10	5+5	30	70	100	4
6.	BZO-151	ZOOLOGY LAB-1	-	-	4	-	-	30	70	100	2
7.	BCHE-101	INORGANIC CHEMISTRY	3	1	0	10+10	5+5	30	70	100	4
8.	BCHE-102	ORGANIC CHEMISTRY	3	1	0	10+10	5+5	30	70	100	4
9.	BCHE-151	CHEMISTRY LAB-1	-	-	4	-	-	30	70	100	2
10.	AECC*	ENVIRONMENTAL STUDIES	3	0	0	10+10	5+5	30	70	100*	3*
		Total	21	6	12					900	30
Semester-II											
1.	BBO-201	PTERIDOPHYTES, GYMNOSPERM AND PALAEOBOTANY	3	1	0	10+10	5+5	30	70	100	4
2.	BBO-202	SYSTEMATICS OF FLOWERING PLANTS AND ECONOMIC BOTANY	3	1	0	10+10	5+5	30	70	100	4
3.	BBO-251	BOTANY LAB-2	-	-	4	-	-	30	70	100	2
4.	BZO-201	CELL AND MOLECULAR BIOLOGY	3	1	0	10+10	5+5	30	70	100	4
5.	BZO-202	GENETICS	3	1	0	10+10	5+5	30	70	100	4
6.	BZO-251	ZOOLOGY LAB-2	-	-	4	-	-	30	70	100	2
7.	BCHE-201	PHYSICAL CHEMISTRY	3	1	0	10+10	5+5	30	70	100	4
8.	BCHE-202	BASICS OF ANALYTICAL CHEMISTRY	3	1	0	10+10	5+5	30	70	100	4
9.	BCHE-251	CHEMISTRY LAB-2	-	-	4	-	-	30	70	100	2
		Total	18	6	12					900	30

*This is an audit course which is mandatory for UG courses.

Course Structure and Evaluation Scheme
B. Sc. (ZBC) II Year

S. No.	Subject Code	Subject Title	Periods			EVALUATION SCHEME				Total	Credit
			L	T	P	Internal Exam			External Exam		
						MSE	AS+AT	Total			
Semester-III											
1.	BBO-301	SEXUAL REPRODUCTION IN FLOWERING PLANTS	3	1	0	10+10	5+5	30	70	100	4
2.	BBO-302	PLANT ANATOMY	3	1	0	10+10	5+5	30	70	100	4
3.	BBO-351	BOTANYLAB-3	-	-	4	-	-	30	70	100	2
4.	BZO-301	CHORDATA	3	1	0	10+10	5+5	30	70	100	4
5.	BZO-302	DEVELOPMENTAL BIOLOGY	3	1	0	10+10	5+5	30	70	100	4
6.	BZO-351	ZOOLOGY LAB-3	-	-	4	-	-	30	70	100	2
7.	BCHE-301	INORGANIC CHEMISTRY	3	1	0	10+10	5+5	30	70	100	4
8.	BCHE-302	ORGANIC CHEMISTRY	3	1	0	10+10	5+5	30	70	100	4
9.	BCHE-351	CHEMISTRY LAB-3	-	-	4	-	-	30	70	100	2
		Total	18	6	12					900	30
Semester-IV											
1.	BBO-401	CELL AND MOLECULAR BIOLOGY	3	1	0	10+10	5+5	30	70	100	4
2.	BBO-402	GENETICS, PLANT BREEDING AND BIostatISTICS	3	1	0	10+10	5+5	30	70	100	4
3.	BBO-451	BOTANY LAB-4	-	-	4	-	-	30	70	100	2
4.	BZO-401	PHYSIOLOGY AND BIOCHEMISTRY	3	1	0	10+10	5+5	30	70	100	4
5.	BZO-402	ANIMAL DISTRIBUTION & EVOLUTION	3	1	0	10+10	5+5	30	70	100	4
6.	BZO-451	ZOOLOGY LAB-4	-	-	4	-	-	30	70	100	2
7.	BCHE-401	PHYSICAL CHEMISTRY	3	1	0	10+10	5+5	30	70	100	4
8.	BCHE-402	ENVIRONMENTAL CHEMISTRY	3	1	0	10+10	5+5	30	70	100	4
9.	BCHE-451	CHEMISTRY LAB-4	-	-	4	-	-	30	70	100	2
10.	UDM*	DISASTER MANAGEMENT	3	0	0	10+10	5+5	30	70	100*	3*
		Total	21	6	12					900	30

***This is an audit course which is mandatory for UG courses.**

**B. SC. - III Year (H) (V Semester)
(CHEMISTRY)**

S. No.	Course Code	Course Titles	Periods			EVALUATION SCHEME					Total Marks
			L	T	P	Internal Exam			External Exam	Credits	
						CT	AS+AT	Total			
1.	BCHE(H)-501	Inorganic Chemistry	3	1	0	20	10	30	70	04	100
2.	BCHE(H)-502	Organic Chemistry	3	1	0	20	10	30	70	04	100
3.	BCHE(H)-503	Green Chemistry	3	1	0	20	10	30	70	04	100
4.	BCHE(H)-504	Pharmaceutical Chemistry	3	1	0	20	10	30	70	04	100
5.	BCHE(H)-505	Novel Inorganic Solids	3	1	0	20	10	30	70	04	100
6.	BCS(H) - 506	Computer Fundamentals & Programing in C [common to all branches]	3	1	0	20	10	30	70	04	100
7.	BCHE(H)-552	Chemistry Practical	-	-	4	-	-	30	70	02	100
8.	BCS(H)-556	Lab in Programing in C [common to all branches]	-	-	4	30	20	30	70	02	100
TOTAL										28	800

**B. SC. - III Year (H) (VI Semester)
(CHEMISTRY)**

S. No.	Course Code	Course Titles	Periods			EVALUATION SCHEME					Total Marks
			L	T	P	Internal Exam			External Exam	Credits	
						CT	AS+AT	Total			
1.	BCHE(H)-601	Physical Chemistry	3	1	0	20	10	30	70	04	100
2.	BCHE(H)-602	Polymer Chemistry	3	1	0	20	10	30	70	04	100
3.	BCHE(H)-603	Fuel Chemistry	3	1	0	20	10	30	70	04	100
4.	BCHE(H)-604	Cosmetic Chemistry	3	1	0	20	10	30	70	04	100
5.	BCHE(H)-605	Organometallics and Bioinorganic Chemistry	3	1	0	20	10	30	70	04	100
6.	BCHE(H)-651	Chemistry Practical	-	-	4	-	-	30	70	02	100
7.	BCHE(H)-661	Chemistry Project	-	-	4	-	-	50	150	06	200
TOTAL										28	800

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) I Year (I Semester)
BCHE (H)-101: INORGANIC CHEMISTRY

Objectives: This course will equip students with the necessary knowledge to understand chemistry at the most fundamental level to understand the periodic properties of different elements, different principles for filling electrons in different energy levels and to draw energy diagrams, and how to calculate bond order.

Unit-I

(08 Sessions)

Periodic Properties:

Atomic and ionic radii, ionization energy, electron affinity and electro negativity - definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour.

Unit – II

(08 Sessions)

Chemical Bonding:

Covalent Bond – Valence bond theory and its limitations, directional characteristics of covalent bond, MO theory, homonuclear and heteronuclear (CO and NO) diatomic molecules , multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electro – negativity difference .

Unit-III

(10 Sessions)

s-Block Elements:

Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their function in biosystems , an introduction to alkyls and aryls .

Unit -IV

(10 Sessions)

p – Block Elements:

Comparative study of group 13 – 17 elements , compounds like hydrides, oxides, oxyacids and halides of group 13–16, hydrides of boron– diborane and higher boranes, fullerenes, carbides, silicates, interhalogens.

Chemistry of Noble Gasses: Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

Course Outcomes:

Students completing this course will be able to:

- ❖ Gain an understanding of the bonding fundamentals for both ionic and covalent compounds, including electronegativities, bond distances and bond energies using MO diagrams and thermodynamic data
- ❖ Predicting geometries of simple molecules
- ❖ The fundamentals of the chemistry of the main group elements, and important real world applications of many of these species

Suggested Readings:

1. Inorganic Chemistry by J.E.Huheey
2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. Organic Chemistry by Morrison and Boyd
4. Concise Inorganic Chemistry by J.D.Lee

Website Sources:

- ❖ <https://www.internetchemistry.com/>
- ❖ <http://www.chemguide.co.uk/>
- ❖ <https://freebookcentre.net/>
- ❖ Chemical Elements.com

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) I Year (I Semester)
BCHE(H)-102: ORGANIC CHEMISTRY

Objectives: The main objective of this course is to make the students knowledgeable about the fundamentals of carbon chemistry, to understand the consequences (reactivity, properties) of the three-dimensionality of molecules, so that they may be able to interpret patterns of reactivity on the basis of mechanistic reasoning,

Unit – I

(08 Sessions)

Mechanism of Organic Reactions:

Homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions.

Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples), charge transfer complexes, resonances, hyperconjugation, inductive and electromeric effects.

Unit – II

(10 Sessions)

Stereochemistry of Organic Compounds:

Concept of isomerism, types of isomerism: Optical isomerism – elements of symmetry, molecular chirality, enantiomers, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomer and racemization. Relative and absolute configuration, sequence rules, R & S systems of nomenclature.

Geometric isomerism – determination of configuration of geometric isomers, E & Z system of nomenclature.

Unit – III

(08 Sessions)

Cycloalkanes: Nomenclature, Baeyer's strain theory and its limitations, Ring strain in small rings (cyclopropane and cyclobutane), theory of strain less rings. Preparation and properties of cyclo alkane.

Unit – IV

(08 Sessions)

Arenes and Aromaticity: Huckel's rule, aromatic ions, Nomenclature of benzene derivatives, the aryl group, aromatic nucleus and side chain, Aromatic electrophilic substitution – Mechanism of nitration, halogenation, sulphonation and Friedel – Crafts reaction. Orientation and ortho/para ratio, side chain reactions of benzene derivatives, Birch reduction: Methods of preparation and chemical reactions of alkyl benzenes and naphthalene and anthracene.

Course Outcomes:

Students completing this course will be able to:

- ❖ Interpret the concept of aromaticity and the main properties of aromatic compounds.
- ❖ Associate polarization of a bond with electronegativity.
- ❖ Understand nucleophile and electrophile groups and their properties.
- ❖ Associate different bond types of carbon and its hybrid orbitals.
- ❖ Express the differences between valence bond and molecular orbital approaches.
- ❖ Derive mechanism of a reaction.
- ❖ Interpret the reactions and properties of cyclo alkanes, arenes, halogen compounds.

Suggested readings:

1. A Textbook of Qualitative Inorganic Analysis By A.I. Vogel
2. A Text Book Of Organic Chemistry By I L Finar Vol I
3. M.S Singh, Advanced Organic Chemistry/Reactions And Mechanism: Pearson Education Pvt.Ltd.
4. S.M. Mukerjee And S.P., Singh Reaction Mechanism In Organic Chemistry Macmillan India Ltd.

Web sources:

- ❖ <https://www.masterorganicchemistry.com/>
- ❖ <https://www.organic-chemistry.org/>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) I Year (I Semester)
BCHE(H)-151: CHEMISTRY PRACTICAL

Objectives: The objective of this course is to give knowledge to the students about the 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. Students will be able to successfully pursue their career objectives in advanced education in professional and/or graduate schools, in a scientific career in government or industry, in a teaching career in the school systems, or in a related career following graduation.

INORGANIC CHEMISTRY PRACTICALS

(10 Sessions)

1. Qualitative inorganic analysis: Analysis of mixture salt containing two anions and two cations (From two different groups) from the following:
Anions: Carbonate, sulphate, chloride, bromide, acetate, nitrate, borate, phosphate.
Cations: Lead, copper, iron, aluminum, zinc, manganese, calcium, strontium, barium, potassium and ammonium.
2. Semi micro Analysis – cation analysis, separation and identification of ions from Group I, II, III, IV, V and VI.
3. Find the strength in grams per litre of the given solution of sodium hydroxide with the help of standard oxalic acid solution.
4. Determine the total alkalinity in ppm in the given sample of water using standard sulphuric acid solution.
5. Determination of Fe (II) using KMnO_4 with oxalic acid as primary standard.

ORGANIC CHEMISTRY PRACTICALS

(10 Sessions)

- 1) Determination of melting point:
Naphthalene $80 - 82^\circ$, Benzoic acid $121.5 - 122^\circ$ m - Dinitrobenzene 90°
Urea $132.5 - 133^\circ$, Succinic acid $184.5 - 185^\circ$ P - Dichlorobenzene 52°
- 2) Crystallization:
 - i- Phthalic acid from hot water (using fluted filter paper and steam less funnel)
 - ii- Naphthalene from ethanol
 - iii- Benzoic acid from water
- 3) Decolorisation and crystallization using charcoal:
 - i- Decolorisation of brown sugar (Sucrose) with animal charcoal using gravity filtration.
 - ii- Crystallization and decolorisation of impure naphthalene (100g of naphthalene mixes with 0.3 gm of Congo Red using 1 g decolorizing carbon) from ethanol.
- 4) Detection of extra element (n and halogens) and functional groups in the given organic compound
- 5) Qualitative analysis of phenols, carboxylic acids, carbonyl compounds (aliphatic and aromatic), carbohydrates, amines, Acetamide amides) organic compounds.

Course outcomes:

Students completing this course will be 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.
- ❖ 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. Instrumental Methods 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
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) I Year (II Semester)
BCHE(H)-201-PHYSICAL CHEMISTRY

Objectives: The main objectives of this course are to learn errors and data analysis methods. To understand the fundamental theory and laboratory techniques in physical chemistry. Also to calculate gaseous state numerical problem analysis and to know about colloids and their practical application.

Unit – I

(10 Sessions)

Mathematical Concepts and Computers:

Mathematical Concepts: Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like Kx , X^n , $\sin x$, $\log x$ maxima and minima, differentiation and reciprocity relations. Integration of some useful/relevant functions

Computers: General introduction to computers, different components of a computer, hardware and software, input – output devices, binary numbers and arithmetic.

Unit – II

(10 Sessions)

Gaseous State:

Postulates of kinetic theory of gases, deviation from ideal behavior, Vander Waals equation, relationship between critical constants and Vander Waals constants, law of corresponding states, reduced equation of state.

Molecular velocities: Root mean square, average and most probable velocities, collision number, mean free path and collision diameter, Liquefaction of gases.

Liquid State:

Intermolecular forces, structure of liquids (a qualitative description).

Liquid crystals: classification & application of liquid crystals

Solid State: space lattice, unit cell. Laws of crystallography, X – Ray diffraction by crystals, Derivation of Bragg's equation.

Unit – III

(08 Sessions)

Colloids: Definition and classification

Sols: kinetic, optical and electrical properties, coagulation, stability of colloids, Hardy – Schulze law, gold number.

Emulsions: types of emulsions, preparation, Emulsifiers.

Gels: preparation and properties.

Applications of colloids.

Unit – IV

(08 Sessions)

Chemical kinetics:

Rate of a reaction, factors influencing the rate of a reaction.

Reactions: Zero order, first order, second order, half life and mean life. Determination of the order of reaction - integration method, Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy. Collision theory and transition state theory.

Course outcomes:

Students completing this course will be able to:

- ❖ Describe the ideal and real gases.
- ❖ By interpreting the real gases, the student will be able to solve the problems.
- ❖ Uses the Van Der Waals gas equation.
- ❖ Uses the real gas and Van Der Waals isotherms.

- ❖ Describes the critical state, adapts critical state equation to the problems.

Suggested readings:

1. Spectroscopy by William Kemp
2. Spectroscopy by Pavia
3. Organic Spectroscopy by J. R. Dyer
4. Modern Electrochemistry by J.O. M. Bockris and A.K.N.Reddy
5. Advanced Physical Chemistry by Atkins
6. Introduction to Electrochemistry by S. Glasstone
7. Elementary organic spectroscopy by Y.R. Sharma
8. Spectroscopy by P.S.Kalsi

Web Sources:

- ❖ <https://www.edx.org/learn/physical-chemistry>
- ❖ <https://www.learnchem.net/>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) I Year (II Semester)

BCHE(H)-202: BASICS OF ANALYTICAL CHEMISTRY

Objectives: The main objectives of this course are to learn intermediate theory and laboratory techniques in analytical and physical chemistry. To know about the advanced data analysis methods and goodness-of-fit criteria . Fourier transforms spectroscopic methods and instrumentation. Students will know the applications of Electrochemistry and Liquid chromatography.

Unit -I

(10 Sessions)

Data Analysis –

Concept of significant figures—its importance, accuracy, methods of expressing accuracy, error analysis, types of errors, minimizing errors, precision-mean, median, mean deviation, standard deviation and confidence limit.

Chemical and single pan balance , precautions in using balance, sources of error in weighing, correction for buoyancy, temperature effects, calibration of weights.

Unit -II

(10 Sessions)

Calibration of glassware and volumetric analysis

Calibration of pipette, volumetric flask , Burette. Measurements in analytical chemistry, S.I units-Fundamental units (Mass, amount of substances, distance, time, temperature, current) and Derived. Units(Area, Volume ,density, velocity, force, pressure, energy, heat, work, power, charge, potential, resistance, frequency) (S.I Units and Symbol only)

Preparation of standard solution, indicators, acid base titration, complex metric titration

Unit -III

(08 Sessions)

Chromatographic Techniques-

Types of chromatography, principle , column chromatography-principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications.

TLC-principles, choice of adsorbent and solvent, preparation of chromatoplates. Rf values.

Factors affecting the Rf values .Significance of Rf values.

Paper Chromatography-principle, solvent used development of chromatogram, ascending, descending and radial paper chromatography.

Unit -IV

(08 Sessions)

Gravimetric Analysis –

Principle-theories of precipitation-solubility product and precipitation-factors affecting solubility. Conditions of precipitation, co- precipitation and post precipitation. Reduction of errors. Precipitation from homogeneous solution-washing and drying of precipitate.

Choice of the precipitant-Specific and Selective precipitants-Anthranilic acid , Cupferon, Dimethyl glyoxime, Ethylenediamine .

Course Outcomes:

Students completing this course will able to:

- ❖ Explain the theoretical principles and important applications of classical analytical methods within titration (acid/base titration, complexometric titration, redox titration.
- ❖ Various techniques within gravimetric and coulometric methods.
- ❖ Theoretical principles of selected instrumental methods within electro analytical and spectrometric/spectrophotometric methods
- ❖ Main components in such analytical instruments. Like various separation techniques in chromatography, and typical applications of chromatographic techniques.

- ❖ Assess and suggest a suitable analytical method for a specific purpose, and evaluate sensitivity, important sources of interferences and errors, and also suggest alternative analytical methods for quality assurance.

Suggested readings:

1. Analytical Chemistry by Skoog and Miller
 2. A textbook of qualitative inorganic analysis by A.I. Vogel
 3. Nanochemistry by Geoffrey Ozin and Andre Arsenault
 4. Stereochemistry by D. Nasipuri
 5. Organic Chemistry by Clayden.
5. J.H. Keneedy, Analytical Chemistry:

Web Sources:

- ❖ <https://edu.rsc.org/teacher-pd/in-person/analytical-chemistry/classroom-resources>.

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) I Year (II Semester)
BCHE(H)-251: CHEMISTRY PRACTICAL

Objectives: Students will understand the scientific reasoning, quantitative analysis laboratory practice and safety. They will know the basic analytical and technical skills to work effectively in the various fields of chemistry. The ability to perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions.

PHYSICAL CHEMISTRY

(10 Sessions)

1. Determination of relative surface tension of the given organic compound.
2. Determination of relative viscosity of the given organic compound.
3. Determination of order of reaction.
4. Determination of number of molecules of water of crystallisation (n) in the given sample of Mohr's salt.
5. Determination of percentage purity of an impure sample of KMnO_4 .

ANALYTICAL CHEMISTRY

(10 Sessions)

1. Determination of r_f value by using paper chromatography.
2. Determination of common food adulteration in various food sample (desi ghee, mustard oil, turmeric powder, chili powder).
3. Determination of oxalate ion content in the guava fruit.
4. Determination of quantity of casein present in different samples of milk.
5. Determination of dosage of bleaching powder required for disinfection of different samples of water taken from different sources.

Course Outcomes:

Students completing this course will be 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
- ❖ Statistical treatment of the data and significance tests for the final evaluation of analytical data; potentiometry and its applications.

Suggested Readings:

1. D.A. Skoog, Principles of Instrumental Analysis: Sundars College Publishing.
2. Modern Methods of Chemical Analysis: R.L. Pecsok: John Wiley New York
3. Experiments in Physical Chemistry - J.C. Ghose, Bharti Bhawan.

Web Sources

- ❖ <https://www.labster.com/chemistry-virtual-labs/>
- ❖ <https://digitalllearning.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
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) II Year (III Semester)
BCHE(H)-301: INORGANIC CHEMISTRY

Objectives: This course will equip students with the necessary knowledge to understand chemistry at the most fundamental level. Understand the Characteristic properties of d-block elements. To understand Coordination Compounds, Werner's coordination theory and its experimental verification. Learning of Lanthanides and Actinides their properties and applications

Unit – I

(09 Sessions)

Elements of First Transition Series

Characteristic properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and study of their complexes with respect to relative stability of their oxidation states, coordination number and geometry.

Unit – II

(09 Sessions)

Coordination Compounds

Werner's coordination theory and its experimental verification, effective atomic number (E.A.N.) concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

Unit – III

(09 Sessions)

Lanthanides and Actinides

Electronic configuration, oxidation states, ionic radii and magnetic properties, lanthanide and actinide contraction, complex formation .

Unit – IV

(09 Sessions)

Oxidation and Reduction:

Oxidation Number, Oxidising agents, Reducing agents, Electrode potential, electrochemical series and its applications,

Acids and Bases:

Arrhenius , Bronsted-Lowry, Lewis , Lux-Flood concept , Usanovitch and solvent system concepts of acids and bases.

Non-aqueous Solvents:

Physical properties of a solvent, types of solvents and their general characteristics, Reactions in non-aqueous solvents with reference to liquid NH₃ and Liquid SO₂.

Course outcomes:

Students completing this course will able to:

- ❖ Gain an understanding of Elements of First Transition Series elements.
- ❖ Coordination compounds and their applications.
- ❖ Predicting stereo chemistry and geometries of coordination compounds.
- ❖ Electrode potential, electrochemical series and its applications.

Suggested readings:

1. Inorganic Chemistry by J.E.Huheey
2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. Organic Chemistry by Morrison and Boyd
4. Concise Inorganic Chemistry by J.D.Lee

Website Sources:

- ❖ <https://www.internetchemistry.com/>
- ❖ <http://www.chemguide.co.uk/>
- ❖ <https://freebookcentre.net/>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) II Year (III Semester)

BCHE(H)-302: ORGANIC CHEMISTRY

Objectives: This course will give an introduction to modern spectroscopic techniques including time-resolved laser methods. Students will learn theory and application to, ultraviolet and visible spectroscopy, infrared spectroscopy, Raman, fluorescence, nuclear magnetic resonance spectroscopy, time-resolved spectra including lifetime measurements, etc. Comprehension and industrial applications of alcohols, phenols and ethers and synthesis of many carboxylic acids and their industrial production will be learned by students.

Unit – I

(09 Sessions)

Electromagnetic Spectrum: Absorption Spectra-

Brief idea about Ultraviolet (UV) absorption spectroscopy –Beer-Lambert's law ; molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation. Concept of chromophore and auxochrome, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts.

Infrared (I.R.) absorption spectroscopy – molecular vibrations, Hooke's law, selection rules, intensity and position of I.R. bands, fingerprint region, characteristic absorptions of various functional groups and interpretation of I.R. spectra of simple organic compounds.

Unit – II

(09 Sessions)

Phenols:

Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols: electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Friedel Craft reaction, Fries rearrangement, Kolbe Schmitt reaction, oxidation and reduction of phenol, brief idea about dihydric phenols.

Unit – III

(09 Sessions)

Aldehydes and Ketones:

Nomenclature and structure of the carbonyl group , synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of ketones from nitrile and from carboxylic acids, Mechanism of nucleophilic additions to carbonyl group with particular emphasis on Benzoin, Aldol, Perkin and Knoevenagel Condensations.

Unit – IV

(09 Sessions)

Carboxylic Acids:

Nomenclature, structure and bonding, acidity of carboxylic acids, effects of substituent on acid strength, Preparation of carboxylic acids, Reactions of carboxylic acids , Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids , Hydroxy acids: lactic , Tartaric and Citric Acids.

Carboxylic Acid Derivatives: Preparation of carboxylic acid derivatives, chemical reactions. Mechanisms Of Esterification And Hydrolysis(Acidic And Basic).

Course Outcomes:

Students completing this course will be able to:

- ❖ understand how to use their understanding of organic mechanisms to predict the outcome of reactions
- ❖ How to design syntheses of organic molecules.
- ❖ How to determine the structure of organic molecules using IR and NMR spectroscopic techniques
- ❖ Students will demonstrate an advanced level of knowledge in organic spectroscopy.

Suggested readings:

1. Inorganic Chemistry by J.E.Huheey

2. Basic Inorganic Chemistry by Cotton and Wilkinson
3. Organic Chemistry by Morrison and Boyd
4. Concise Inorganic Chemistry by J.D.Lee

Web Sources:

- ❖ <https://www.masterorganicchemistry.com/>
- ❖ <https://www.organic-chemistry.org/>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) II Year (III Semester)
BCHE(H)-351: 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. Students will be able to communicate the concepts and results of their laboratory experiments through effective writing and oral communication skills.

A) Inorganic Chemistry:

(10 Sessions)

- 1) Determination of alkali content – an acid tablet using HCl.
- 2) Estimation of hardness of water by EDTA.
- 3) Estimation of ferrous and ferric ions by dichromate method.
- 4) Estimation of copper using sodium thiosulphate solution.
- 5) Inorganic preparations:
 - a) Preparation of chrome alum.
 - b) Preparation of potash alum.
 - c) Preparation of chrome red.

B) Organic Chemistry:

(10 Sessions)

- 1) Determination of R_f values and identification of organic compounds using paper chromatography.
- 2) Separation of green leaf pigments (spinach leaves may be used).
- 3) Separation of a mixture of phenylalanine and glycine, Alanine and aspartic acid, Leucine and glutamic acid, using Spray reagent –ninhydrin.
- 4) Separation of monosaccharide – a mixture of D- galactose and D-fructose using n-butanol: acetone: water (4:5:1), spray reagent – aniline hydrogen phthalate.
- 5) Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

Course outcomes:

Students completing this course will be able to:

- ❖ Demonstrate mastery of basic organic chemistry laboratory techniques, including identification of organic compounds using paper chromatography.
- ❖ Students will demonstrate the ability Separation of a mixture of amino acids by paper chromatography.
- ❖ Students will understand the estimation of hardness of water.
- ❖ 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
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) II Year(IV Semester)
BCHE(H)-401: PHYSICAL CHEMISTRY

Objectives: To learn electrochemistry and Conductance in electrolyte. Fundamental theory of thermodynamics and variables used to calculate gaseous state numerical problem related to thermodynamics and electrochemistry. To know the Statement and meaning of the terms-phase equilibrium system of two component system-(Pb-Ag system).

Unit – I

(10 Sessions)

Thermodynamics – I

First Law of Thermodynamics:

Statement, definition of internal energy and enthalpy, Heat capacity, heat capacities at constant volume and pressure and their relationship, Joule's law – Joule-Thomson coefficient and inversion temperature. Calculation of w , q , dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process. Kirchhoff's equation.

Unit – II

(10 Sessions)

Thermodynamics – II

Second Law of Thermodynamics:

Need for the law, different statements of the law, Carnot's cycle and its efficiency, Carnot's theorem. Thermodynamic scale of temperature.

Concept of entropy:

Entropy as a state function, entropy as a function of V & T , entropy as a function of P & T , entropy change in physical change, Clausius Clapeyron equation, entropy as a criteria of spontaneity and equilibrium.

Gibbs and Helmholtz functions:

Gibbs function (G) and *Helmholtz* function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P , V and T .

Unit – III

(08 Sessions)

(Electrochemistry)

Conductance in electrolyte solutions, variation of molar equivalent and specific conductance with dilution. Migration of ions and Kohlrausch's law, weak and strong electrolytes, Ostwald's dilution law, Transport number, and its determination by Hittorf's method. Applications of conductivity measurements. Nernst theory and equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode, standard electrode potential, sign conventions, Electrolytic and Galvanic cells.

Unit – IV

(08 Sessions)

(Phase Equilibrium)

Statement and meaning of the terms-phase, component and degree of freedom, phase equilibrium system of one component system-(water, and Sulphur) phase equilibrium system of two component system-(Pb-Ag system), desilverisation of lead (Pattinson's Process)

Course Outcomes:

Students completing this course will able to:

- ❖ Know how to make solutions of various molar concentrations.
- ❖ Understand the calculation of internal energy and enthalpy, Heat capacity, heat capacities.

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

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
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) II Year (IV Semester)
BCHE(H)-402: ENVIRONMENTAL CHEMISTRY

Objectives: This course provides an overview of the concepts and applications used to predict and explain chemical concentrations found in different parts of indoor and outdoor environments. The course main objectives are to answer the connection between chemical uses and mishaps, and damage to human health or to ecologies. This course introduces concepts that form a basis for rationalizing or predicting environmental behavior of pollutant chemicals.

Unit – I

(09 Sessions)

Components of Environment (a brief introduction), air and water pollutants and their classification, air and water quality standards, soil chemistry: inorganic and organic chemistry of soil, macro and micro nutrients of soil.

Unit – II

(09 Sessions)

Methods of control of air and water pollution:

Adsorption of gaseous pollutants, electrostatic precipitation of air pollutants, cyclonic separation of air pollutants, aeration of water, waste water treatment, softening of water .

Unit – III

(09 Sessions)

Sampling and analysis of air and water pollutants:

Methods of sampling gaseous, liquid and solid pollutants, analysis of NO₂, SO₂, H₂S And CO, analysis of toxic heavy metals(Cd, Cr, As, Pd, Cu, Hg)

Analysis of total cationic and anionic burdens of water.

Analytical techniques for pesticide residue analysis.

Unit – IV

(09 Sessions)

Environmental Toxicology:

Bio-degradability, Bio-Oxidation, Bio-reduction, Bio-hydrolysis, Biochemical effects of arsenic, cadmium, lead, mercury, designing a green synthesis, designing safer chemicals.

Course Outcomes:

Students completing this course will able to:

- ❖ Demonstrate knowledge of chemical and biochemical principles of fundamental environmental processes in air, water, and soil.
- ❖ Recognize different types of toxic substances & responses and analyze toxicological information.
- ❖ Apply basic chemical concepts to analyze chemical processes involved in different environmental problems
- ❖ Describe water purification and waste treatment processes and the practical chemistry involved.
- ❖ Describe causes and effects of environmental pollution by energy industry and discuss some mitigation strategies. 6. Explain energy crisis and different aspects of sustainability.

Suggestive Readings:

1. Fundamentals of ecology by M.C.Dash
2. A Text book of Environmental chemistry by W. Moore and F.A. Moore
3. Environmental Chemistry by Samir k. Banerji

Web Sources:

- ❖ <https://nptel.ac.in/courses/104/103/104103020/>
- ❖ <https://www.openlearning.com/courses/introduction-to-environmental-chemistry/>
- ❖ <https://environmentalchemistry.com/>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) II Year(IV Semester)
BCHE(H)-451: CHEMISTRY PRACTICAL

Objectives: To give ability to perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions to the students. They will understand the scientific reasoning and quantitative analysis, laboratory practice and safety. Students will learn the basic analytical and technical skills to work al and technical skills to work effectively in the various fields of chemistry like physical and environmental chemistry.

Physical Chemistry:

(10 Sessions)

1. Determination of the transition temperature of the given substance by thermometric method (e.g. $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$ / $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ / $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$)
2. Determination of the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.
3. Determination of the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base.
4. Acid-base titration by pH meter.
5. Determination of the equivalent conductance of given electrolyte solution at room temperature using conductivity meter.

Environmental Chemistry:

(10 Sessions)

1. Determination of the percentage of available chlorine in the given sample of bleaching powder.
2. Determination of total dissolved solids in water / effluent sample.
3. Determination of Biological Oxygen Demand (BOD) of the given water sample.
4. Determination of Chemical Oxygen Demand (COD) of the given water sample using $\text{K}_2\text{Cr}_2\text{O}_7$ solution.
5. Determination of the conductivity of the soil sample.

Course outcomes:

Students completing this course will able to:

- ❖ Understand the principles defining physical chemistry and environmental chemistry from the point of view of the "problem solving" approach.
- ❖ Furthermore, he will acquired knowledge about total dissolved solids in water, Chemical Oxygen Demand (COD) of the given water sample carrying out simple qualitative tests and of defining the optimal conditions for a reaction to proceed.

Suggestive 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://digitalllearning.ucf.edu/ilab/remote-labs/college-of-sciences-remote-lab-resources/>

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

Bachelor of Science (Honors Chemistry) Programme

B.Sc (Honors Chemistry) III Year (V Semester)

BCHE(H)-501 -INORGANIC CHEMISTRY

Objectives: This course deals with the production, chemistry and properties of the transition metals, lanthanides and actinides. Specifically, the class introduces electron configurations for the elements and oxidation state trends for each group. Including bonding and isomerism in coordination compounds, crystal field theory, and electronic properties of ligands. Also cover metal bonding in clusters, the HSAB concept, chelate effect, and complex stability.

Unit – I

(09 Sessions)

Transition Metal Complexes:

Limitations of valence bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.

stability of metal complexes and factors affecting the stability, stability constants of complexes and their determination .

Unit – II

(09 Sessions)

Magnetic Properties of Transition Metal Complexes:

Types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.

Unit – III

(09 Sessions)

Metal carbonyls, Silicones and Phosphazenes

Metal carbonyls: 18 electron rule, preparation, structure and nature of bonding in the mononuclear carbonyls. Silicones and phosphazenes as examples of inorganic polymers.

Unit – IV

(09 Sessions)

Hard and Soft Acids and Bases (HSAB)

Classification of acids and bases as hard and soft, Pearson's HSAB concept, acid-base strength and hardness and softness, Symbiosis, theoretical basis of hardness and softness, electro negativity and hardness and softness.

Course Outcomes:

Students completing this course will be able to:

- ❖ To know the relative stability about coordination complexes.
- ❖ A brief knowledge about hardness and softness of Lewis acids and bases
- ❖ Nature of bonding in carbonyl, silicones and phosphazenes.
- ❖ Useful applications about magnetic properties of transition metal complexes.

Suggested Readings:

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

Web Sources:

1. www.chem.tamu.edu
2. www.academia.edu
3. www.amu.ac.in
4. www.chem.tamu

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) III Year (V Semester)
BCHE(H)-502: ORGANIC CHEMISTRY

Objective: To Predict and explain patterns in shape, structure of organic compounds. To give idea about synthesis and reactivity for carbohydrates . To provide explanation of the chemistry of amino acids and proteins to understand the concepts of organic chemical structure and bonding and stability found in fats and oils.

Unit – I

(09 Sessions)

Spectroscopy

Nuclear magnetic resonance (NMR) spectroscopy, Proton magnetic resonance (¹H- NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of ¹H NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1, 1, 2-tribromoethane, ethyl acetate, toluene and acetophenone, Problems pertaining to the structures elucidation of simple organic compounds using UV, IR and ¹H NMR spectroscopic, techniques.

Unit – II

(09 Sessions)

Carbohydrates

Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Conversion of glucose into mannose, Formation of glycosides, Determination of ring size of monosaccharides, Structures of ribose and deoxyribose, An introduction to disaccharides (maltose, sucrose and lactose)

Unit – III

(09 Sessions)

Amino Acids, Peptides and Proteins:

Classification, structure and stereochemistry of amino acids, Acid-base behavior isoelectric point and electrophoresis, Preparation and reactions of α-amino acids, classification and structure of proteins, selective hydrolysis of peptides, Protein denaturation/renaturation.

Unit – IV

(09 Sessions)

Fats, Oils and Detergents

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils, Saponification value, iodine value, acid value, Soaps, synthetic detergents.

Course Outcomes:

Students completing this course will be able to:

- ❖ Confirm the structure of carbohydrates.
- ❖ Student can understand the synthesis and properties of amino acids and proteins
- ❖ To predict the synthesis and properties of detergents and soaps.
- ❖ Explore the knowledge about effects of fats and oils

Suggested Readings:

- ❖ Biochemistry : L. Steyer, Freeman And Co.; New York
- ❖ Organic Synthesis: M.B. Smith: Mc Graw Hill, New York
- ❖ Advanced Organic Chemistry Reaction, Mechanism And Structure, M.B. Smith And J. March: John Willey And Sons, New York.

Web Sources:

1. [www.structbio.ptt.edu>notes>nmr_ref_notes-2011](http://www.structbio.ptt.edu/notes/nmr_ref_notes-2011)
2. [www.academia.edu>CHE_320_organic_spectroscopy](http://www.academia.edu/CHE_320_organic_spectroscopy)
3. [www.chtf.stuba.sk>files>Carbohydrates_Boudreaux](http://www.chtf.stuba.sk/files/Carbohydrates_Boudreaux)
4. <https://nptel.ac.in/content/storage2/courses/104103071/pdf/mod11.pdf>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) III Year (V Semester)
BCHE(H)--503 -GREEN CHEMISTRY

Objectives: The primary objective of this course is to make students aware of how chemical processes can be designed, developed and run in a sustainable way. Student will acquire the competence to think of chemistry as a sustainable activity. To give information about the design competitive chemical products and processes that attain the highest level of the pollution-prevention hierarchy by reducing pollution at its source.

Unit – I

(09 Sessions)

Introduction to Green Chemistry

Introduction to Green Chemistry Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.

Unit – II

(09 Sessions)

Principles of Green Chemistry

Principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis; Prevention of Waste/ byproducts/ toxic products; maximum incorporation of the materials used in the process into the final products (Atom Economy).

Unit –III

(09 Sessions)

Designing a Chemical synthesis

Designing safer chemicals – different basic approaches to do so; selection of appropriate auxiliary substances (solvents, separation agents), green solvents, solventless processes, immobilized solvents and ionic liquids; energy requirements for reactions -; selection of starting materials;; designing of biodegradable products;

Green Synthesis of the following compounds: adipic acid, catechol, methyl methacrylate, urethane, benzyl bromide, citral, ibuprofen, paracetamol, furfural.

Unit – IV

(09 Sessions)

Trends in Green Chemistry

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; Green chemistry in sustainable development, Use of microwaves in green chemistry.

Course Outcomes:

Students completing this course will able to:

- ❖ learn the basic principles of green and sustainable chemistry.
- ❖ They must be able to do and understand stoichiometric calculations and relate them to green process metrics.
- ❖ They learn alternative solvent media and energy sources for chemical processes.
- ❖ They learn about renewable requirements for the chemical industry, present and under development.
- ❖ They review the principles of catalysis, photochemistry and other interesting processes from the viewpoint of green chemistry.
- ❖ They put into practice some of the principles of green chemistry.

Suggested Readings:

1. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).

2. P.T. Anastas & J.K. Warner: Oxford Green Chemistry- Theory and Practical, University Press
3. A.S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001).
4. M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
5. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).
6. Green Chemistry Theory and Practice. P.T.Anatas and J.C. Warner
7. Real world cases in Green Chemistry M.C. Cann and M.E. Connolly
8. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry (London)
9. Green Chemistry: Introductory Text, M.Lancaster
10. Principles and practice of heterogeneous catalysis, Thomas J.M., Thomas M.J., John Wiley

Web Sources:

- ❖ <https://www.internetchemistry.com/chemistry/green-chemistry.php>
- ❖ <https://www.asdlib.org/onlineArticles/ecourseware/Manahan/GreenChem-2.pdf>
- ❖ <https://ncert.nic.in/ncerts/l/kech207.pdf>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) III Year (V Semester)
BCHE(H)504: PHARMACEUTICAL CHEMISTRY

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Objectives: A main objective of this course is to understand the fundamentals pharmaceutical organic chemistry. To know the reactions of functional groups with mechanism to convert organic molecule as medicine. Understanding of the basics of stereochemistry of different drugs and their physiological effects. Also to learn the applications of reagents in organic synthesis of drugs. To learn the therapeutic uses of organic compounds as drug.

Unit –I

(09 Sessions)

Drugs & Pharmaceuticals: Drug discovery, design and development; Basic Retro synthetic approach. Physicochemical properties of drugs (carboxylic acids and phenols).

Unit –II

(09 Sessions)

Non-steroidal Anti-inflammatory Drugs (NSAIDs):

Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, Ibuprofen);

Unit-III

(09 Sessions)

Antibiotics, Antiviral, antibacterials and anti-fungal drugs:

antibiotics (Chloramphenicol),

Antiviral – Acyclovir

antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim)

Unit-IV

(09 Sessions)

Fermentation:

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B₂ and Vitamin C.

Course outcomes:

Students completing this course will be able to:

- ❖ Understand the significance of Pharmaceutical Analysis in the profession
- ❖ Learn the various tools and techniques available for the analysis of drugs.
- ❖ Principles of various conventional analytical techniques used in the formulation of drugs.

Suggested Readings:

1. G.L. Patrick: Introduction to *Medicinal Chemistry*, Oxford University Press, UK.
2. Hakishan, V.K. Kapoor: *Medicinal and Pharmaceutical Chemistry*, Vallabh Prakashan, Pitampura, New Delhi.
3. William O. Foye, Thomas L., Lemke, David A. William: *Principles of Medicinal Chemistry*, B.I. Waverly Pvt. Ltd. New Delhi.

Web Sources:

- ❖ <https://guides.lib.uiowa.edu/c.php?g=132196&p=863259>
- ❖ <https://stuvera.com/pharmaceutical-chemistry-books-pdf/>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) III Year (V Semester)
BCHE(H)-505-NOVEL INORGANIC SOLIDS

Objectives: To learn about advanced material characterization and synthesis. To know about the connections between the structure and properties of solids, including theory and methods. Students will understand the development of new materials with particular desired properties conduct chemical analyses and characterization of the physical properties of solids.

Unit-I

(09 Sessions)

Synthesis and modification of inorganic solids:

Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods.

Inorganic solids of technological importance:

Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments.

Unit-II

(09 Sessions)

Nanoparticles/Nanomaterials:

Overview of nanostructures and nanomaterials: classification.

Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials, bionano composites.

Unit-III

(09 Sessions)

Composite materials:

Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of composites.

Unit-IV

(09 Sessions)

Specialty polymers:

Conducting polymers -Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrrole, applications of conducting polymers, Ion-exchange resins and their applications. Ceramic & Refractory: Introduction, classification, properties, raw materials, manufacturing and applications.

Course outcomes:

Students completing this course will able to:

- ❖ To understand the mechanism of the synthesis of novel solid.
- ❖ Understand the concept of nano particles and nanomaterials, their synthesis and properties and applications.
- ❖ Explain the mechanism of growth of nanostructures.
- ❖ Learn the existence of bioinorganic materials.

- ❖ Understand the importance of composites materials, polymers and their applications.
- ❖ Understand the use of solid materials in various articles , instruments, batteries.

Suggested readings:

1. Shriver & Atkins. Inorganic Chemistry, Peter Alkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012)
2. Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry.
3. Frank J. Ovens, Introduction to Nanotechnology .

Web Sources

- ❖ <http://www.freebookcentre.net/Chemistry/InOrganic-Chemistry-Books.html>
- ❖ <http://www.freebookcentre.net/Chemistry/InOrganic-Chemistry-Books.html>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) III Year (V Semester)
BCHE(H)-551-CHEMISTRY PRACTICAL

Objectives: Chemistry lab includes basic laboratory operation, separation and purification of organic compounds for honors students. They will learn to identify simple and fractional distillation, precipitation and crystallization, sublimation, solid-liquid and liquid-liquid extraction, and chromatography.

(20 Sessions)

- 1) Estimation of Copper by gravimetric method.
- 2) Estimation of Nickel by gravimetric method.
- 3) Synthesis of hydrogel by co-precipitation method.
- 4) Synthesis of metal nanoparticles.
- 5) Determination of saponification value of an oil or Fat.
- 6) Determination of Iodine value of an oil or fat.
- 7) Preparation of Aspirin/Ibuprofen.
- 8) Preparation of Antacid.
- 9) Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide
- 10) Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

Course outcomes:

Students completing this course will be able to:

- ❖ Understand the gravimetric analysis.
- ❖ Understand the synthetic process of nano materials.
- ❖ Learn the synthesis of drugs.

Suggested readings:

1. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
3. A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.
4. F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman (1960).M University.

Web Sources

- ❖ <http://www.freebookcentre.net/Chemistry/InOrganic-Chemistry-Books.html>
- ❖ <http://www.freebookcentre.net/Chemistry/InOrganic-Chemistry-Books.html>
- ❖ <http://onlinelabs.in/chemistry>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) III Year (VI Semester)
BCHE(H)-601: PHYSICAL CHEMISTRY

Objectives: To develop basic and advance concepts regarding the Physical Properties and Molecular Structure. To derive the expressions for Schrödinger wave equation and its importance. To study the concept, Interaction of radiation with matter and Laws of photochemistry.

Unit – I

(09 Sessions)

Physical Properties and Molecular Structure:

Optical activity, polarization – (Clausius – Mossotti equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and structure of molecules, magnetic properties paramagnetism, diamagnetism and ferromagnetism.

Unit – II

(09 Sessions)

Quantum Mechanics:

Schrödinger wave equation and its importance, postulates of quantum mechanics, particle in a one dimensional box., calculation of energy levels from wave functions, Hybrid orbitals – sp, sp³, sp², calculation of coefficients of A.O's used in sp and sp² hybrid orbitals and interpretation of geometry.

Unit – III

(09 Sessions)

Spectroscopy:

Introduction: electromagnetic radiation, regions of the spectrum.

Rotational *Spectrum*-

Diatomic Molecules:

energy levels of a rigid rotor (semi-classical principles), selection rules, determination of bond length, qualitative description of non-rigid rotor, isotope effect.

Infrared Spectrum: Energy levels of simple harmonic oscillator, selection rules, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, , idea of vibrational frequencies of different functional groups.

Unit – IV

(09 Sessions)

Photochemistry:

Interaction of radiation with matter, Laws of photochemistry: Grothus – Drapper law, Stark – Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non- radiative processes (internal conversion, intersystem crossing), quantum yield.

Course outcomes:

Students completing this course will able to:

- ❖ Derive mathematical expressions for different energy levels from wave functions.

- ❖ Explain the electromagnetic radiation, regions of the spectrum.
- ❖ Explain the concept of Jablonski diagram depicting various processes occurring in the excited.
- ❖ Apply the concepts of dipole moment and structure of molecules.

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

Web Sources:

- ❖ <http://www.freebookcentre.net/Chemistry/Chemistry-Books-Online.html>
- ❖ <https://guides.lib.umich.edu/c.php?g=282900&p=1885122>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) III Year (VI Semester)
BCHE(H)-602: -POLYMER CHEMISTRY

Objectives: To Know about polymeric materials and their classification and to learn about different mechanisms of polymerization along with polymerization techniques To determine chain length of polymers based on their kinetic mechanism To learn about different methods of finding out average molecular weight of polymers and transition temperature (T_g) and crystalline melting point (T_m) Determination of T_g and T_m

Unit – I

(09 Sessions)

Introduction and nomenclature:

Characteristic, Classification, Nomenclature of Polymer, Functionality, Physical Properties of Polymer, Mechanism of Polymerization (Addition Polymerization)

Unit-II

(09 Sessions)

Molecular Weight Determination:

Molecular weight, Determination of molecular weight of polymers by osmotic pressure and viscosity method and its practical significance, Viscometry, Chemical and geometrical structure of Polymers

UNIT-III

(09 Sessions)

Characterization:

Glass-transition temperature (T_g) of Polymer, Factors that affect the value of T_g , T_g and molecular weight, melting point, Importance of T_g , Brief idea of crystallinity.

Unit-IV

(09 Sessions)

Processing of Polymers:

Processing of Polymers (Calendering, Die casting, Film casting, Moulding), High Performance Polymers (PPS, PES, PEEK, Polyamides), Classification and application of composites.

Course Outcomes:

Students completing this course will able to:

- ❖ Understand the importance of macromolecules/polymers in day to day life and apply their knowledge in sustainable development of mankind.
- ❖ Apply the learned fundamental instrumental techniques in the polymer characterization.
- ❖ Explain (1) step-growth and chain-growth polymerization, with respect to synthesis mechanisms and kinetics, (2) crystalline melting temperature and glass transition temperature, including the influence of kinetics, and (3) the flow properties of polymer melts and polymer solutions, with respect to both temperature and molecular weight.
- ❖ Demonstrate an ability to quickly acquire knowledge in new polymer related applications and to acquire new knowledge for the innovation and development of polymer materials and related processes.

Suggested Readings:

1. Text Book Of Polymer Science, F.W. Billmeyer, Willey Science New York.

- 2 .Principles Of Polymerization, 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://guides.lib.umich.edu/c.php?g=282900&p=1885122>
- ❖ <http://www.freebookcentre.net/Chemistry/Chemistry-Books-Online.html>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) III Year (VI Semester)
BCHE(H) 603: FUEL CHEMISTRY

Objectives: The main objective is to provide a basic scientific and technical understanding of fuel. Handling of hydrocarbon fuels and lubricants. Students will learn the emerging alternative & renewable fuels. This will enable students to be industry ready to contribute effectively in the field of petroleum chemistry and technology.

Unit-I

(09 Sessions)

Energy sources

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

Unit-II

(09 Sessions)

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Unit-III

(09 Sessions)

Petroleum and Petrochemicals:Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels.

Unit-IV

(09 Sessions)

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Course Outcomes:

Students completing this course will able to:

- ❖ Learn about the both conventional petroleum-based fuels, and their alternative
- ❖ The students will learn the chemistry of petroleum fuel technology.
- ❖ Student will understand the refining processes for fuels and lubricants .
- ❖ The course will clear the different refining processes employed industrially to obtain different fractions of petroleum. Further, course will cover various alternative and renewable fuels like Bio-fuels .

Suggested Readings:

E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.

P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.

B.K. Sharma: *Industrial Chemistry*, Goel Publishing House, Meerut.

Web sources:

- ❖ <https://onlinelibrary.wiley.com/doi/book/10.1002/9781118796214>
- ❖ <http://www.freebookcentre.net/Chemistry/Chemistry-Books-Online.html>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) III Year (VI Semester)
BCHE(H)-604-COSMETIC CHEMISTRY

Objectives: Cosmetic chemistry will provide students with the opportunities to develop professional skills and fundamental concepts driving cosmetic science. To focus on the needs of the cosmetic industry and its consumers, in addition to providing students with the critical and evaluative skills to become professional scientists. To cover a range of sciences, both pure and applied, formulation development and industry operations, all of which give a broad range of career opportunities.

Unit –I

(09 Sessions)

Raw Materials for Cosmetics

Surfactants (basic, mild anionic, amphoteric, non-ionic and cationic), shampoo and bath additives (thickeners, foam stabilizers, conditioning agents, emollients and sequestering agents), oil components (mineral, natural and synthetic oils).

Unit –II

(09 Sessions)

Hair Dyes (Preparation and properties)

Temporary, semi-permanent and permanent hair dyes, dye removers and stability testing of dyes.

Unit – III

(09 Sessions)

Skin Care Products (Preparation and Properties)

Formulation of skin care products (stability and microbiological testing of skin care products),

Skin cleansers: anhydrous oily cleansers, super fatted bar soaps, astringents/toners, bar soaps.

Moisturisers, anti-aging products and sun screen products.

Unit –IV

(09 Sessions)

Colour Cosmetics, perfumes and oral care products (Preparation and properties)

Lip colour, nail polish, face powders, foundation, blushers, eye shadow, mascara, eyeliners.

Perfumes and deodorants: Natural and synthetic perfumes, fragrance, fixative and solvents.

Oral Care products: Toothpaste formulation, oral rinses, anti-caries agents.

Course Outcomes:

Students completing this course will be able to:

- ❖ Prepare cosmeceuticals (cosmetics with skin, hair and oral care benefits), Personal care and hygiene products.
- ❖ Provide a multidisciplinary scientific knowledge to gain expertise in the field and to respond to industry challenges effectively.
- ❖ Provide with knowledge on marketing approaches on studying consumer need, need gaps, managing competition and global markets.

- ❖ Provide practical skills in the area of biology, formulation science and analytical techniques required to scientifically design and develop products.

Suggested readings

1. Chemistry and Technology of the Cosmetics and Toiletries Industry, S.D. Williams, W.H. Schmitt.
2. The Chemistry of Fragrances: From Perfumer to Consumer, Charles Sell
3. Chemical Technology of Cosmetics, Kirk-Othmer, John Wiley & Sons,

Web Sources:

- ❖ <https://sp-sg.libguides.com/c.php?g=377339&p=6724406>
- ❖ <https://chemistscorner.com/top-10-book-cosmetic-science-book-resources/>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) III Year (VI Semester)
BCHE(H) 605: ORGANOMETALLICS AND BIOINORGANIC CHEMISTRY

Objectives: Main Objectives of this course is to classify the different types of transition-metal derived organometallic compounds. To prepare main-group and transition-metal derived organometallic compounds. Students will know about the stability and reactivity of the various types of organometallic compounds. Also to apply the appropriate characterization technique to the analysis of organometallic compounds. To know and demonstrate the utility of the organometallic compounds to the synthesis of drugs, especially by catalytic methods.

Unit - I

(09 Sessions)

Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties);

Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.

Unit –II

(09 Sessions)

Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide.

Unit – III

(09 Sessions)

Bio-Inorganic Chemistry

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+ , K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).

Unit – IV

(09 Sessions)

Polynuclear and heteronuclear aromatic compounds:

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole and Thiophene.

Course outcomes:

Students completing this course will able to:

- ❖ Use electron counting to know the reactivity and stability of organometallic compounds
- ❖ Can describe bond modes and determine reactivity for normally occurring ligands in organometallic complexes

- ❖ confers typical organometallic reactions, explain their mechanisms and what controls their reactivity
- ❖ Explain a number of homogenous catalysis reactions in which organometallic compounds play an important role and the mechanisms of such reactions, e.g. hydrogenation, hydroformylation and polymerisation
- ❖ Explain and exemplify organometallic applications within organic synthesis, e.g. olefin metathesis, cross-coupling

Suggested Readings:

1. James E. Huheey, Ellen Keiter & Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
2. G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry*, Pearson Publication.
3. J.D. Lee: *A New Concise Inorganic Chemistry*, E.L.B.S.
4. F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley & Sons.
5. I.L. Finar: *Organic Chemistry* (Vol. I & II), E.L.B.S.
6. R.T. Morrison & R.N. Boyd: *Organic Chemistry*, Prentice Hall.
7. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry*, Orient Longman.
8. Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand.

Web Sources:

- ❖ <https://www.pdfdrive.com/organometallic-organometallic-chemistry-e10520936.html>
- ❖ <http://www.freebookcentre.net/Chemistry/OrganoMetallic-Chemistry-Books.html>

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

IFTM University, Moradabad
Bachelor of Science (Honors Chemistry) Programme
B.Sc (Honors Chemistry) III Year (VI Semester)
BCHE(H)--651-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.

PRACTICALS

(20 Sessions)

- 1) Determination of rate constant of acid catalyzed hydrolysis of an ester.
- 2) Determination of order of hydrolysis of an ester by sodium hydroxide.
- 3) Verify Beer – Lambert Law for KMnO_4 / $\text{K}_2\text{Cr}_2\text{O}_7$ and determining the concentration of the given solution of the substance from absorption measurement.
- 4) Preparation of a Rubber Ball from Rubber Latex.
- 5) Preparation of casein glue from milk and testing of its activity.
- 6) Preparation of talcum powder/face cream.
- 7) Preparation of nail polish and nail polish remover
- 8) Preparation of shampoo.
- 9) Paper chromatographic separation of
 Fe^{3+} , Al^{3+} and Cr^{3+} OR Ni^{2+} , Co^{2+} , Mn^{2+} and Zn^{2+}
- 10) Preparation of any of the following complexes
 - I. Tetra ammine carbonato cobalt (III) nitrate
 - II. tetraamminecopper (II) sulphate
 - III. potassium trioxalato ferrate (III) trihydrate

Course outcomes:

Students completing this course will able to:

- ❖ Understand the qualitative and quantitative analysis.
- ❖ Understand the synthetic process of commercial chemical materials like cosmetics.

Suggested readings:

1. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
2. A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
3. A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn.
4. F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman (1960).M University

Web Sources:

<https://sp-sg.libguides.com/c.php?g=377339&p=6724406>

<https://chemistscorner.com/top-10-book-cosmetic-science-book-resources/>

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