LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (LOCF) FOR UNDERGRADUATE PROGRAMMES

Department of Chemistry

LOYOLA COLLEGE (AUTONOMOUS)
CHENNAI 600034

PREFACE

The curriculum of undergraduate chemistry has been designed to explain the concepts in various branches of chemistry such as physical, inorganic, organic chemistry, etc. The purpose of the outcome-based education is meant to provide an exposure to the fundamental aspects in different branches of chemistry and its applications, keeping in mind the growing needs for higher education, employability, entrepreneurship and social responsibility. The periodical restructuring of the syllabi is carried out to fulfill the requirements of graduate attributes, qualification descriptors, programme learning outcomes and course-level learning outcomes.

The outcome-based education enriches the curriculum to deliver the basic principles, synthetic strategies, mechanisms and application-oriented learning for the benefit of students. It also includes self-learning module, minor projects and industrial internship to enable students to get equipped for higher studies and employment.

The programme also includes training to students for seminar presentation, preparation of internship reports, hands-on training in lab courses, skills to handle instruments, synthesis and its analysis, developing leadership qualities, organization and participation in the interdepartmental academic competitions. The allied papers provide a platform to strengthen the understanding of the core subjects. The non-major elective courses offer chances to learn and augment interest in other related fields.

The outcome-based curriculum is intended to enrich the learning pedagogy to global standards. ICT enabled teaching-learning platforms are provided to students along with the interaction of international scientists. The seminars periodically delivered by industrialists, subject experts and former professors would certainly help the students to update with latest technology/trends in different fields of chemistry.

The exposure to the industrial internship and MoUs with industries can open an avenue for a start-up and its progress would be followed regularly. The OBE based evaluation methods will reflect the true cognitive levels of the students as the curriculum is designed with course outcomes and cognitive level correlations as per BLOOM’s Taxonomy.

CONTENTS

VISION AND MISSION OF LOYOLA COLLEGE

VISION

Towards holistic formation of youth, grounded in excellence, through accompaniment to serve the humanity.

MISSION

- To provide inclusive education through an integral and holistic formative pedagogy.
- To promote skills that prepare them for the future.
- To kindle in young minds the spirit of social and environmental justice with a blend of academic excellence and empathy.
- To stimulate critical and conscientious scholarship leading to meaningful and innovative human capital.

CORE VALUES

- *Cura Personalis*
- Pursuit of Excellence
- Moral Rectitude
- Social Equity
- Fostering solidarity
- Global Vision
- Spiritual Quotient

VISION AND MISSION OF THE DEPARTMENT

VISION

To strive with excellence in teaching and research in Chemistry to empower students with values for the society.

MISSION

To render competent and empathetic educational service to meet global standards in academia/industry through commitment, dedication and continuous learning.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)
(School of Physical Sciences)

PEO 1	**Professional Skill Development** To provide professional training and skill development to students in physical sciences and related disciplines and nurture them to be employable in science career.
PEO 2	**Core Competency Development** To augment their core-competencies and knowledge levels in science, humanities and inter-disciplinary areas by imparting education of high standards and advanced technological tools.
PEO 3	**Innovative Curriculum of Global Relevance** To upgrade the curriculum periodically based on scientific advancements, innovations and societal relevance so as to cater to the shifting global demands.
PEO 4	**Environmental Sensitivity and Sustainability** To infuse environmental sensitivity in students through academic activities and hence equip them with technical skills and scientific knowledge required to protect and safeguard the environment for a sustainable future.
PEO 5	**Ethical Principles and Holistic Development** To promote ethical principles and focus on the holistic development of students to become proficient, skilled, competent and socially responsible persons.
PEO 6	**Accessibility and Academic Excellence** To provide an accessible learning environment of excellence and equal opportunity to students enabling them to develop their creativity, critical thinking, leadership and entrepreneurship skills.

PROGRAMME OUTCOMES (POs)
(School of Physical Sciences)

PO 1	**Disciplinary and Inter-disciplinary Knowledge for Capacity Building** Students will acquire improved knowledge of the laws governing nature through classroom teaching and experimenting in the laboratories. They will develop a sense of interdisciplinary approach to identify and resolve issues through projects, seminars, field work, internships and industrial visits.
PO 2	**Skills for Effective and Efficient Communication** Students will be able to improve and enhance their communication skills such as reading, writing, listening and speaking. This will help them to express their scientific ideas clearly and effectively and empower them to become agents of social change and hence pave the way for betterment of the society at large.
PO 3	**Sense of Inquiry and Problem-solving Skills** Students will demonstrate the core competencies of their discipline through analytical reasoning, problem solving and research related skills, cooperation and teamwork, scientific reasoning and thinking which would make them emerge as entrepreneurs or administrative personnel.
PO 4	**Skills to Impact Society** Students will develop leadership, team spirit and scientific skills which will help them to identify, approach and analyze the problems of the immediate neighborhood and society with an eye to look beyond gender, age, caste, creed or nationality and work for the emancipation and empowerment of humanity.
PO 5	**Energy, Ethics and Environment** They will be able to involve themselves in designing policies and developing scientific temper to harness energy and work on alternate sources. They will be aware of the environmental issues and imbibe the spirit of ethical values in establishing a self-sustained environment for a healthy society.
PO 6	**Self-directed and Lifelong Learning** Through digital literacy students will engage in self-paced and curious learning with no limit on scientific knowledge acquisition and hence develop motivation for a sustained lifelong learning capability. Students will accumulate knowledge by continuous learning and leverage the past knowledge seamlessly to solve the problems in the future.
PO 7	**National and International-priorities Preferences and Perspectives** Students will be able to prioritize national interest in the global perspective with an aim to achieve and build a nation and an integrated world through contributions that imbibe the spirit of multicultural competency, creative thinking, critical analysis, political awareness and the much-needed international policies.

PROGRAMME SPECIFIC OUTCOMES (PSOs)
(Department of Chemistry)

PSO 1	Recall the fundamental concepts and apply the various scientific principles in industry, environment and society.
PSO 2	Propose solutions for complex scientific problems that meet the specified needs of public health, safety, cultural, societal, and environmental issues.
PSO 3	Transform acquired knowledge to succeed in competitive exams for higher studies / research / administration and self-employment.
PSO 4	Familiarize with the different branches of chemistry like analytical, organic, inorganic, physical, food medicinal, polymer, biochemistry and allied level physics and mathematics.
PSO 5	Rationalize the societal importance of chemistry to develop leadership and entrepreneurship skills.
PSO 6	Synthesize, evaluate, interpret and effectively apply the basic laws, principles, and mechanism involved in the domain of chemistry.
PSO 7	Impart a broad foundation in chemistry and enable them to evaluate and analyze critically the scientific facts.

B.Sc. Chemistry Restructured CBCS Curriculum effective from June, 2019

PART	SEMESTER I	SEMESTER II	SEMESTER III	SEMESTER IV	SEMESTER V		SEMESTER VI	CREDITS
I	G. Language (3h/3c)	G. Language (3h/3c)	G. Language (3h/3c)	G. Language (3h/3c)				12
II	General English (6h/3c)	General English (6h/3c)	General English (5h/3c)	General English (5h/3c)				12
III MC	Basic Concepts in Inorganic Chemistry (4h/4c)	Chemistry of Hydrocarbons (4h/4c)	Stereochemistry and Organic Functional Groups-I (4h/4c)	Electrochemistry (3h/3c)	Organic Functional Groups – II (5h/5c)		Coordination Chemistry (6h/6c)	84
	Analytical Chemistry (4h/4c)	Chemical bonding and Main group elements (4h/4c)	Inorganic Qualitative Analysis (4h/4c)	Physical Chemistry Practicals (3h/3c)	Phase Equilibria and Chemical Kinetics (5h/5c)		Molecular Dynamics (6h/6c)	
	Volumetric Analysis and Inorganic Preparations (4h/4c)	Organic Qualitative Analysis (4h/4c)	Thermodynamics (4h/4c)		Spectroscopy (5h/5c)		Synthetic Organic Chemistry and Heterocyclic compounds (6h/6c)	
					Transition Elements and Nuclear Chemistry (5h/5c)			
					Gravimetric Analysis and Organic Preparations (5h/5c)			
AR/ AO		Chemistry for Biology-I (Plant bio) (4h/2c) / Chemistry Practical for Biology (Plant bio) (2h/1c)	Applied Chemistry for Physics (3h/2c) / Applied Chemistry Practical for Physics (2h/1c)	Applied chemistry for Maths (3h/2c) / Applied Chemistry Practical for Maths (2h/1c)		Internship		12
		Chemistry for Biology-I (Adv zoo) (4h/2c) / Chemistry Practical for Biology (Adv zoo) (2h/1c)	Bio-Chemistry (Bot & Zoo) (3h/2c) / Bio-Chemistry Practical (Bot & Zoo) (2h/1c)	Food Chemistry (Bot & Adv. Zoo) (3h/2c) / Food Chemistry Practical (Bot & Adv. Zoo) (2h/1c)				
		Chemistry for Physics (4h/2c) / Chemistry Practical for Physics (2h/1c)						
ME				Chem. of Food and Consumer Products (6h/6c)	Biochemistry and Natural Products (6h/6c)			12
				Chemistry of Materials (6h/6c)	Medicinal and Pharmaceutical Chemistry (6h/6c)			
MS							Industrial Chemistry + Industrial Chemistry Lab - Computer Lab - Seminar + Internship (12h/15c)	15 (MS&TP)
BT/AT /NME					MOOC/SSP			4
			Chemistry in Everyday Life (3h/2c)	Basic Clinical and Pharmaceutical Chemistry (3h/2C)				
FC	FC (3/1)	FC (3/2), EVS	FC (2/1)	FC 2(1)				5
CCA	CC	CCA (90/1)						1
ORA			OR	OR (120/2)		30days		2
Hr/C	30h/22c	30h/(23+1c)	30h/24c	30h/(24+2c)	30h/30c		30h/33c	180(159)

Note: A Theory paper shall have 3 to 6 contact hours and a practical session shall have 2 to 4 contact hours.

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI
DEPARTMENT OF CHEMISTRY
(2019 - Restructured Curriculum)

OVERALL COURSE STRUCTURE

Sem	Sub. Code	Course Title	T/L	Category	Cr	Hrs
I	UTL 1101 UFR 1101 UOL 1101 UOL 1104	General Tamil-I French for Beginners-I Hindi Prose-I General Sanskrit-I	T	GL	3	3
I	UEL 1201 UEL 1202 UEL 1203	General English-I (Advanced) General English-I (Intermediate) General English-I (Basic)	T	GE	3	6
I	UCH 1501	Basic Concepts in Inorganic Chemistry	T	MC	4	4
I	UCH 1502	Analytical Chemistry	T	MC	4	4
I	UCH 1503	Volumetric Analysis and Inorganic Preparations	L	MC	4	4
I	UMT 1302	Mathematics for Chemistry	T	AR	3	6
I	UHE 1001	Personality Development		FC	1	3
II	UTL 2101 UFR 2101 UOL 2101 UOL 2103	General Tamil-II French for Beginners-II Hindi Prose-II General Sanskrit-II	T	GL	3	3
II	UEL 2201 UEL 2202 UEL 2203	General English-II (Advanced) General English-II (Intermediate) General English-II (Basic)	T	GE	3	6
II	UCH 2501	Chemistry of Hydrocarbons	T	MC	4	4
II	UCH 2502	Chemical Bonding and Main Group Elements	T	MC	4	4
II	UCH 2503	Organic Qualitative Analysis	L	MC	4	4
II	UPH 2301	Physics for Chemistry	T	AR	2	4
II	UPH 2302	Physics for Chemistry Practical	L	AR	1	2
II	UHE 2001	Life Issues and Coping Strategies	T	FC	2	3
III	UTL 3101 UFR 3101 UOL 3101 UOL 3102	General Tamil-III French for Beginners - III Hindi Poetry -III General Sanskrit-III	T	GL	3	3
III	UEL 3201 UEL 3202 UEL 3203	General English- III (Advanced) General English- III (Intermediate) General English- III (Basic)	T	GE	3	5
III	UCH 3501	Stereochemistry and Organic Functional Groups-I	T	MC	4	4
III	UCH 3502	Inorganic Qualitative Analysis	L	MC	4	4
III	UCH 3503	Thermodynamics	T	MC	4	4
III	UMT 3401 / UPB 3401	Mathematics for Chemistry – II / Applied Microbiology	T	AO	3/ 2	5 / 3
III	UCS 3401 / UPB 3402	Data Analytics using Excel / Applied Microbiology Practicals - I	L	AO	3 / 1	5 / 2

III	UHE 3001	Social Awareness	L	FC	1	2
III				NME	2	3
III				ORA		
IV	UTL 4102 UFR 4101 UOL 4101 UOL 4102	General Tamil-IV French for Beginners - IV Hindi Poetry -IV General Sanskrit-IV	T	GL	3	3
IV	UEL 4201 UEL 4202 UEL 4203 UEL 4204 UEL 4205 UEL 4206 UEL 4207	Introduction to Technical Translation Soft skills for Professional Development Professional Content Writing English for Technical Writing English for Employability Skills Essential skills for group Communication Theatre Performance and Film Review	T	MC	3	5
IV	UCH 4501	Electrochemistry	T	MC	3	3
IV	UCH 4502	Physical Chemistry Practicals	L	MC	3	3
IV	UCH 4601	Chem. of Food and Consumer Products	T	ME	2	3
IV	UCH 4602	Chemistry of Materials	L	ME	2	3
IV	UAZ 4401 / UPH 4401	Animal Biotechnology and Bioinformatics / Applied Physics	T	AO	2	3
IV	UCA 4402 / UAZ 4402 / UPH 4402	Web Development / Animal Biotechnology and Bioinformatics Lab / Applied Physics Lab	L	AO	3 / 1	5 / 2
IV	UHE 4001	Environmental Studies	T	FC	1	2
IV				NME	2	3
IV				ORA		
V	UCH 5501	Organic Functional Groups – II	T	MC	5	5
V	UCH 5502	Phase Equilibria and Chemical Kinetics	T	MC	5	5
V	UCH 5503	Spectroscopy	T	MC	5	5
V	UCH 5504	Transition Elements and Nuclear Chemistry	T	MC	5	5
V	UCH 5505	Gravimetric Analysis and Organic Preparations	L	MC	4	4
V	UCH 5601	Biochemistry and Natural Products	T	ME	6	6
V	UCH 5602	Medicinal and Pharmaceutical Chemistry	T	ME	6	6
VI	UCH 6501	Coordination Chemistry	T	MC	6	6
VI	UCH 6502	Molecular Dynamics	T	MC	6	6
VI	UCH 6503	Synthetic Organic Chemistry and Heterocyclic compounds	T	MC	6	6
VI	UCH 6701	Industrial Chemistry Theory	T	MS	5	6
VI	UCH 6706 UCH 6705	Industrial Chemistry Lab-Computer Lab-Seminar / Internship	L I	MS	5 / 5	6 / --

COURSES OFFERED TO OTHER DEPARTMENTS

II	UCH 2301	Chemistry for Biology-I **(Bot)**	T	AR	2	4
II	UCH 2302	Chemistry Practical for Biology **(Bot)**	L	AR	1	2
II	UCH 2301	Chemistry for Biology **(Zoo)**	T	AR	2	4
II	UCH 2302	Chemistry Practical for Biology **(Zoo)**	L	AR	1	2
II	UCH 2303	Chemistry for Physics	T	AR	2	4
II	UCH 2304	Chemistry Practical for Physics	L	AR	1	2
III	UCH 3401	Applied Chemistry for Physics	T	AO	2	33
III	UCH 3402	Applied Chemistry Practical for Physics	L	AO	1	2
III	UCH 3403	Bio-Chemistry (Bot & Zoo)	T	AO	2	3
III	UCH 3404	Biochemistry Practical (Bot & Zoo)	L	AO	1	2
III	UCH 3801	Chemistry in Everyday Life	T	NME	2	3
IV	UCH 4401	Applied chemistry for Mathematics	T	AO	2	3
IV	UCH 4402	Applied Chemistry Practical for Mathematics	L	AO	1	2
IV	UCH 4403	Food Chemistry (Bot & Adv. Zoo)	T	AO	2	3
IV	UCH 4404	Food Chemistry Practical (Bot & Adv. Zoo)	L	AO	1	2
IV	UCH 4801	Basic Clinical & Pharmaceutical Chemistry	T	NME	2	3

COURSE DESCRIPTORS

Course Code	UCH 1501
Course Title	BASIC CONCEPTS IN INORGANIC CHEMISTRY
Credits	04
Hours/Week	04
Category	Major Core (MC) – Theory
Semester	I
Regulation	2019

Course Overview

1. Basic Concepts in Inorganic Chemistry comprises different modules of periodic properties, different types of chemical reactions, solvent systems, theories of bonding and chemistry of halogens.
2. The aim of the course is to give basic knowledge about the atomic structure, periodicity, bonding in covalent compounds and metals, concepts of acid-base and chemistry of halogens.
3. The other important aspects that will be discussed in the course include: structure of atom models, electronegativity scales, aqueous and non-aqueous solvents of homo- and hetero diatomic molecules and pseudohalogens.
4. In this course, the effect of bonding and non-bonding electrons on the molecule, MO diagram, the different bonding models, structure of molecules, semi- and superconductors will also be examined.
5. The module deals with various theories of bonding for predicting the structure of interhalogen compounds.

Course Objectives

1. To understand the basic concepts of periodic properties and nature of elements.
2. To balance the chemical reactions by various methods and to understand the different types of chemical reactions.
3. To discuss the structure and geometry of covalent molecules.
4. To draw the MO diagrams and predict bond order and magnetic properties.
5. To explain the nature of bonding and chemistry of halogens.

Prerequisites	Basic knowledge of chemistry

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	1.1 Electronic configuration, dual nature of electrons, Heisenberg uncertainty principle, Bohr theory, Schrodinger equation, significance of wave functions, normalization of wave function, radial and angular wave functions, Pauli's exclusion principle, Hund's rule, and Aufbau principle. Isoelectronic molecules. 1.2 Periodic table: periodic law and arrangement of elements, group number.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	1.3 Periodicity: atomic, ionic and covalent radii; trend in ionic radii, ionization energy, electron affinity; electronegativity, scales-Pauling, Mulliken-Jaffe, Allred-Rochow and calculations. Diagonal relationships in the periodic table. Inert-pair effect.			
II	2.1 Oxidation Number and State: calculation of oxidation number of elements. Oxidation, reduction, redox and half reactions. Oxidizing and reducing agents. Equivalent weight of oxidizing and reducing agents-calculations. 2.2 Types of chemical reactions: disproportionation (self-oxidation-reduction), electron transfer and double decomposition. Balancing chemical reactions by oxidation number and ion-electron methods. Direct and indirect (electrochemical cell) redox reactions and importance. 2.3 Theories of acids and bases: Arrhenius, Bronsted-Lowry, Lewis, solvent system, Lux-Flood and Usanovich. HSAB concept. 2.4 Non-aqueous solvents: Classification-protic and aprotic. Liquid ammonia as a solvent. Acid-base, precipitation and complex formation reactions. Solutions of alkali and alkaline earth metals in ammonia-application.	12	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	3.1 Lewis theory-octet rule and exception, electron dot structural formula. Sidgwick-Powell theory-prediction of molecular shapes; Valance Bond Theory (VBT). Comparison of VBT and MOT. Slater's rule. σ- and π-bond. Hybridization and geometry of molecules-BeX_2, $SnCl_2$, $PbCl_2$, NH_3, PCl_3, CH_4, PCl_5, and SF_6. 3.2 VSEPR model: effect of bonding and nonbonding electrons on the structure, effect of electronegativity. Illustration of structure of molecules containing σ-bonds and π-bonds (NH_3, SF_4, ICl_4^-, ICl_2^-, XeF_4, XeF_6, XeO_3 and CO_3^{2-}).	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	4.1 MO theory: LCAO method-criteria of orbital overlap, types of molecular orbitals-σ-, π- and δ-MOs; formation of σ- and π-MOs and their schematic illustration; qualitative MO energy level diagram of homo- (H_2 to X_2) and heterodiatomic molecules (HCl, NO, CO), magnetic properties, bond order and stability	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	of molecules and ions. 4.2 Metallic bond: metallic properties, band theory of metals. Semiconductors: n- and p-type. Superconductors.			
V	5.1 Group-17: anomalous behaviour of fluorine, ionic-, covalent- and bridging halides; reactivity of halogens, reduction by thiosulfate and application to iodo- and iodimetry. 5.2 Halogen oxides: oxygen difluoride, dioxygen difluoride, dichlorine monoxide, chlorine dioxide, bromine dioxide, iodine pentoxides-preparation, properties and structure. Bleaching powder-estimation of available chlorine. 5.3 Oxoacids: hypohalous, halous, halic and perhalic acid-oxidation state, strength and hybridization. 5.4 Interhalogen compounds: ClF, ClF_3, BrF_5 and IF_7-preparation, properties and structure. 5.5 Pseudohalogens: cyanide, thiocyanate, and azide-structure and properties.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5. K6

Text Books

1. Principles of Inorganic Chemistry, B. R. Puri, L. R. Sharma and K. C. Kalia, Shoban Lal Nagin Chand and Co., New Delhi, 2018.
2. Advanced Inorganic Chemistry, Vol. I, Satyaprakash, G. D. Tuli, S. K. Basu, R. D. Madan, S. Chand & company, New Delhi, 2017, 5th edn.
3. Concise Inorganic Chemistry, J. D. Lee, Blackwell Science, London, 2010, 5th edn.
4. Inorganic Chemistry, C. Housecroft and A. G. Sharpe, Pearson, 2012, 4th edn.

Suggested Readings

1. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, P. L. Guas, John Wiley, 2002, 3rd edn.
2. Concepts and Models of Inorganic Chemistry, B. Douglas, D. McDaniel, J. Alexander, John Wiley, 1994, 3rd edn.
3. Inorganic Chemistry, J. E. Huheey, E. A. Kieter and R. L. Keiter, Harper Collins, New York, 2006, 4th edn.
4. Inorganic Chemistry, D. F. Shriver, P. W. Atkins, W. H. Freeman and Co, London, 2010.
5. Inorganic Chemistry: A Modern Introduction, T. Moeller, Wiley, New York, 1990.

Web Resources

1. https://bit.ly/3vB6v0N
2. https://bit.ly/3juWayu

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand and recall the atomic model, bonding theories and periodic table of elements, HSAB principle.	**K1, K2**
CO 2	To integrate and assess the electrons arrangement and bonding characteristics to infer the structure of compounds.	**K3**
CO 3	To analyse and differentiate compounds based on structure, composition and bonding interactions.	**K4**
CO 4	To explain the role of electron pairs arrangement in orbitals and properties of compounds through bonding theories.	**K5**
CO 5	To construct and simulate the molecular orbital diagrams to explain the bonding interactions, magnetic behaviour and geometry.	**K6**

Course Code	UCH 1502
Course Title	ANALYTICAL CHEMISTRY
Credits	04
Hours/Week	04
Category	Major Core (MC) – Theory
Semester	I
Regulation	2019

Course Overview

1. Analytical chemistry involves the separation, identification and quantification of the chemical components of natural and artificial materials.
2. The aim of the course is to give the basic knowledge in handling of chemicals, gravimetric, volumetric, thermal, data analysis, separation and purification techniques.
3. This course covers the safety and hygiene in the chemistry laboratories and different types of error in analytical measurements.
4. It also offers theoretical aspects of different types of titrations including acid –base, redox, precipitation and complexometric titrations.
5. It also deals with the principles and applications of different chromatographic, distillation and thermal techniques.

Course Objectives

1. To understand the safe methods of handling toxic chemicals and analyze the different types of error in analytical measurements.
2. To explain and apply the theories of acid-base, redox and complexometric titrations in volumetric analysis.
3. To recognize the basis of quantitative analysis such as gravimetric and precipitation titrations.
4. To apply the chromatographic techniques to separate and identify the components present in a mixture.
5. To classify and infer thermo analytical techniques and to assess the thermal stability of a chemical compound.

Prerequisites	Basic knowledge of Chemistry

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Handling of Chemicals and Data Analysis:** 1.1 Safety and hygiene in the Chemistry Lab - Storage and handling of chemicals, handling of acids, ethers, toxic and poisonous chemicals. Antidotes, threshold vapour concentration and first aid procedure. Material safety data sheet (MSDS), Control of substances hazardous to health (COSHH).	12	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	1.2 Calibration of volumetric apparatus: burette, pipette and standard flask. 1.3 Errors in chemical analysis - Accuracy and precision, Types of errors – Determinate and indeterminate errors. Methods of eliminating or minimizing errors. Precision: mean, median, average deviation and coefficient of variation. Significant figure and its relevance. Normal error curve and its importance.			
II	**Titrimetric Methods of Analysis** 2.1 Methods of expressing concentration of solutions – Molarity, molality, formality, normality, mole fraction, ppm and ppb. Law of volumetric analysis. Types of titrations. Requirements for titrimetric analysis. Primary and secondary standards. Limitation of volumetric analysis. 2.2 Acid-base Equilibria - pH of strong and weak acid solutions. Buffer solutions. Henderson equation. Preparation of acidic and basic buffers. Relative strength of acids and bases from K_a and K_b values. Neutralization-titration curve, theory and choice of indicators. 2.3 Complexometric titrations - Stability of complexes. Titration involving EDTA. Usage of metal ion indicators.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Solubility Equilibria** 3.1 Precipitation titrations - Concept of solubility product. Relation between solubility and solubility product. Argentometric titrations, indicators for precipitation titrations involving silver nitrate. Determination of chloride by Volhard's method. Theory of adsorption indicators. 3.2 Gravimetric methods of analysis - Separation by precipitation. Factors affecting solubility, gravimetric factor. Purity of precipitates, Von Weimarn ratio. Co-precipitation and post precipitation. Precipitation from homogeneous solution.	11	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

IV	**Separation and Purification Techniques** 4.1 Chromatographic techniques and applications - Principles of adsorption and partition chromatography: Paper, Thin layer, Column chromatography and ion-exchange chromatography. 4.2 General purification techniques - Purification of solid organic compounds: re-crystallization, sublimation. Use of miscible solvents. Use of drying agents and their properties. Purification of liquids. Techniques of distillation. Chemical methods of purification and test of purity.	11	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Thermal Analysis** 5.1 Thermogravimetric analysis (TGA) and differential thermal analysis (DTA): Principle, instrumentation and applications. 5.2 Factors affecting TGA and DTA curves. DTG and TG-DTA curve of $AgNO_3$, $CaC_2O_4.H_2O$, $CuSO_4.5H_2O$.	5	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. U. N. Dash, Analytical Chemistry: Theory and Practice, Sultan Chand and sons Educational Publishers, New Delhi, 2011.
2. R. Gopalan, P. S. Subramanian and K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand, New Delhi, 2007.
3. S. Usharani, Analytical Chemistry, MacMillan Publisher, 2000.
4. B. Sivasankar, Instrumental Methods of Analysis, Oxford University Press,2012.
5. Shoba Ramakrishnan, Analytical Chemistry, Pearson Education, 2017.
6. K.S. Vishwanathan, R. Gopalan, Analytical Methods: Interpretation, Identification, Quantification, University press,2018

Suggested Readings

1. D. A. Skoog, D. M. West and F. J. Holler, Analytical Chemistry: An Introduction, 5thedn., Saunders college publishing, Philadelphia, 1998.
2. R.A. Day and A.L. Underwood, Quantitative Analysis, 6thedn., Prentice Hall of India Private Ltd., New Delhi, 1993.
3. H. Kaur, Instrumental Methods of Chemical Analysis, Pragati Prakashan, Meerut, 2010.
4. V.K. Srivastava, K.K. Srivastava, Introduction to Chromatography: Theory and Practice, S. Chand and Company, New Delhi, 1987.
5. A.K. Srivastava, P.C. Jain, Chemical Analysis: An Instrumental Approach for B.Sc. Hons. and M.Sc. Classes, S. Chand and Company Ltd., Ram Nagar, New Delhi, 2010.
6. M. Dekker, Inorganic titrimetric analysis: contemporary methods, Clarence Joseph Hull, 1971.
7. R. Speyer, Thermal Analysis of Materials, CRC Press, 1993.
8. G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney, Vogel's Textbook of Quantitative Chemical Analysis, sixth edition Pearson Education, 2000.

Web Resources

1. https://bit.ly/3pz9NR1
2. https://bit.ly/3vCz4uA
3. https://bit.ly/3lBgbos
4. https://bit.ly/3lENibe

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand the safety in handling of chemicals, principles of volumetric, gravimetric, thermal analysis and describe the separation techniques.	**K1, K2**
CO 2	To apply different chromatographic techniques in identifying the components and classify thermo analytical techniques and solve problems related to pH, solubility product, standard deviation.	**K3**
CO 3	To analyse the types of error, thermal behaviour of materials using TGA, DTA and examine the significance of complexometric, precipitation titrations and distillation techniques.	**K4**
CO 4	To compare different precipitation processes, separation techniques and determine the concentration of solutions, thermal stability of a chemical compound and evaluate analytical data.	**K5**
CO 5	To develop analytical skills in volumetric, gravimetric, thermal analysis, chromatographic techniques for its applications in industries and research.	**K6**

Course Code	UCH 1503
Course Title	VOLUMETRIC ANALYSIS AND INORGANIC PREPARATIONS
Credits	04
Hours/Week	04
Category	Major Core (MC) – Practical
Semester	I
Regulation	2019

Course Overview

1. Volumetric analysis and inorganic preparations comprise of two different modules: (i) Quantitative estimations by volumetric titrations. (ii) Preparations of inorganic compounds.
2. Basic knowledge needed for preparing standard solutions in different concentration units such as molarity, normality and equivalent weight will be discussed.
3. Analytical skill of the students will be enhanced by doing experiments individually.
4. Suitable trainings will be offered for the computation of needed parameters from the experimental data.
5. Students will perform the preparation of inorganic compounds and learn crystallization techniques.

Course Objectives

1. To understand the calibration of apparatus.
2. To learn the preparation of standard solutions.
3. To analyze the end point and estimate the unknown solution in acid-base, redox and complexometric titrations.
4. To acquire the knowledge about the preparation of inorganic compounds in the laboratory.
5. To explain the theories of chemical reactions involved in the titrations and preparations of inorganic compounds.

Prerequisites	Basic knowledge of Chemistry.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**A. Volumetric Estimations** 1. Calibration of volumetric apparatus: Burette, pipette and standard flasks. 2. Estimation of HCl. 3. Estimation of oxalic acid. 4. Estimation of Ferrous ammonium sulphate (permanganometry). 5. Estimation of calcium (permanganometry). 6. Estimation of $KMnO_4$ (iodometry). 7. Estimation of copper (iodometry). 8. Estimation of Fe^{2+}-Fe^{3+} mixture using diphenyl amine (dichrometry). 9. Estimation of calcium. 10. Estimation of magnesium.	46	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
II	**B. Inorganic Preparations** 1. Cuprous chloride 2. Potash alum 3. Ferrous sulfate 4. Ferrous ammonium sulphate 5. Microcosmic salt 6. Reinecke's salt	06	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Textbooks

1. Venkateswaran V, Veeraswamy R., Kulandaivelu A.R., Basic Principles of Practical Chemistry, New Delhi, Second edition, Sultan Chand & Sons, (1997).
2. Bassett, J., et al., Vogel's Textbook of Quantitative Inorganic Analysis, (4th edition), ELBS Longman, (1985).
3. Kamboj, P. C. Advanced University Practical Chemistry Vol-I January (2013).

Web Resources

1. https://bit.ly/3C9SZDK

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand the calibration of apparatus.	**K1, K2**
CO 2	To prepare and utilize the standard solutions.	**K3**
CO 3	To determine the end point of the acid-base, redox and complexometric titrations.	**K4**
CO 4	To predict the suitable methods used to prepare the inorganic compounds in the laboratory.	**K5**
CO 5	To integrate the basic knowledge in volumetric analysis and inorganic preparations.	**K6**

Course Code	UCH 2501
Course Title	CHEMISTRY OF HYDROCARBONS
Credits	04
Hours/Week	04
Category	Major Core (MC) - Theory
Semester	II
Regulation	2019

Course Overview

1. Chemistry of hydrocarbons becomes the basis of organic chemistry.
2. The course gives a detailed discussion on the occurrence and synthesis of hydrocarbons.
3. The importance of this course is to explain the nomenclature, classification, bonding and structure of organic compounds.
4. The physical and chemical properties of aliphatic and aromatic hydrocarbons have been discussed in detail.
5. The other important aspects include the preparation of various functional organic compounds from hydrocarbons.

Course Objectives

1. To understand the basic concepts of organic chemistry and the chemistry of hydrocarbons.
2. To understand the electronic effects, preparation and the properties of aliphatic hydrocarbons.
3. To learn the mechanism of preparation and chemical properties of hydrocarbons.
4. To correlate the difference in properties of aliphatic and aromatic hydrocarbons.
5. To design various synthetic strategies for the preparation of hydrocarbons and various other organic compounds.

Prerequisites	Basic knowledge of Chemistry.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Electronic Effects of Organic Compounds** 1.1 Cleavage of bonds: Homolytic and heterolytic cleavages, bond energy, bond length and bond angle. Electron displacement effects: Inductive, inductomeric, electromeric, mesomeric, resonance, hyperconjugation and steric effects. Tautomerism: Keto-enol, amido-imidol and nitro-acinitro forms 1.2 Formation and stability of reaction intermediates: carbocation, carbanion, free radicals, carbene and benzyne.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

II	**Alkanes and Cycloalkanes** 2.1 Alkanes: Nomenclature, Classification, Preparation by Industrial method, Wurtz reaction, reduction or hydrogenation of alkenes and Corey-House method. Reactions: Mechanism of halogenation, free radical substitution, sulphonation, nitration, oxidation. 2.2 Cycloalkanes: Preparation using Wurtz reaction, Dieckmann's ring closure and reduction of aromatic hydrocarbons. Reactions: Mechanism of substitution and ring-opening reactions. Baeyer's strain theory and theory of strain less rings.	12	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Alkenes** 3.1 Alkenes: Nomenclature, Classification, General methods of preparation by dehydrogenation, dehydrohalogenation, dehydration, Hoffmann and Saytzeff rules, cis and trans eliminations. Reactions: Mechanism of electrophilic and free radical addition, addition of hydrogen, halogen, hydrogen halide (Markownikoff's rule), hydrogen bromide (peroxide effect), sulphuric acid, water, hydroboration, ozonolysis, dihydroxylation with $KMnO_4$. 3.2 Dienes: Stability of alkenes and dienes (conjugated, isolated and cumulative dienes). General methods of preparation, mechanism of dehydrohalogenation of dienes. Reactions: Mechanism of 1,2- and 1,4-additions, Diels-Alder reactions.	12	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**Alkynes** 4.1 Nomenclature, types of alkynes, preparation by dehydrohalogenation and dehydrogenation. 4.2 Reactions: acidity of alkynes, formation of acetylides, addition of water, hydrogen halides and halogens, oxidation, ozonolysis and hydroboration/oxidation.	6	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Aromatic Hydrocarbons** 5.1 Nomenclature, Aromaticity, antiaromaticity and non-aromaticity. Benzene: extraction, industrial and laboratory preparations, purification. Properties: Electrophilic substitution reactions: nitration, sulphonation,	12	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	halogenation, Friedel Crafts alkylation and acylation with mechanisms. Orientation and reactivity of disubstitution reactions: nitration and halogenations. 5.2 Polynuclear aromatic hydrocarbons: Preparation and properties of naphthalene, anthracene and phenanthrene.			

Text Books

1. B. Y. Paula, Organic Chemistry, 7th edn., Pearson Education, Inc. (Singapore), New Delhi, reprint, 2014.
2. T. W. Graham Solomons, Organic Chemistry, Global edn., John Wiley and sons, 2017.
3. R. T. Morrison and R. N. Boyd, Organic Chemistry, 7th edn., Printice-Hall of India Limited, New Delhi, 2010.
4. Arun Bahl and B. S. Bahl, Organic Chemistry 22nd edn, S. Chand and sons, New Delhi, 2016.
5. V.K. Ahluwalia and Madhuri Goyal, A Text book of Organic Chemistry, Narosa Publishing House, New Delhi, 2001.
6. M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing company, New Delhi, 2017.

Suggested Readings

1. J. March and M. Smith, Advanced Organic Chemistry, 6th edn., John-Wiley and sons, 2007.
2. S. H. Pine, Organic Chemistry, 5th edn., McGraw Hill International Edition, Chemistry Series, New York, 1987.
3. S. N. Ege, Organic Chemistry, Structure and Reactivity, 3rd edn., A.I.T.B.S., New Delhi, 1998.
4. D. J. Cram,G. S. Hammond, Organic Chemistry, 3rd edn., McGraw-Hill, Kogakusha, Limited, 1970.
5. F. A. Carey, Organic Chemistry, 3rd edn., Tata-McGraw Hill Publications, New Delhi, 1999.
6. I.L. Finar, Organic Chemistry, Vol-1, 6th edn., Pearson Education Asia. 2004

Web Resources

1. https://bit.ly/3Gb99iy
2. https://www.organic-chemistry.org/
3. https://bit.ly/3GduvMi
4. https://bit.ly/30TXm8d

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To recall the method of naming organic compounds.	**K1, K2**
CO 2	To understand the chemistry of aliphatic and aromatic hydrocarbons with their preparation and properties.	**K3**
CO 3	To predict the reaction mechanism for the synthesis and reactions of alkanes, alkenes, alkynes and aromatic hydrocarbons.	**K4**
CO 4	To apply the theory of hydrocarbons for their analysis.	**K5**
CO 5	To design and synthesize new compounds by correlating the properties of hydrocarbons.	**K6**

Course Code	UCH 2502
Course Title	CHEMICAL BONDING AND MAIN GROUP ELEMENTS
Credits	04
Hours/Week	04
Category	Major Core (MC) - Theory
Semester	II
Regulation	2019

Course Overview

1. Chemical Bonding and Main Group Elements comprises bonding in ionic compounds and chemistry of *s*- and *p*-block elements.
2. The aim of the course is to give detailed information about the ionic bond, packing of atoms/molecules in solids, non-covalent interactions, and chemistry of main group elements.
3. The different modules of the course will examine the extent of ionic bonding in crystals, prediction of compounds as more ionic or covalent, atoms/molecules packing models and characteristics of s- and p-block elements and their compounds.
4. In this course, the vivid group analysis of boron, carbon and nitrogen will also be examined.
5. The other important aspects that will be discussed in the course include: lattice energy, covalency in ionic compounds, radius ratio, inclusion compounds, crown ethers and oxides and oxoacids of phosphorous.

Course Objectives

1. To understand and explain the concepts of ionic, covalent and non-covalent bonding interactions.
2. To predict the chemical reactions of s- and p-block elements and their compounds.
3. To discuss the different types of packing of atoms/molecules and their geometry.
4. To analyze the energy associated with the bonding interactions and their strength.
5. To explain the nature of bonding and chemistry of main group compounds.

Prerequisites	Basic knowledge of chemistry and the elements of periodic table.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Ionic Bond** 1.1. Introduction and properties of ionic compounds, factors influencing the formation of ionic compounds-ionization energy, electron affinity, and electronegativity. 1.2. Lattice energy (U_o): Born-Landé equation (derivation not required). Factors affecting lattice energy. Born-Haber cycle-enthalpy of formation (ΔH_f). Stability and solubility of ionic compounds. Hydration and lattice energy. Enthalpy of solvation and solution.	11	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	1.3. Covalency in ionic compounds: Fajan's rules; effects of polarization-solubility, melting point, and thermal stability of ionic compounds.			
II	**Structure of Solids** 2.1. Classification of solids: amorphous and crystalline. Elements of crystal symmetry, lattice points and crystal lattice. Unit cell, simple, primitive, body- (bcc) and face centered (fcc) cubic systems. 2.2. Seven crystal systems and 14-Bravais lattices. 2.3. Weiss and Miller indices-drawing various planes in a cubic lattice. 2.4. Structure of ionic solids: packing of ions in solids-hexagonal- and cubic closed packings, radius ratio, coordination number. Crystal structures-sodium chloride, zinc blende, wurtzite and cesium chloride, TiO_2 and CaF_2 (unit cell diagrams); identification of simple cubic, bcc, fcc lattices. 2.5. Crystal defects: Stoichiometric and non-stoichiometric, F-center.	11	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Non-Covalent Interactions** 3.1. Hydrogen bond: intra- and intermolecular; influence on the physical properties of molecules; comparison of bond strength and properties of hydrogen bonded nitrogen, oxygen, and fluorine compounds; structure of ice and water. Variation of boiling point of hydrides of group-15, 16 and 17. 3.2. van der Waals forces, ion dipole-dipole interactions, London forces. 3.3. Crystalline hydrates and clathrates-preparation, properties, structure and uses.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**Chemistry of s-block Elements** 4.1. Chemical properties of s-block metals: reaction with water, air, and nitrogen; uses of s-block metals and their compounds, anomalous behaviour of Li and Be. 4.2. Compounds of s-block metals: oxides, hydroxides, peroxides and superoxides-preparation and properties; Na_2CO_3, $NaHCO_3$. Extraction of beryllium. 4.3 Complexes of *s*-block metals: complexes with crown ethers, biological importance of sodium and potassium.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

V	**Chemistry of p-block Elements** 5.1. Boron group: extraction of boron; hydrides-classification of boranes and carboranes. Diborane- preparation, properties and structure elucidation, types of compounds-borates, and borax. Borazine-preparation and structure. 5.2. Carbon group: catenation and heterocatenation, carbides-salt-like carbides, interstitial carbides, covalent carbides. Silicates-classification, three dimensional silicates-properties and structures. 5.3. Nitrogen group: group discussion, hydrides of elements-hydrazine, hydroxylamine. Structure of oxides of nitrogen (NO, N_2O, NO_2, N_2O_4 and N_2O_5). Structure of oxyacids of nitrogen-HNO_2, HNO_3, $H_2N_2O_2$, HN_3. Nitrides-classification, preparation properties and uses. Preparation, properties, uses and structure of nitrosyl chloride and sodium nitroprusside. 5.4. Oxides and oxoacids of phosphorus: structure and oxidation state of phosphorous in phosphorous acids and phosphoric acids. Salts of phosphorus acids-distinction among ortho-, meta- and pyrophosphate. Permonophosphoric acid, Triphosphazenes.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. Principles of Inorganic Chemistry, B. R. Puri, L. R. Sharma and K. C. Kalia, Shoban Lal Nagin Chand and Co., New Delhi, 2018.
2. Advanced Inorganic Chemistry, Vol. I, Satyaprakash, G. D. Tuli, S. K. Basu, R. D. Madan, S. Chand & company, New Delhi, 2017, 5th edn.
3. Concise Inorganic Chemistry, J. D. Lee, Blackwell Science, London, 2010, 5th edn.
4. Inorganic Chemistry, C. Housecroft and A. G. Sharpe, Pearson, 2012, 4th edn.

Suggested Readings

1. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, P. L. Guas, John Wiley, 2002, 3rd edn.
2. Concepts and Models of Inorganic Chemistry, B. Douglas, D. McDaniel, J. Alexander, John Wiley, 1994, 3rd edn.
3. Inorganic Chemistry, J. E. Huheey, E. A. Kieter and R. L. Keiter, Harper Collins, New York, 2006, 4th edn.
4. Inorganic Chemistry, D. F. Shriver, P. W. Atkins, W. H. Freeman and Co, London, 2010.
5. Inorganic Chemistry: A Modern Introduction, T. Moeller, Wiley, New York, 1990.

Web Resources

1. https://bit.ly/3AyV3mZ
2. https://nptel.ac.in/courses/104/104/104104101/
3. https://nptel.ac.in/courses/104/103/104103019/
4. https://nptel.ac.in/courses/104/101/104101090/
5. https://nptel.ac.in/courses/104/105/104105103/

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand the basic concepts of lattice energy, crystal packing, impact of hydrogen bonding on the properties of molecules, chemical properties of *s*- and *p*-block elements.	**K1, K2**
CO 2	To illustrate the factors, influence the formation of ionic and non-covalently bonded compounds, preparation and properties of compounds of main group elements.	**K3**
CO 3	To analyze the covalency in ionic compounds, different types of crystal packing, van der Waals forces and structure of oxides of *s*- and *p*-block elements.	**K4**
CO 4	To determine the effect of polarization in ionic compounds, crystal systems, effect of hydrogen bonding on the physical properties, properties of *s*- and *p*-block elements.	**K5**
CO 5	To construct Born-Haber cycle, hcp and ccp closed packing and to synthesize the clathrates, crystalline hydrates and compounds of main group elements.	**K6**

Course Code	UCH 2503
Course Title	ORGANIC QUALITATIVE ANALYSIS
Credits	04
Hours/Week	04
Category	MAJOR CORE (MC) - Practical
Semester	II
Regulation	2019

Course Overview

1. This course deals with the practical knowledge of chemistry of organic functional groups.
2. This course provides the theory behind characteristic reactions of various organic functional groups.
3. The aim of this course is to give the knowledge of identification of organic functional groups by characteristic reactions and methods of preparation.
4. The other important aspect of this course is to check the purity of prepared compounds.
5. This course also discusses on the preparation of derivatives of all functional groups.

Course Objectives

1. To understand the chemistry of functionalized organic compounds.
2. To describe the physical and chemical properties of simple organic compounds.
3. To explain the procedure for the systematic analysis of oxygen and nitrogen based functional groups.
4. To analyze and articulate simple methods of preparation of functional group derivatives.
5. To determine the chemical nature and the purity of the prepared derivatives by simple testing.

Prerequisites	Knowledge on basic concepts of chemistry.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	1. Organic analysis of mono- and bifunctional compounds. a. Identification of acidic, basic, phenolic, and neutral organic substances. b. Detection of nitrogen, sulphur and halogens. c. Test for aliphatic and aromatic nature of substances d. Test for saturation and unsaturation. e. Identification of functional groups: (i) Carboxylic acids (ii) Phenols (iii) Aldehydes (iv) Ketones (v) Esters (vi) Carbohydrates (vii) Amines (viii) Amides (ix) Anilides (x) Nitro (xi) Halogen compounds. f. Preparation of derivatives for the functional groups.	40	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

II	Determination of melting and boiling points of organic compounds.	12	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. N.S. Gnanapragasam and G. Ramamurthy, Organic Chemistry -Lab manual, S. Viswanathan Co. Pvt., 2002.
2. Jeyavathana Samuel, Chemistry practical book, G.G. Printers, Chennai.

Suggested Readings

1. J.N. Gurthu and R. Kapoor, Advanced Experimental Chemistry S. Chand and Co., New Delhi1987.
2. S. Sundaram, P. Krishnan and P.S. Raghavan, Practical Chemistry S. Viswanathan Pvt. Ltd, Chennai, 1996.
3. B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, Vogel's Text Book of Practical Organic Chemistry Pearson Edition, 2005, 5th edn.

Web Resources

1. https://bit.ly/3vEytbP
2. https://bit.ly/3vet23a

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand the basic concepts of chemistry of various organic functional groups.	**K1, K2**
CO 2	To assess the physical and chemical properties of various functionalized organic compounds.	**K3**
CO 3	To explain the procedure for the systematic analysis of different functional groups by various methods.	**K4**
CO 4	To analyze the chemical nature of various functional groups as well as their methods of preparation.	**K5**
CO 5	To examine the purity of the derivatives prepared for various functional groups.	**K6**

Course Code	UCH 3501
Course Title	STEREOCHEMISTRY AND ORGANIC FUNCTIONAL GROUPS-I
Credits	04
Hours/Week	04
Category	Major Core (MC) - Theory
Semester	III
Regulation	2019

Course Overview

1. The importance of this course is to explain the basic concepts, requirements and types of various stereoisomerism.
2. This paper explains the nomenclature, classification and synthesis of some important organic compounds.
3. It also illustrates the mechanism, orientation, and stereochemistry of various types of organic reactions.
4. The aim of this subject is to provide the knowledge on physical and chemical properties of some important organic functional groups.
5. This course also covers the applications of different organic reagents.

Course Objectives

1. To identify the type of isomerism existing in organic molecules.
2. To predict the mechanism, stereochemistry and orientation of nucleophilic substitution and elimination reactions.
3. To apply various methods of synthesis of organic compounds.
4. To describe the physical and chemical properties and applications of some important class of organic compounds.
5. To demonstrate the mechanism and synthetic applications of some important name reactions.

Prerequisites	Basic knowledge of the concepts of organic chemistry

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Stereochemistry** 1.1 Nomenclature, Geometrical isomerism: *cis-trans*, *Z/E*, *syn-anti*, Conformational isomerism, conformations of ethane, butane, and cyclohexane. Optical isomerism, optical activity, prochirality, optical and specific rotations, conditions for optical activity, asymmetric centre, chirality, achiral molecules, meaning of (+) and (-) notations, elements of symmetry, racemization, methods of racemization (by substitution and tautomerism), methods of resolution (mechanical, seeding, biochemical and conversion to diastereomers),	12	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	asymmetric synthesis (partial and absolute synthesis), Walden inversion. 1.2 Projection Formula, Fischer, flying wedge, sawhorse and Newman projection formulae – notation of optical isomers. D & L notations, Cahn-Ingold-Prelog rules, R & S notations for optical isomers with one and two asymmetric carbon atoms, *erythro*- and *threo*-representations. 1.3 Optical activity in compounds not containing asymmetric carbon atoms namely biphenyls, allenes and spiranes (atropisomerism).			
II	**Aliphatic and Aromatic Halides** 2.1 Nomenclature and classification. Preparation of aliphatic and aromatic halides: Free radical mechanism, addition and Substitution reactions. 2.2 Reactions: Nucleophilic substitutions, S_N1, S_N2, S_NAr and S_Ni mechanisms and stereochemistry 2.3 Eliminations: E1 and E2 mechanisms, Saytzeff and Hoffmann rules, orientations and stereochemistry.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Hydroxy Derivatives** 3.1 Aliphatic alcohols: Preparation by hydroboration-oxidation, oxymercuration- demercuration, reduction of carbonyl compounds, epoxidation, Grignard synthesis and haloform reaction, reactions with reference to C-OH bond cleavage and O-H bond cleavage. 3.2 Aromatic alcohols: Phenols: Nomenclature, physical properties, hydrogen bonding. Preparation: Industrial source, preparation from diazonium salts. 3.3 Reactions: acidity, ether formation, ester formation, mechanism of ring substitution, nitration, sulphonation, halogenation, Friedel-Craft's reaction, nitrosation, coupling reactions, Kolbe's reaction and Riemer-Tiemann reaction.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**Ethers and Epoxides** 4.1 Nomenclature and classification,	9	CO 1 CO 2	K1, K2, K3, K4, K5, K6

	preparation of aliphatic, aromatic and cyclic ethers including crown ethers by Williamson's synthesis, alkoxymercuration-demercuration and bimolecular dehydration of alcohols. 4.2 Reactions: Cleavage by acids and oxidation to peroxides. 4.3 Preparation and reactions of epoxides. Ring opening reactions by acid and base catalysts and organometallic reagents.		CO 3 CO 4 CO 5	
V	**Nitro and Amine Compounds** 5.1 Nitro compounds: Nomenclature and classification, aliphatic and aromatic nitro compounds, physical and chemical properties. Preparation by nitration and oxidation of amines. Reactions: reduction by chemical and electrolytic methods. Di- and tri-substitution of aromatic nitro compounds: synthesis of o-, m-, p-dinitrobenzenes and trinitrobenzene. 5.2 Aromatic amines: Preparation of primary, secondary and tertiary amines: Gabriel phthalimide synthesis; separation of primary, secondary and tertiary amines: Hinsberg test. Reactions: basicity of amines, effect of substituents on basicity of aromatic amines. 5.3 Diazonium salts: Preparation, diazotisation reactions, replacement reactions: Sandmeyer, Gatterman and Gomberg reactions, coupling reactions.	11	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. R. T. Morrison, R.N. Boyd, S. K. Battachargee, 2014, Organic Chemistry, 7th Edition, Printice-Hall of India Limited, New Delhi.
2. P.S. Kalsi 2019, Stereochemistry of Carbon Compounds,10thEdition, New Age International, New Delhi
3. Bahl and Arun Bahl, 2016, Organic Chemistry, 22nd Edition, S. Chand and Sons, New Delhi
4. M.K. Jain and S.C. Sharma, 2017, Modern Organic Chemistry, Vishal Publishing Company, New Delhi.
5. T. W. Graham Solomons, 2015, Organic Chemistry, 11th Edition, John Wiley and Sons
6. B. Y. Paula, 2013, Organic Chemistry, 7th Edition, Pearson Education, Inc., New Delhi, reprint.

Suggested Readings

1. M. B. Smith, 2015, March's Advanced Organic Chemistry,7th Edition, John Wiley and sons.
2. E. L. Eliel,2001, Stereochemistry of Carbon Compounds, Tata-McGraw Hill Publications, New Delhi.

3. S. H. Pine, 2006, Organic Chemistry, 5th Edition, McGraw Hill, International Edition, Chemistry Series, New York.
4. F. A. Carey,2017, Organic Chemistry, 8th Edition, Tata-McGraw Hill, Publications, New Delhi.
5. I. L. Finar, 2004, Organic Chemistry – Volume 1, 6th Edition, Pearson Education Asia.

Web Resources

1. https://www.chemistryworld.com/organic-chemistry/211.subject
2. https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm
3. https://www.studyorgo.com/summary.php
4. https://bit.ly/3niyxKx

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To recall and understand the nomenclature and classifications of some important organic compounds.	**K1, K2**
CO 2	To predict the orientation, mechanism and applications of different types of organic reactions.	**K3**
CO 3	To explain the type of isomerism, synthesis, physical and chemical properties of oxygen, halogen and nitrogen based organic compounds.	**K4**
CO 4	To justify the stereochemistry and mechanism of different functionalized organic compounds.	**K5**
CO 5	To validate and apply the knowledge of stereochemistry and mechanistic approach for various organic reactions.	**K6**

Course Code	UCH 3502
Course Title	INORGANIC QUALITATIVE ANALYSIS
Credits	04
Hours/Week	04
Category	Major Core (MC) - Practical
Semester	III
Regulation	2019

Course Overview

1. The aim of the course is to give basic knowledge about the various chemical reactions of interfering and non-interfering anions, and cations present in a salt/salt mixture
2. The different modules of the course will examine the analytical skills in inorganic qualitative analysis.
3. Analysis of a salt by preliminary test often furnishes important information, which simplifies further course of analysis.
4. Qualitative analysis of inorganic salts includes the grouping of cations and separation of cations into different groups.
5. This course discusses on the preparation of coordination compounds and the various techniques used for crystallization.

Course Objectives

1. To identify the anions and cations present in a salt and in a mixture of salts.
2. To demonstrate the principles of solubility product, pH and common ion effect involved in the semimicro qualitative analysis.
3. To develop qualitative analytical skills.
4. To learn the effective usage of chemical reagents.
5. To acquire the knowledge in the preparation of coordination compounds.

Prerequisites	Basic knowledge of Chemistry

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Semimicro Qualitative Analysis** 1. Analysis of mixture containing interfering and noninterfering anions. **Simple anions**: carbonate, nitrate, sulphate, sulphide, sulphite, chloride and bromide. **Interfering anions**: borate, fluoride, oxalate and phosphate 2. Mixture of cations of simple radicals to familiarize with the inter group separation techniques. Cations: Group I : lead. Group II : copper, cadmium, bismuth, antimony, tin. Group III: aluminium, ferrous, ferric, chromium. Group IV: cobalt, nickel, manganese, zinc. Group V : barium, strontium, calcium Group VI: magnesium. Zero group: ammonium ion.	48	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
II	**Preparations of Coordination Complexes** 1. Preparation of tetraamminecopper(II) sulphate. 2. Preparation of potassium trisoxalatoaluminate(III). 3. Preparation of potassium trisoxalatochromate(III). 4. Preparation of hexamminecobalt(III) chloride	4	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Textbooks

1. Jeya Rajendran, Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis, United Global Publishers, Chennai, 2021.
2. Vogel's Inorganic Qualitative Analysis, 4th edn., ELBS, London, 1974.
3. Jeyavathana Samuel, Chemistry Practical Book, Lab Manual, Chennai, 2020.

Suggested Readings

1. V.V. Ramanujam, Inorganic Semi Micro Qualitative Analysis, 3rd Ed., The National Publishing Company, 3rd Edn., Chennai, 1974.
2. G. Svehla, Vogel's Qualiltative Chemical Analysis, Pearson, Delhi, 2009.
3. D.N. Pandey, D.N. Bajpai, S. Chand & Co Ltd, Practical Chemistry, S. Chand & Co Ltd, 2010

Web Resources

1. https://bit.ly/3vaGgxV

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive level
CO 1	To identify the anions and cations present in a mixture of salts.	**K1, K2**
CO 2	To apply the principles of semi micro qualitative analysis to categorize acid radicals and basic radicals.	**K3**
CO 3	To acquire the qualitative analytical skills by selecting suitable confirmatory tests and spot tests.	**K4**
CO 4	To choose the appropriate chemical reagents for the detection of anions and cations.	**K5**
CO 5	To synthesize coordination compounds with high purity.	**K6**

Course Code	UCH 3503
Course Title	THERMODYNAMICS
Credits	04
Hours/Week	04
Category	Major Core (MC) - Theory
Semester	III
Regulation	2019

Course Overview

1. Thermodynamics deals with the energy changes accompanied with all physical and chemical processes.
2. The aim of the course is to provide the fundamental knowledge about the flow of heat energy and spontaneity of the chemical reactions.
3. This course illustrates the behaviour of ideal and real gases and determine the thermodynamic parameters for different physical and chemical processes.
4. This course describes the applications of thermodynamics in construction of heat engines, refrigerator, etc., and deals with the effect of pressure, temperature and concentration on heat energy and equilibria.
5. It helps in evaluation of thermodynamic parameters using the concepts of classical and statistical thermodynamics

Course Objectives:

1. To understand the fundamental differences between real and ideal gases.
2. To outline the basic aspects of various processes and the laws of thermodynamics.
3. To assess the relationship among various thermodynamic parameters and to predict the feasibility of chemical reactions.
4. To analyze the effect of temperature and pressure on chemical equilibria.
5. To compute the energies, thermodynamic state and partition functions.

Prerequisites	Basic knowledge of Chemistry, Physics and Mathematics

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Gaseous State and First Law of Thermodynamics** 1.1 Behaviour of ideal gases: Kinetic theory of gases – postulates and derivation of the equation, $PV = 1/3\ mnc^2$ and derivation of the gas laws- Maxwell's distribution of molecular velocities-effect of temperature-types of molecular velocities-degrees of freedom-	12	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	Principle of equipartition of energy. 1.2 Behaviour of Real gases: Deviation from ideal behaviour, derivation of van der Waals equation of state and critical constants. 1.3 Terminology used in thermodynamics: Thermodynamic processes- Exact & inexact differentials, state & path functions, intensive and extensive properties. First law of thermodynamics: Statement and mathematical formulation.			
II	**Applications of First Law of Thermodynamics and Thermochemistry** 2.1 Applications of first law of thermodynamics to ideal gases: Heat capacity, relation between C_P and C_V. Isothermal process: Change in internal energy, enthalpy change, heat absorbed, $W_{(rev)}$ and $W_{(irrev)}$. Adiabatic process: Calculation of q, w, ΔE and ΔH. 2.2 Applications of first law of thermodynamics to real (van der Waals) gases: Isothermal process- Work done, change in internal energy, heat absorbed. Adiabatic process: Work done - Joule - Thomson effect. Joule-Thomson coefficient and its significance, inversion temperature. 2.3 Thermochemistry: Measurements of thermal changes, heat of a reaction. Calculation of change in internal energy from the enthalpy change. Standard states and standard heat of formation. Variation of enthalpy change of reaction with temperature (Kirchoff's equation). 2.4 Integral and differential heat of solution and dilution, heat of neutralization, heat of hydration, heat of transition, heat of combustion. Bond energy and its applications. Hess's law – Illustration and applications.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Second Law of Thermodynamics** 3.1 Limitations of first law and need for the second law. Statements of second law. Carnot cycle-Efficiency. Thermodynamic principle of working of a refrigerator. 3.2 Concept of entropy-Helmholtz work function-Gibbs free energy-Criteria of spontaneity. Evaluation of ΔG and ΔS for the mixing, Maxwell's equations and	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	thermodynamic equation of state. Gibbs-Helmholtz equation and its applications.			
IV	**Thermodynamics of Reversible Processes** 4.1 Law of mass action: Various forms of equilibrium constants. Relationship between Kp and Kc, significance of equilibrium constants. van't Hoff isotherm. Derivation of thermodynamic equilibrium constant and its relationship with change in standard free energy. van't Hoff isochore. 4.2 Le-Chatelier-Braun principle: Formation of ammonia. Application of law of mass action and Le-Chatelier-Braun principle to homogeneous gaseous reactions: Dissociation of N_2O_4, NH_3, HI and PCl_5.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Third Law of Thermodynamics and Statistical Thermodynamics** 5.1 Nernst heat theorem- Planck and Lewis Randall formulation of third law. 5.2 Absolute entropy of solids, liquids and gases. Evaluations of the standard entropy of oxygen, on the basis of heat capacity. Exceptions to third law of thermodynamics. 5.3 Difference between classical thermodynamics and statistical thermodynamics. Thermodynamic probability – macro and microstates, most probable distribution. Stirling's approximation. Maxwell–Boltzmann statistics (No Derivation)- Assumptions. Partition function –separation and relation between partition function and energy.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. Puri, B. R., Sharma, L.R. Pathania, M.S. 2013, Principles of Physical Chemistry, 35th edition, Shoban Lal Nagin Chand and Co., Delhi.
2. Bahl, B. S. Arun, Bahl, Tuli, G.D. 2009, Essentials of Physical Chemistry, S Chand & Company Pvt Ltd, Multicolour edition.
3. Maron, S.H. Lando, J.B. 1974, Fundamentals of Physical Chemistry, New Edition, Macmillan limited, NY.
4. Atkins, P.W. 2001, Physical Chemistry, 7th edition, Oxford university press
5. Dogra, S.K. Dogra, S.1996, Physical Chemistry Through Problems, 4th edition, New age international.
6. Sangaranarayanan MV, Mahadevan V, 2011, Textbook of Physical Chemistry, University press, Hyderabad, India.

Suggested Readings

1. Kalidas, C, Sangaranarayanan, M. V. 2019, Problems and Solutions: Physical Chemistry, 1st edition, Universities Press
2. Rajaram, G. Kuriacose, J.C. 2006, Thermodynamics, new edition, Shoban Lal Nagin Chand and Co.
3. Castellan, G. W. 1985, Physical Chemistry, 3rd edition, Narosa Publishing House
4. Klotz, M. Rosenberg, R.M. 1994, Chemical Thermodynamics, 5th revised edition, John Wiley and sons Inc.
5. Gupta, M. C. 1991, Statistical Thermodynamics, 1st edition, Halsted Press.

Web Resources

1. https://bit.ly/3ax89GS
2. https://bit.ly/3pry1N6
3. https://bit.ly/3BGE6Z9
4. https://bit.ly/3lCzUUP

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To describe the behaviour of ideal and real gases, characteristics of equilibrium constant and state the principle and fundamental aspects of classical and statistical thermodynamics.	**K1, K2**
CO 2	To demonstrate the basic aspects of various physical and chemical processes and predict the value of thermodynamic state functions using laws of thermodynamics.	**K3**
CO 3	To analyze the principle of thermodynamics in the calculation of thermal energies, state functions, construction of heat engines, refrigerator, prediction of absolute entropies and equilibrium.	**K4**
CO 4	To evaluate thermodynamic parameters, the effect of temperature, pressure and concentration in different equilibria.	**K5**
CO 5	To derive the expressions for the evaluation of thermodynamic quantities classically and statistically.	**K6**

Course Code	UCH 4501
Course Title	ELECTROCHEMISTRY
Credits	03
Hours/Week	03
Category	Major Core (MC) - Theory
Semester	IV
Regulation	2019

Course Overview

1. Electrochemistry deals with the inter-conversion of chemical and electrical energies in electrolytic and electrochemical cells.
2. One of the aims of the course is to give knowledge on the components of an electrochemical cell, types of electrodes and the importance of electrochemical series.
3. This course involves the calculation of thermodynamic parameters such as ΔG, ΔH, ΔS, K_{equi}, etc. using Nernst equation.
4. The other aspects of electrochemistry to be covered include: types of cells, theories of electrolytic dissociation, behaviour of electrolytes in solutions, conductance of ionic species.
5. This course also deals with the applications of electro chemistry such as corrosion, over voltage and polarography.

Course Objectives:

1. To apply Nernst equation to different electrochemical systems and calculate the thermodynamic parameters using EMF measurements.
2. To classify electrochemical and concentration cells with and without transference.
3. To apply the laws of electrochemistry to electrolytes.
4. To evaluate conductance and transport number of ionic species of an electrolyte.
5. To differentiate between polarization and overvoltage, outline the principle of polarography.

Prerequisites	Basic knowledge of Chemistry, Physics and Mathematics

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**EQUILIBRIUM ELECTROCHEMISTRY** 1.1 Electrode potential – measurement, electrode types - reference electrodes-standard hydrogen electrode and calomel electrode, graphite, Metal-Metal ion, gas, Metal-insoluble salt and redox electrodes. 1.2 Cell potential –Weston cell, measurement using potentiometer. Calculation of cell potential from single electrode potentials. Electrochemical series and its applications.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

II	**THERMODYNAMICS OF ELECTROCHEMICAL SYSTEMS** 2.1 Thermodynamics of electrochemical reactions –Nernst equation and its applications – relationship between EMF and free energy, enthalpy, entropy changes and equilibrium constant. Chemical and concentration cells with and without transference. Liquid junction potential. 2.2 Potentiometric titrations –principle, types – redox and precipitation titrations. Applications of EMF - potentiometric measurement of pH using hydrogen, quinhydrone and glass electrodes. Solubility product of sparingly soluble salt.	7	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**NON-EQUILIBRIUM ELECTROCHEMISTRY** 3.1 Equivalent and molar conductance and variation with concentration. Kohlrausch's law and its applications. Applications of conductance measurements – determination of degree of dissociation and conductometric acid-base (strong acid-strong base, weak acid-strong base and mixture of acids - strong base) and precipitation titration. 3.2 Transport number: Absolute velocity of ions and ionic mobilities. Hittorf's rule, Determination of transference numbers – Hittorf's and moving boundary method.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**IONICS** 4.1 Ostwald's dilution law. Arrhenius theory of electrolytic dissociation – evidences and limitations – van't Hoff factor. 4.2 Activities and activity coefficients of electrolytes – ionic strength - Debye-Huckel theory of activity coefficients and Debye-Huckel-Onsager equation (no derivation required)– electrophoretic effect and asymmetric effect.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**POLARISATION AND OVERVOLTAGE** 5.1 Polarization of electrodes –concentration polarization. Polarography –Principle, dropping mercury electrode, Ilkovic equation, significance of half-wave potential and diffusion current. 5.2 Overvoltage – Decomposition potential, Hydrogen overvoltage. Electrochemical	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	theory of corrosion.			

Text Books

1. Puri, B. R., Sharma, L.R. Pathania, M.S. 2017, Principles of Physical Chemistry, 47th edition, Shoban Lal Nagin Chand and Co., Delhi.
2. Glasstone.S. 2008, An Introduction to electrochemistry, 6th edition, East-West Press Pvt. Ltd., New Delhi.
3. Dogra, S.K. Dogra, S.1996, Physical Chemistry through Problems, 4th edition, New age international.
4. Atkins. P and Paula J.D. 2014, Physical Chemistry, 10th edition, Oxford University press.
5. Sangaranarayanan MV, Mahadevan V, 2011, Textbook of Physical Chemistry, University press, Hyderabad, India.
6. Kapoor K L, A, 2020, Textbook of Physical Chemistry - Quantum Chemistry and Molecular Spectroscopy, McGraw-Hill; Sixth edition, Delhi.

Suggested Readings

1. Gurtu. J.N. and Gurtu.A, 2006, Advanced Physical Chemistry, 8th edition, Pragati Prakashan.
2. Vladimir S. Bagotsky. 2005, Fundamentals of electrochemistry, 2nd edition, Wiley.
3. John O'M. Bockris Amulya K.N. Reddy Maria E. Gamboa-Aldeco. 2008, Modern Electrochemistry (Vol-1 and 2), 2nd Edition, Springer, Plenum Press, New York, US.

Web Resources

1. https://bit.ly/3FHfySh
2. https://bit.ly/2YN7RJu
3. https://study.com/academy/topic/electrochemistry.html
4. https://calango.org/modules/539/electrochemistry

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To describe electrode potential, types of electrodes, electrolytes, electrochemical cells, polarization, over voltage and discuss the theories of electrolytes.	**K1, K2**
CO 2	To apply Nernst equation to calculate cell potential and illustrate the principles of corrosion, conductometric and potentiometric titrations.	**K3**
CO 3	To outline the concepts of polarization, overvoltage, polarography and deduce ΔG, ΔH, ΔS, etc using EMF.	**K4**
CO 4	To measure the electrochemical parameters such as potential, conductance, pH, EMF, ionic strength, mobility, transport number of ionic species, etc.	**K5**
CO 5	To develop problem solving skills and derive expressions for transference number of ions, activity coefficient, electrochemical and concentration cells with and without transference.	**K6**

Course Code	UCH 4502
Course Title	PHYSICAL CHEMISTRY PRACTICALS
Credits	03
Hours/Week	03
Category	Major Core (MC) - Lab
Semester	IV
Regulation	2019

Course Overview

1. This practical paper makes use of the concepts of thermodynamics, equilibria, kinetics and electrochemistry.
2. This course helps the students to get trained in safe handling of chemicals, apparatus and instruments.
3. The laboratory ambience gained through this course can cultivate the required skill for a position in an industry/company/factory/research laboratory.
4. The paper aims at improving analytical skills and it is reflected in terms of the agreement between graphical and experimental data.
5. The course shapes the students' frame of mind towards the scientific interpretation of data and helps to improve their efficiency for societal developments.

Course Objectives:

1. To apply the concepts of phase rule for the construction of phase diagrams of simple eutectic systems.
2. To utilize potentiometric and conductometric methods for quantitative estimations.
3. To evaluate the rate constant of pseudo first order and second order reactions.
4. To determine the critical solution temperature (CST) and study the effect of impurities in the phenol-water system.
5. To scientifically verify the agreement between experimental and graphical data.

Prerequisites	Basic knowledge of Chemistry, Physics and Mathematics

SYLLABUS

EXPT	CONTENT	HOURS	COs	COGNITIVE LEVEL
1	1. Determination of partition coefficient of iodine between water and carbon tetrachloride 2. Determination of equilibrium constant for the formation of potassium triiodide from iodine and KI. 3. Construction of phase diagram of a simple eutec system and determination of unknown composition. 4. Determination of critical solution temperature of phenol-water system. 5. Effect of impurities on critical solution temperature of phenol-water system.	39	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	6. Determination of molecular weight of a non-volatile solute by Rast's method. 7. Determination of transition temperature of salt hydrates by Rast's method. 8. Kinetics of acid catalyzed hydrolysis of an ester. 9. Kinetics of persulphate-iodide reaction. 10. Verification of Freundlich adsorption isotherm –Study of adsorption of acetic acid or oxalic acid on charcoal and determination of concentration of the given acid. 11. Determination of strength of a strong acid by conductometric titration (HCl *vs* NaOH). 12. Determination of strength of a weak acid by conductometric titration (CH_3COOH *vs* NaOH). 13. Determination of limiting molar conductance of a strong electrolyte (KCl) by conductometry. 14. Determination of strength of a strong acid by potentiometric titration (HCl *vs* NaOH). 15. Determination of strength of a weak acid by potentiometric titration (CH_3COOH *vs* NaOH). 16. Determination of solubility product of a sparingly soluble substance by potentiometric titration. 17. Determination of the strength of Fe(II) by potentiometric redox titration.			

Text Books

1. R. Veeraswamy, V. Venkateswaran and A. R. Kulandaivelu 2015, Basic principles of practical Chemistry, 2nd edition, Sultan Chand & Sons.
2. Jeyavathana Samuel 2000, Chemistry Practical Book, 1st edition, Kalos Offset Division, Chennai.
3. Dr. R. Rajalakshmi 2020, Physical Chemistry Experiments for Undergraduate Students, 1st edition, Notion Press India.
4. Dr. Ashok Kumar Acharya 2018, Experiments in Physical Chemistry, 1st edition, AkiNik Publications.
5. Gurtu J.N., Amit Gurtu 2011, Adv. Physical Chemistry Experiments,1st edition, Pragati Prakashan

Suggested Readings

1. Kapoor K L.2019,A Textbook of Physical Chemistry –Experimental aspects in physical chemistry Volume-7, 1st edition, McGraw-Hill India.
2. Khosla, B. D.; Garg, V. C. & Gulati, A.2018, Senior Practical Physical Chemistry,18th edition, R. Chand & Co.: New Delhi.
3. B.Viswanathan; P.S. Raghavan 2005, Practical Physical Chemistry, 2nd edition, Viva books.
4. Athawale, V. D. & Mathur, P. 2001, Experimental Physical Chemistry, 1st edition, New Age International: New Delhi.
5. David P. Shoemaker, Carl W. Garland, Joseph W.Nibler, 1989, Experiments in Physical Chemistry, 5th edition, McGraw-Hill Book Company.

Web Resources

1. https://nptel.ac.in/content/storage2/courses/122101001/downloads/lec-24.pdf
2. https://bit.ly/3AKVuuL

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To recall the principles of various physical chemistry experiments.	**K1, K2**
CO 2	To systematically perform the procedure relating to electrical and non-electrical experiments.	**K3**
CO 3	To scientifically observe and record the readings in all the experiments.	**K4**
CO 4	To calculate and process the measured values obtained from the experiments.	**K5**
CO 5	To consolidate, summarize and present the results of all the experiments.	**K6**

Course Code	UCH 4601
Course Title	CHEMISTRY OF FOOD AND CONSUMER PRODUCTS
Credits	04
Hours/Week	06
Category	Major Elective (ME) – Theory
Semester	IV
Regulation	2019

Course overview

1. The importance of this course is to explain the basic concepts of chemistry of food materials.
2. It also elaborates the basic functions of food constituents.
3. This paper explores the various analytical techniques to quantify the standard of food materials.
4. The course covers the hygiene and usage of food additives.
5. The course also describes the various components of manufacture of consumer products.

Course objectives

1. To illustrate the basic concepts of carbohydrates, proteins and enzymes in food materials.
2. To elaborate the functions of food constituents like vitamins and minerals.
3. To estimate the standard of various food materials.
4. To justify the usage of additives in modern food components.
5. To compile the various components in the manufacture of soaps, detergents, and cosmetics.

Prerequisites	Basics of Food Chemistry and Industrial Chemistry

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Introduction and Constituents of Foods-I** 1.1 Food: source, functions of food–basic five food groups 1.2 Carbohydrates: Classification and structure of monosaccharides, glucose, fructose structure of sucrose, maltose, lactose and starch. Functions Artificial sweetening agents. Effect of cooking on the nutritive value of rice and of baking of wheat– bread and biscuit, processing and storage of carbohydrates. 1.3 Proteins: amino acids– peptides– proteins, modification of food products through heat processing. Effect of cooking–steaming or cooking under pressure of legumes. Detoxication. 1.4 Enzymes: Enzymes used in food processing. Enzymic browning–mode of action, secondary reaction of o-quinones, prevention of enzymic browning– thermal inactivation, Non-enzymic browning-	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	Maillard reaction, prevention of non-enzymic browning.			
II	**Introduction and Constituents of Foods-II** 2.1 Lipids: Nomenclature and classification. Emulsions and emulsifiers, rancidity of fats – chemistry of fat and oil processing – function and storage of fats. Heat treatment on the nutritive value of oil seeds, nuts and oil-seed meals. Role of MUFA and PUFA in preventing heart diseases. Characterisation of oil: iodine number, RM value, acid number and saponification values–(Only terms) 2.2 Minerals and vitamins: Sources, functions, bioavailability and deficiency of the following minerals (calcium, iron, iodine, fluorine, sodium and potassium (elementary treatment). Vitamins-classification, sources, functions and deficiencies of fat- soluble vitamins–A, D, E and K, water-soluble vitamins–C, thiamin, niacine, riboflavin, B-complex, -B6, Folic acid and B12. Fortification with vitamins and minerals. Effect of cooking on vitamins and minerals–different methods of cooking of vegetables, fruits–dehydrated fruits, canned fruit, canned fruit juices.	15	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Food Additives, Modern Foods and Nutrition** 3.1 Food additives: Artificial sweeteners–saccharin, cyclamate, aspartame–food flavours – esters, aldehydes and heterocyclic compounds. Antioxidants. Food colours – changes in cooking. Restricted use. Spurious colours. Preservatives – leavening agents. Baking powder–Yeast. Taste enhancers– MSG-vinegar. 3.2 Modern food: Mushroom cultivation and types, spirulina composition. Candy manufacturing. Caramellisation. Fast foods. Instant foods. Dehydrated foods. Oleoresin of spices. Condiments. Milk Products, Heat Processing of Milk, Pasteurization, Cheese, Butter, Ghee and Kova. 3.3 Beverages: Carbonation. Composition of soft drinks. Excessive use leading	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	tourinary bladder stones. Preservation of tetrapak. Nitrogen preservation and packing of fruit juices. Coconut water. 3.4 Nutrition – calorific value of food stuff– RQ of food (Respiratory quotient of food) – basal metabolic rate – factors influencing BMR, specific dynamic action (SDA) of food. 3.5 Thermogenic effect–energy requirements of individuals–diet and its components– the protein requirements – biological value of proteins, supplementary value of proteins. Diseases associated with protein malnutrition. Nutritional value of carbohydrates. – Fibers in the diet, dietary sugars– nutritional aspects of lipids			
IV	**Food Adulteration and Hygiene** 4.1 Adulterants: Common adulterants in different foods–milk and milk products, vegetable oils, and fats, spices and condiments, cereals, pulses, sweetening agents and beverages. Contamination with toxic chemicals– pesticides and insecticides. Principles involved in the analysis of detection and prevention of food adulteration. 4.2 Microbial growth: growth curve of bacteria. Effect of environmental factors on growth of microorganisms. pH, water activity, oxygen availability temperature–beneficial effect of microorganisms. Food borne illness– bacteria, virus, moulds and parasites. (Any two illness each)- Enzyme production from microorganisms. Application of enzymes in food processing. 4.3 Factors affecting Food deterioration: methods of preservation and processing. Quality control: Specifications and standards: PFA, FPO, FDA, drug license, WHO standards, BIS specifications, packing and label requirements, essential commodities act, consumer protection act. AGMARK. FSSAI	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Soaps, Detergents and Cosmetics** 5.1 Saponification of oils and fats. Manufacture of soaps. Formulation of toilet soaps. Different ingredients used. Their	21	CO 1 CO 2 CO 3 CO 4	K1, K2, K3, K4, K5, K6

	functions. Medicated soaps. Herbal soaps. Mechanism of action of soap. Soft soaps. Shaving soaps and creams. BIS specifications. (Introductory note). 5.2 Anionic detergents: Manufacture of LAB (linear alkyl benzene). Sulphonation of LAB– preparation of acid slurry. Different ingredients in the formulation of detergent powders and soaps. Liquid detergents. Foam boosters. AOS (alpha olefin sulphonates). Cationic detergents: examples. Manufacture and applications. Non-ionic detergents: examples. Manufacture of ethylene oxide condensates. 5.3 Mechanism of action of detergents. Comparison of soaps and detergents. Biodegradation–environmental effects. ISI specifications/limits. 5.4 Shampoos- Role of SLS and SLES. Ingredients. Functions. Different kinds of shampoos– anti-dandruff, anti-lice, herbal, anti hair fall and baby shampoos. 5.5 Hair dye. Manufacture of conditioners. Coco betaines or cocodi-ethanolamides 5.6 Skin lightening materials: face and skin powders. Ingredients, functions. Different types. Snows and face creams. Chemical ingredients used. Antiperspirants. Sun screen preparations. UV absorbers. Skin bleaching agents. Depilatories. Turmeric and Neem preparations. Vitamin oil. 5.7 Nail polishes: nail polish preparation, nail polish removers. Cuticle removers. Lipsticks, rouge, eyebrow pencils. Ingredients and functions –hazards.		CO 5	

Text Books

1. S. Gobala Rao, 1998, Outlines of chemical technology, 2nd Edition, Affiliated East West press.
2. Kafaro1995, Wasteless chemical processing, Latest, Edition, Mir Publishers.
3. W. Sawyer, 2000, Experimental cosmetics, 1st Edition, Dover publishers, New York
4. Perry Romanowski and Randy Schueller, 2009, Beginning Cosmetic Chemistry, 3rd Edition, Allured Books Media, USA
5. M. Swaminathan, 1993, Advanced Text Book on Food and Nutrition, Vol. I & II, 2nd Edition, Printing and Publishing Co., Ltd., Bangalore
6. N. Norman Potter, 1994, Food Science, 5th Edition, CBS publishers and distributors, New Delhi.

7. L.H. Meyer, 1994, Food Chemistry, Latest Edition, CBS publishers and distributors, New Delhi.
8. H.K. Chopra and P.S. Panesar, 2010, Food Chemistry, Latest Edition, Narosa Publishing House.
9. M. Vimaladevi, 2019, Text Book of Cosmetics, New Edition, CBS publishers and distributors, New Delhi.

Suggested Readings

1. K. Bagavathi Sundari, 2006, Applied chemistry,1st Edition, MJP Publishers.
2. V.K. Ahluwalia, 2010, Organic chemistry, Narosa Publications house.
3. Owen R Fennema,1996, Food Chemistry,1st Edition, Marcel Decker Inc, New York.
4. B. Srilakshmi,2003, Food Science, 3rd Edition, New age International Pvt. Ltd.
5. B. SivaSankar, 2002, Food Processing and Preservation,1st Edition, Prentice–Hall of India Pvt. Ltd. New Delhi.
6. S. Ramakrishnan, K.G. Prasannam and R. Rajan, 2001, Textbook of Medical Biochemistry, 2nd Edition, Orient Longman Ltd.
7. N. Shakuntala Manay and M. Shadaksharaswamy, 2002, FOODS: Facts and Principles, 2nd Edition, New age International Pvt. Ltd.

Web Resources

1. https://www.sciencedirect.com/topics/engineering/cosmetic-product
2. https://bis.gov.in/index.php/product-certification/product-specific-guideline/

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	Describe the basic concepts of food components, food additives, food adulterants and consumer products.	**K1, K2**
CO 2	Predict and apply the chemistry of food and consumer products.	**K3**
CO 3	Analyse and outline the advantages of different food processing methods and functions of cosmetic products.	**K4**
CO 4	Recommend the analytical techniques to quantify food constituents and to detect adulterants.	**K5**
CO 5	Summarize and validate the effect of various chemical constituents in food and consumer products.	**K6**

Course Code	UCH 4602
Course Title	CHEMISTRY OF MATERIALS
Credits	04
Hours/Week	06
Category	Major Elective (ME) - Theory
Semester	IV
Regulation	2019

Course Overview

1. Chemistry of Materials is an interdisciplinary subject, spanning the physics and chemistry of matter, engineering applications and industrial manufacturing processes.
2. This Course spans the subject from its foundations in physics and chemistry to the mechanical, electrical, magnetic and optical properties of materials, and the design, manufacture and applications of metals, alloys, ceramics, polymers and composites.
3. In this course, the students will study the relationships between the structure and properties of a material and how it is made.
4. This course also helps the students develop new materials and devise processes for manufacturing them.
5. Chemistry of Materials is vital for developments in the field of nanotechnology, sensors and polymer materials.

Course Objectives

1. To understand the properties and applications of nanomaterials.
2. To provide students a fundamental understanding of electrical, magnetic and superconducting properties of materials.
3. To acquire knowledge about sensors, requirements, volatile Organic Compounds and biosensors.
4. To describe the techniques and processes involved in polymerization.
5. To explain the importance of industrial polymers and processing techniques.

Prerequisites	Basic knowledge of materials and their properties

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Nanomaterials** 1.1 Introduction and types of materials. Nanomaterials: bottom-up and top-down approaches with examples. Physical methods-inert gas condensation and arc discharge. Chemical methods-sol-gel, solvothermal and hydrothermal methods and chemical vapour deposition. Biological methods-role of bacteria and fungi in nanomaterials synthesis.	18	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	1.2 Carbon nanotubes (CNTs)-synthesis and purification; single and multiwalled-advantages and disadvantages, filling of nanotubes, mechanism of growth, electron structure. Properties of CNTs-physical, transport, and mechanical; applications. Nanoparticles-types; pure metals- gold and silver. Metal Oxides-silica and alumina; synthesis and properties. 1.3 Characterization of nanostructures-SEM and TEM (principle and instrumentation only).			
II	**Electrical, Magnetic and Superconducting materials** 2.1 Conductors: variation of conductivity with temperature. Semiconductors-p- and n-type, p-n junction; applications in transistors, rectifiers and photo-splitting of water. Photovoltaic and photogalvanic cells. 2.2 Magnets: classification-diamagnetic, paramagnetic, antiferromagnetic, ferro- and ferrimagnetic, magnetic susceptibility. Variation with temperature-Curie-Weiss law, Curie- and Neel temperatures. Permanent and temporary magnets, Domain theory. 2.3 Superconductors: definition, Meissner effect, Bardeen-Cooper and Schrieffer theory and Cooper pairs; examples of superconducting oxides; applications of superconducting materials	14	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Sensors** 3.1 Sensors: definition, types-optical, mass- and heat sensitive, temperature, electromagnetic, mechanical and electrochemical sensors. 3.2 Humidity sensors-relative humidity, requirements, miniaturization-capacitive, resistive, hygrometric, gravimetric and optical. Metal oxides-single and doped and polymers. Sensing mechanism. 3.3 Volatile Organic Compounds (VOC) sensors: sources, health effects, need for detection of VOCs, Metal oxides-single and doped and polymers. Sensing mechanism.	14	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	3.4 Biosensors: definition, principle of detection, types-optical and electrochemical. Applications- cancer, point of care testing.			
IV	**Polymers** 4.1 Introduction-monomers, oligomers, polymers and their characteristics. Plastics, elastomers, fibres, homo- and co-polymers. Bonding: primary and secondary bond forces; cohesive energy. Determination of molecular mass: number average molecular mass (M_n) and weight average molecular mass (M_w). Dendrimers – introduction and applications. 4.2 Polymerization: mechanism and techniques; chain-growth-cationic, anionic, free radical, Stereo regular polymers; Ziegler-Natta polymerization, Step-growth, bulk, solution, emulsion, suspension, interfacial and gas-phase. Kinetics of polymerization, polymer degradation and types.	18	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Industrial Polymers and Processing Techniques** 5.1 Thermoplastics (synthesis and applications only): polyethylene, polypropylene, polyacrylonitrile, polyvinyl chloride, polytetrafluoroethylene, nylon and polyester. Thermosetting Plastics (synthesis and applications only): phenol-formaldehyde and epoxide resins. Elastomers (synthesis and applications only): natural and synthetic rubbers- Buna-N, Buna-S and neoprene. Conducting Polymers: polyphenylene, polypyrrole and polyacetylene. 5.2 Processing Techniques: calendaring, die-casting; compression, injection, blow mouldings; reinforcing; vulcanisation. 5.3 Impact of polymers on human health and ecosystems, Biodegradable polymers: synthesis, recycling and downcycling processes.	14	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. P. K. Palanisamy, Materials Science, Scitech Publications, 2002, 1st Edition.
2. T. Balachandran, Materials Science, Charulatha Publications, 2003, 1st Edition.
3. Charles P. Poole, Jr., Frank J. Owens, Introduction to nanotechnology, Wiley-India, 2003, 1st Edition.

4. T. Pradeep, A Text book of nanoscience and nanotechnology, Tata-McGraw Hill Publications, New Delhi, 2012, 1st Edition.
5. Anthony and Andrady, Plastics and environmental sustainability, Wiley, 2015, 1st Edition.
6. G.S. Misra, Introductory Polymer Chemistry, New Age International (Pvt) Limited, 1996, 1st Edition.
7. V. R. Gowarikar, N. R. Viswanathan, Jayadev Sreedhar, Polymer Science, New Age International, 2019, 3rd Edition.
8. M. S. Bhatnagar, A Textbook of Polymer Science, S.Chand, 2012, 1st Edition.

Suggested Readings

1. D. F. Shriver, P.W. Atkins, Inorganic chemistry, Oxford University Press, 2004, 3rd Edition.
2. H. P. Meyers, Introductory Solid State Physics, Viva Books Private Limited, 1998, 1st Edition.
3. A.R. West, Solid State Chemistry and its applications, John-Wiley and sons, 1987, 1st Edition.
4. J. George Odian, Principles of Polymerization, Wiley & sons, 2004, 4th Edition.
5. J. Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, Springer Science & Business Media, 2010, 1st Edition.
6. Sulabha K. Kulkarni, Nanotechnology - Principles and Practices, Capital Publishing Company, New Delhi, 2007, 1st Edition.
7. F. W. Billmeyer Jr. Textbook of Polymer Science, John-Wiley and sons, 1984, 3rd Edition.

Web Resources

1. https://ec.europa.eu/health/scientific_committees/opinions_layman/nanomaterials/en/index.htm
2. https://www.elprocus.com/what-is-superconductor-types-materials-properties/
3. https://www.electronicshub.org/different-types-sensors/
4. https://www.hardiepolymers.com/knowledge/polymer-manufacturing-processes/

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Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand and recall the characteristics of nanomaterials, magnets, sensors and polymers.	**K1, K2**
CO 2	To integrate and assess how the structure of materials are affected by their properties.	**K3**
CO 3	To analyze and identify new materials for various applications.	**K4**
CO 4	To explain the importance of nanomaterials, magnets, sensors, polymers, their uses, structures and synthesis	**K5**
CO 5	To design and develop new materials with improved property for specialized applications	**K6**

Course Code	UCH 5501
Course Title	ORGANIC FUNCTIONAL GROUPS-II
Credits	05
Hours/Week	05
Category	Major Core (MC) - Theory
Semester	V
Regulation	2019

Course Overview

1. Organic functional groups-II deals with the chemistry of selected organo-oxygen compounds such as carbonyl, carboxylic acid and their derivatives.
2. This course provides the basic concepts involved in organometallics, active methylene compounds, aldehydes, ketones, carboxylic acids and its derivatives.
3. The aim of this course is to give the knowledge of synthetically important organic compounds including organometallics.
4. The other important aspect is to give the knowledge of types of organic reactions as well rearrangement reactions with applications.
5. Nomenclature of organic compounds and reaction mechanisms of various interconversions will be discussed.

Course Objectives

1. To understand the nomenclature and basic concepts of functionalized organic compounds.
2. To explain the different methods of preparation and properties of aldehydes, ketones, carboxylic acids and their derivatives.
3. To discuss the mechanism of molecular rearrangement reactions and the applications of active methylene compounds.
4. To analyze and appraise the reaction mechanisms involved in preparation and properties of organometallic compounds.
5. To facilitate new methods of constructing various organo-oxygen compounds through suitable reaction mechanisms.

Prerequisites	Knowledge of nomenclature and basic concepts of organic chemistry.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Aldehydes and Ketones** 1.1 Nomenclature and classification; Preparation and reactions of carbonyl compounds: reactivity of carbonyl groups, acidity of alpha hydrogen; mechanism of aldol, Perkin, Knoevenagel reactions, benzoin and Claisen condensation; Wittig, Cannizarro and Reformatsky reaction; Michael addition and haloform reactions. 1.2 Mechanisms of reduction with $NaBH_4$, $LiAlH_4$, Wolf-Kishner and MPV reduction.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	1.3 Photochemical reactions of carbonyl compounds: Norrish type I and II reactions.			
II	**Carboxylic Acids and its Derivatives** 2.1 Nomenclature and classification of aliphatic and aromatic carboxylic acids. Acidity – effect of substituents, salt formation; preparation of acetic acid, halogenated acids, cyano acids, lactic and pyruvic acids. 2.2 Preparation of dicarboxylic acids: oxalic, malonic, succinic, glutaric, adipic, pimelic and phthalic acids; unsaturated carboxylic acids: acrylic, crotonic and cinnamic acid; reactions: action of heat and stereospecific addition to maleic and fumaric acids. 2.3 Preparation and reactions of acid chlorides, acid anhydrides, amides and esters; acid and alkaline hydrolysis of esters, trans-esterification.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Molecular Rearrangements** 3.1 Classification: anionotropoic, cationotropic, free radical, inter and intramolecular. 3.2 Mechanism of pinacol-pinacolone, semi-pinacol-pinacolone rearrangements and stereochemical aspects: ring contraction and ring enlargement reactions, Beckmann, benzil-benzilic acid, Hoffmann, Lossen, Curtius and Schmidt rearrangements. 3.3 Claisen and *para*-Claisen, Cope and oxy-Cope, Fries and photo-Fries rearrangements.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**Active Methylene Compounds** 4.1 Introduction and tautomerism. 4.2 Preparation, properties and synthetic applications of malonic, acetoacetic and cyanoacetic ester. 4.3 Preparation, properties and synthetic applications of diazomethane and diazoacetic ester.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Organometallic Compounds** 5.1 Introduction, classification and importance. Preparation and properties of organometallic compounds of Li and Mg. 5.2 Preparation and properties of organometallic compounds of Cu and Zn metals. 5.3 Reactions with alkylating agents, carbonyl compounds (by substitution) and coupling reactions.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. Jonathan Clayden, Nick Greeves and Staurt Warren, Organic Chemistry, Oxford University Press, 2nd edition, 2016.
2. M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co. 2020.
3. S. N. Sanyal, Reactions, Reagents and Rearrangements, Bharathi Bhavan Publishing. 4th edition, 2019.
4. R.T. Morrison & R.N. Boyd Organic Chemistry, Prentice-Hall of India (P) Ltd, 2003, 6th edition.
5. Paula Yurkanisand Bruice, Organic Chemistry, Pearson Publishing, 8th edition, 2017.
6. R. L. Madhan, Organic Chemistry, Tata Mcgraw Hill Education (P) Ltd, 2013.
7. T. W. G. Solomons, Organic Chemistry, Wiley Publishers, Global Edition, 2017.
8. G. S. Sodhi Organometallic Chemistry, Ane Books Pvt. Ltd, 2009.

Suggested Readings

1. V. K. Ahluwalia, Organic Reaction Mechanism, Ane Books Pvt. Ltd, 2007.
2. Marc Lauden, Organic Chemistry, Roberts and company publisher, 5th edition, 2009.
3. N. Tewari, Advanced Organic Reaction Mechanism (Problems & Solutions), Books and Allied (P) Ltd, 2nd edition, 2010.
4. Jagadamba Singh and L. D. S. Yadav Advanced Organic Chemistry, Pragati Prakashan, 7th edition, 20191.
5. Reinhard Bruckner, Advanced Organic Chemistry (Reaction Mechanism) by Academic press, 2008.
6. S. Renuga, Name reactions and reagents in organic synthesis, Vishal publishing Co. 2017.
7. B. Y. Paula Pearson, Organic Chemistry by Education, Inc. (Singapore), 3rd edition, New Delhi 2002.
8. Sehan, N. Ege, Organic Chemistry, Structure and Reactivity, AITBS, New Delhi, 3rdedition, 1998.
9. J. B. Hendrickson, D.J. Cram and G. S. Hammond, Organic Chemistry, McGraw-Hill, Kogakusha, Limited, 3rd edition,1970.

Web Resources

1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic
2. https://www.clutchprep.com/organic-chemistry
3. https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm
4. https://bit.ly/3m4M60M
5. https://www.masterorganicchemistry.com/organic-1/

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand and recall the nomenclature and basic concepts of carbonyl, carboxylic acids, active methylene and organometallic compounds.	**K1, K2**
CO 2	To integrate and assess the different methods of preparation and types of reactions in the chemistry of synthetically important various organic compounds.	**K3**
CO 3	To explain the applications of different organic functional groups and their derivatives.	**K4**
CO 4	To analyze and differentiate the type of reaction mechanisms involved in preparation and interconversion of selected organo-oxygen compounds.	**K5**
CO 5	To construct new routes to achieve the structure of the target molecule through suitable reaction mechanisms.	**K6**

Course Code	UCH 5502
Course Title	PHASE EQUILIBRIA AND KINETICS
Credits	05
Hours/Week	05
Category	Major Core (MC) – Theory
Semester	V
Regulation	2019

Course Overview

1. Phase equilibria provide an insight for the design of all kinds of chemical processes that involve separations and reactions.
2. This course highlights the relationship between all three phases of a substance in terms of phase diagram which provides valuable hints to understand the existence of equilibria.
3. This course explains the phase behaviours in the construction of phase diagrams for unary, binary and ternary systems.
4. This course aims at the utility of several colligative properties in the determination of molecular weight of solutes and gives insight on CST and distribution law.
5. Chemical Kinetics deals with the rate, mechanisms of reactions, factors influencing the rate and its applications.

Course Objectives:

1. To understand the Gibbs phase rule and its application in the phase diagram construction.
2. To know the basic principles involved in separation of liquid mixtures by distillation.
3. To comprehend the basics of chemical kinetics, determination of order, molecularity, and the theories of reaction rates.
4. To study the rates of complex reactions namely consecutive, opposing, parallel and chain reactions with suitable examples.
5. To learn about the characteristics of catalysts, acid base and enzyme catalysis.

Prerequisites	Basic knowledge of Thermodynamics

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Phase Equilibria** 1.1 Phase rule: Concepts of phase, component and degrees of freedom with examples. Gibb's phase rule – derivation. Clapeyron and Clausius-Clapeyron equations and their applications to equilibria in phase transitions (solid – liquid, liquid – vapour, solid – vapour) 1.2 Application of phase rule to one component system-Water and Sulphur.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	1.3 Reduced phase rule- Two component system: Simple eutectic: Lead-silver system, Formation of compound with congruent and incongruent melting points: Ferric chloride – water system. 1.4 Three component system: General account of graphical representation of three component systems, acetic acid-chloroform-water system.			
II	**Solutions** 2.1 Ideal solutions -vapour pressure-composition diagrams of solutions. Raoult's law, positive and negative deviations. 2.2 Principle of fractional distillation - binary systems. Vapour diagram and azeotropic distillation, partially miscible binary systems (Critical Solution Temperature (CST), upper and lower CST). Effect of addition of solute on CST. Steam distillation. Solubility of gases in liquids; Henry's law and relationship with Raoult's law. 2.3 Colligative properties -Lowering of vapour pressure: Thermodynamic derivation for elevation of boiling point and depression of freezing point. Relationship between osmotic pressure and vapour pressure, Vant Hoff's theory of dilute solutions. Analogy between solute particles and gas molecules. 2.4 Nernst distribution law- Thermodynamic derivation; limitation and its application in association, dissociation and solvation, study of formation of complex ions. Extraction with solvents; efficiency of extraction.	18	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Chemical Kinetics** 3.1 Rate, rate law, rate constant, order, molecularity and activation energy. Differential form of rate expression and reactions involving zero, first, second and third order reactions. 3.2 Derivation of integrated rate equations for zero, first and second order reactions (both equal and unequal concentration), Half-life period.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	3.3 Pseudo-first order reactions- acid catalyzed hydrolysis of ester and inversion of cane sugar. Determination of order by different methods.			
IV	**Theories of Reaction rates** 4.1 Types of reactions - opposing, parallel, consecutive and thermal chain. Hydrogen-bromine reaction and dissociation of acetaldehyde (only mechanism and no derivation required). 4.2 Factors affecting reactions – nature of reactants, concentration, catalyst, solvent polarity and ionic strength (only qualitative ideas). Arrhenius theory of chemical reaction rates. 4.3 Collision theory of bimolecular and unimolecular reactions -Lindemann hypothesis. Transition state theory – significance of entropy and free energy of activation.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Catalysis** 5.1 Properties of catalysts, action of catalytic promoters and inhibitors- homogeneous and heterogeneous catalysis – Intermediate compound formation and adsorption theories – acid-base catalysis. 5.2 Kinetics of enzyme catalysis – Michaelis-Menten equation and its verification, turnover number – effect of temperature and pH. Reversible and irreversible enzyme inhibitions, degree of inhibition.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. Puri, B. R., Sharma, L.R. Pathania, M.S., Principles of Physical Chemistry, 46th edition, Shoban Lal Nagin Chand and Co., Delhi, 2013.
2. Bahl, B.S. Arun, Tuli, G. D., Essentials of Physical Chemistry, S Chand & Company Pvt Ltd, Multicolour edition, 2009.
3. Keith J. Laidler and John H. Meiser, Physical Chemistry, Physical Chemistry, CBS Publishers, 2nd Indian edition, 2006.
4. Atkins, P.W, J de Paula, Physical Chemistry, Oxford University Press, New Delhi, 8th Edition, 2006.
5. Dogra, S.K. Dogra, S., Physical Chemistry through Problems, New age international, 2nd Edition, 2006.
6. Sangaranarayanan MV, Mahadevan V, 2011, Textbook of Physical Chemistry, University press, Hyderabad, India.

Suggested Readings

1. Kalidas, C, Sangaranarayanan, M. V., Problems and Solutions: Physical Chemistry, 1st

edition, Universities Press, 2019
2. Rajaram, G. Kuriacose, J.C., Kinetics and Mechanism of chemical Transformations, Macmillan India Ltd., New Delhi, new edition, 2011.
3. Kapoor, K L., A Textbook of Physical Chemistry, Macmillan India Ltd, Volume 1 and 3, 2012.
4. Farrington Daniels, Chemical Kinetics, BiblioBazaar, Cornell University Press London, 3rd edition, 2011.
5. Anderson, A W, Physical Chemistry of Surfaces, Wiley –Interscience, Newyork, 5th Edition, 1990.

Web Resources

1. https://application.wiley-vch.de/books/sample/3527316728_c01.pdf

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To define the various terms involved in Phase equilibria and chemical kinetics and to compare ideal and non-ideal solutions.	**K1, K2**
CO 2	To sketch phase diagrams for unary, binary and ternary systems, solve numerical problems and relate the terms involved in phase equilibria and chemical kinetics.	**K3**
CO 3	To deduce expressions for phase rule, colligative properties, distribution law and rate constant of reactions and outline the factors influencing the rate of a reaction.	**K4**
CO 4	To estimate parameters of Phase equilibria and kinetics and validate the parameters using various methods.	**K5**
CO 5	To construct phase diagrams for various systems, design techniques for the separation of binary solutions and write the mechanism of chemical reactions.	**K6**

Course Code	UCH 5503
Course Title	SPECTROSCOPY
Credits	05
Hours/Week	05
Category	Major Core (MC) - Theory
Semester	V
Regulation	2019

Course Overview

1. Spectroscopy deals with the interaction of electromagnetic radiation with atoms and molecules. It also talks about quantization of energy, relative population of energy levels, transition probability, etc.
2. The aim of the course is also to highlight the significance of principles, absorption laws, Franck-Condon principle, Woodward-Fieser rule, Hooke's law etc., for structural elucidations.
3. The principles behind the transitions and instrumentation techniques in various branches of spectroscopy will be dealt with.
4. This course difference between i) IR and Raman spectroscopy ii) NMR and EPR techniques will also be discussed.
5. This course explains the salient features of mass spectrometry such as fragmentation pattern, base peak, McLafferty rearrangement, retro Diels-Alder reaction along with the structural elucidation of organic compounds using combined spectral data.

Course Objectives:

1. To understand the importance of quantization of energy, relative population of energy levels, transition probability, etc.,
2. To learn the significance of absorption laws and the influence of chromophores and auxochromes.
3. To distinguish between IR and Raman spectroscopy and infer their importance in the structural elucidation of molecules.
4. To interpret the splitting patterns and coupling parameters in NMR and EPR for structural determination.
5. To make use of the various spectral data such as vibrational, electronic, Mass, NMR etc., to predict the structures of organic compounds.

Prerequisites	Basic knowledge of electromagnetic spectrum.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Basic concepts of spectroscopy** 1.1 Electromagnetic spectrum and its interaction with matter, quantization of energy, electronic, vibrational and rotational energy levels, transitions in atoms and molecules, absorption and emission spectra. 1.2 Boltzmann distribution (formula only), relative population of translational, vibrational and rotational energy levels at different temperatures, Born-Oppenheimer approximations. 1.3 Selection rules, transition probabilities, factors affecting the line width and intensity of the spectral lines, resolution, signal-to-noise ratio.	12	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
II	**Electronic spectroscopy** 2.1 Absorption laws, Beer –Lambert's law – verification and its limitations, instrumentation of double beam spectrophotometer, Franck-Condon Principle, types of electronic transitions, chromophores and auxochromes, absorption bands and intensity, factors governing absorption maximum and intensity, solvent effects. 2.2 Applications: calculation of λ_{max} of conjugated dienes and α,β-unsaturated ketones using Woodward – Fieser rules. 2.3 Atomic absorption spectroscopy and flame photometry – principles and applications (No instrumentation).	12	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Infrared and Raman spectroscopy** 3.1 IR spectroscopy: Principle, Hooke's law and harmonic oscillator, Normal degrees of freedom, types of stretching and bending vibrations, vibrational frequencies, instrumentation, cell sampling techniques, factors affecting the fundamental vibrational frequencies. 3.2 Raman spectroscopy: Rayleigh and Raman scattering, stokes and anti-stokes lines, instrumentation – block diagram,	15	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	differences between IR and Raman spectroscopy, mutual exclusion principle - CO_2, N_2O, NO_2, H_2O. 3.3 Applications of IR and Raman spectroscopy: Functional group identifications from characteristic IR and Raman bands.			
IV	**Nuclear Magnetic Resonance (NMR) and Electron Paramagnetic Resonance (EPR) spectroscopy** 4.1 Principle, instrumentation, chemical shift, factors affecting chemical shifts, spin - spin coupling. NMR reference compounds: Tetramethylsilane (TMS) and 4,4-dimethyl-4-silapentane-1-sulfonic acid (DSS) – advantages and disadvantages. 4.2 Coupling constant, vicinal, geminal, allylic, long-range coupling, factors affecting the coupling constant, deuterium labelling, introduction to ^{13}C–NMR spectra, chemical shift, elementary problems involving ^{1}H and ^{13}C NMR. 4.3 Introduction to Electron Paramagnetic Resonance (EPR) spectroscopy: Principle, hyperfine splitting, EPR spectra of methyl and benzene radicals.	15	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Mass spectrometry** 5.1. Principle, fragmentation pattern, molecular ion peak, base peak, isotopic peak and metastable peak. Nitrogen rule, McLafferty rearrangement, retro-Diels-Alder reaction. 5.2 Instrumentation, determination of molecular formula, mass spectrum of simple organic compounds - hydrocarbons, alcohols, carbonyl compounds and amines. 5.3 Structural elucidation of organic compounds by combined spectral techniques.	11	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. Banwell, C. N. 2017, Fundamentals of Molecular Spectroscopy, 4th edition, McGraw-Hill Education.
2. Sharma, Y. R. Chand, S. 2013, Elementary Organic Spectroscopy – Principles and Chemical Applications, 5th edition
3. Sathyanarayana, D. N. 2001, Electronic Absorption Spectroscopy and Related Techniques, 2nd edition, University Press.
4. Kalsi, P. S. 2020, Spectroscopy of Organic Compounds, 8th edition, New Age International Publishers.
5. Kemp, W. 2016, Organic Spectroscopy, 3rd edition, Palgrave Macmillan.
6. Kaur, H. 2019, Spectroscopy, 1st edition, Pragathi Prakashan.

Suggested Readings

1. Pavia, D. L. Lampman, G. M. Kriz, G. A. Vyvyan, J. R. 2009, Introduction to Spectroscopy, 5th edition, Cengage Learning.
2. Silverstein, R. M. Webster, F. X. Kiemle, D. J. Bryce, D. L. 2014, Spectroscopic Identification of Organic Compounds, 8th edition, Wiley.
3. Sathyanarayana, D. N. 2020, Introduction to Magnetic Resonance Spectroscopy, 3rd edition, Dream Tech Press.
4. Sathyanarayana, D. N. 2005, Vibrational Spectroscopy- Theory and Applications, New Age International Pvt. Ltd.
5. Jag Mohan, 2020, Organic Spectroscopy-Principles and Applications, 2nd edition, Narosa Publishing agency.

Web Resources

1. https://nptel.ac.in/content/storage2/courses/115101003/downloads/module2/lecture23.pdf
2. https://nptel.ac.in/content/storage2/courses/104106075/Week4/MODULE%2017.pdf

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To recognize the significance of the principles, laws, approximations, etc., to understand the transitions in atoms and molecules.	**K1, K2**
CO 2	To apply the concepts of various branches of spectroscopy to calculate relevant spectral parameters.	**K3**
CO 3	To analyse scientifically the various spectra and identify the appropriate structure of chemical compounds.	**K4**
CO 4	To compare the spectral pattern and evaluate the parameters essential for structural determinations.	**K5**
CO 5	To integrate the various spectral data such as vibrational, electronic, Mass, NMR etc., to elucidate the structures of organic compounds.	**K6**

Course Code	UCH 5504
Course Title	TRANSITION ELEMENTS AND NUCLEAR CHEMISTRY
Credits	05
Hours/Week	05
Category	Major Core (MC) - Theory
Semester	V
Regulation	2019

Course Overview

1. Transition elements and nuclear chemistry comprises the chemistry of transition elements, inner-transition elements, metallurgy and nuclear chemistry.
2. General overview of the properties of transition elements as well as iron group elements, copper group elements, lanthanides and actinides will be deliberated.
3. The important aspects that will be discussed in the course include the general processes involved in the extraction of Ti, V, Fe and Cr as well as extraction of individual metals.
4. This course illustrates the different types of nuclear reactors, counters, kinetics of nuclear reactions, calculation of the age of earth and dead wooden articles.
5. This course will also examine the properties of iron triad, copper group, lanthanides and actinides, the various processes in the extraction of metals from ores, chemistry of nucleus and different types of nuclear reactions.

Course Objectives

1. To understand and explain the properties and applications of transition elements.
2. To describe the techniques and processes involved in the extraction of metals.
3. To discuss the characteristics of inner-transition elements and their applications.
4. To predict the nature of a nucleus and nuclear reactions.
5. To explain the radioactive phenomenon and their applications in various fields.

Prerequisites	Basic knowledge of Chemistry.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Transition Elements** 1.1 General characteristics of first row *d*-block elements: -Introduction, atomic radii, ionic radii, atomic volumes, density, metallic character, melting and boiling points ionization energy, reactivity, oxidation states, complex formation, reducing properties, colour and magnetic properties, catalytic properties, variable oxidation states, lower oxidation states and stabilization. Differences between the first and the other rows of *d*-block elements.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	1.2 Iron triad - Group discussion, horizontal comparison with Fe, Co, Ni groups, occurrence and commercial forms of iron, manufacture and properties of cast iron – Steel: classification, properties and heat treatments of steel (iron passivity, corrosion). compounds of iron- potassium ferrocyanide and potassium ferricyanide, sodium nitroprusside-uses of compounds of iron in blue prints, test for iron. 1.3 Copper group: Similarities and gradation in Cu, Ag, Au. Compounds of Cu, halides of Ag- photography, silvering of mirrors. Compounds of Gold, electroplating of metals.			
II	**Metallurgy** 2.1 Occurrence of elements in nature- minerals and ores, types of ores. 2.2 General principles of extraction of metal – metallurgy: pulverisation, concentration of ores- electromagnetic, hydraulic leaching and froth flotation process; calcination and roasting, reduction-thermite welding, alumino thermic, smelting process, electrolytic reduction, purification of metals–zone refining, van-Arkel, Mac-Arther forest cyanide process. Mineral beneficiation. 2.3 Factors influencing the choice of extraction process, thermal decomposition methods; displacement of metal; high temperature chemical reduction methods-thermodynamics of reduction processes-Ellingham diagram. Reduction by carbon and metal. Self-reduction, reduction of oxides with hydrogen; electrolytic reduction-in aqueous solution, in non-aqueous solvents, in fused melts; metallurgy of Ti, V, Fe, and Cr.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Inner-Transition Elements** 3.1 Lanthanides: lanthanide series, position in the periodic table, abundance and natural isotopes, lanthanide contraction, similarity in properties, occurrence, oxidation states, chemical properties of lanthanide (III) cations, electronic spectra. Separation of lanthanides: solvent extraction, ion	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	exchange, chemical properties of Ln (III) metal ions. 3.2 Actinides: actinide series, abundance and natural isotopes, occurrence, separation of actinides, oxidation states, general properties, the later actinide elements. 3.3 Uranium-occurrence, metallurgy; chemical properties of hydrides, oxides, and halides.			
IV	**Nuclear Chemistry** 4.1 Chemistry of nucleus: types of nucleons. Nature of subatomic particles. Isotopes, isobars, isotones and nuclear isomers. isotopic mass-meson exchange theory of the origin of nuclear forces-density of nucleus-radioactive elements. Nuclear stability: n/p ratio, packing fraction, mass defect, binding energy and calculations. Nuclear model: shell (magic numbers) and liquid drop model. 4.2 Natural and induced radioactivity: radioactive decay α-, β- and γ-decays, Soddy-Fajans and Russel Group displacement law. Neutron and positron emission, electron capture; Geiger-Nuttall rule, radioactive displacement law, natural and artificial radioactivity, unit of radioactivity. Radioactive series and calculation of number of α, and β particles. 4.3 Disintegration constant, activity; half-life period, average life period (t_{avg}); radioactive equilibrium; law of successive disintegration; activity of radioactive substances and calculations. Measurement of radioactivity: ionization chamber, Geiger and scintillation counters, pulse radiolysis.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Nuclear Reactions** 5.1 Nuclear reactions: types, nuclear cross section, spallation, nuclear fission and fusion. Theory of fission-chain reaction, critical mass; nuclear reactors-fast breeder reactor, fuels used in nuclear reactors-fissile, fertile separation of isotopes, moderators, coolants. Nuclear reactors in India. Atom bomb-principle. 5.2 Stellar energy, carbon-nitrogen and proton-	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	proton cycles. Hydrogen bomb-principle. 5.3 Applications: energy tapping, dating of objects, neutron activation analysis, isotopic labelling studies. Nuclear medicine-^{99m}Tc radiopharmaceuticals-isotopes used in non-invasive imaging techniques.			

Text Books

1. Satya Prakash, G.D. Tuli, S.K. Basu, R.D. Madan, Advanced Inorganic Chemistry, S. Chand & company, New Delhi, 2000, 5thedn.
2. Puri, Sharma and Kalia, Principles of Inorganic Chemistry, Vishal Publicating co. 2016, 5thedn.
3. J.D.Lee, Concise Inorganic Chemistry, Blackwell Science Ltd, 2005, 5thedn.
4. F.A. Cotton, G. Wilkinson, C. Murillo, M. Bochman, Advanced Inorganic Chemistry, John Wiley, New York, 2006, 6thedn.
5. H.J. Arnikar, Essentials of Nuclear Chemistry, New Age International, New Delhi, 2007, 4thedn.

Suggested Readings

1. M. L.Tobe, J.Burgess, Inorganic Reaction Mechanisms, Addison Wesley Longman, 1999.
2. F.A. Cotton, G.Wilkinson, C.A. Murillo, M. Bochmann, Advanced Inorganic Chemistry, John Wiley, 1999, 6thedn.
3. D. F.Shriver, P.W Atkins, C.H. Langford, Inorganic Chemistry, Oxford University press, 2000, 3rdedn.
4. B.R. Puri, L.R. Sharma, K.C. Kalia & Geetanjli Kaushal, S & P block elements, Transition Metals & Coordination Chemistry, Vishal Publishing Co. 2020, 1st edn.
5. R. Gopalan, Elements of Nuclear Chemistry, S.Chand (G/L) & Company Ltd, 1999.

Web Resources

1. https://archive.org/details/atextbookinorga03newtgoog
2. https://chemistry.com.pk/books/free-download-chemistry-dictionary/

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand and recall the characteristics of transition and inner transition elements and nuclear stability.	**K1, K2**
CO 2	To Illustrate the different processes employed during the extraction of metals and their applications.	**K3**
CO 3	To analyze and differentiate the transition, inner-transition and radioactive elements based on their nature, occurrences and properties.	**K4**
CO 4	To explain the importance of calculating $t_{1/2}$ and its applications in determining age of earth.	**K5**
CO 5	To construct a table for explaining the properties of transition and inner transition elements and propose possible radioactive isotopes for nuclear reactions.	**K6**

Course Code	UCH 5505
Course Title	GRAVIMETRIC ANALYSIS AND ORGANIC PREPARATIONS
Credits	04
Hours/Week	04
Category	Major Core (MC) - Practical
Semester	V
Regulation	2019

Course Overview

1. The aim of the course is to impart the Basic knowledge of the gravimetric analysis and the preparation of organic compounds.
2. This course includes skill development to estimate the ions from their corresponding salt solutions accurately.
3. This course enables to determine suitable precipitating agents and pH of the medium for the determination of the analyte.
4. This covers the theoretical concepts for the computation of gravimetric factor.
5. This demonstrates the preparation of organic compounds and the techniques related with crystallisation.

Course Objectives

1. To quantify the particular ion, present in the given solutions accurately.
2. To get acquainted with the experimental procedure of gravimetric analysis.
3. To acquire the skills to perform gravimetric estimation precisely.
4. To apply the knowledge of quantitative analysis in determining the amount of the analyte present in the given solution.
5. To learn the methods of different preparation of organic compounds.

Prerequisites	Basic knowledge of chemistry.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**A. Gravimetric Analysis** 1. Estimation of sulphate as barium sulphate. 2. Estimation of barium as barium chromate. 3. Estimation of copper as copper thiocyanate. 4. Estimation of nickel as nickel dimethylglyoxime. 5. Estimation of lead as lead chromate. 6. Estimation of magnesium as magnesium pyrophosphate. 7. Estimation of calcium as calcium oxalate. 8. Estimation of lead as lead sulphate. 9. Estimation of copper as copper sulphide in brass.	40	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

II	**B. Organic Preparations** 1. Preparation of benzoic acid from benzaldehyde 2. Preparation of p-bromoacetanilide from acetanilide 3. Preparation of picric acid from phenol 4. Preparation of salicylic acid from methyl salicylate 5. Preparation of benzanilide from aniline Preparation of p-nitroacetanilide from acetanilide	12	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part III), S. Viswanathan Co. Pvt. (1996)
2. N.S. Gnanapragasam, G. Ramamurthy, Organic Chemistry-Lab manual, S. Viswanathan Co. Pvt. New edn. (2013)
3. V.K. Ahluwalia, College Practical Chemistry, University press, 1st edn. (2005)

Suggested Readings

1. B.A. Furniss, A.J. Hanna Ford, P.W.G. Smith, A.R. TatChell, Vogel's Textbook of practical organic chemistry, ELBS/Longman England, 5th edn. (1989)
2. G.H. Jeffery, J. Bassett, J. Mendham, R.C. Denny, Vogel's textbook of quantitative chemical analysis, Longman Scientific & Technical, 5th edn. (1989)

Web Resources

1. https://bit.ly/3BWrVYg

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand and recall the basic principles of gravimetric analysis and organic compound preparations	**K1, K2**
CO 2	To predict the role of various precipitating agents.	**K3**
CO 3	To determine the mass of the analyte and to analyse the accuracy of analysis.	**K4**
CO 4	To interpret a suitable method for the preparation of organic compounds.	**K5**
CO 5	To propose a suitable method for recrystallization.	**K6**

Course Code	UCH 5601
Course Title	BIOCHEMISTRY AND NATURAL PRODUCTS
Credits	06
Hours/Week	06
Category	Major Elective (ME) - Theory
Semester	V
Regulation	2019

Course Overview

1. This subject deals with the chemistry of selected biologically important biomolecules and natural products.
2. This course provides the basic concepts of amino acids, proteins, carbohydrates, enzymes, lipids and also nucleic acids.
3. The aim of this subject is to give the knowledge of synthesis and properties of biomolecules and medicinally important alkaloids and terpenoids.
4. The other important aspect is to give the knowledge of structure determination of biomolecules and their applications.
5. This course explains nomenclature of carbohydrates, enzymes and characteristic tests for proteins, alkaloids and terpenoids.

Course Objectives

1. To learn the basic biological concepts of biomolecules and natural products.
2. To explain various methods of preparations and functions of amino acids, proteins, enzymes, lipids, nucleic acids and carbohydrates.
3. To articulate the functions of alkaloids, terpenoids and anthocyanins.
4. To elucidate the structure determination of biomolecules and natural products.
5. To construct the structure of new alkaloids and terpenoids from different methods.

Prerequisites	Basic concepts of organic chemistry.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Amino Acids and Proteins** 1.1 Amino acids - Introduction, classification: natural, essential and non-essential amino acids, preparation of α-amino acids by Gabriel's phthalimide and Strecker's synthesis; resolution of DL-amino acids. 1.2 Physical (zwitterion and isoelectric point) and chemical properties; structural relationship of amino acids to peptides and proteins; synthesis of peptides by carbobenzoxy, Sheehan and Merrifield methods. 1.3 Proteins - Introduction, classification – fibrous and globular, classification based on composition (simple and conjugated), general properties-hydrolysis, colloidal and amphoteric character, denaturation and renaturation, tests for proteins and amino acids by Biuret, Ninhydrin and Millon's reagents; determination of structure of proteins - C- and N-terminal residue analysis by Sanger's and Edman's method; primary, secondary and tertiary structure of proteins.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
II	**Enzymes and Lipids** 2.1 Enzymes – Introduction, nomenclature and classification, salient characteristics, specificity, mode of enzyme action – Lock and Key and induced fit models, factors influencing enzyme action. 2.2 Coenzymes, cofactors, prosthetic groups of enzymes (Definitions only). mechanism of inhibition (competitive, non- and uncompetitive, allosteric), kinetics of enzyme reaction, isoenzymes and applications. 2.3 Lipids – Introduction, biological functions, classification- simple, sphingolipids, glycolipids, triglycerides, common fatty acids present in fats and oils, extraction and refining of oils, physical and chemical properties – hydrolysis, hydrogenation, hydrogenolysis, trans-esterification, rancidity and autoxidation, prevention of rancidity; identification of fats and oils – acid value, iodine value, Polenske number, Reichert-	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	Meissl number; uses of fats and oils; biosynthesis of fatty acids, metabolism - oxidation of glycerol – β-oxidation of fatty acids.			
III	**Carbohydrates and Nucleic acids** 3.1 Carbohydrates - classification – reducing and non-reducing sugars, ring structure of D(+) glucose, anomers, mutarotation and its mechanism, Haworth projection formulae to represent α- and β-D(+) glucose and chair conformation, epimer and epimerization. 3.2 Metabolism: Glycolysis and its reversal-TCA cycle. 3.3 Nucleic acids – Introduction, purine and pyrimidine bases, structure of nucleosides, nucleotides and polynucleotides, difference between DNA and RNA. RNA-types and functions, DNA replication, genetic code and biosynthesis of proteins and mutation.	**13**	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**Alkaloids and Terpenoids** 4.1 Alkaloids - Introduction, classification, occurrence, general properties, isolation and tests for alkaloids; general methods of structure determination by chemical methods, structural elucidation and synthesis of coniine, piperine, nicotine and papaverine. 4.2 Terpenoids - Introduction, special isoprene rule, classification and isolation, general methods of structure determination by chemical methods, structural elucidation and synthesis of citral, menthol, geraniol, camphor, β-carotene and vitamin-A.	**13**	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Anthocyanins and Flavones** 5.1 Anthocyanins - introduction, biological functions, colour and constitution, structure determination of anthocyanidins, general methods of synthesis. 5.2 Structural elucidation of cyanidin chloride, pelargonidin chloride, delphinidin chloride, peonidin chloride, malvidin chloride and hirsutidin chloride. 5.3 Flavones - Introduction, biological functions, structural elucidation of flavones, flavonol, isoflavone, depsides and tannins.	**13**	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. G.P. Talwar, L.M. Srivatsava and K.D. Moudgil, Textbook of Biochemistry and Human Biology, Prentice-Hall of India Limited, New Delhi 2003.
2. J.L. Jain, Biochemistry, S. Chand and Sons, New Delhi 2004.
3. M. K. Jain and S. C. Sharma, Modern Organic chemistry, Vishal publishing Co. 2014, 4th edn.
4. A. Lehninger, D. L. Nelson, M. Cox and M. M. Cox, Principles of Biochemistry, MPS Publishers, New York, 2009.
5. A.V.S.S. Rama Rao, Text Book of Biochemistry, U B S Publishers, 2008, 9th edn.
6. Gurdeep R. Chatwal, Chemistry of Natural products, Himalaya publishing House Pvt. Ltd, Mumbai, 2018, Vol I & II.
7. O.P. Agarwal, Chemistry of Natural products, Goel publishing Co, New Delhi 2001, Vol I & II.
8. U. Satyanarayana and U. Chakrapani, Biochemistry, Elsevier, 2019, 5th edn.

Suggested Readings

1. T. Palmer and P. Bonner, Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, First East West Press Pvt Ltd., New Delhi 2008, 2th edn.
2. J.L. Tymoczko and L. Stryer J.M WH-Freeman and Co, Biochemistry, Herg, 2002, 5th edn.
3. Keshav Trehan, Biochemistry, Wiley Eastern Ltd, 1987.
4. E.J. Wood and W.R. Pickering, Introducing Biochemistry, ELBS, 1984.
5. I. L. Finar, Stereochemistry and the chemistry of natural products, The English language book society and Longman group limited, 1970, 5th edn.
6. N.Tewari, Advanced organic chemistry (Organic synthesis, Heterocycles and biomolecules) Books and Allied (p) Ltd. 2015.

Web Resources

1. https://microbenotes.com/category/biochemistry/
2. https://www.masterorganicchemistry.com/organic-1/
3. https://www.organic-chemistry.org/
4. https://www.chemistryworld.com/organic-chemistry/211.subject

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand the basic concepts of biomolecules, alkaloids and terpenoids.	**K1, K2**
CO 2	To integrate and assess the different methods of preparation structurally different biomolecules and natural products.	**K3**
CO 3	To illustrate the applications of biomolecules and their functions in the metabolism of living organisms.	**K4**
CO 4	To analyze and differentiate the structure determination of biomolecules and natural products.	**K5**
CO 5	To construct the structure of new alkaloids and terpenoids from different methods	**K6**

Course Code	UCH 5602
Course Title	MEDICINAL AND PHARMACEUTICAL CHEMISTRY
Credits	06
Hours/Week	06
Category	Major Elective (ME) – Theory
Semester	V
Regulation	2019

Course Overview

1. Medicinal and pharmaceutical chemistry deals with the topics, theories, testing chemical action, new drug design and various parameters.
2. The aim of the course is to give the basic information about new concepts of drug design.
3. This paper clearly explains the chemical action of various common drugs used in daily life.
4. This paper also examines the concepts, theories and various steps involved in the new drug design.
5. This paper explains various parameters involved in the new drug design.

Course Objectives

1. To understand the basic concepts of medicinal and pharmaceutical chemistry.
2. To acquire the knowledge about the theories and testing of drugs.
3. To explain the chemical action for various types of common drugs.
4. To apply various theories and action is used in new drug design.
5. To learn the different parameters of new drug design.

Prerequisites	Basic knowledge of medicinal and pharmaceutical chemistry

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Clinical Hygiene and Biochemical Analysis** 1.1 Definition of health. WHO guidelines. 1.2 Sterilization of surgical instruments. Disinfectants, antiseptics, sanitation. Treatment for specific poisons- acids, alkalis, arsenic and mercury compounds. 1.3 Body fluid: blood volume, blood pH, blood groups, coagulation of blood. Plasma lipoproteins. Blood pressure. Arteriosclerosis, diseases affecting red cells: Hyperchromic and hypochromic anemia. Blood transfusion. Coagulation, biochemical analysis of urine, serum and fecal matter, Methods of determination of blood sugar and diabetes.	15	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

II	**Introduction to Pharmaceutical Chemistry** 2.1 Terminologies - molecular pharmacology pharmacodynamics, pharmacokinetics, pharmacognosy, pharmacophore, metabolites, antimetabolites, actinomycetes, virus, bacteria and fungi. Drugs: names (chemical proprietary, non-proprietary, trivial and trade), code number, dosage and storage. 2.2 Definition of biological, chemical and immunological assays. Metabolism of drugs and their effect on pharmacological activity. 2.3 Physiological effects of hydroxyl and carboxylic acid functional groups in drugs: testing of potential drugs and their side effect- ethical clearance and clinical trials.	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Common Drugs** 3.1 Testing of drugs: biological variation, screening and toxicity, therapeutic index and use of pharmacopoeia; Biological functions of drugs- quinine, reserpine, only structure for atopside and d–tubocurarine. 3.2 Types of drugs and their modes of action: Antidepressant drugs sedatives and hypnotics: Phenobarbital & Paramethadione. Anticonvulsant drugs: sodium valproate, hydantoins. Narcotic analgesics: only morphine compounds. Antipyretic analgesics: acetylsalicyclic acid, p–aminophenol derivatives. Muscle relaxants. Type 1: Acting at neuromuscular junction: d– tubocurarine chloride. Type 2: Acting at spinal cord: glycerylguaiacolate, diazepam. 3.3 Antibiotics: penicillin, streptomycin, tetracycline, chloramphenicol. Cardiovascular drugs: nitrates, betablockers: propranolol and atenolol and calcium channel blockers. Stent	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**New Drugs and Drug Action** 4.1 Genesis of new drugs: serendipity, random screening, extraction of active principles from natural sources	16	CO 1 CO 2 CO 3 CO 4	K1, K2, K3, K4, K5, K6

	(Hesperdin from Orange Peel), molecular modification of known drugs (morphine), synthesis of soft drugs like diazepam and barbitol, drug latentiation. 4.2 Compounds of medicinal interest: Structure, structural modifications, mechanism of action and therapeutic uses of taxanes and camptothecin. 4.3 Theoretical aspects of drug action: stereochemical aspects of drugs. Structure activity relationship of penicillin and streptomycin.		CO 5	
V	**Drug Discovery and Drug Design** 5.1 Modern methods of drug discovery target validation: Introduction to discovery of lead molecule, rational drug discovery models. Target structure, active site identification and methods of validation. 5.2 Rational Drug Design: QSAR and QSPR (Introduction only). QSAR parameters - lipophilicity(polarisabiltiy, electronic and steric parameters).Quantitative models. Hansch analysis, Free Wilson analysis and their relationships, linear relationships and applications of Hansch and Free Wilson analysis. 5.3 Introduction to Computer Aided Drug Design (CADD) and molecular modelling.	15	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. K. Bagavati Sundari, Applied Chemistry, MJP Publishers, Chennai, 2008, 1st edn.
2. B.L. Oser, Hawk's physiological chemistry, Tata-McGraw - Hill Publishing Co. Ltd, 1965, 14th edn.
3. H. Singh and V.K. Kapoor, Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Delhi, 1996, 14th edn.
4. Graham L Patrick, An Introduction to Medicinal Chemistry, Oxford University Press, 2017, 5th edn.
5. Ilango, Valentina, Text Book of Medicinal Chemistry volume- I & II, Keerthi Publishers, 2017, 1st edn.
6. Paula Yurkanis Bruice, K.J. Rajendra Prasad. Essential Organic Chemistry, Pearson, Fourth Impression, 2012 New Delhi. New edn.
7. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, John M. Beale Jr and John M. Block, Wolters Kluwer, 2011, 12th edn.
8. P. Parimoo, A Textbook of Medical Chemistry, New Delhi: CBS Publishers.1995.
9. S. Ramakrishnan, K. G. Prasannan and R. Rajan, Textbook of Medical Biochemistry, Hyderabad: Orient Longman. 3rd edition, 2001.

Suggested Readings

1. Jayashree Ghosh, A text book of Pharmaceutical Chemistry, S. Chand and Co. Ltd, 1999, 1999 edn.
2. O. LeRoy, Natural and synthetic organic medicinal compounds, Ealemi, 1976.
3. S. Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, New Delhi, 1993, New edn.
4. D. J. Abraham, D. P. Rotella, Burger's Medicinal Chemistry, Drug Discovery and Development, Wiley Publications, New York, 2010, 7th edn., Vol- 8.

Web Resources

1. https://www.ncbi.nlm.nih.gov/books/NBK482447/
2. https://training.seer.cancer.gov/treatment/chemotherapy/types.html
3. https://www.classcentral.com/course/swayam-medicinal-chemistry-12908
4. https://www.edx.org/course/medicinal-chemistry-the-molecular-basis-of-drug-di
5. https://www.pharmpress.com/product/9780857110831/fasttrack-chemistry-of-drugs
6. https://bit.ly/3aFuxy4

Course Outcomes (COs) and Cognitive Level Mapping

Cos	CO Description	Cognitive Level
CO 1	To understand the safe handling of chemicals used in medicine.	**K1, K2**
CO 2	To apply the theories of drug action and biomolecules.	**K3**
CO 3	To recognize the basis of physiological functions of common drugs.	**K4**
CO 4	To identify the types of common drugs.	**K5**
CO 5	To classify drugs and to design drugs.	**K6**

Course Code	UCH 6501
Course Title	COORDINATION CHEMISTRY
Credits	06
Hours/Week	06
Category	Major Core (MC) - Theory
Semester	VI
Regulation	2019

Course Overview

1. Coordination Chemistry comprises the chemistry of coordination, organometallic compounds and bioinorganic chemistry.
2. The aim of the course is to impart the basic knowledge about the coordination and organometallic compounds and overview the applications of bioinorganic chemistry.
3. The different modules of the course will examine the nomenclature, theories and reaction mechanism of the coordination and organometallic compounds, and their applications in biosystems.
4. In this course, the biological role of transition metal ions, role of organometallic compounds in catalysis and synthesis of macrocyclic coordination compounds will also be examined.
5. The course also focuses to study the following concepts: isomerism, effect of ligands on the geometry of the metal ion, electron and energy transfer reactions, popular organometallic catalysts used in the manufacture of chemicals and contrast agents in MRI.

Course Objectives

1. To understand and explain nomenclature and properties of coordination and organometallic compounds.
2. To predict and ascertain the magnetic properties of coordination compounds.
3. To describe the mechanisms of substitution and electron transfer reactions.
4. To construct the qualitative molecular orbital diagram for σ-bonding in octahedral geometry.
5. To formulate and explain the biological role of metal ions in enzymes and radiopharmaceuticals and formulate methods for synthesizing coordination compounds.

Prerequisites	Basic knowledge of bonding of covalent and ionic compounds

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Introduction** **1.1 Introduction:** ligands-mono-, bi-, and polydentate ligands; terminology, nomenclature of mono- and dinuclear complexes; thermodynamics of formation of coordination compounds. **1.2 Isomerism:** linkage-, ionization-, hydrate-, coordination-, coordination	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	position isomerism, geometrical-(cis/trans and fac/mer), and optical isomerism. **1.3 Theories:** Werner's and Sidgwick - EAN and stability, formation of metal-metal bond in dimers, limitations; valence bond theory-hybridization, formation of tetrahedral and octahedral complexes, geometry -magnetic property relationship, drawbacks of VBT.			
II	**Theory of Coordination Compounds** **2.1 Crystal field theory:** assumptions, crystal field splitting in octahedral, tetragonally distorted octahedral, tetrahedral and square planar geometries, qualitative crystal field splitting diagrams, high- and low-spin complexes, CFSP and factors affecting, computation of CFSE. Evidences of crystal field splitting, spectrochemical series. **2.2 Jahn-Teller theorem:** static and dynamic, distortions in octahedral complexes. **2.3 Covalency in transition metal complexes:** evidence, intensity of d-d transitions, nephelauxetic effect, adjusted crystal field theory. MO Theory: Metal orbitals and LGOs suitable for σ - and π - bonding in octahedral geometry, construction of qualitative MO energy level diagram for σ - bonding in octahedral geometry. R-S coupling – derivation of ground state term symbol.	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Reaction Mechanisms in Coordination compounds** **3.1 Substitution reactions in octahedral complexes:** dissociative, associative and interchange mechanisms. Thermodynamic stability of complexes, spectrophotometric determination of stability constant. 3.2 Kinetic inertness and lability. Substitution reactions in square planar complexes: dissociative and associative mechanisms-cis- and trans-effects in the synthesis of square planar and octahedral complexes. Electron transfer reactions: inner and	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	outer sphere, complementary and non-complementary electron transfer reactions. 3.3 Metal template synthesis - metal phthalocyanins and Schiff bases. Vaska's complexes: structure, reactivity, oxidative addition and reductive elimination reactions.			
IV	**Organometallic Compounds and Catalysis** 4.1 Nomenclature, 16- and 18-electron rule. Structure and bonding in transition metal carbonyls: polynuclear carbonyls, bridging and terminal carbonyls 4.2 Transition metal alkyls, carbenes and carbynes. Metallocenes – synthesis, properties, and structure of ferrocene. 4.3 Wilkinson's catalyst-alkene hydrogenation, hydroformylation, Monsanto acetic acid process, Ziegler-Natta catalyst - polymerization of olefins.	15	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Inorganic Biochemistry** 5.1 Biological roles of transition metal ions containing proteins and enzymes: apoenzymes and coenzymes; heme proteins-hemoglobin and myoglobin-general structures and functions. 5.2 Biological role of cytochromes, carboxypeptidase A, superoxide dismutase; in vivo and in vitro nitrogen fixation. 5.3 Inorganic medicinal chemistry: radiopharmaceuticals, chelate therapy and contrast agents in MRI.	15	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. Ajai Kumar, Coordination Chemistry, Aaryush Education 6th edn 2020.
2. R. Gopalan, V. Ramalingam, Concise Coordination Chemistry, S. Chand 2001.
3. J.D. Lee, Concise Inorganic Chemistry, Blackwell Science Ltd 5th edn 2005.
4. D. Banerjee, Coordination Chemistry, Asian Books 3th edn 2009.
5. Puri, Sharma and Kalia, Principles of Inorganic Chemistry, Vishal Publicating Co. 5th edn 2016.

Suggested Readings

1. M. L. Tobe, J. Burgess Addison, Inorganic Reaction Mechanisms, Wesley Longman 1999.
2. F.A. Cotton, G. Wilkinson, C.A. Murillo, M. Bochmann, Advanced Inorganic Chemistry, John Wiley 6th edn 1999.
3. D. F. Shriver, P.W Atkins, C.H. Langford, Inorganic Chemistry, Oxford University press 3rd edn 2000.

4. J. E. Huheey, E.A. Keiter, R.L. Keiter, Inorganic Chemistry, Principles of Structure and Reactivity, Harper Collins, 4th edn 2006.
5. Catherine House Croft, Inorganic Chemistry, Pearson 5th edn 2018.
6. B.D. Gupta and A. Elias, Basic in Organometallic Chemistry, University Press 2nd edn 2013.

Web Resources

1. https://bit.ly/3GdSdbm
2. https://bit.ly/3vB59mu

Course Outcomes (COs) and Cognitive Level Mapping

Cos	CO Description	Cognitive Level
CO 1	To understand the basic concepts of coordination compounds.	**K1, K2**
CO 2	To illustrate the application of crystal field theory in predicting the properties of coordination compounds.	**K3**
CO 3	To construct the qualitative molecular orbital diagram for σ-bonding in octahedral geometry and in sandwitch type metal complexes.	**K4**
CO 4	To predict the mechanisms of substitution and electron transfer reactions of octahedral and square planar metal complexes.	**K5**
CO 5	To create the knowledge about methods for synthesizing coordination compounds.	**K6**

Course Code	UCH 6502
Course Title	MOLECULAR DYNAMICS
Credits	06
Hours/Week	06
Category	Major Core (MC) – Theory
Semester	VI
Regulation	2019

Course Overview

1. The aim of the course is to give the basic knowledge in quantum mechanics, group theory, photochemistry and surface chemistry.
2. The course covers fundamental concepts of quantum mechanics: Concepts of operators, Eigenfunction, Eigenvalues. Derivation of time independent Schrodinger wave equation and particle in one-dimensional box. The course also examines the failures of classical mechanics in detail.
3. This course introduces the basic concepts of Group theory such as symmetry elements, symmetry operations, classes, groups, point groups and few applications.
4. It also deals with the laws of photochemistry, radiative and non-radiative processes, actinometer, photophysical kinetics of unimolecular processes, flash photolysis, static and dynamic quenching.
5. This course covers the chemistry of adsorption and colloids.

Course Objectives

1. To understand the limitations of classical mechanics and correlate the quantum mechanical observables.
2. To explain the importance of molecular symmetry and its applications in physical and chemical properties.
3. To outline the fundamental laws of photochemistry to interpret different photophysical processes.
4. To compare the kinetics of thermal and photochemical reactions.
5. To describe the assumptions of adsorption isotherms and utilize it for the measurement of surface area of molecules

Prerequisites	Basic knowledge of Chemistry and Mathematics

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Quantum mechanics** 1.1 Classical mechanics: assumptions and failures - Photoelectric effect, Compton effect, Energy distribution in black body radiation – Ultraviolet catastrope, Wien's and Stefan-Boltzmann's laws of emissive power, Hydrogen atomic spectrum (Problems Only). 1.2 Postulates of quantum mechanics. Concepts of operators, eigen function, eigen values. Derivation of time independent Schrodinger wave equation, particle in one-dimensional box - derivation for energy, application to ethylene and butadiene.	17	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
II	**Group theory** 2.1 Molecular symmetry**:** Symmetry elements, symmetry operations, product of symmetry operations, classes, group, sub-group, Abelian group, group multiplication table – properties of a group – point groups C_s, C_i, C_1, C_{2v}, C_{3v}, C_{2h}, $C_{\infty v}$, D_{2h}, D_{3h}, D_{4h}, D_{6h} and $D_{\infty h}$. 2.2 Applications: optical activity, dipole moment, polarity and mutual exclusion principle.	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Fundamentals of photochemistry** 3.1 Comparison of thermal and photochemical reactions. Laws of photochemistry: Grotthus-Draper Law, Kasha's rule and Stark-Einstein law. Quantum yield. Jablonski diagram - radiative and non-radiative processes – internal conversion and inter system crossing. Photosensitization and photosynthesis (PSI and PSII). 3.2 Primary and secondary processes – Factors affecting fluorescence, conditions for phosphorescence, chemiluminescence, bio-luminescence.	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

IV	**Kinetics and characterization of photochemical reactions** 4.1 Experimental techniques– chemical actinometers - uranyl oxalate, ferric oxalate and malachite green. 4.2 Kinetics of photochemical reactions – photophysical kinetics of unimolecular processes, formation of HCl, HBr – flash photolysis. Quenching - static and dynamic, Stern-Volmer equation.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Surface chemistry and colloids** 5.1 Physical and chemical adsorption – Adsorption isotherms – Langmuir, Freundlich and Brunauer–Emmett–Teller (BET) equations (No derivation for BET) – derivation of Gibb's adsorption equation. Determination of surface area using Langmuir and BET equations. 5.2 Colloids: Lyophobic and lyophilic sols, origin of charge and stability of lyophobic colloids – coagulation and Schultz-Hardy rule, zeta potential and Stern double layer (qualitative idea) – optical properties – Tyndall effect. Mechanical properties – Brownian motion, electrokinetic phenomenon (qualitative idea), micelles and reverse micelles, critical micelle concentration – applications of colloids.	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. Quantum Chemistry, I.N. Levine, 7th Edition, 2016, Pearson Education, London,
2. Physical Chemistry, P.W. Atkins ,8th edition,2016, Pearson Education, London
3. Chemical applications of Group theory, F.A. Cotton,2nd Edition,1992, Wiley Eastern, Singapore.
4. Principles of Physical Chemistry, B.R Puri, L.R Sharma, M.S. Pathania, 47 th edition, 2016, Vishal publishing.
5. Fundamentals of Physical Chemistry, S.H. Maron, J.B. Lando, C.F. Prutton, Macmillan 1971.
6. Group theory and its applications in Chemistry, K.V. Raman,1990,7th Edition, Tata McGraw Hill
7. Text book of Physical Chemistry, M.V.Sangaranarayanan, B.Mahadevan, University press,2011.

Suggested Readings

1. Quantum Chemistry, D.A. McQuarrie, 3rd Edition, 1970. Univ.Sci.Books, Mill Valley, California.
2. Quantum Chemistry, J.P.Lovwe, K.A.Peterson, 3rd Edition, 2008, Academic Press, New York.
3. Group Theory in Chemistry, V. Ramakrishnan, M.S. Gopinath, 2010, Vishal publication.

4. Physical Chemistry, P. Atkins, J.D. Paula, 9th edition,2010,Oxford University Press.
5. Quantum Chtemistry, R.K. Prasad, 3rd Edition, 2001, New Age International.
6. Introductory Quantum Chemistry, A.K Chandra 4 Edition, 1994, Tata McGraw Hill Education.
7. Fundamentals of Photochemistry, K.K. Rohatgi Mukherjee, 1978,New Age International Publication, New Delhi.

Web Resources

1. https://nptel.ac.in/content/storage2/courses/122101001/downloads/lec-36.pdf
2. https://nptel.ac.in/courses/104/101/104101124/
3. https://nptel.ac.in/courses/104/108/104108057/

Course Outcomes (COs) and Cognitive Level Mapping

Cos	CO Description	Cognitive Level
CO 1	To define and understand the basic concepts of quantum mechanics, group theory, photochemistry and surface chemistry.	**K1, K2**
CO 2	To classify the molecules into point groups and solve problems based on surface area, quantum yield and eigen function.	**K3**
CO 3	To examine the importance of molecular symmetry, photoelectric effect, photo physical processes, properties of colloids and kinetics of photochemical reactions.	**K4**
CO 4	To critique the limitations of classical mechanics and compare thermal, photochemical reactions, actinometry adsorption isotherm and to interpret symmetry of molecules.	**K5**
CO 5	To derive the Schrodinger wave equation, stern-volmer equation and different adsorption isotherm equation and summarize the applications of group theory.	**K6**

Course Code	UCH 6503
Course Title	SYNTHETIC ORGANIC CHEMISTRY AND HETEROCYCLIC COMPOUNDS
Credits	06
Hours/Week	06
Category	Major Core (MC) - Theory
Semester	VI
Regulation	2019

Course Overview

1. Synthetic organic chemistry covers the fields of organic chemistry, natural products and medicinal chemistry.
2. The aim of the course is to give advanced knowledge about the planning of synthesis of organic molecules from simple starting materials.
3. The different modules of the course will explore the applications of various reagents towards the target molecules.
4. This course also reviews the chemistry of 5,6-membered heterocyclic compounds.
5. This course will focus on the planning of synthesis of any chosen target molecule, use of various selected reagents and their application in the organic synthesis and chemistry of 5-, 6- and benzo fused heterocyclic compounds.

Course Objectives

1. Construct synthetic routes to achieve any given target molecules through retrosynthetic analysis.
2. Choose different reagents and use them for the fundamental organic transformations.
3. Compare the concepts of pericyclic reaction mechanisms.
4. Associate the basic aspects of 5- & 6- membered heterocyclic compounds.
5. Deduce the synthetic methodologies of heterocyclic compounds.

Prerequisites	Knowledge of basic concepts of chemistry.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Retrosynthetic analysis** 1.1 Synthetic strategies: Introduction, retro synthetic analysis, target molecule, disconnection, synthons, synthetic equivalent functionalization, functional group interconversion. 1.2 Retrosynthetic analysis: Strategies; C-C and C-hetero atom disconnection, two group disconnections: 1,2- and 1,3-difunctional compounds, alternate synthetic routes, key intermediates; consecutive and convergent synthesis; synthesis based on Umpolung concepts of Seebach; regiospecific control elements;	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	use of protecting groups, activating groups and bridging elements. 1.3 Retrosynthesis of simple organic compounds: Acetyl acetone, 2,3-butadione, trans-diols, *sym*-tribromobenzene, *m*- and *p*-bromoaniline, N, N-dipropylamine, amelfolide, daminozide, cetaben ethyl ester, 2,4-dichlorophenoxyacetic acid and ofornine.			
II	**Synthetic applications of selected reagents** 2.1 Reduction: Catalytic hydrogenation (homogeneous and heterogeneous), Reductions with LAH, $NaBH_4$ and DIBAL; hydroboration-oxidation, Birch, Clemmenson and Wolf-Kishner reduction. 2.2 Oxidation: Catalytic dehydrogenation, oxidation with Cr (VI) and Mn (VII) reagents. Use of $Pb(OAc)_4$, OsO_4, peracids, DMSO with oxalyl chloride, NBS, SeO_2 and Ti (III) nitrate. 2.3 Organoboron and organoaluminium: synthesis and applications in C-C bond forming reactions.	15	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Pericyclic Reactions** 3.1 Cycloaddition reactions: (2+2, 4+2); Diels -Alder, intramolecular addition reactions. Electrocyclization reaction: 1,3-butadiene, 1,3,5-hexatriene derivatives. 3.2 Sigmatropic rearrangements: (1,3), (1,5), (3,3) and (5,5)-sigmatropic rearrangements, Cope, Oxy-Cope, Claisen, Sommelet-Hauser rearrangement; Group transfer reactions. 3.3 Thermal and photochemical Frontier Molecular Orbital approach.	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**Heterocyclic Compounds-I** 4.1 Introduction, classification and aromaticity. 4.2 Five membered rings: Preparation of furan, pyrrole and thiophene; reactions: electrophilic and nucleophilic substitutions, oxidation and reduction reactions; six membered rings: pyridine; preparation by ring closure reactions, reactions: mechanism of electrophilic and nucleophilic substitutions, oxidation and	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	reduction reactions. 4.3 Saturated and partially saturated heterocyclic compounds: reactions and synthesis of tetrahydrofuran, dioxan, sulpholones, tetrahydropyrrole, tetrahydrothiophene, piperidine and derived systems.			
V	**Heterocyclic Compounds-II** 5.1 Indole, isoindole, benzofuran and benzothiophene, preparation and properties. 5.2 Quinoline and isoquinoline: preparation by ring closure reactions. 5.3 Reactions: mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions.	15	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, Second Edition, 2016.
2. M. B. Smith, Organic Synthesis 3rd edn, McGraw Hill International Edition, 2011.
3. Ian Fleming, Pericyclic Reactions 2nd edn, Oxford Science Publications, 2015.
4. V.K. Ahluwalia and Renu Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, 2001.
5. J.A. Joule, G.F. Smith, Heterocyclic Chemistry, Garden City Press, Great Britain, 2004.
6. W. Caruthers, Some Modern Methods of Organic Synthesis 4thedn, Cambridge University Press, Cambridge, 2007.
7. Rakesh K. Parashar, Heterocyclic Compounds, Ane Books Pvt. Ltd, 2010.
8. N.K. Tewari, Aromaticity and Pericyclic Reactions, Ayushman Publication House, 2018.

Suggested Books

1. R.E. Ireland, Organic synthesis, Prentice Hall India, Goel publishing house, 1990
2. Kiochi Tanaka, Solvent Free Organic Synthesis, Wiley VCH, Weinheim, 2003.
3. Paula Yurkanis Bruice, Organic Chemistry 8thedn, Pearson, 2017.
4. R. T. Morrison, R. N. Boyd and S. K. Bhattacharjee, Organic Chemistry 7thedn, Pearson, 2016.
5. V. K. Ahluwalia, Organic Reaction Mechanism, Ane Books Pvt. Ltd, 2007.
6. J. A. Joule, K. Mills, Heterocyclic Chemistry 4thEdn, John-Wiley, 2010.
7. Ratan Kumar Kar, Applications of Redox and Reagents in Organic Synthesis Vol I, New Central Book Agency, 2008.
8. S.P. Bhutani, Organic Chemistry, Ane Books Pvt. Ltd, 2007.

Web Resources

1. https://bit.ly/3Ec2Id4
2. https://bit.ly/2Zng5bF
3. https://bit.ly/3m6rVzs
4. https://bit.ly/3BbvR6m

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	understand the basic concepts of retrosynthesis, pericyclic reactions and heterocyclic chemistry.	**K1, K2**
CO 2	integrate and assess the different methods of disconnection approaches and heterocyclic compounds synthesis.	**K3**
CO 3	illustrate the applications of retrosynthesis and to study the mechanism of specialized reactions.	**K4**
CO 4	analyse various pericyclic reactions, target molecule synthesis and to appreciate the synthesis and reactions of heterocyclic compounds.	**K5**
CO 5	construct the structure of new heterocyclic and other organic compounds by retrosynthesis, pericyclic and modern synthetic reactions.	**K6**

Course Code	UCH 6701 + UCH 6706 + UCH 6705
Course Title	INDUSTRIAL CHEMISTRY-THEORY - LAB - INTERNSHIP
Credits	15 (Theory: 5, Lab: 5, Internship: 5)
Hours/Week	12 (Theory: 6, Lab: 6)
Category	Major Skill (MS)
Semester	VI
Regulation	2019

Course Overview

1. Industrial Chemistry is a skill-based course that will govern through theory, practicals, computer lab and seminar.
2. The aim of the course is to impart blended knowledge on industrial methods and products.
3. This course covers chemistry of the fuels, agricultural, water treatment, chemical toxicology, analysis of food products and communications skills.
4. This course illustrates MS Excel, drawing chemical structures using Chem Draw, and presentation of data.
5. The course imparts the importance of internship.

Course Objectives

1. To develop their creativity, critical thinking, leadership, and employability skills.
2. To transform the acquired theoretical knowledge to industry and vice-versa,
3. To familiarize with different branches of chemistry and to develop entrepreneurship skills.
4. To apply computational knowledge in data handling.
5. To develop communication skill in oral presentation.

Prerequisites	Basic knowledge of chemistry.

Course Code	UCH 6701
Course Title	INDUSTRIAL CHEMISTRY - THEORY
Credits	05
Hours/Week	06
Category	Major Skill (MS)
Semester	VI
Regulation	2019

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Industrial fuels** 1.1 Energy: Types- heat, electrical, mechanical, light, nuclear and solar energy, hydrogen, fuel cells. Sources: renewable and non-renewable, classification of fuels: solid, liquid and gaseous. 1.2 Solid fuels: Coal- types– lignite, sub-bituminous coal, bituminous coal and anthracite. Coking and non-coking coal – properties and uses. 1.3 Liquid fuels: Refining of crude petroleum and uses of fractions. Hydro desulphurisation. Cracking: thermal and catalytic - fixed bed and fluidized bed. Octane and cetane number. Uses of ethyl tertiary butyl ether and methyl tertiary butyl ether. 1.4 Gaseous fuels: Natural and gobar gas: production, composition and uses. Gobar electric cell.	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
II	**Agricultural chemistry** 2.1 Fertilizers: NPK, superphosphate, triple superphosphate, uses of mixed fertilizers. Micro nutrients and their role, bio fertilizers, plant growth hormones. 2.2 Pesticides: classification with examples, insecticides; stomach poisons, contact insecticides, fumigants. Manufacture and uses of aldrin, dieldrin, endrin and pentachlorophenol and its sodium salts, bio pesticides. Herbicides: 2,4-D and 2,4,5-T.	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	Fungicides: Preparation of Bordeaux mixture. Mention of lime-sulphur and creosote oil. 2.3 Sugar industry: Refining and grading of sugar. Saccharin: synthesis and use of sugar substitutes- aspartame. Ethanol: manufacture from molasses by			
III	**Water Treatment** 3.1 Introduction: Hardness of water – temporary and permanent. Units of hardness, disadvantages of hard water –domestic, industry and steam generation in boilers. Effect of iron and manganese in water. Estimation of hardness – EDTA method – Estimation of total hardness – O. Hehner's method or alkali titration method. 3.2 Water softening methods: Lime – soda and zeolite process; ion-exchange - demineralization - deionization process. Mixed – bed deionization. Removal of suspended impurities and microorganism – chlorination, break point chlorination, reverse osmosis, desalination and waste water treatment.	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**Pollution and Chemical Toxicology** 4.1 Pollution: Air pollution - acid rain. Greenhouse effect (global warming), ozone layer depletion - photochemical oxidants. Smog and Control of air pollution. Water pollution – organic pollutants, chemical oxygen demand (COD), biological oxygen demand (BOD), total organic carbon. International standards for water and air quality and regulations. 4.2 Chemical toxicology: Effect of toxic chemicals on enzymes. Lead, mercury and cyanide pollution and their biochemical effects. Carbon monoxide, sulfur dioxide, oxides of nitrogen, ozone –biochemical effects.	15	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Common Industrial Products** 5.1 Paint: manufacture and types-enamel, oil, emulsion, cement, bituminous, plastic, anticorrosive and cellulose. Glass: manufacture and types-potash, pyrex, crown and lead crystal. Dyes: manufacture and types-acid, direct, vat, disperse.	15	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	5.2 Lubricants, greases, refractories, abrasives. 5.3 Preparation of perfumes, matches and explosives. Vulcanization of rubber			

Books for Study

1. B. K. Sharma, Industrial Chemistry: Including Chemical Engineering, Goel Publishing house, Meerut, India, 1994.
2. P. C. Jain, M. Jain, Engineering chemistry, 15th edn, Dhanpat Rai publications, 2015.
3. D. J.Zalucha,., and K. J. Abbey. "Kent and Riegel's Handbook of Industrial Chemistry and Biotechnology." Springer, 2007
4. W. Francis, M. C. Peters, Fuel and fuel Technology, Pergamon, 2nd edition, 1980.
5. R.K. Kaleeswari R. Rajeswari J. Prabhaharan C. Bharathi, Elements of Agricultural Chemistry, Sathish Serial publishing House,2014.

Suggested Readings

1. C. A. Heaton, An Introduction to Industrial Chemistry, Springer Science & Business Media,1996.
2. J. C. Kuriakose, J. Rajaram, Chemistry in engineering and technology, Tata Mcgraw hill: New Delhi, Vol. 2, 2001.
3. Jugal, Kishore, Agrawal, Practicals in Engineering Chemistry, Oxford and IBH Publishing Co., New Delhi,1976.

Web Resources

1. https://bit.ly/3GgvJGE
2. https://bit.ly/3CffaIQ
3. https://bit.ly/3FNHWSQ
4. https://bit.ly/3B8lPD1

Course Outcomes of UCH 6701(COs) and Cognitive Level Mapping

Cos	CO Description	Cognitive Level
CO1	To understand the basic differences in the properties of types of fuels, fertilizers. Pesticides, lubricants and dyes.	**K1, K2**
CO 2	To illustrate the different processes of water Softening and estimation of hardness of Water and biochemical effects of pollutants in air and water.	**K3**
CO 3	To construct new methods of synthesizing consumer product.	**K4**
CO 4	To predict the advantages and disadvantages of using industrial products against natural products.	**K5**
CO 5	To create the knowledge about purification of water, paints, varnishes, fertilizers and pesticides and to integrate their contribution with pollution and to explain the refining and grading of sugar, water and air qualities, paints, dyes and lubricants.	**K6**

Course Code	UCH 6706 + UCH 6705
Course Title	INDUSTRIAL CHEMISTRY LAB + INTERNSHIP
Credits	5 + 5
Hours/Week	6 + 3-4 WEEKS
Category	Major Skill (MS)
Semester	VI
Regulation	2019

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**A. Analysis of Food Products** 1. Estimation of hardness of water. 2. Estimation of iodine value/acid value/Reichert Meissel value of edible oil. 3. Estimation of iodine in iodised salts. 4. Estimation of ascorbic acid. 5. Estimation of calcium content in sugar cane juice. 6. Estimation of glucose. 7. Estimation of glycine. 8. Estimation of acetic acid in vinegar. 9. Isolation of casein/lactose from milk. 10. Detection of adulterants in common food products.	26	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
	B. Small scale preparation of following consumer products. 1. Hard Soap 2. Soft Soap 3. Pain Balm 4. Chalk piece 5. Tooth paste 6. Shampoo 7. Detergent powder 8. Ink 9. Phenoyl (Toilet Cleaner) 10. Soda 11. Bleaching powder 12. Hand sanitizer 13. Natural mosquito repellent 14. Perfumes	16	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	15. Shoe polish 16. Nail polish			
II	**Application of computers in Chemistry** **(2 Hours/week)** 1. General introduction to MS Excel 2010 2. Building worksheets. 3. Calculations involving standard mathematical functions. 4. Data – Editing, manipulation. Data presentation –Table, Chart, Graph. 5. Printing of spread sheet data and graph. 6. Chem. Draw (Demonstration)	36	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Books for Study

1. N. S. Gnanapragasam and G. Ramamurthy, Organic Chemistry Lab Manual, S. Viswanathan printers and publishers Ltd, I ed., 2002.
2. R. Norris Shreve, and A. Joseph Brink, Chemical process industries, McGraw Hill Kogakusha Ltd. 4th ed., 1997.
3. George T. Austin, Shreve's Chemical Process Industries, McGraw – Hill, I ed.,1984.
4. N. S. Subbarao, Biofertilizers in agriculture, University press, 1st edn, 2005.
5. K.V. Raman, Computers in Chemistry, Tata McGraw-Hill Ltd 1st edn. 1993.

Suggested Readings

1. 1. P. Kamaraj, R. Jeyalakshmi, V. Narayanan, Chemistry in engineering and technology, Sudhandhira publications: Chennai. 2001.
2. J.C. Kuriakose, J. Rajaram, Chemistry in engineering and technology, Tata McGraw Hill: New Delhi, vol.2, 1988
3. Jugal, Kishore, Agarwal, Practicals in Engineering Chemistry, Oxford and IBH Publishing Co., New Delhi, 1976.
4. Mary George and Geetha Swaminathan, Laboratory Chemical Methods in Food Analysis, Margham Publications, Chennai, 2002
5. Julia Kelly, Using Microsoft Excel 2000, Prentice-Hall of India, 1999.
6. A. Robert de Lavie, Spreadsheet workbook for Quantitative chemical analysis, McGraw-Hill, Inc. New Delhi, 1997.

Web Resources

1. https://bit.ly/2XBVcZu
2. https://bit.ly/2ZqJIZE
3. https://bit.ly/3vQf6wN
4. https://bit.ly/3pJMuUX
5. https://bit.ly/3E73jwF

Course Outcomes of UCH 6706

COs	Statements	Bloom's Level
CO 1	To estimate the characteristic parameters of water, fats and oils.	**K1 K2**
CO 2	To determine the amount of calcium, ascorbic acid, glucose, glycine, acetic acid, casein and lactose present in food products.	**K3**
CO 3	To apply the Microsoft excel to solve simple chemistry problems and present the data in the form of table and graph.	**K4**
CO 4	To acquire entrepreneur skills to prepare consumer products in a small scale.	**K5**
CO 5	To develop the presentation and communication skills through seminar	**K6**

Overall Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand the basic concepts of fuels, fertilizers, water and air qualities, industrial products, building worksheets, isolation and estimation of compounds.	**K1, K2**
CO 2	To illustrate the different types of industrial fuels, agricultural products, water softening methods, toxicological effects, preparation of cosmetic products.	**K3**
CO 3	To analyse the fuels, pesticides, water softening agents, chemical toxicology, dyes, data from practical experiments and different methods of estimations of compounds.	**K4**
CO 4	To determine the calorific value of fuels, grading of sugar, BOD and COD, compositions of industrial products, iodine, acid and RM value of an edible oils.	**K5**
CO 5	To construct the water softening methods, a table of experiment data in MS Excel and to synthesize the sugar substitutes and perfumes.	**K6**

Course Code	UCH 2301
Course Title	CHEMISTRY FOR BIOLOGY
Credits	02
Hours/Week	04
Category	Allied Required (AR) – Theory
Semester	II
Regulation	2019

Course Overview

1. Chemistry for biology paper provides the fundamental concepts in chemistry that are essential to biologists.
2. An exposure to error and data analysis can certainly help to achieve precision and accuracy in their experiments.
3. A few modules of the course explore the application of chemical techniques including separation and titrimetry.
4. The other module illustrates the safe means to use, store and transport chemicals.
5. This course focuses on achieving a fundamental understanding of chemistry that is broadly applicable in everyday life.

Course Objectives

1. To understand the guidelines regarding the proper use, handling and storage of chemicals, and the quick response in the event of an emergency in the laboratory.
2. To have a mastery over the methods for separating mixtures using the techniques such as distillation, crystallization and the chromatography.
3. To provide students with the required theory on the quantitative analysis which includes preparation of standard solution, standardization of the solutions, calculation and interpretation of the results.
4. To familiarize with the characteristics of ionic, covalent, coordinate and hydrogen bonds.
5. To comprehend the chemistry of polymers, dyes, soaps, detergents and milk.

Prerequisites	Basic knowledge of Chemistry

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Safety, Storage and handling of chemicals** 1.1 Safety: Safety rules, first aid procedure, LPG, material safety data sheet (MSDS). 1.2 Storage of chemicals: Rules for storing chemicals. 1.3 Handling: Handling of acids, ethers, toxic and poisonous chemicals. Antidotes.	9	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

II	**Separation techniques** 2.1 Solvent extraction, Distillation: Steam and fractional distillation, crystallization, fractional crystallization. 2.2 Chromatography: Types – paper, thin layer and column chromatography, gel electrophoresis.	9	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Unit 3. Volumetric Analysis** 3.1 Data analysis, Errors in chemical analysis: Accuracy, precision. Types of error-absolute and relative errors, methods of eliminating and minimizing errors. 3.2 Principle of titrations, Concentration terms: Molarity, molality, normality, formality, ppm and ppb. 3.3 Titrations: Types, acid-base titrations, ionic product, Indicators: types and uses, pH, common ion effect, buffer solutions: Principle, preparations and uses.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**Unit 4. Chemical bonding** 4.1 Ionic Bond: Characteristics of ionic compounds, Factors influencing the formation of ionic bond. 4.2 Covalent Bond: Characteristics of covalent compounds. 4.3 Coordinate Bond: Nature of coordinate bond. Coordination complexes - Structure and functions of chlorophyll and hemoglobin. 4.4 Hydrogen Bond: Theory, types and importance of hydrogen bonding.	13	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Chemistry in everyday life** 5.1 Polymers: Monomers, Types - Natural and synthetic, biodegradable polymers, vulcanization of rubber. 5.2 Dyes: Requirements, Chromophore, auxochrome, types based on application. 5.3 Soaps and detergents: Types, Saponification, cleaning action. 5.4 Milk: Composition of milk, homogenization, pasteurization.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. R. Gopalan, S. Sundaram, Allied Chemistry, Sultan Chand & Sons (P) Ltd, 4th edn., 2006.
2. R. Gopalan, P. S. Subramanian and K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand & Sons, New Delhi, 2003.
3. U. N. Dash, Analytical Chemistry: Theory and Practice, Sultan Chand and sons Educational Publishers, New Delhi, 2011.
4. U. Sathyanarayana, Biochemistry, Books and allied (P) Ltd, 4th edn., 2013.
5. B.R. Puri and L.R. Sharma, M.S. Pathania, Principles of physical chemistry, Vishal Publication Co., 46th edn., 2013.

Suggested Readings

1. D.A. Skoog, D.M. West, F.J. Holler, Analytical Chemistry: An Introduction, Saunders college publishing, 5th edn., 1998.
2. B.R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand and Co., 2014.
3. G.C. Hill, J.S. Holman, Chemistry in Context 5thedn., ELBS, 2017.
4. W.R. Kneen, M.J.W. Rogers, P. Simpson, Chemistry – Facts, patterns and principles, ELBS, 1999.
5. B. K. Sharma, Industrial Chemistry, Goel Publishing House, New Delhi, 2000.

Web Resources

1. https://bit.ly/3vEuTOV
2. https://bit.ly/3aKo2K0
3. https://bit.ly/3pr9Tu5
4. https://bit.ly/3lHcuh2
5. https://bit.ly/3vm55Hd
6. https://bit.ly/3ANpbLw

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand and recall definitions, basics of titration, chemical bonding and composition of chemical compounds.	**K1, K2**
CO 2	To Calculate errors in chemical analysis to express concentration of solutions in various units and clarify the chemical compounds used in day-to-day life.	**K3**
CO 3	To illustrate the characteristics of different types of chemical bonding, principle of volumetric analysis and separation techniques	**K4**
CO 4	To outline the importance of safe handling, storage of chemicals, data analysis, chemistry in daily life, bonding and functions of biologically important compounds.	**K5**
CO 5	To explain the role of different chemicals and bonding, buffer solutions, methods of separating mixtures and chemistry in everyday life.	**K6**

Course Code	UCH 2302
Course Title	CHEMISTRY PRACTICALS FOR BIOLOGY
Credits	01
Hours/Week	02
Category	Allied Required (AR) - Practicals
Semester	II
Regulation	2019

Course Overview

1. Chemistry practical for biology involves the analysis of organic compounds.
2. The laboratory exercise has been designed to give a practical knowledge on analysing organic compounds.
3. The importance of this course is to understand the properties of organic compounds and their possible impact on biological molecules.
4. The analysis includes nitrogen containing and non-nitrogen containing organic functional groups.
5. This course gives understanding of overall analysis of any organic compound.

Course Objectives

1. To understand the basic principles of practical organic chemistry.
2. To handle the chemicals safely and properly to analyse the functional groups of organic compounds.
3. To interpret the results to identify various organic compounds.
4. To explain the reason for the results obtained during each experiment.
5. To develop a technique to analyze biological compounds based on the knowledge of organic analysis.

Prerequisites	Basic knowledge of organic chemistry.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Organic Analysis** 1) Detection of nitrogen 2) Tests for aromaticity 3) Tests for saturation 4) Identification of chemical nature (acidic/basic/neutral) of the following functional groups I. Carboxylic acid II. Phenols III. Aldehydes IV. Ketones V. Carbohydrates VI. Primary amines VII. Amides	26	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Suggested Readings

1. V. Venkateswaran, R. Veeraswamy and A.R. Kulandaivelu, Basic Principles of Practical Chemistry, 2nd edn., S. Chand Publications, New Delhi, 2017.
2. N.S. Gnanapragasam, G. Ramamurthy, Organic chemistry – Lab manual, S. Viswanathan Co. Pvt. Ltd., 2012.
3. Raj K. Bansal, Laboratory Manual of Organic Chemistry, 5th edn., New Age International Edition, New Delhi, 2012.
4. J.N. Gurtu and R. Kapoor, Advanced Experimental Chemistry (Organic), S. Chand and Co., 1987.

Web Resources

1. https://bit.ly/3m6u2Dx
2. https://bit.ly/3vet23a

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand the principle of organic analysis.	**K1, K2**
CO 2	To identify the properties of organic compounds.	**K3**
CO 3	To analyse the functional groups systematically.	**K4**
CO 4	To obtain skills to test the organic compounds.	**K5**
CO 5	To differentiate the aromatic and aliphatic functional compounds through complete analysis.	**K6**

Course Code	UCH 2303
Course Title	CHEMISTRY FOR PHYSICS
Credits	02
Hours/Week	04
Category	Allied Required (AR) – Theory
Semester	II
Regulation	2019

Course Overview

1. The course Chemistry for Physics facilitates learners to understand the fundamentals of analytical, coordination, ionic equilibria, kinetics and industrial chemistry.
2. The course also imparts learners with the essential information about concepts of various chemistry fields.
3. This paper clearly explains the basic knowledge about volumetric analysis, theories of coordination compounds and concepts of acids and bases.
4. This course explains the rate, order of the reactions, types of batteries, and photochemical laws.
5. The course provides the theoretical knowledge of industrial chemistry like water treatment, water purification process and polymer.

Course Objectives

1. To understand the basic principles of volumetric analysis, learn to use it in practical ways.
2. To acquire the knowledge about the name of the given coordination compounds.
3. To explain the basic concepts of acids and bases.
4. To apply the knowledge about order in different types of reactions.
5. To learn the different types of water purification process.

Prerequisites	Basic knowledge of Chemistry

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	1.1 Safety and handling of chemicals: Methods of expressing concentration: normality, molarity, molality, mole fraction, ppm, ppb. Primary and secondary standards: preparation of standard solutions. 1.2 Principle of volumetric analysis: end point and equivalence point. Accuracy-Precision-Types of error, methods of minimization of errors.	9	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

II	2.1 Double salts and coordination compounds. Basic concepts and rules for naming coordination compounds, Types of ligands – Chelate effect. 2.2 Theories: Werner and valence bond theories - Relationship between magnetism and geometry - $K_4Fe(CN)_6]$, $[CoF_6]^{3-}$, $[Ni(CO)_4]$, $[NiCl_4]^{2-}$. Application of coordination complexes: Erio chrome black - T as metal ion indicator.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	3.1 Ionic Equilibria**:** Acids and bases- Arrhenius and Lewis concept. Strong and weak electrolytes. Ionic product of water, pH, pK_a, pK_b. Solubility, solubility product of sparingly soluble salts. Common ion effect, buffer solutions, Henderson equation. 3.2 Electrochemistry: Electrolytic and electrochemical cells, cell representation. Energy storage – primary and secondary batteries – Laclanche cells, Sodium-Sulphur, Lead-acid and Lithium ion batteries.	10	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	4.1 Kinetics: Rate, rate law, rate constant, order and molecularity. Derivation of rate expression for first and second order reaction – equal concentration of reactants. Methods of determining order of a reaction. Factors affecting the rate of a reaction, Arrhenius equation. 4.2 Photochemistry: Comparison between thermal and photochemical reactions, Grotthus-Draper law, Stark-Einstein law, Beer-Lambert law - derivation, verification and applications. Jablonski diagram, quantum yield, photosensitization.	12	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	5.1 Water treatment: hardness of water- temporary and permanent hardness, disadvantages of hard water. Estimation of hardness by EDTA method. 5.2 Water purification process – ion exchange, reverse osmosis, activated charcoal treatment, Desalination,	11	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	Disinfection – ozone, UV, chlorination, BIS- specification of drinking water. 5.3 Polymers: Classification – natural and synthetic, addition and condensation polymerization. Thermoplastics: Polyvinyl chloride and Polytetrafluoro ethylene and thermosetting plastics: Bakelite (Synthesis and applications only). Recycling of polymers - significance. Biodegradable polymers – examples and significance.			

Text Books

1. R. Gopalan, K. Rangarajan, P.S. Subramanian, Elements of Analytical Chemistry, 3rd.edn., Sultan Chand and Sons, 2017.
2. R. Gopalan, S. Sundaram, Allied Chemistry, 4th.edn., Sultan Chand and Sons, 2006.
3. G. D. Tuli, R. D. Madan, Wahid U. Malik, Selected Topics in Inorganic Chemistry, 17th.edn., Sultan Chand and Sons, 2017
4. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, 46th.edn., Vishal Publishing Co. Jalandhar, 2013.
5. V.R. Gowariker, Polymer Science, Wiley Eastern, 1995.
6. P.C. Jain, M. Jain, Engineering Chemistry, 16thedn., Dhanpatrai and sons: Delhi, 2004.

Suggested Readings

1. G.C. Hill, J.S. Holman, Chemistry in Context, ELBS, 1998.
2. W.R. Kneen, M.J.W. Rogers, P. Simpson, Chemistry – Facts, patterns and principles, ELBS, 1999.
3. Bruce H. Mahan, University Chemistry, 3rd.edn., Addition-Wesley Publishing Company, 1977.

Web Resources

1. https://bit.ly/3m5qK3h
2. https://bit.ly/3E6ntHh

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand the safe methods of handling chemicals	**K1, K2**
CO 2	To write the IUPAC nomenclature of coordination complexes and discuss the theories of coordination compounds.	**K3**
CO 3	To compute parameters such as pH, pka, pkb of electrochemical cells.	**K4**
CO 4	To derive kinetic parameters and fundamental laws of photochemistry.	**K5**
CO 5	To discuss the various industrial processes.	**K6**

Course Code	UCH 2304
Course Title	CHEMISTRY PRACTICAL FOR PHYSICS
Credits	01
Hours/Week	02
Category	Allied required (AR) - Lab
Semester	II
Regulation	2019

Course Overview

1. This course helps the students to get trained in the preparation of solutions, safe handling of chemicals and apparatus.
2. The hands-on training gained in performing the experiments would harness the skill for industry.
3. This course provides an opportunity to develop the experimental skills of the students.
4. This course accomplishes analytical and technical caliber for their career.
5. The laboratory experience gained would develop skills in scientific methods of planning, executing and reporting the experimental data.

Course Objectives:

1. To equip the students with practical skills in Chemistry.
2. To understand the basic principles behind the volumetric analysis.
3. To find out the end point and estimate the amount of the analyte using titrations.
4. To develop the skills to obtain accuracy and precision in experiments.
5. To gain the analytical skills for the estimation of chemical compounds.

Prerequisites	Basic knowledge of volumetric analysis

SYLLABUS

EXPT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**ACIDIMETRY AND ALKALIMETRY** 1. Estimation of NaOH 2. Estimation of Na_2CO_3 3. Estimation of HCl	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
II	**PERMANGANOMETRY** 1. Estimation of Oxalic acid. 2. Estimation of ferrous ammonium sulphate	4	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**IODOMETRY** 1. Estimation of $K_2Cr_2O_7$ 2. Estimation of copper.	7	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

IV	**COMPLEXOMETRIC TITRATIONS** 1. Estimation of zinc 2. Estimation of hardness of water by EDTA.	7	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. J.N. Gurtu and R. Kapoor, Experimental Chemistry, S.Chand and Co, 1987.
2. D. N. Bajpai, O. P. Pandey, S. Giri, Practical Chemistry, S.Chand and Co, 2013.
3. V K Ahluwalia, Sunita Dhingra, Sunita Dhingram, College Practical Chemistry, Universities Press, 2005.
4. P.C. Kamboj, Advanced University Practical Chemistry, Part I, Vishal Publishing Co. 2014.
5. Chirag Fultariya, Jalpa Harsora 2017, Volumetric Analysis Concepts and Experiments, Lulu.com.

Suggested Readings

1. Peter McPherson, Practical Volumetric Analysis, Royal Society of Chemistry, 2015.
2. R. Shobha, M. Banani, Essentials of Analytical Chemistry, Pearson, 2017.
3. V. Venkateswaran, R. Veeraswamy and A.R. Kulandaivelu, Basic Principles of Practical Chemistry, 2ndedn.,S.Chand Publications, New Delhi, 2004.
4. S. Sundaram and K. Raghavan, Practical Chemistry, S. Viswanthan Co. Pvt, 1996.
5. G. Svehla, 2011, Vogel's Text Book of Inorganic Qualitative Analysis, 7th edition, Pearson Education.

Web Resources

1. https://bit.ly/3B7tOQV
2. https://bit.ly/30V85ze
3. https://bit.ly/3B5WOIQ
4. https://bit.ly/3C9PXPS
5. https://bit.ly/30Ip9rZ
6. https://bit.ly/3BPnwqc

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To recall the principle of the volumetric analysis and the significance of indicators.	**K1, K2**
CO 2	To perform the titrations of different types based on the relevant procedure.	**K3**
CO 3	To observe the end points of the titration and record the concordant titre values.	**K4**
CO 4	To determine quantitatively the concentration and weight of the given analyte.	**K5**
CO 5	To consolidate and present the result of the experiments scientifically.	**K6**

Course Code	UCH 3401
Course Title	APPLIED CHEMISTRY FOR PHYSICS
Credits	03
Hours/Week	03
Category	Allied Optional (AO) - Theory
Semester	III
Regulation	2019

Course Overview

1. The specific aim of the course is to provide the fundamental aspects of functional materials.
2. This course discusses and relates the phase rule and its applications for various phase transitions.
3. The course also provides the knowledge of different types of corrosion and prevention methods.
4. This subject also covers the principle and applications of thermogravimetric analysis.
5. The classifications of carbohydrates and lipids are also included in this course to discuss the structures of biomolecules**.**

Course Objectives

1. To list the theories and applications of various functional materials.
2. To analyze the stability of chemical compounds by thermogravimetric analysis.
3. To explain the applications of phase rules in the separation of pure component from the mixtures.
4. To access the knowledge of corrosion chemistry and its prevention methods.
5. To evaluate the structure and functions of biomolecules**.**

Prerequisites	Basic knowledge of chemistry

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Functional Materials** 1.1 Superconductivity: Introduction, Meissner effect, critical magnetic field, critical current. Josephson effect. Bardeen, Cooper and Schrieffer theory and cooper pairs. Types and applications of superconducting materials. 1.2 Nonlinear optics and liquid crystals: Introduction to nonlinear optics, single harmonic generation and optical mixing. Liquid crystals – Introduction, classification with examples of nematic, smectic, cholestric and columnar liquid crystals. Properties and applications.	7	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
II	**Thermoanalytical methods** 2.1 Thermal methods – principle and instrumentation of TGA, DTA and DTG.TGA of $CaC_2O_4 \cdot H_2O$ and $AgNO_3$. DTG of $CuSO_4 \cdot 5H_2O$. DTA of sulphur and $CaC_2O_4 \cdot H_2O$.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	2.2 Factors affecting thermogram.			
III	**Phase Diagram and Phase Transitions** 3.1 Phase rule: Concepts of phase, components and degrees of freedom with examples. Gibb's phase rule – derivation and their applications to equilibrium in phase transitions. (solid- liquid, liquid- vapour and solid- vapour). 3.2 One component and two component systems: Phase diagram of water and sulphur, simple eutectic, lead- silver system.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**Corrosion** 4.1 Introduction – definition, types of corrosion – direct, electrochemical, galvanic, liquid metal, erosion and microbiologically influenced corrosion. 4.2 Corrosion and its prevention, control by internal and external means - conditioning and alloying the metals, corrosion inhibitors, modification of corrosion environment, protective and organic coatings, cathodic and anodic protection.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Biomolecules** 5.1 Lipids and amino acids: Classification of lipids, iodine value, acid value, RM value and saponification value of oils. Essential fatty acids. Classification of amino acids (acidic, basic, neutral; cyclic and aromatic) isoelectric point, zwitterion, essential amino acids. 5.2 Carbohydrates: Classification, reducing and non-reducing sugar, tests for carbohydrates – Benedict's test, Fehling's test, Molish's test. Structure of glucose, fructose, sucrose, lactose and starch (no elucidation).	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. S. Mohan, V Arjunan, Sujin P Jose and M Kanchana Mala, (2019) Principles of Material Science, MJP Publishers.
2. P.K. Palanisamy, Material Science (2017) Scitech Publications, Chennai.
3. B. R. Puri, L. R. Sharma and M. S. Pathania (2007) Principle of Physical Chemistry 38th edition S. Nagin Chand and Co.
4. S. Usharani (2008) Analytical Chemistry, Macmillan India Limited.
5. S.C. Rastogi (2007) Biochemistry, Tata McGraw Hill publishers.

Suggested Readings

1. L. Veerakumari, (2004) MJP Publishers, 1st edition.
2. R. Gopalan, P.S. Subramanian, K. Rengarajan, Elements of Analytical Chemistry (2004) Sultan Chand & Sons, New Delhi.

Web Resources

1. https://nptel.ac.in/courses/113108051/
2. https://nptel.ac.in/courses/104/101/104101093/

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand and recall the basic concepts of various types of chemical reactions.	**K1, K2**
CO 2	To integrate and apply the physical and chemical changes of materials.	**K3**
CO 3	To analyze and classify the structure of chemical compounds.	**K4**
CO 4	To formulate the significance of redox and decomposition reactions.	**K5**
CO 5	To access the fundamental aspects of chemical reactions.	**K6**

Course Code	UCH 3402
Course Title	APPLIED CHEMISTRY PRACTICAL FOR PHYSICS
Credits	01
Hours/Week	02
Category	Allied Optional (AO) - Lab
Semester	III
Regulation	2019

Course Overview

1. This course helps the students to get trained in safe handling of chemicals and apparatus.
2. The laboratory ambience obtained through this course could develop the required skill for a position in an industry/company/factory/research laboratory.
3. This course can bring about the scientific interpretation of data and helps them to improve their efficiency for societal developments.
4. This laboratory experience would develop skills in scientific methods of planning, executing and reporting the experimental data.
5. The analytical approach followed in the quantitative estimations of biologically important compounds would certainly develop technical skills**.**

Course Objectives:

1. To understand the principle of volumetric analysis and the significance of indicators in titrations.
2. To estimate the amount of glucose and starch using Benedict's method.
3. To determine iodine, acid and saponification value of oils.
4. To estimate the amount of biologically important analytes such as ascorbic acid, glycine and iodine quantitatively.
5. To systematically isolate biomolecules from food samples.

Prerequisites	Basic knowledge of Chemistry, Physics and Mathematics

SYLLABUS

UNIT	CONTENT	HOURS	COS	COGNITIVE LEVEL
1	1. Estimation of iodine value of oil. 2. Estimation of acid value of oil 3. Estimation of RM (Reichert Meissel) value of oil. 4. Estimation saponification value of oil. 5. Estimation of ascorbic acid in Vitamin C tablet. 6. Estimation of glycine. 7. Estimation of glucose by Benedict's method. 8. Estimation of starch by Benedict's method. 9. Isolation of casein and lactose from milk. 10. Estimation of iodine in iodised salt.	26	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	11. Estimation of available carbon dioxide in baking powder. 12. Determination of molecular weight of high polymer by viscosity measurement. 13. Construction of phase diagram for a simple eutectic system.			

Text Books

1. Geetha Swaminathan and Mary George, Laboratory chemical methods in food analysis, Margham Publications, 2002, Second edition.
2. Jeyavathana Samuel, Chemistry Practical Book, G. G. Printers, Chennai, 2012, New edition.
3. S. Sundaram, P. Krishnan and P.S. Raghavan, Practical Chemistry, S. Viswanathan Co. Pvt.1996.
4. V K Ahluwalia, Sunita Dhingra, Sunita Dhingram, College Practical Chemistry, Universities Press, 2005.
5. P.C. kamboj, Advanced University Practical Chemistry, Part I, Vishal Publishing Co. 2014.

Suggested Readings

1. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas and B. Sivashankar, Vogel's Text book of quantitative chemical Analysis, Pearson education, Chennai, 2014, Sixth edition.
2. Peter McPherson, Practical Volumetric Analysis, Royal Society of Chemistry, 2015.
3. R.Shobha, M. Banani, Essentials of Analytical Chemistry, Pearson, 2017.
4. V.Venkateswaran, R.Veeraswamy and A.R.Kulandaivelu, Basic Principles of Practical Chemistry, 2nd edn. S.Chand Publications, New Delhi, 2004.

Web Resources

1. https://bit.ly/3m4xYVp
2. https://bit.ly/3Cc5uPg
3. https://bit.ly/3b3xto9
4. https://bit.ly/3jw8T3T

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To recall the principle of the volumetric analysis and the significance of indicators.	**K1, K2**
CO 2	To perform the titrations of different types based on the relevant procedure.	**K3**
CO 3	To observe the end points of the titration and record the concordant titre values.	**K4**
CO 4	To determine quantitatively the concentration and weight of the given analyte.	**K5**
CO 5	To consolidate and present the result of the experiments scientifically.	**K6**

Course Code	UCH 3403
Course Title	BIOCHEMISTRY FOR BIOLOGY
Credits	02
Hours/week	03
Total Hours	45
Category	Allied Optional (AO)- Theory
Semester	III

Course Overview

1. This course deals with important classes of biomolecules such as nucleic acids, proteins, carbohydrates and lipids.
2. It discusses the structural features and biological functions of selected biomolecules.
3. The course outlines the factors affecting the structures and functions of biomolecules.
4. It highlights the importance and the role of biomolecules.
5. This course also gives isolation, structure and functions of natural products.

Course Objectives

1. To understand and state the importance of biomolecules such as nucleic acids, proteins, carbohydrates and lipids in living organisms.
2. To determine the classification and the characteristic structural features of these biomolecules.
3. To correlate their physicochemical properties with their structural features.
4. To formulate the significant role of these biomolecules in key biological functions.
5. To appraise the chemistry of these biomolecules to understand the functions of life**.**

Prerequisites	Basic knowledge of Biochemistry and Chemistry

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**PROTEINS AND ENZYMES** **1.1 Amino acids:** Classification, zwitter ions, isoelectric point, peptide linkage. Proteins: Classification based on structure and functions, primary and secondary structure, denaturation and renaturation, test for protein- Ninhydrin test, Biuret test. **1.2 Enzymes:** Classification, factors affecting enzyme activity, mechanism of enzyme action.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

II	**NUCLEIC ACIDS** 2.1 Components of nucleic acids, structure of purine and pyrimidine bases. 2.2 Hydrogen bonding in nitrogeneous bases in DNA, structure of DNA, types and functions of RNA, differences between DNA and RNA, replication, translation and transcription.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**LIPIDS** 3.1 Types and functions of lipids (fatty acids, glycerides, complex lipids and non-glycerides). 3.2 Fats and oils (rancidity, saponification, hydrogenation of oils) waxes, phospholipids (lecithins, cephalins, plasmalogens)	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**CARBOHYDRATES** 4.1 Introduction, classification and functions of carbohydrates, structure of glucose and fructose, mutarotation. 4.2 Differences between reducing and non-reducing sugars, test for carbohydrates, structure of sucrose, maltose and lactose, inversion of cane sugar.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**NATURAL PRODUCTS** 5.1 **Alkaloids:** Classification, isolation and biological importance (structure and functions of papaverine, nicotine, coniine) 5.2 **Terpenes:** Isoprene rule, classification, extraction and biological importance (structure and functions of camphor, citral and α-pinene).	7	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. G.P. Talwar and L.M. Srivatsava, Textbook of Biochemistry and Human Biology, 3rd edn, Printice-Hall of India Limited, New Delhi, 2006.
2. J.L. Jain, Sunjay Jain and Nitin Jain, Fundamentals of Biochemistry, 7th edn, S. Chand and Sons, New Delhi, 2005
3. A. Lehninger, D. L. Nelson, M. Cox and M. M. Cox, Principles of Biochemistry, 7th edn, MPS Publishers, New York, 2017.
4. A.V.S.S. Rama Rao, Text Book of Biochemistry, 9th end., U B S Publishers, 2008.
5. Gurdeep R. Chatwal, Organic chemistry of Natural Products, Vol I & II, 1stedn, Himalaya publishing House Pvt. Ltd, Mumbai, 2018
6. O.P. Agarwal, Organic Chemistry of Natural Products, Vol I & II, Goel publishing Co, New Delhi, 2015.
7. U. Satyanarayana an7d U. Chakrapani, Biochemistry, 5th edn., Elsevier, 2019.

Suggested Readings

1. T. Palmer and P. Bonner, Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, 2nd edn.,
   First East West Press Pvt Ltd., New Delhi, 2008.
2. J.M. Herg, J.L. Tymoczko and L. Stryer, Biochemistry, 5thedn, WH-Freeman and Co, 2002.
3. Keshav Trehan, Biochemistry, 2nd edn, Wiley Eastern Ltd, 1990.
4. E.J. Wood and W.R. Pickering, Introducing Biochemistry, ELBS, 1984.

Web Resources

1. https://library.umac.mo/
2. https://www.iict.res.in/
3. https://www.louisbolk.org

Course Outcomes (COs) and Cognitive Level Mapping

CO	CO Description	Cognitive Level
CO 1	To understand and recall the biological importance of the class of biomolecules such as nucleic acids, proteins, carbohydrates and lipids.	**K1, K2**
CO 2	To establish and correlate the structure and the properties of these biomolecules.	**K3**
CO 3	To compare the structural features and the biological functions of these molecules.	**K4**
CO 4	To analyze and formulate the functions of the natural products such as terpenes and alkaloids.	**K5**
CO 5	To appraise the chemistry of these biomolecules and natural products to understand their key functions in living organisms.	**K6**

Course Code	UCH 3404
Course Title	BIOCHEMISTRY PRACTICALS FOR BIOLOGY
Credits	02
Hours/week	02
Category	Allied optional (AO)-Practicals
Semester	III
Regulation	2019

Course Overview

1. This course intends to develop necessary experimental skills required for the analysis of biomolecules.
2. It deals with the estimation of biomolecules.
3. It provides an overview on the techniques utilized for the estimation of biomolecules.
4. The course discusses various separation techniques used for the isolation of biomolecules.
5. It also describes the methods to quantify the activity of the biomolecules.

Course Objectives

1. understand the principles of quantitative analysis.
2. apply the concepts of quantitative analysis to estimate biomolecules.
3. develop various analytical skills and techniques necessary for the analysis of biological molecules.
4. compare and apply various separation techniques to isolate biologically important compounds.
5. appraise and utilize the analytical knowledge to understand various biological processes.

Prerequisites	Basic knowledge of Biochemistry and Chemistry

SYLLABUS

CONTENT	COs	COGNITIVE LEVEL
QUANTITATIVE EXPERIMENTS: 1. Estimation of ascorbic acid using iodimetric method. 2. Estimation of glucose using Benedict's method. 3. Estimation of glycine. 4. Determination of hardness of water. 5. Determination of acid value of oil. 6. Determination of iodine value of oil. 7. Determination of saponification value of oil. 8. Estimation of activity of catalase in raddish and chow chow.	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
QUALITATIVE EXPERIMENTS: (INCLUDED FOR EVALUATION) 1. Column chromatography of leaf and flower extract. 2. TLC – Separation of triglycerides. 3. Paper Chromatography – Separation of amino acids. 4. Tests for carbohydrates and amino acids.	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. N. S. Gnanapragasam & G. Ramamurthy Organic Chemistry – Lab manual, 3rd edn, S. Viswanathan Co. Pvt. Ltd., 2002.
2. Jeyavathana Samuel, Chemistry Practical Book, G. G. Printers, Chennai, 2012.
3. Geetha Swaminathan and Mary George, Laboratory Chemical Methods in Food Analysis 2nd edn, Margham Publications, Chennai-17,, 2017.

Suggested Readings

1. J.N. Gurthu and R. Kapoor, Advanced Experimental Chemistry S. Chand and Co., New Delhi 2nd edn., 1987.
2. S. Sundaram, P. Krishnan and P.S. Rashaan, Practical Chemistry, S. Viswanathan Pvt. Ltd, Chennai, 2002.
3. B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, Vogel's Text Book of Practical Organic Chemistry., 5th edn , Pearson Edition , 2005.

Web Resources

1 https://bit.ly/3B7jbxt
2 https://bit.ly/3p3IHkG

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	Recall and explain the principles of quantitative analysis.	**K1, K2**
CO 2	apply the knowledge on the concepts of quantitative analysis to estimate biomolecules.	**K3**
CO 3	exercise various analytical skills and techniques learned to analyze biological molecules	**K4**
CO 4	Formulate appropriate separation techniques for the isolation of biologically important compounds.	**K5**
CO 5	assess and apply the analytical techniques to understand the various biological processes.	**K6**

Course Code	UCH 3801
Course Title	CHEMISTRY IN EVERYDAY LIFE
Credits	02
Hours/Week	03
Category	Non Major Elective (NME)
Semester	III
Regulation	2019

Course Overview

1. Chemistry in everyday life paper is an interdisciplinary subject covering concepts on the fields of fuels, agrochemistry, food safety, water treatment and environmental pollution.
2. The aim of the course is to give basic knowledge on the role of chemistry in day to day life.
3. This course explains the characteristics and classification of fuels, soils and fertilizers.
4. This course provides an insight on the importance of various food laws, food standards in India, preservation of food, water treatment and prevention of pollution.
5. This course helps the students in solving environmental issues related to air, noise, water and soil pollution.

Course Objectives

1. To highlight the importance of calorific values of fuels, classification of fuels and their composition.
2. To learn the classification of soil and understand the role of different fertilizer and pesticides.
3. To understand the components of food nutrients, food adulteration and its prevention.
4. To learn about hardness and treatment of hard water.
5. To explain the concepts of environmental pollution, types, sources and its effects on ecosystem and human health.

Prerequisites	Basic knowledge of Chemistry

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Fuels** 1.1 Fuels: calorific value, characteristics, classification. Solid fuels-coal and types. 1.2 Liquid fuels: petroleum-fractional distillation- fractions and their uses, octane number, cetane number, TEL, gaseous fuel-composition and uses of CNG, LPG and biogas.	7	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

II	**Agrochemistry** 2.1 Soil: classification- alluvial, black, laterite and red soils. Soil fertility-permanent and temporary. 2.2 Fertilizers: requisites, nitrogenous, phosphatic, potash, NPK and bio fertilizers, organic manures, effect of excess fertilization. Pesticides, Classification- Insecticides, Fungicides, Herbicides, Acaricides, Rodenticides - BHC, aldrin, pyrethrin, nicotine-functions only, bio pesticides.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Food Safety and Quality** 3.1 Introduction to basic components of food-nutrients and their functions. Food adulteration- intentional and incidental adulterants, food laws- prevention of food adulteration act, Essential Commodities Act, BIS, AGMARK and FSSAI. 3.2 Food spoilage and food preservation: principles and methods-temperature, preservatives, dehydration, pressure and irradiation. (Demonstration: Identification of food adulterants in milk, turmeric powder, chilli powder, honey and coconut oil)	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**Water Treatment** 4.1 Sources of water, potability of water, hard and soft water, temporary and permanent hardness, disadvantages of hard water in domestic and industrial purposes. 4.2 Treatment of water: disinfection by ozone and bleaching powder, desalination-reverse osmosis, WHO and BIS specification of drinking water (TDS, hardness, pH, dissolved oxygen)	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Environmental pollution** 5.1 Air and noise pollution: Types and sources, effects on ecosystem and human health. 5.2 Water and soil pollution: Types and sources, effects on ecosystem and human health, eutrophication and its control, effects of pesticides and heavy metals on ecosystem and human health, biomagnification, preventive measures of pollution.	8	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

Text Books

1. P. C. Jain, M. Jain (2015) Engineering chemistry, Dhanpat Rai publications, 15th edition.
2. B. Srilakshmi (2003) Food Science, New age International Pvt.Ltd. Publishers, 3rdedition.
3. B. K. Sharma (1994) Industrial Chemistry: Including Chemical Engineering, Goel Publishing house, Meerut, India, 1st edition.
4. G.T. Austin, Shreve's (1984) Chemical Process Industries, Tata Mc-Graw-Hill, 5th edition.
5. B.A. Yagodin (1976) Agricultural Chemistry, Mir Publishers (Moscow), Vol.2.
6. Thankamma Jacob (1976) Food adulteration, Macmillan Company India, 1st edition.

Suggested Readings

1. G.D.Gem Mathew (2013) Chemistry in everyday life, Vishal Publishing Co. 1st edition.
2. K. Bagavathi Sundari (2006) Applied Chemistry, MJP Publishers, 1st edition.
3. Mary George and Geetha Swaminathan (2002) Laboratory Chemical Methods in Food Analysis, Margham Publications, Chennai, 2ndedition.
4. C. A. Heaton (1996) An Introduction to Industrial Chemistry, Springer Science & Business Media, 3rdedition.
5. A.K.De (1987) Environmental Chemistry, Wiley eastern Ltd, 2ndedition.
6. N. S. Subbarao (1982) Biofertilizers in agriculture, Oxford and IBH publishing Co.: New Delhi, 3rd revised edition.

Web Resources

1. https://bit.ly/3EbVyWf
2. https://bit.ly/3BefWEE
3. https://bit.ly/3C7Xe2t
4. https://bit.ly/3Gfjdaf
5. https://bit.ly/3pyJwCm

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand and recall the basic definitions related to fuels, fertilizers, food safety, water treatment and environmental pollution.	**K1, K2**
CO 2	To classify and illustrate the characteristics of fuels, fertilizers, food, water and pollution.	**K3**
CO 3	To analyze the principles of chemistry in determining the fuel composition, functions of fertilizers, food adulteration, water hardness and preventive measures of pollution.	**K4**
CO 4	To assess the importance of fuels, agrochemistry, food safety, water treatment and pollution control.	**K5**
CO 5	To summarize the significance of fuels, fertilizers, food preservation, specifications of drinking water and preventive measures of pollution.	**K6**

Course Code	UCH 4401
Course Title	APPLIED CHEMISTRY FOR MATHS
Credits	02
Hours/Week	03
Category	Allied Optional (AO) - Theory
Semester	IV
Regulation	2019

Course Overview

1. The aim of the course is to give basic knowledge about the handling of chemicals, various titrimetric methods, biomolecules, consumer protection, environment and its related problems.
2. This course develops an attitude of concern for the storage and handling of various chemicals in the laboratory and environment.
3. This course will explore carbohydrates, lipids, amino acids and vitamins.
4. This course appreciates the central role of chemistry in the environment and in consumer products.
5. This course lays a firm foundation in the fundamentals of water treatment and pollution controlling measurements.

Course Objectives

1. To understand the basics of handling and storage of chemicals.
2. To learn about standard solutions, types of titrations and indicators.
3. To have a deep knowledge about lipids, amino acids, carbohydrates and vitamins.
4. To know the ingredients of various consumer products and consumer protection.
5. To apply the knowledge of water treatment and pollution control in day to day life.

Prerequisites	Basic knowledge of Chemistry

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Handling of chemicals and data** 1.1 Safety and hygiene in the Chemistry Lab: Storage and handling of chemicals, handling of acids, ethers, toxic and poisonous chemicals. Antidotes, threshold vapour concentration and first aid procedures. Material Safety Data Sheet (MSDS). 1.2 Error in chemical analysis: Accuracy and precision, absolute and relative errors. Methods of eliminating or minimizing errors. Precision: mean, median, average deviation, standard deviation and coefficient of variation. Significant figure and its relevance.	08	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, L6

II	**Titrimetric Methods of Analysis** 2.1 Methods of expressing concentration of solutions- Molarity, Molality, Normality, Mole Fraction, ppm and ppb. Principle of titrimetric analysis- End point and equivalence point, Primary and secondary standards – Prerequisites and examples. 2.2 Acid-base and complexometric titrations principle, choice of indicators- Phenolphthalein, methyl orange and Eriochrome black-T (structures not needed).	08	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
III	**Biomolecules** 3.1 Lipids and amino acids: classification of lipids, iodine value and saponification value of oils. Essential fatty acids. Classification of amino acids (acidic, basic, neutral) isoelectric point, zwitterion, essential and non-essential amino acids (structure not needed). 3.2 Carbohydrates and vitamins: classification of carbohydrates, reducing and non-reducing sugar, tests for carbohydrates- Benedict's test, Fehling's test, Molish's test. Vitamins- water and fat soluble-Sources, functions and deficiency.	08	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
IV	**Consumer products** 4.1 Soaps and cosmetics - ingredients and functions, cleansing action of soap. Comparison of soaps and detergents. Shampoos- ingredients and functions, types: anti-dandruff, herbal and anti-hair fall shampoos. Cosmetics: Ingredients; face cream, sunscreen, skin bleaching agents and anti perspirants. 4.2 Consumer Protection: rights, responsibilities, consumer forum, consumer protection Act (2019), Consumer protection in India, consumer redressal forum.	08	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6
V	**Water treatment and pollution control** 5.1 Water treatment: sources of water, hard and soft water, hardness of water, Disadvantages of hard water. Purification process- reverse osmosis, activated charcoal treatment. Disinfection-ozone, UV, chlorination, BIS specification of drinking water. 5.2 Pollution and its control: Air pollution, effect of air pollution- acid rain and greenhouse	07	CO 1 CO 2 CO 3 CO 4 CO 5	K1, K2, K3, K4, K5, K6

	effect, ozone depletion. Water pollution-significance of dissolved oxygen (DO), biological oxygen demand (BOD) and Chemical oxygen demand (COD).			

Text Books

1. S. Usharani (2008) Analytical Chemistry, Macmillan India Limited, I Edition.
2. P.C. Kamboj (2014) Advanced University Practical Chemistry, Part-I, Vishal Publishing Co.
3. S.C. Rastogi (2007) Biochemistry, Tata McGraw Hill publishers, II Edition.
4. W.Sawyer (2000) Experimental cosmetics, Dover publishers, I Edition.
5. P. C. Jain, M. Jain (2015) Engineering chemistry, Dhanpat Rai publications, XV Edition.

Suggested Readings

1. K. Bagavathi Sundari (2006) Applied Chemistry, MJP Publishers, I Edition.
2. A.K. De (1987) Environmental Chemistry, Wiley eastern Ltd, II Edition.
3. C. A. Heaton (1996) An Introduction to Industrial Chemistry, Springer Science & Business Media, III Edition.

Web Resources

1. https://bit.ly/3juuBFq
2. https://bit.ly/3AJqOKj
3. https://bit.ly/3aFN8tS
4. https://bit.ly/3DMzO30

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To understand and recall the basics of storage and handling of chemicals, different titrimetric methods, importance of biomolecules, ingredients in soaps and detergents, water treatment and pollution control.	**K1,K2**
CO 2	To illustrate the errors in chemical analysis, classification of biomolecules, ensuring consumer's rights and responsibilities, and determining the solution's concentration, water hardness and preventive measures of pollution.	**K3**
CO 3	To analyse the principles of chemistry in identifying the methods of minimizing errors, requirements of primary and secondary standard solutions, tests for carbohydrates, cleansing action of soap, purification of drinking water.	**K4**
CO 4	To assess the importance of lab safety, choice of indicators, functions and deficiency of vitamins, consumer protection in India, water treatment and pollution control.	**K5**
CO 5	To Specify and summarize the importance of Material Safety Data Sheet (MSDS) and antidotes, types of titrimetric analysis, biomolecules, consumer protection and effects of air pollution.	**K6**

Course Code	UCH 4402
Course Title	APPLIED CHEMISTRY PRACTICAL FOR MATHS
Credits	01
Hours/Week	02
Category	Allied optional (AO) - Lab
Semester	IV
Regulation	2019

Course Overview

1. This course helps the students to get trained in the preparation of solutions, safe handling of chemicals and apparatus.
2. The hands-on training gained in performing the experiments would cultivate experimental skill.
3. The course shapes the students' frame of mind towards the scientific interpretation of data and helps them to improve their efficiency for societal developments.
4. This laboratory experience gained through this paper would develop skills in scientific methods of planning, executing and reporting the experimental data.
5. The analytical approach followed in quantitative techniques would certainly develop technical skills for nation development.

Course Objectives:

1. To understand the principle of volumetric analysis and the significance of indicators in titrations.
2. To estimate the amount of glucose using Benedict's method and the hardness of water using a complexometric method.
3. To determine acid value and saponification value of an oil.
4. To understand the concepts involved in acidimetry, alkalimetry, permanganometry, and iodometry.
5. To learn the preparation of a few consumer products on a small scale.

Prerequisites	Basic knowledge of volumetric analysis

SYLLABUS

EXPT/S.NO	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	1. Estimation of sodium hydroxide (Acidimetry). 2. Estimation of oxalic acid (Alkalimetry). 3. Estimation of sodium carbonate (Acidimetry). 4. Estimation of Ferrous Ammonium Sulphate (Permanganometry). 5. Estimation of oxalic acid (Permanganometry).	**26**	**CO 1 CO 2 CO 3 CO 4 CO 5**	**K1, K2, K3, K4, K5, K6**

	6. Estimation of $KMnO_4$ (Iodometry). 7. Estimation of magnesium (Complexometry). 8. Determination of total hardness of water 9. Estimation of saponification value of oil. 10. Estimation of acid value of oil. 11. Estimation of glycine. 12. Estimation of glucose by Benedict's method. 13. Estimation of Ascorbic acid (Vitamin C). 14. Demonstration of preparation of soap and pain balm			

Text Books

1. Geetha Swaminathan and Mary George, Laboratory chemical methods in food analysis, Margham Publications, 2002, Second edition.
2. Jeyavathana Samuel, Chemistry Practical Book, G. G. Printers, Chennai, 2012, New edition.
3. S. Sundaram, P. Krishnan and P.S. Raghavan, Practical Chemistry, S. Viswanathan Co. Pvt.1996.
4. V K Ahluwalia, Sunita Dhingra, Sunita Dhingram, College Practical Chemistry, Universities Press, 2005.
5. P.C. kamboj, Advanced University Practical Chemistry, Part I, Vishal Publishing Co. 2014.

Suggested Readings

1. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas and B. Sivashankar, Vogel's Textbook of quantitative chemical Analysis, Pearson education, Chennai, 2014, Sixth edition.
2. Peter McPherson, Practical Volumetric Analysis, Royal Society of Chemistry, 2015.
3. R. Shobha, M. Banani, Essentials of Analytical Chemistry, Pearson, 2017.
4. V. Venkateswaran, R. Veeraswamy and A.R. Kulandaivelu, Basic Principles of Practical Chemistry, 2nd edn. S. Chand Publications, New Delhi, 2004.

Web Resources

1. https://bit.ly/2XFOq56
2. https://bit.ly/3m3rMwS
3. https://bit.ly/3m4ua6C

Course Outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Level
CO 1	To recall the principle of the volumetric analysis and the significance of indicators.	**K1, K2**
CO 2	To perform the titrations of different types based on the relevant procedure.	**K3**
CO 3	To observe systematically the end points of the titration and record the concordant titre values.	**K4**
CO 4	To determine quantitatively the concentration and weight of the given analyte.	**K5**
CO 5	To consolidate and present the results of the experiments scientifically.	**K6**

Course Code	UCH 4403
Course Title	FOOD CHEMISTRY
Credits	02
Hours/week	03
Total Hours	45
Category	Allied Optional (AO)-Theory
Semester	IV

Course Overview

1. This course deals with the constituents of food and edible materials with a chemistry perspective.
2. It discusses the classification of nutrients and their impact in food processing.
3. The course describes the role of food preservatives and sweeteners.
4. It outlines the additives used in food materials to increase taste, flavor, color and stability of food materials
5. It also deliberates the adulterants used in food materials and measures to be taken for food safety.

Course Objectives

1. To understand and recall the classification of nutrients.
2. To identify the impact and significance of nutrients.
3. To analyze various chemical reactions involved in food processing.
4. To assess the usage of additives in food materials.
5. To critique the adulterants used in food and to determine the quality of food materials

Prerequisites	Basic knowledge of Food chemistry and Biochemistry

SYLLABUS

UNIT	CONTENTS	HOURS	COs	COGNITIVE LEVEL
I	**Macronutrients** 1.1 Macronutrients - Definition, types and functions. Carbohydrates-Maillard reaction, caramelization and pyrolytic reaction. Food applications of polysaccharides-carboxymethyl cellulose, Guar gums, Xanthan gums, Carrageenan, Pectin and Gum Arabic. Effect of cooking on carbohydrates. 1.2 Proteins: Denaturation, hydrolysis and cross-linking reactions. Effect of cooking – steaming or cooking under pressure of legumes. Wheat protein- Detoxification and dough forming.	9	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

II	**Micronutrients** 2.1 Micronutrients-Definition, types and functions. Vitamins - Bio availability, factors affecting the stability, toxicity, restoration, enrichment and fortification. Anti-oxidants -Vitamin C and E. 2.2 Effect of different methods of cooking - blanching, boiling, microwaving, and steaming on vegetables, fruits–dehydrated fruits, canned fruit juices. 2.3 Minerals. Recommended dietary allowances, bioavailability, effect of processing, fortification, chemical and functional properties of calcium, iron, copper, iodine, fluorine, sodium and potassium in food.	7	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Food Preservatives and sweeteners** 3.1 Food additives: Definition, principle, types and need for food additives. Preservatives-Definition, Class I and II, functions of natural and chemical preservatives. Anti- microbial agents-sulphites and nitrites. 3.2 Sweeteners: Definition, types and properties. Nutritive and non-nutritive sweeteners-functions and limitations in food processing-cyclamate, saccharin, aspartame, alitame, acesulfame K and sucralose. Bio-sweeteners-Stevia.	7	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**Unit 4: Food Colorants and flavoring agents** 4.1 Colorants: Natural and synthetic colorants, limitations. Pigments in animals and plants tissues-myoglobin, met myoglobin, deoxy myoglobin, sulpha myoglobin, chlorophyll, carotenoids, anthocyanins and flavonoids. Factors affecting stability, and color change on processing. 4.2 Flavoring Agents: Natural, nature identical and artificial. Flavor enhancers–(MSG) astringency (tea and Red wine) and pungency (chilli pepper, Black pepper and Ginger), Fish food flavors and thermally induced flavors.	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**Unit 5: Food Adulterants & Food Safety** 5.1 Food Adulterants-Definition, classification, general health effects. Contamination-chemicals (melamine, acrylamide), pesticides and insecticides (DDT, Chlorpyrifos-methyl,Malathion, and Dieldin), Detection and prevention. 5.2 Quality control: Specifications and standards,	8	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	PFA, FPO, FDA, drug license, WHO standards, BIS specifications, packing and label requirements, AGMARK, and FSSAI.			

Books for Reference

1. De Man, John M., Principles of Food Chemistry, 3rdedn, Springer, 1999.
2. M. Shafiur Rahman, Handbook of Food Preservation, 2nd edn, CRC Press, Taylor & Francis Group, 2007.
3. Potter, Norman N., Hotchkiss, Joseph H., Food Science, 5thedn, Springer science media, New York. 1998.
4. Hayes P.R and S.J. Forsythe, Food Hygiene, Microbiology and HACCP, 3rdedn, Springer Science, 2010.

Web Resources

1. https://bit.ly/2ZeqI0F
2. https://bit.ly/3pw9LcO
3. https://bit.ly/3pvMIPo
4. https://rsc.li/3juVitz

Course Outcomes (COs) and Cognitive Level Mapping

CO	CO Description	Cognitive Level
CO 1	understand and recall the basic concepts of food chemistry.	**K1, K2**
CO 2	determine the types of nutrients and important chemical reactions involved in food processing.	**K3**
CO 3	analyse the different constituents, additives and adulterants in food.	**K4**
CO 4	formulate the structure of various components present in food, additives and adulterants.	**K5**
CO 5	evaluate and ensure the quality and safety of food materials.	**K6**

Course Code	UCH 4404
Course Title	FOOD CHEMISTRY PRACTICAL
Credits	01
Hours/Week	02
Category	Allied Optional (AO) –Practical
Semester	IV
Regulation	2019

Course Overview

1. The specific aim of the laboratory course is to provide the fundamental knowledge of handling the apparatus and chemicals.
2. This paper provides the methods to check the quality of various food samples.
3. This course discusses the separation and determination of phytochemicals from the plant extracts.
4. The course also provides the hands-on experience to detect the food adulterants in various samples.
5. The outcome of the experimental results will be evaluated by quantitative and qualitative analysis.

Course Objectives

1. To distinguish the basic glass wares and volumetric apparatus.
2. To understand the importance of recording the data and calculations.
3. To detect and analyse the various food samples by titration and simple identification methods.
4. To acquire knowledge in the use of chromatographic techniques.
5. To recommend the healthy and quality food products to the society.

Prerequisites	Basic knowledge of chemistry

SYLLABUS

S.NO	EXPERIMENTS	HOURS	COS	COGNITIVE LEVEL
1.	**Qualitative Experiments** 1. Detection of macronutrients in food. (Carbohydrate, protein, fat and oil) 2. Detection of phytochemicals in plant extracts. (Alkaloids, flavonoids, saponins, phenol, steroids, glycosides and tannin) 3. Detection of natural and synthetic colorants in food. 4. Detection of fortified iron content in cereal breakfast. 5. Detection of adulterants in milk and milk products. (Cane sugar, Starch,	12	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	cellulose, Urea, sulphates, Sodium chloride, nitrates, Hydrogen peroxide, vanaspati, formalin, and detergent in milk and milk products) 6. Detection of adulterants in oils, sweetening agents and miscellaneous food components. (Miscellaneous food components -Tea, coffee, turmeric powder, chili powder, sugar, jaggery and flour) 7. Separation of plant pigments by column chromatographic technique.			
2.	**Quantitative Experiments**: 1. Estimation of peroxide value of an oil. 2. Estimation of total titratable acidity of different fruit juices. 3. Estimation of wet gluten content in wheat flour. 4. Estimation of iodine content in iodate salt. 5. Estimation of calcium in milk by complexometric titration. 6. Estimation of ferrous ion by permanganometry method. 7. Estimation of available CO_2 in baking powder 8. Determination of percentage of acetic acid in vinegar. 9. Identification and determination of food colors in food products by TLC / Paper chromatography. 10. Determination of DO/COD/BOD of water sample. Detection of phytochemicals in plant extracts. (Alkaloids, flavonoids, saponins, phenol, steroids, glycosides and tannin)	14	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Neilson Suzanne S (2003) Food analysis.Plenum Publishing Corporation, U.S.A.
2. FSSAI lab manual -Methods for analysis of foods - Test for food additives. (2012) FSSAI
3. B. R. Puri, L. R. Sharma and M. S. Pathania (2007) Principle of Physical Chemistry 38th edition S. Nagin Chand and Co.
4. Geetha Swaminathan andMary George S. (2010) Laboratory Chemical Methods in Food Analysis, Margham Publications, 3rd edition.

5. N.S. Gnanapragasam and G. Ramamurthy (2002) Organic Chemistry – Lab manual S. Viswanathan Co. Pvt.

Suggested Readings

1. S.Ranganna, (1987) Manual of analysis of fruits and vegetable products Tata McGraw Hill Publishing company Ltd, New Delhi, 2nd edition.
2. Manual of methods ofAnalysis of foods, Fssai manual
3. B.S. Furniss, A.J. Hannaford, P.W. G. Smith and A.R. Tatchell, (2005) Vogel's Text Book of Practical Organic Chemistry. Pearson Edition, 5th edition.

Web Resources

1. https://bit.ly/3mY0dnL

Course Outcomes (COs) and Cognitive Level Mapping

CO	CO Description	Cognitive Level
CO 1	To recall and explain the principle involved in each experiment.	**K1, K2**
CO 2	To examine and determine the different components present in the food samples.	**K3**
CO 3	To estimate the components, present in food samples quantitatively and minimize the experimental errors.	**K4**
CO 4	To decide and recommend a suitable procedure for the analysis of various food products.	**K5**
CO 5	To create the food awareness and food safety procedures.	**K6**

Course Code	UCH 4801
Course Title	BASIC CLINICAL AND PHARMACEUTICAL CHEMISTRY
Credits	02
Hours/Week	03
Category	Non Major Elective (NME) – Theory
Semester	IV
Regulation	2019

Course Overview

1. The aim of the course is to give basic knowledge about the drugs.
2. The different modules of the course will examine analytical skills in clinical chemistry.
3. Understanding the concepts and chemical action of various types of common drugs used in today life.
4. Inputs on preparation of drugs opens avenues in pharmaceutical industrial processes.
5. Skill of the students will be examined in the testing, mechanism of action and adverse drug reactions of drugs.

Course Objectives

1. To understand the safe methods of handling of chemicals used in clinical practice.
2. To demonstrate the principles of drug action and testing of drugs.
3. To develop clinical and analytical skills.
4. To learn the effective usage of drugs.
5. To acquire the knowledge in the preparation of drugs and clinical testing reagents.

Prerequisites	Basic knowledge of pharmaceutical chemistry

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**CLINICAL HYGIENE AND BIOCHEMICAL ANALYSIS** 1.1. Definition of health. Role of WHO 1.2. Sterilization of surgical instruments 1.3. Disinfectants, antiseptics, sanitation 1.4. Biochemical analysis of acids, alkalis, arsenic and mercury compounds.	06	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**INTRODUCTION TO DRUGS** 2.1 Definitions of pharmacology, pharmacophore, pharmacodynamics, pharmacokinetics, API (active pharmaceutical ingredients) 2.2 Types of drugs and their functions: Depressant drugs (special reference to sedatives and hypnotics). Anticonvulsant	10	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	drugs (sodium valproate, hydantoins). Narcotic analgesics (only morphine compounds). Testing of drugs: biological variation, screening and toxicity. Use of pharmacoepia and therapeutic index.			
III	**COMMON DISEASES AND THEIR DRUGS** 3.1 Antipyretic analgesics (acetyl salicyclic acid, p – amino – phenol derivatives). Muscle relaxants. Acting at neuromuscular junction (d – tubocurarine chloride). Acting at spinal cord alone (glycerylguaiacolate, diazepam). 3.2 Antibiotics (penicillin, streptomycin, tetracyclin, chloramphenicol) Cardiovascular drugs-stent, nitrates, beta blockers (propranalol and atinelol), triglycerides. Anti-cancer drugs taxol, cisplatin.	05	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**BLOOD AND HAEMATOLOGICAL AGENTS** 4.1 Blood volume, blood groups, coagulation of blood. Plasma lipo protiens. 4.2 Blood pressure. Arteriosclerosis, diseases affecting red cells: Hyperchromic and hypochromic anaemia 4.3 Blood transfusion. Blood sugar and diabetes. 4.4 Knowledge of measuring blood pressure, influence of blood pressure. 4.5 blood sugar control levels and medicine used to control blood pressure and blood sugars.	09	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**TRADITIONAL SYSTEMS OF MEDICINE** 5.1 Sources of drugs (e.g. quinine, reserpine, atopside and d – tubocurarine) from Indian medicinal plants. Introduction to Siddha, Unani, Ayurvedha, Homeopathy. 5.2 Examples of traditional medicine.	09	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

Text Books

1. Jayashree Ghosh, A text book of Pharmaceutical Chemistry, 1999 Edition., S.Chand and Co. Ltd., 1999.
2. S.C. Rastogi. Biochemistry, Tata McGraw Hill Publishing Co., 2019 Edition, New Delhi 1993.
3. S. Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, New Delhi., New edition, 1993
4. M.Z. Abdin Y.P. Abrol, Traditional Systems of Medicine, Narosa, Publishers, New Delhi, New Edition, 2006.

Suggested Readings

1. O.Le Roy, Natural and synthetic organic medicinal compounds, Ealemi Publishers, Latest edition, 1976.

2. B.L. Oser, Hawk's Physiological Chemistry, 14th edition, Tata McGraw Hill Publishing Co., New Delhi, 1965.
3. O. Kleiner and J. Martin, Bio-Chemistry, Prentice-Hall of India (P) Ltd, New Delhi 1974.
4. Graham L Patrick, an Introduction to Medicinal Chemistry, 5th Edition, Oxford University Press, Chennai, 2017.
5. Ilango, Valentina, Text Book of Medicinal Chemistry volume- I & II, Keerthi Publishers , Chennai, 2017.

Web Resources

1. https://bit.ly/3B5YQIP
2. https://bit.ly/2ZgFjbf
3. https://bit.ly/3CkzHve
4. https://wb.md/3GedHF2
5. https://bit.ly/3npsT9F
6. https://bit.ly/3b4NOcc
7. https://wb.md/3FSjEHh

Course Outcomes (COs) and Cognitive Level Mapping

CO	CO Description	Cognitive level
CO 1	To understand the safe methods of handling of chemicals used in clinical chemistry.	**K1, K2**
CO 2	To explain and apply the theories of chemical action in the various common drugs.	**K3**
CO 3	To recognize the basis of physiological functions and to know drug action on diseases.	**K4**
CO 4	To apply the biochemical techniques to identify the drug action.	**K5**
CO 5	To classify drugs and to assess the various diagnosis methods.	**K6**

CL AND CO BASED CIA QUESTION PAPER FORMAT FOR UG THEORY COURSES
MC, AR, AO, MS, ME, GL and NME* (excluding other languages)

SECTION	MARKS	Q. NO	K1	K2	K3	K4	K5	K6
A	Answer ALL (6 x 1 = 6)	1	+					
		2	+					
		3	+					
		4		+				
		5		+				
		6		+				
B	Answer 1 out of 2 (1 x 6 = 6)	7			+			
		8			+			
C	Answer 1 out of 2 (1 x 6 = 6)	9				+		
		10				+		
D*	Answer 1 out of 2 (1 x 12 = 12)	11					+	
		12						+
No. of CL based Questions with Max. marks			3 (3)	3 (3)	1 (6)	1 (6)	1 (12)	1 (12)
No. of CO based Questions with Max. marks			CO 1		CO 2	CO 3	CO 4	CO 5
			6 (6)		1 (6)	1 (6)	1 (12)	1 (12)

- **MC** - Major Core, **AR** – Allied Required, **AO** – Allied Optional, **MS** - Major Skill, **ME** - Major Elective, **GL** - General Languages, **NME** – Non- Major Elective.
- **Section A** could have one or more of the following: Fill in the blanks, True or False, Match the following, Definition, Comment on, Reason out etc., But, K1 and K2 should carry equal weightage.
- In **Section D** students have choice between K5 and K6. III Component Assessment carries 40% of CIA and the assessment(s) should be for cognitive levels **K1 to K4** and all should carry equal weightage.

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI 60034
DEPARTMENT OF CHEMISTRY
FIRST CONTINUOUS ASSESSMENT TEST, AUGUST 2021
UCH 5501 ORGANIC FUNCTIONAL GROUPS-II (MC)

III BSc Chemistry Date:
Time: 90 minutes Max. Marks: 30

SECTION A			
Answer ALL questions in one or two sentences		**(6 x 1 = 6 Marks)**	
1.	Name the following compounds as per IUPAC system. (i) C_6H_5CHO (ii) $C_6H_5COCH_3$	K1	CO1
2.	State the conditions for Wolf-Kishner reduction.	K1	CO1
3.	List any two hydride transfer reagent.	K1	CO1
4.	Classify the molecular rearrangements.	K2	CO1
5.	Show the order of stability of the following carbocations. Methyl-, allyl-, benzyl-, secondary, tertiary-	K2	CO1
6.	Explain the importance of isotopic labelling study.	K2	CO1
SECTION B			
Answer any ONE of the following in 150 words		**(1 x 6 = 6 Marks)**	
7.	Predict the product formation in the following reactions with mechanism. (i) Aldol condensation (ii) Cannizarro reaction	K3	CO2
8.	Explain the ring-contraction and ring-expansion reaction with an example.	K3	CO2
SECTION C			
Answer any ONE of the following in 150 words		**(1 x 6 = 6 Marks)**	
9.	Analyze the importance of $LiAlH_4$ and $NaBH_4$ with suitable example.	K4	CO3
10.	Differentiate the mechanism of Curtius and Schimdt rearrangement.	K4	CO3
SECTION D			
Answer any ONE of the following in 100 words		**(1 x 12 = 12 Marks)**	
11.	a. Evaluate Norrish Type I & II reactions with an example for each. b. Predict the mechanism of Perkin and Haloform reactions.	K5	CO4
12.	a. "Claisen rearrangement is a typical sigmatropic reaction". Justify with suitable mechanism and explanation. b. Write the mechanism of Hoffmann's rearrangement.	K6	CO5

CL AND CO BASED END SEMESTER EXAMINATION QUESTION PAPER FORMAT FOR UG THEORY COURSES
MC, AR, AO, MS, ME and GL

SECTION		Q. NO	K1	K2	K3	K4	K5	K6
A	Answer ALL (10 x 1 = 10)	1 (a to j)	+					
	Answer ALL (5 x 2 =10)	2 (a to e)		+				
B	(2 x 10 = 20) Answer 2 out of 4	3			+			
		4			+			
		5			+			
		6			+			
C	(2 x 10 = 20) Answer 2 out of 4	7				+		
		8				+		
		9				+		
		10				+		
D	(2 x 20 = 40) Answer 2 out of 4	11					+	
		12					+	
		13						+
		14						+
No. of CL based Questions with Max. marks			1 (10)	1 (10)	2 (20)	2 (20)	2 (40)	2 (40)
No. of CO based Questions with Max. marks			CO 1		CO 2	CO 3	CO 4	CO 5
			2 (20)		2 (20)	2 (20)	2 (40)	2 (40)

* **MC**-Major Core, **AR**–Allied Required, **AO**–Allied Optional, **MS**-Major Skill, **ME**-Major Elective, **GL**-General Languages.

- **Section A** could have one or more of the following: Fill in the blanks, True or False, Match the following, Definition, Comment on, Reason out, but K1 and K2 should carry equal weightage. In **Section D** students have choice between K5 and K6.

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI 60034
DEPARTMENT OF CHEMISTRY
END SEMESTER EXAMINATION, NOVEMBER 2021
UCH 5501 ORGANIC FUNCTIONAL GROUPS-II (MC)

III BSc Date:
Duration: 3 hrs Max. Marks: 100

	SECTION A		
Answer ALL the Questions			
1.	**Choose the correct answer.** **(10 x 1 = 10 Marks)**		
(a)	Which of the following compound will give Cannizzaro's reaction? Identify. (a) CH_3CHO (b) $C_6H_5CH_2CHO$ (c) $(CH_3)_3C\text{-}CHO$ (d) CH_3CH_2CHO	K1	CO1
(b)	Grignard reagents add to the carbonyl group of ketones to form_____. (a) primary alcohol (b) secondary alcohol (c) tertiary alcohol (d) None of these	K1	CO1
(c)	Tartaric acid when treated with Fenton's reagent gives_____. (a) Dihyroxy fumaric acid (b) Oxalic acid (c) Tartonic acid (d) Mesooxalic acid	K1	CO1
(d)	Indicate which of the following is not a dicarboxylic acid? (a) Phthalic acid (b) Malic acid (c) Salicylic acid (d) Maleic acid	K1	CO1
(e)	Indicate which one of the following is non-enolisable keto-ester? (a) $CH_3COCH_2COOC_2H_5$ (b) $CH_3COCH(R)COOC_2H_5$ (c) $CH_3COC(R_2)COOC_2H_5$ (d) None of these	K1	CO1
(f)	Acetoacetic ester may be used to prepare _____. (a) Ketones (b) Carboxylic acids (c) Heterocyclic compounds (d) All these	K1	CO1
(g)	The order migratory aptitude in pinacol-pinacolone rearrangement is _____. a) H > Me > Ph b) Ph > H > Me c) Me > H > Ph d) Ph > Me > H	K1	CO1
(h)	The major product obtained when 2-phenyl-2,3-pentanediol treated with an acid is a) 2-phenyl-2-methylbutanal b) 3-phenyl-2-pentanone c) 2-ethyl-2-phenylpropanal d) 2-phenyl-3-pentanone	K1	CO1
(i)	Which metal-carbon bond will be most ionic? (a) C-Mg (b) C-Zn (c) C-Li (d) C-Cd	K1	CO1
(j)	The hybridization state of Zn in dialkylzinc compound is _____. (a) sp^1 (b) sp^2 (c) sp^3 (d) Unhybridized	K1	CO1
2.	**Answer ALL questions.** **(5 x 2 = 10 Marks)**		
(a)	Convert salicylic acid into aspirin.	K2	CO1
(b)	Predict the product obtained when a carboxylic acid reacts with thionyl chloride ($SOCl_2$) and sodium azide (NaN_3).	K2	CO1
(c)	Show the mechanism of Cope and oxy-Cope reaction.	K2	CO1
(d)	Indicate any two synthetic applications of cyanoacetic ester.	K2	CO1
(e)	Explain why organolithium compounds are more reactive than Grignard reagents?	K2	CO1
	SECTION B		
Answer any TWO of the following in 150 words **(2 x 10 = 20 Marks)**			
3.	Explain the mechanism of Michael addition and MPV reduction.	K3	CO2
4.	Illustrate the effects of substituents on acidity of aliphatic and aromatic carboxylic acids with suitable examples.	K3	CO2
5.	Write the mechanism of Hoffmann's and Fries rearrangement.	K3	CO2
6.	Prepare the following compounds from ethyl acetoacetate. i) Hexanoic acid (ii) Glutaric acid (iii) Pentanone (iv) Succinic acid	K3	CO2

	(v) Uracil		
	SECTION C		
Answer any TWO of the following in 150 words			**(2 x 10 = 20 Marks)**
7.	Compare the mechanism of benzoin and Claisen condensation.	K4	CO3
8.	Distinguish between maleic and fumaric acids with reactions.	K4	CO3
9.	Illustrate the applications of pinacol-pinacolone rearrangement with any two examples.	K4	CO3
10.	Analyse any five applications of Grignard reagent.	K4	CO3
	SECTION D		
Answer any TWO of the following in 250 words			**(2 x 20 = 40 Marks)**
11.	a) Summarize the reactions of any two characteristic tests for an aromatic aldehyde. b) Compare Norrish type I and II reactions with an example for each.	K5	CO4
12.	a) Summarize any one method of preparation for the following compounds. (i) Lactic acid (ii) Pyruvic acid (iii) Glutaric acid (iv) Pimelic acid (v) Crotonic acid b) Compare the mechanism of acid and alkaline hydrolysis of an ester.	K5	CO4
13.	a) Construct a plausible mechanism for Claisen and *para*-Claisen rearrangement with an example. b) Write the mechanism of benzil-benzilic and Beckmann rearrangement.	K6	CO5
14.	a) Prepare the following compounds using diethyl malonate. (i) 2-Methyl butanoic acid (ii) Cyclobutane carboxylic acid b) Write any two method of preparation and any three synthetic applications of organolithium compound.	K6	CO5

UNIT WISE DISTRIBUTION OF CL AND CO BASED QUESTIONS AND MARKS FOR END OF SEMESTER QUESTION PAPER SETTING FOR UG COURSES
(MC, AR, AO, MS, ME and GL)

	SECTION A (1 Mark/Question)		SECTION B (10 Marks/Question)	SECTION C (10 Marks/Question)	SECTION D (20 Marks/Question)	
	K1	**K2**	**K3**	**K4**	**K5**	**K6**
UNIT I	2 (1)	1 (2)	-	1 (10)	1 (20)	-
UNIT II	2 (1)	1 (2)	1 (10)	1 (10)	1 (20)	-
UNIT III	2 (1)	1 (2)	1 (10)	1 (10)	-	1 (20)
UNIT IV	2 (1)	1 (2)	1 (10)	1 (10)	-	0.5 (10)
UNIT V	2 (1)	1 (2)	1 (10)	-	-	0.5 (10)
No. of CL based Questions with Max. Marks	**10 (10)**	**5 (10)**	**2 (20)**	**2 (20)**	**2 (40)**	**2 (40)**
No. of CO based Questions with Max. Marks	**CO1**		**CO2**	**CO3**	**CO4**	**CO5**
	15 (20)		**2 (20)**	**2 (20)**	**2 (40)**	**2 (40)**

* **MC**-Major Core, **AR**–Allied Required, **AO**–Allied Optional, **MS**-Major Skill, **ME**-Major Elective, **GL**-General Languages.

- In **Section D** students have choice between K5 and K6.

CL AND CO BASED MARKS DISTRIBUTION FOR DIRECT ASSESSMENTS OF UG COURSES
MC, AR, AO, MS, ME and GL

SECTION	CL	CO	CIA I	CIA II	III Component	Semester	Total (200)	CL and CO %
A	K1, K2	CO1	6	6	20	20	52	26%
B	K3	CO2	6	6	10	20	42	21%
C	K4	CO3	6	6	10	20	42	21%
D	K5, K6	CO4, CO5	12	12	-	40	64	32%

* **MC**-Major Core, **AR**–Allied Required, **AO**–Allied Optional, **MS**-Major Skill, **ME**-Major Elective, **GL**-General Languages.

CL AND CO BASED CIA QUESTION PAPER FORMAT FOR UG LAB COURSES* (MC, AR, AO, MS, ME and GL)

SECTION	MARKS	Q. NO	K1	K2	K3	K4	K5	K6
A	10	1	+					
		2		+				
B	10	3			+			
C	10	4				+		
D	10	5					+	
E	10	6						+
No. of CL based Questions with Max. marks			1(5)	1(5)	1(10)	1(10)	1(10)	1(10)
No. of CO based Questions with Max. marks			CO 1		CO 2	CO 3	CO 4	CO 5
			2(10)		1(10)	1(10)	1(10)	1(10)

No Comp III for Lab Courses and total marks assigned to CIA is 50

This template for Lab Courses is suggestive. But based on specific requirements if a department wants to develop a common template (Only one) for all its Lab courses it is encouraged to do so, but the template must have all Cognitive Levels and the final version

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI 60034

Department of Chemistry

FIRST CONTINUOUS ASSESSMENT TEST, JULY 2021

Chemistry Lab Course (MC/AR/AO)

II BSc Chemistry Date:
Time: 10.00 am to 1.00 pm Max. Marks: 50

SECTION A			**(10 Marks)**
1.	Recall the principle of the experiment / MCQ	K1	CO1
2.	Record work	K2	CO1
SECTION B			**(10 Marks)**
3.	Perform preliminary tests / procedure of the experiment	K3	CO2
SECTION C			**(10 Marks)**
4.	Experiment / Recording / Table / graph/ Confirmatory tests	K4	CO3
SECTION D			**(10 Marks)**
5.	Calculation / Preparation/ Derivatization / Observation & Inference	K5	CO4
SECTION E			**(10 Marks)**
6.	Consolidate, summarize and present the results of the experiments	K6	CO5

CL AND CO BASED END SEMESTER QUESTION PAPER FORMAT FOR UG LAB COURSES* (MC, AR, AO, ME)

SECTION	MARKS	Q. NO	K1	K2	K3	K4	K5	K6
A	10	1	+					
	10	2		+				
B	20	3			+			
C	20	4				+		
D	20	5					+	
E	20	6						+
No. of CL based Questions with Max. marks			1(10)	1(10)	1(20)	1(20)	1(20)	1(20)
No. of CO based Questions with Max. marks			CO 1		CO 2	CO 3	CO 4	CO 5
			2(20)		1(20)	1(20)	1(20)	1(20)

No Comp III for Lab Courses and total marks assigned to Semester is 100

This template for Lab Courses is suggestive. But based on specific requirements

if a department wants to develop a common template (Only one) for all its Lab courses it is encouraged to do so, but the template must have all Cognitive Levels and the final version of the template should be sent to us for approval.

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI 60034

Department of Chemistry

END SEMESTER EXAMINATION, NOVEMBER 2021

Chemistry Lab Course (MC/AR/AO)

II BSc Chemistry Date:

Time: 10.00am to 1.00 pm Max. Marks: 100

SECTION A		**(20 Marks)**	
1.	Recall the principle of the experiment / MCQ	K1	CO1
2.	Record work	K2	CO1
SECTION B		**(20 Marks)**	
3.	Perform preliminary tests / procedure of the experiment	K3	CO2
SECTION C		**(20 Marks)**	
4.	Experiment / Recording / Table / graph/ Confirmatory tests	K4	CO3
SECTION D		**(20 Marks)**	
5.	Calculation / Preparation/ Derivatization / Observation & Inference	K5	CO4
SECTION E		**(20 Marks)**	
6.	Consolidate, summarize and present the results of the experiments	K6	CO5