DEPARTMENT OF CHEMISTRY

About the Department

G.T.N. Arts College is the only Aided Institution in Dindigul district serving for the welfare of urban and rural students belonging to both genders. It caters to the needs of the most economically downtrodden students. The Chemistry department was started during the academic year 1971-72. The department was upgraded with P.G.Programme in the year 2000. This department was also recognized as Centre for Research by Madurai Kamaraj University in the year 2003. The department started under the headship of Prof.K.Gopalan, brought laurels to the Institution by securing University ranks and producing 100% results in the first Batch itself.. After the retirement of Prof.Gopalan, Prof.P.Jayaram took charge as the Head of the Department, who was followed by Dr.N.Rajendran, Dr.S.Rajendran, Dr.M.S.Dheenadyalan and Dr.J.Sathiyabama.At present, Dr. G.N. Kousalya is the Head of the Department of Chemistry. This P.G and Research Department has successfully produced more than 50 Ph.Ds and 150 M.Phil. Our Chemistry Department is considered as one of the best departments among colleges affiliated to Madurai Kamaraj University for producing university rank holders and gold medallists almost every year. The department also offers consultation for various chemical based industries in and around Dindigul district. Our Chemistry students regularly visit various chemical industries and industries in SIDCO Industrial Estate, Dindigul every year as part of the academic and industries Interaction Programmes. These visits help the students to gain knowledge about the industrial environment and enhance their entrepreneurial skills.

PRINCIPAL

Dr. P. Balagurusamy, M.A., M.Phil., M.Ed., P.G.D.C.A., Ph.D.,

STAFF

1. **Dr. J. Sathiyabama, M.Sc., M.Phil., M.Ed., Ph.D.,** Associate Professor & Dean of Science
2. **Dr. G.N. Kousalya, M.Sc.,M. Phil.,Ph.D.,** Assistant Professor and Head
3. **Mr. T. Srinivasan, M.Sc.,M. Phil.,B.Ed.,** Assistant Professor
4. **Mr. S. Kannan, M.Sc.,M.Phil.,B.Ed.,**Assistant Professor
5. **Dr. A. Sahaya Raja, M.Sc.,M.Phil., B.Ed., Ph.D.,**Assistant Professor
6. **Dr. M. Pandeeswaran, D.S.I.,M.Sc.,Ph.D.,** Assistant Professor
7. **Mrs. K. Rathika, M.Sc.,M.Phil.,M.Phil.,** Assistant Professor and Head (SSC)
8. **Mrs.V. Vanitha, M.Sc.,B.Ed.,M.Phil.,(Ph.D).,** Assistant Professor (SSC)
9. **Ms. P. Angel, M.Sc.,B.Ed.,M.Phil.,** Assistant Professor (SSC)
10. **Mrs. S. Sulochana, M.Sc.,B.Ed.,M.Phil.,(Ph.D).,** Assistant Professor (SSC)
11. **Mr. C.Siva Kumar, M.Sc., PGDCA., DFN., (Ph.D).,**Assistant Professor (SSC)

Programme Outcomes for Science

On successful completion of the B.Sc.programme, the graduates will be able to,

1. Apply the knowledge acquired in the respective disciplines and also have a multidisciplinary perspective towards the study of sciences.
2. Develop skills like analytical reasoning, critical thinking and problem solving to evince interest in higher education and research for offering solutions to societal and environmental problems.
3. Communicate articulately and effectively and interpret the results obtained from scientific studiesand put forthinnovative ideas to carve a niche in their domain.
4. Inculcate the principles and ethics learnt from the field of studyand exhibit the qualities like leadership, entrepreneurship and teamwork for discharging their duties as responsible citizens.
5. Utilize the growing advancements in Information and Communication Technology and embrace digital learningto become life-long learners.

Programme Specific Outcomes (PSOs)

On successful completion of the B.Sc., programme, the graduate will be able to

PSO1	Apply the principle of chemistry and the basic fundamental applications of chemical and scientific theories involving environmental and biological chemistry.
PSO2	Exhibit skills in problem solving, critical thinking and analytical reasoning as applied to chemistry related issues.
PSO3	Carry out scientific experiments with the help of laboratory, as well as analytical instruments and accurately record and analyse the results of such experiments.
PSO4	Pursue postgraduate programme in higher educational institutions.
PSO5	Get suitable employment opportunities in industries and academic institutions and enhance employment chances and instill confidence to turn into entrepreneur.
PSO6	Qualify common entrance competitive and service commission examinations.
PSO7	Explicitly communicate and exchange their ideas in view of the theoretical and experimental findings, impact of chemistry on environment and society to connect the chemists and the non- chemists.
PSO8	Apply the concept of chemistry and carry out minor research project for solving impacts on society.
PSO9	Gaining knowledge of grammatical conventions, varieties, formulations courses and culture. Becoming competent to face competitive examination through development of language skills.
PSO10	Get the knowledge on conservation of environmental resources, ecosystem, and biodiversity and face the global conflicts.
PSO11	Develop the spirit of co-operation, team and leadership qualities, Involve in various social activities as a responsible citizen, Enhance the moral and ethical awareness by providing valuable courses
PSO12	Develop soft skills and abilities to become lifelong learners.

Department of Chemistry

Under Choice Based Credit System (CBCS)

Course Pattern for Chemistry

The Undergraduate degree course consists of five vital components. They are as follows:

Part I Language (Tamil / French)

Part II English

Part III Core Course (Theory, Practical, Electives, Allied and Project).

Part IV Skill Based, Non Major Electives, Environmental Studies, Value Education andSelf Study

Part V Physical Education (Non Semester) and Extension Activities.

Note: Internship will be during the vacation of IV and V Semester respectively (for a minimum of 15 days).

Objectives

The Syllabus for UG Chemistry Programme under semester system has been designed on the basis of Choice Based Credit System (CBCS), which would focus on job oriented programmes and value added education. It will come into effect from June 2020 onwards.

Eligibility

Candidates should have passed the Higher Secondary Examination, Government of Tamil Nadu or any other examination accepted by the syndicate of Madurai Kamaraj University as equivalent there to.

Duration of the Course

The students who join the UG Chemistry Programme shall undergo a study period of three academic years – Six semesters.

Summary of Hours and Credits – B.Sc Chemistry

Part	Semester	Specification	No. of Courses	Hours	Credit	Total credits
I	I - IV	**Languages(Tamil/French)**	4	24	12	12
II	I - IV	**English**	4	24	12	12
III	I - VI	**Core Courses** Theory Practicals Electives Project	 10 5 2 1	 36 24 8 -	 36 16 8 2	102
		Allied Courses Theory Practicals	 8/8 4/2	 32/40 16/8	 3/2 8	
IV	V & VI	Skill Based Courses	4	8	8	20
	III & IV	Self Study Courses Soft Skills I Soft Skills II	2	-	4	
	I & II	Non Major Electives	2	4	4	
	I & II	1. Value Education 2. Environment and Gender Studies	1 1	2 2	4	
V	I & II	Physical Education Practical (Non-Semester Course)	1	-	2	4
	IV	Extension Activities	1	-	2	
		Total	**50/48**	**180**	**150**	**150**

Note: Internship will be during the vacation of IV and V Semester respectively (for a minimum of 15 days).

Department of Chemistry (B.Sc.)
Course Pattern – from 2020-2021 Onwards

Sem.	Part	Study Component	Course Code	Course Title	Hrs	Credit
I	I	Tamil I / French I	20UTAL11/ 20UFRL12	jw;fhy ftpijAk; rpWfijAk; French Language And Civilization I	6	3
	II	English I	20UENL11	English Language Through Literature – I	6	3
	III	Core Course I	20UCHC11	Organic Chemistry- I	3	3
		Core Course II	20UCHC12	Inorganic Chemistry- I	3	3
		Allied Course I	20UMAA11 / 20UZOA11	Allied Mathematics – I / Life and Diversity of Non Chordates	6/4	5/4
		Core practical I	20UCHC2P	Inorganic Semi micro Qualitative Analysis	2	1
		Allied Practical I	20UZOA2P	Allied Zoology Practical-I	2	1
		Non Major Elective CourseI	20UCHN11	Industrial Chemistry	2	2
	IV	Value Education	20UVEV11	Value Education	2	2
				Total	**30**	**21/20**
II	I	Tamil II / French II	20UTAL21/ 20UFRL22	gf;jp ,yf;fpaKk; GjpdKk; French Language And Civilization II	6	3
	II	English II	20UENL21	English Language Through Literature – II	6	3
	III	Core Course III	20UCHC21	Physical Chemistry-I	3	3
		Core Course IV	20UCHC22	Organic Chemistry-II	3	3
		Allied Course II	20UMAA21	Allied Mathematics II	6	5
			20UZOA21	Life and Diversity of Chordates	4	4
		Core practical I	20UCHC2P	Inorganic Semi micro Qualitative Analysis	2	2
		Allied Practical I	20UZOA2P	Allied Zoology Practical-I	2	2
	IV	Non Major Elective Course II	20UCHN21	Chemistry of Drugs	2	2
		Environment and Gender Studies	20UEGS21	Environmental and Gender Studies	2	2
	V	Physical Education Practical	20UPEV2P	Physical Education – Practical (Non-Semester Course)		2
				Total	**30**	**25/26**

III	I	Tamil III / French III	20UTAL31/ 20UFRL31	fhg;gpa ,yf;fpaKk; ciueilAk; French Language And Civilization III	6	3
	II	English III	20UENL31	EnglishLanguage Through Literature – III	6	3
	III	Core Course V	20UCHC31	Inorganic Chemistry-II	4	4
		Allied Course III	20UMAA31 /20UZOA31	Allied Mathematics – III / Zoology for Chemist – I	6/4	5/4
		Allied Course I	20UPHA11	Allied Physics - I	4	4
		Core Practical II	20UCHC4P	Volumetric Analysis	2	-
		Allied Practical II	20UZOA4P	Allied Zoology Practical-II	2	-
		Allied Practical I	20UPHA2P	Allied Physics Practical I	2	-
	IV	Self Study Course	20USSS31	Soft Skills I	-	2
				Total	**30**	**21/20**
IV	I	Tamil IV / French IV	20UTAL41 / 20UFRL41	gz;ila ,yf;fpaKk; ehlfKk; / French Language, Culture And Civilization IV	6	3
	II	English -IV	20UENL41	EnglishLanguage Through Literature – IV	6	3
	III	Core Course VI	20UCHC41	Physical Chemistry - II	4	4
		Allied Course IV	20UMAA41	Allied Mathematics - IV	6	5
			20UZOA41	Zoology for Chemist – II	4	4
		Allied CourseII	20UPHA21	Allied Physics - II	4	4
		Core Practical II	20UCHC4P	Volumetric Analysis	2	2
		Allied Practical II	20UZOA4P	Allied Zoology Practical II	2	2
		Allied Practical I	20UPHA2P	Allied Physics Practical I	2	2
	IV	Self Study Course	20USSS31	Soft Skills II		2
	V	Extension Activity	Common Code	Club Activities	-	2
				Total	**30**	**27/28**
V	III	Core Course VII	20UCHC51	Organic Chemistry III	4	4
		Core Course VIII	20UCHC52	Inorganic Chemistry III	4	4
		Allied Course III	20UPHA31	Allied Physics - III	4	4
		Core Elective Course I	20UCHE51	Nano Science and Technology	4	4
			20UCHE52	Analytical Chemistry		
			20UCHE53	Medicinal Chemistry		

		Core Practical III	20UCHC6P	Gravimetric Analysis and Organic Preparation	3	*
		Core Practical IV	20UCHC6Q	Organic Analysis and Estimation	2	*
		Core Practical V	20UCHC6R	Experiments in Physical Chemistry Experiments	3	*
		Allied Practical II	20UPHA4P	Allied Physics Practical II	2	*
		Core Project I	20UCHC5P	Project	-	2
	IV	Skill Based Course I	20UCHS51	Water Technology	2	2
		Skill Based Course II	20UCHS52	Food Chemistry	2	2
				Total	**30**	**22**
VI	III	Core Course IX	20UCHC61	Physical Chemistry III	4	4
		Core Course X	20UCHC62	Applied Chemistry	4	4
		Allied Course IV	20UPHA41	Allied Physics - IV	4	4
		Core Elective Course II	20UCHE61	Industrial Chemistry	4	4
			20UCHE62	Biochemistry		
			20UCHE63	Green Chemistry		
		Core Practical III	20UCHC6P	Gravimetric Analysis and Organic Preparation	3	4
		Core Practical IV	20UCHC6Q	Organic Analysis and Estimation	2	4
		Core Practical V	20UCHC6R	Experiments in Physical Chemistry	3	4
		Allied Practical II	20UPHA4P	Allied Physics Practical II	2	2
	IV	Skill based course III	20UCHS61	Polymer Chemistry	2	2
		Skill based course IV	20UCHS62	Dairy Chemistry	2	2
				Total	**30**	**34**
				Totalfor all Semesters	**180**	**150**

***Practical Examinations held at the end of each academic year.**

Courses offered to Non-major Students by the Department of Chemistry (UG)

Supportive:

SEM	Part	Course Code	Course Title	For the Department	Hr/Wk	Cr.	Marks
I	III	20UCHA11	Inorganic and Organic Chemistry	B.Sc Zoology	4	4	100
III	III	20UCHA11	Inorganic and Organic Chemistry	B.Sc Physics	4	4	100
II	III	20UCHA21	Inorganic and Physical Chemistry	B.Sc Zoology	4	4	100
IV	III	20UCHA21	Inorganic and Physical Chemistry	B.Sc Physics	4	4	100
III	III	20UCHA31	Organic and Physical Chemistry	B.Sc Zoology	4	4	100
V	III	20UCHA31	Organic and Physical Chemistry	B.Sc Physics	4	4	100
IV	III	20UCHA41	Organic, Inorganic and Physical Chemistry	B.Sc Zoology	4	4	100
VI	III	20UCHA41	Organic, Inorganic and Physical Chemistry	B.Sc Physics	4	4	100
II	III	20UCHA2P	Volumetric Analysis	B.Sc Zoology	2	2	100
IV	III	20UCHA2P	Volumetric Analysis	B.Sc Physics	2	2	100
IV	III	20UCHA4P	Organic Analysis	B.Sc Zoology	2	2	100
VI	III	20UCHA4P	Organic Analysis	B.Sc Physics	2	2	100

Allied Courses

There will be FOUR Allied courses to fulfill the B.Sc programme during three years.

Subject	Maximum Marks	Year of Study
Mathematics/Zoology	100	I& II
Physics	100	II &III

The Syllabus for the Allied Courses can be obtained from the Allied Department of Physics and Mathematics/Zoology

Practicals

Record Note Book		: 10 marks
Internal Examinations		: 30 marks
External Examinations	:	60 marks
Total		: 100 marks

Value Added Courses

The Department of Chemistry is offering the following Value Added Courses for thirty hours for all the UG students with no prejudice to the Under Graduate programme results.

Sl.No.	Semester	Course Code	Course Title
1.	III	20CCHE31	Sugar Technology
2	IV	20CCHE41	Perfume Chemistry
3	V	20CCHE51	Paper & Pulp Technology
4	VI	20CCHE61	Leather Technology

Extra-Credit Self Paced Courses For Advanced Learners

The Department of Chemistry has offered the following Extra Credit Self Paced Courses to enlighten the advanced learners. The department persuades the students to take virtual courses on MOOCS, SWAYAM and NPTEL.

(i) Nuclear Technology
(ii) Agricultural Chemistry
(iii) Polymer Technology
(iv) Clinical Chemistry
(v) Pyrotechnology
(vi) Fuel Chemistry

Programme	**B.Sc**	**Programme Code**	**UCH**
Course Code	**20UCHC11**	**Number of Hours/Cycle**	**3**
Semester	**I**	**Max. Marks**	**100**
Part	**III**	**Credit**	**3**
Core Course I			
Course Title	**Organic ChemistryI**		
Cognitive level – Upto K3			

Preamble

This course highlights the fundamentals of organic chemistry. Topics such as structure and physical properties , chemical reactivity of various organic compounds will be discussed in detail. Study of various fundamental groups such as alkanes, alkenes, alkyl halides, carbohydrates etc, will be conducted in detail.

Unit I: Structure and Bonding **9 Hours**

Nomenclature and classification of dienes - isolated, conjugated and cumulated dienes -butadiene-1,2 and 1,4 additions - thermodynamic and kinetic controlled products - Diels - Alder reaction - synthesis of dienes - 1,3-butadiene, isoprene & chloroprene.

Cycloalkanes - Nomenclature-methods of formation-Wurtz reaction, Dieckmann ring closure & reduction of aromatic hydrocarbons - Chemical reactions. Baeyer‘s strain theory and its limitations.

Unit II:Stereoisomerism **9 Hours**

Geometrical Isomerism:

Definition - geometrical isomerism of maleic and fumaric acids - aldoximes and ketoximes - determination of configuration of geometrical isomers - E, Z notations - stereochemistry of addition of bromine to double bond.

Optical Isomerism:

Asymmetric synthesis, chirality, specifications of absolute configurations by R and S notation - Optical activity of compounds without asymmetric carbon atoms, allenes, spiranes, and biphenyl compounds - Optical activity of elements other than carbon atoms - Quaternary ammonium compounds and tertiary amine oxides.

Unit III: Polyhalogen derivatives **9 Hours**

Chloroflurocarbons: Westran, Westrasol and Freon - preparation and applications, preparation and properties of $CHCl_3$, CHI_3 and CCl_4.

Organometalic compounds:Grignard reagents - preparation, structure and synthetic applications, limitations, organozinc, organocadmium and organolithium compounds.

Unit IV: Carbohydrates **9 Hours**

Introduction - classification - mono, di, oligo and polysaccharide with examples, occurrence, manufacture, physical and chemical properties and uses, structural elucidation of sucrose, maltose, starch, cellulose, glycogen.

Unit V: Dyes **9 Hours**

Introduction - theories of colour and constitution - natural and synthetic dyes - classification based on structure and application. Azodyes: preparatiom of Methylorange,Congo red and Bismarck brown - Triphenyl methane dyes: Preparation of Malachite green -Rosalinine and Crystal violet - Phthalein dyes: Phenolphthalein - Fluorescein and Eosin preparation and properties - Vat dyes: preparation of Indigo

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations.

Text Books

1. Soni.P.L., (2019),*Text book of Organic Chemistry,*Sultan Chand & Sons.
2. ArunBahl and Bahl.B.S., (2019),*Text Book for Organic Chemistry*S.Chand& Company Ltd, New Delhi.

Reference Books

1. R. L. Madan, (2010), *Organic Chemistry*, S Chand & Company Ltd.
2. Jerry March, (2015),*Reaction Mechanism of Organic compounds*. Wiley, India Edition7th
3. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee., (2011), *Organic Chemistry*, Pearson

Publishers, New Delhi, 7th Ed.,

E-Resources

- https://chem.libretexts.org/
- https://libguides.reading.ac.uk/chemistry/e-resources.
- https://onlinelibrary.wiley.com/series/1079
- https://libguides.library.usyd.edu.au
- https://global.oup.com

Course Outcomes

On completion of the course, students will be able to

CO1	Explain mechanism of addition reaction in Dienes
CO2	Categorise and Demonstrate the Stereoisomers
CO3	Outline the structure and synthetic applications of Organometallic Compounds
CO4	Elucidate the structure of specific Carbohydrates
CO5	Classify the Dyes based on structure the applications

Mapping of Programme outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	2	2	2	1	1	1	1	1	1
CO2	2	2	1	2	2	2	1	1	1	1	1	1
CO3	2	2	2	2	2	2	1	2	1	1	1	1
CO4	1	2	3	2	2	2	1	2	1	2	1	1
CO5	2	1	2	2	3	2	1	2	1	1	1	1

1-Low 2-Moderate 3-High

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
2	CO2	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
3	CO3	Up to K3	2	K1 & K2	2(K2& K2)	1(K3)
4	CO4	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
5	CO5	Up to K3	2	K1 & K2	2(K2& K2)	1(K3)
No. of Questions to be asked			10		10	5
No. of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1-Remembering and recalling facts with specific answers

K2-Basic understanding of facts and stating main ideas with general answers

K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	**5**	**-**	**-**	**5**	**5**	**5%**
K2	**5**	**40**	**30**	**75**	**75**	**75%**
K3	**-**	**-**	**20**	**20**	**20**	**20%**
Total Marks	**10**	**40**	**50**	**100**	**100**	**100%**

Lesson Plan

Unit	Description	Hours	Mode
I Structure and Bonding	a) Nomenclature and classification of dienes isolated, conjugated and cumulated dienes. b) butadiene-1,2 and 1,4 additions c) Thermodynamic and kinetic controlled products of Diels - Alder reaction. d) Synthesis of dienes - 1,3-butadiene, isoprene & chloroprene. e) Cycloalkanes - Nomenclature-methods of formation-Wurtz reaction, f) Dieckmann ring closure & reduction of aromatic hydrocarbons - Chemical reactions. g) Baeyer's strain theory and its limitations.	2 1 2 1 1 1 1	Chalk and talk, Power point presentation
II Stereoisomerism	a) Definition - geometrical isomerism of maleic and fumaric acids - aldoximes and ketoximes b) determination of configuration of geometrical isomers - E, Z notations c) stereochemistry of addition of bromine to double bond. d) Asymmetric synthesis, chirality, e) Specifications of absolute configurations by R and S notation f) Optical activity of compounds without asymmetric carbon atoms, allenes, spiranes, and biphenyl compounds. g) Optical activity of elements other than carbon atoms - Quaternary ammonium compounds and tertiary amine oxides.	1 1 1 1 1 2 2	Chalk and talk, Power point presentation
III Polyhalogen derivatives	a) Chloroflurocarbons: Freon – preparation and application b) Westran and Westrasol preparation and applications, c) preparation and properties of $CHCl_3$, CHI_3 and CCl_4. d) Organometalic compounds:Grignard reagents - preparation, structure and synthetic applications, limitations. e) organozinc, organocadmium and organolithium compounds.	1 1 2 3 2	Chalk and talk, Power point presentation
IV Carbohydrates	a) Introduction - classification - mono, di, oligo and polysaccharide with examples, occurrence. b) Manufacture, physical and chemical properties and uses.	3 3	Chalk and talk, Power point presentation

	c) Structural elucidation of sucrose, Structural elucidation of maltose, Structural elucidation of starch, Structural elucidation of cellulose, Structural elucidation of glycogen.	3	
V **Dyes**	a) Introduction - theories of colour and constitution. b) Natural and synthetic dyes classification based on structure c) Classification based on application. d) Azodyes: preparatiom of methylorange, congo red, bismark brown. e) Triphenyl methane dyes: Preparation of malachite green - rosalinine and crystal violet. f) Phthalein dyes: Phenaolphthalein - fluorsecein and eosin preparation and properties – g) Vat dyes: preparation of Indigo.	1 1 1 2 2 1 1	Chalk and talk, Power point presentation, Group Discussion

Course Designed by: Mr.S.Kannan, Mrs.V.Vanitha

Programme	**B.Sc**	**Programme Code**	**UCH**
Course Code	**20UCHC12**	**Number of Hours/Cycle**	**3**
Semester	**I**	**Max. Marks**	**100**
Part	**III**	**Credit**	**3**
Core Course II			
Course Title	**Inorganic Chemistry-I**		
Cognitive level – Upto K3			

Preamble

The students are enabled to have knowledge on Atomic structure and periodicity of elements, understand the types of chemical bond and aquire the detailed knowledge on acids and bases.

Unit – IAtomic Structure (Wave Nature) 9Hours

Dual Nature of Electron, Debroglie's Equation, Davison & Germer's Experiment, Thomson's Experiment, Heisenberg's Uncertainty Principle, Compton Effect, Schrodinger's Wave Equation (Equation Only), Quantum Numbers, Shape of orbitals, node, nodal planes, orbit,orbitals, Pauli's Exclusion Principle, Hund's Rule of Maximum Multiplicity, Afbau Principle and its limitations.

Unit – IIPeriodicity of Elements 9Hours

The long form of periodic table, detailed discussion of the following properties of the

elements with reference to S & P - block.Effective Nuclear Charge, Screening Effect, Slater's rule, Variation of Effective. Nuclear Charge in Periodic Table. Atomic, Ionic & Covalent Radii- Ionization Energy, Successive Ionization Energy, Factors Affecting Ionization Energy, Applications. Electron Affinity, Variation of Electron Affinity.Electro Negativity, Variation of Electro Negativity with Bond Order, Partial Charge,Hybridizations, Nuclear Charge, Applications of Electro Negativity.

Unit – III Chemical Bonding-I (Lewis Theory) 9Hours

Covalency, variable covalency – explanation, properties of Covalent compounds, Comparison of Ionic and Covalent Compounds, Failure of Octet Rule (Lewis concept) in covalent compounds. Sugden's concept of single linkage, Non-polar and Polar covalent bonds Hanny and Smyth equation. Dipole moment, application of dipole moment, Fajan's rule, Metallic bond..

Unit-IVChemical Bonding-II (Orbital Concept) 9Hours

Linnet's Double – Quartet (D-Q) theory, VSPER Theory, Valence Bond Theory. Resonance, Resonance energy, Resonance structure of CO_2, NO_2, NO_3^-, CO_3^{2-},ions. Hybridisation - AB_6, $AB_5(lp)$, $AB_{4(lp)2}$, AB_4, , $AB_3(lp)$, $AB_2(lp)_2$, $AB(lp)_3$type with examples.

Unit-VAcids And Bases 9Hours

Arrhenius Concept, Proton transfer theory, Concept of Lowry - Bronsted, Lux - Flood

Concept. Solvent - System Concept, Lewis Concept, Relative strength of acids and bases, Hard and Soft acids and bases, Pearson's concept, HSAB Principle and its applications.

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations.

Text Books

1. Soni, P.L., &Katyal, M.,(2019), *Text Book of Inorganic Chemistry*, Sultan Chand
2. Madan R.D,(2010), *Modern Inorganic chemistry*, S.Chand and sons.

Reference Books

1. Lee. J.D, (2019), *Concise Inorganic Chemistry*, Wiley India (P) Ltd, New Delhi.
2. F. Albert Cotton, Geoffrey Wilkinson, Manfred Bochmann and Carlos Murilla, (2007) Advanced Inorganic Chemistry,, 6th Ed., Wiley India Pvt. Ltd.
3. Puri and Sharma, (2016), *Text Book for Inorganic Chemistry*, S. Chand & company Ltd,
4. Malik, Tuli and Madan,(2013), *Selected topics in Inorganic chemistry*, S.Chand and company Ltd,

E-Resources :

- http://www.chem4kids.com/files/atom_structure.html
- http://www.askiitians.com/revision-notes/chemistry/classification-of-elements-and -periodicity-in-properties/
- http://www.slideshare.net/mobile/richardaraneta/chemical-bonding-basic-concepts
- http://www.breslyn.org/chemistry/bonding/3-Theories/index-theories.php
- http://www.freebookcentre.net/chemistry/Acid-Base-Chemistry-Books.html

Course outcomes

On completion of the course, students will be able to

CO1	Acquire the knowledge of an atom, differentiate the wave and particle character of an atom and predict the shape of orbitals and size of an atom.
CO2	Recognize the periodic table and explain the variation of properties in the periodic table.
CO3	Identify the properties of ionic and covalent compounds and generalize the various aspects of covalent compounds.
CO4	Explain the VSEPR and Valence Bond Theory, identify the structure of molecules and constructthe structure based on the concept of Resonance and Hybridization.
CO5	Relate and apply the detailed knowledge of acids and bases.

Mapping of Programme outcomes with Course Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**	**PSO11**	**PSO12**
CO1	**2**	**2**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CO2	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**
CO3	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**
CO4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**
CO5	**2**	**2**	**3**	**2**	**3**	**2**	**1**	**2**	**1**	**1**	**1**	**1**

1-Low 2-Moderate 3-High

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
2	CO2	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
3	CO3	Up to K3	2	K1 & K2	2(K2& K2)	1(K3)
4	CO4	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
5	CO5	Up to K3	2	K1 & K2	2(K2& K2)	1(K3)
No. of Questions to be asked			10		10	5
No. of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1-Remembering and recalling facts with specific answers

K2-Basic understanding of facts and stating main ideas with general answers

K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C Open Choice	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5	5%
K2	5	40	20	65	65	65%
K3	-	-	30	30	30	30%
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit	Description	Hours	Mode
I **Atomic Structure (Wave Nature)**	a)Dual Nature of Electron, Debroglie's Equation, Davison & Germer's Experiment, Thomson's Experiment, Heisenberg's Uncertainty Principle, Compton Effect. b) Schrodinger's Wave Equation (Equation Only), Quantum Numbers, Shape of orbitals, node, nodal planes, orbit,orbitals. c) Pauli's Exclusion Principle, Hund's Rule of Maximum Multiplicity, Afbau Principle and its limitations.	**3** **3** **3**	**PPT presentation, Chalk and Talk, Video presentation**
II **Periodicity of Elements**	a) The long form of periodic table, detailed discussion of the following properties of the elements with reference to S & P - block.Effective Nuclear Charge, Screening Effect, Slater's rule, Variation of Effective. Nuclear Charge in Periodic Table. b)Atomic, Ionic & Covalent Radii-Ionization Energy, Successive Ionization Energy, Factors Affecting Ionization Energy, Applications. c)Electron Affinity, Variation of Electron Affinity.Electro Negativity, Variation of Electro Negativity with Bond Order, Partial Charge,Hybridizations, Nuclear Charge, Applications of Electro Negativity.	**3** **3** **3**	**PPT presentation, Chalk and Talk, Video presentation**
III **Chemical Bonding-I (Lewis Theory)**	a)Covalency, variable covalency – explanation, properties of Covalent compounds, Comparison of Ionic and Covalent Compounds. b)Failure of Octet Rule (Lewis concept) in covalent compounds. Sugden's concept of single linkage, Non-polar and Polar covalent bonds Hanny and Smyth equation. c)Dipole moment, application of dipole moment, Fajan's rule, Metallic bond..	**3** **3** **3**	**PPT presentation, Chalk and Talk, Video presentation.**
IV **Chemical Bonding-II**	a)Linnet's Double – Quartet (D-Q) theory, VSPER Theory, Valence Bond Theory. b) Resonance, Resonance energy, Resonance structure of CO_2, NO_2, NO_3^-, CO_3^{2-},ions.	**3** **3** **3**	**PPT presentation, Chalk and Talk, Video presentation**

(Orbital Concept)	c) Hybridisation - AB_6, $AB_5(lp)$, $AB_{4(lp)2}$, AB_4, , $AB_3(lp)$, $AB_2(lp)_2$, $AB(lp)_3$type with examples.		
V **Acids And Bases**	**a)** Arrhenius Concept, Proton transfer theory, Concept of Lowry - Bronsted, Lux - Flood Concept. b)Solvent- System Concept, Lewis Concept, Relative strength of acids and bases. c) Hard and Soft acids and bases, Pearson's concept, HSAB Principle and its applications.	**3** **3** **3**	**PPT presentation, Chalk and Talk, Video presentation**

Course designed by, Mr.T.Srinivasan, Mrs. S.Sulochana

Programme	**B.Sc/B.A/B.Com**	**Programme Code**	**UCH**
Course Code	**20UCHN11**	**Number of Hours/Cycle**	**2**
Semester	**I**	**Max. Marks**	**100**
Part	**IV**	**Credit**	**2**
Non Major Elective Course I			
Course Title	**Industrial Chemistry**		
Cognitive Level - Upto K3			

Preamble

The course enables the students to gain knowledge on concepts of chemistry and its significant impacts on industries.

Unit I Milk and Milk Products Industry **6 Hours**

Milk - Composition of Milk, flavor and aroma of milk - Physical properties of milk, Effect of heat on milk – Pasteurization and methods – Homogenisation and advantages - Milk products- manufacturing process of cream, Butter, Ice cream, Milk Powder.

Unit II Agricultural Industry **6 Hours**

Nutrients for plants – Major and minor nutrients – Role of NPK – Classification of fertilizers - Nitrogenous fertilizer – Urea - Potash fertilizer – potassium nitrate - Phosphate fertilizer – Super Phosphate – Complex fertilizer - Mixed fertilizers.

Pesticides – classification of pesticides – Insecticides – preparation and uses of DDT and BHC – Health hazards of pesticides

Unit III Polymer Industry **6 Hours**

Rubber - Natural and Synthetic rubber –difference and examples (Structure not necessary) – Distinguish between addition and condensation polymers – Vulcanization of rubber – Plastic - difference between Thermo and Thermosetting plastics. – Important plastics – preparation, properties and uses of PVC, Nylon – 66, Teflon, Bakelite – Synthetic rubber - preparation, properties and uses of Butyl rubber and styrene butadine rubber(SBR).

Unit IV Petrochemical Industry **6 Hours**

Crude oil – Refining of crude oil – Separation of water (Cottrell's process), Removal of Sulphur compounds and Fractional distillation of crude oil – Kerosene oil - Gasoline – octane number - Aviation gasoline - Diesel - cetane number - comparison of gasoline and diesel oil – Natural gas – LPG – CNG.

Unit V Nuclear Power Plants **6 Hours**

Nuclear Power plants in India – Nuclear fuels – Difference between nuclear fission and nuclear fusion – Distinguish between nuclear reaction and chemical reaction - Concepts of Nuclear fission and Nuclear reactor – components of nuclear reactor - energy production – Nuclear waste disposal and hazards.Visit to various nearest industries and submission of report

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations, Industrial visit.

Text Book

1. Sharma.B.K.,(2016),*Industrial Chemistry* (Including Chemical Engineering), Goel Publishing House, Meerut

Reference Books:

1. BagavathiSundari.K.,(2007),*Applied Chemistry*, S.Chand, New Delhi
2. Jaya Shree Ghosh.,(2008), *Fundamental concepts of applied chemistry*, S.Chand, New Delhi
3. Jain and Jain.,(2005), *Engineering chemistry*, DhanpatRai Publications Pvt. Ltd., New Delhi.

E- Resources

- https://bakerpedia.com/processes/pasteurization/
- http://www.aau.in/library-services-dr-m-d-patel-regional-e-library
- https://www.thomasnet.com/articles/plastics-rubber/thermoset-vs-thermoplastics/

- https://www.leamericas.com/en/technologies/petrochemical/petrochemical-components/index.html.
- https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-waste/storage-and-disposal-of-radioactive-waste.aspx.

Course outcomes

On the successful completion of the course, students will be able to

CO 1	Analyse the physico – chemical changes in milk due to Boiling and Pasteurization
CO2	Recognize the chemical compounds used in Fertilizers and Pesticides
CO3	Explain the physical, chemical properties and their application of polymers
CO4	Identify and outline the characteristics, Properties and uses of Crude oil
CO5	Compare and explain the nuclear and Chemical reactions

Articulation Mapping-K Levels with Course Outcomes(COs)

			Section A		**Section B**
			Either/or Choice		**Open Choice**
Units	**COs**	**K-Level**	**No. of Questions**	**K-Level**	**No. of Questions**
1	CO1	Up to K2	2	(K1& K1)	1(K2)
2	CO2	Up to K2	2	(K1 & K1)	1(K2)
3	CO3	Up to K3	2	(K2& K2)	1(K3)
4	CO4	Up to K3	2	(K2 & K2)	1(K3)
5	CO5	Up to K3	2	(K2& K2)	1(K3)
No. of Questions to be asked			10		5
No. of Questions to be answered			5		3
Marks for each Question			3		5
Total Marks for each Section			15		15

On the successful completion of the course, the students will be able to gain knowledge on concepts of Chemistry and its impacts on Industries

K1-Remembering and recalling facts with specific answers

K2-Basic understanding of facts and stating main ideas with general answers

K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	**Section A (Either or Choice)**	**Section B (Open Choice)**	**Total Marks**	**% of Marks without choice**	**Consolidated (Rounded off)**
K1	12	-	12	21.82	22%
K2	18	10	28	50.91	51%
K3	-	15	15	27.27	27%
Total Marks	30	25	55	100	100%

Lesson Plan

Unit	Description	Hours	Mode
I **Milk and Milk Products Industry**	a)Milk - Composition of Milk, flavor and aroma of milk - Physical properties of milk, Effect of heat on milk. b) Pasteurization and methods, Homogenisation and advantages and Milk products- manufacturing process of cream, Butter, Ice cream, Milk Powder.	3 3	• Chalk and talk • Power point presentation
II **Agricultural Industry**	a)Nutrients for plants – Major and minor nutrients – Role of NPK – Classification of fertilizers - Nitrogenous fertilizer – Urea - Potash fertilizer – potassium nitrate - Phosphate fertilizer – Super Phosphate – Complex fertilizer - Mixed fertilizers. b) Super Phosphate, Complex fertilizer, mixed fertilizers. Pesticides, classification of pesticides, Insecticides, preparation and uses of DDT and BHC and Health hazards of pesticides.	3 3	• Chalk and talk • Power point presentation • Seminar • Group discussion
III **Polymer Industry**	a)Rubber - Natural and Synthetic rubber – difference and examples (Structure not necessary) – Distinguish between addition and condensation polymers – Vulcanization of rubber – Plastic - difference between Thermo and Thermosetting plastics. b) Important plastics – preparation, properties and uses of PVC, Nylon – 66, Teflon, Bakelite – Synthetic rubber - preparation, properties and uses of Butyl rubber and styrene butadine rubber(SBR).	3 3	• Chalk and talk • Power point presentation • Seminar • Group discussion
IV **Petrochemical Industry**	a)Crude oil – Refining of crude oil – Separation of water (Cottrell's process), Removal of Sulphur compounds. b) Fractional distillation of crude oil – Kerosene oil - Gasoline – octane number - Aviation gasoline - Diesel - cetane number - comparison of gasoline and diesel oil. c)Natural gas – LPG – CNG.	2 2 2	• Chalk and talk • Power point presentation • Seminar
V **Nuclear Power Plants**	a)Nuclear Power plants in India – Nuclear fuels – Difference between nuclear fission and nuclear fusion. b) Distinguish between nuclear reaction and chemical reaction - Concepts of Nuclear fission and Nuclear reactor, components of nuclear reactor and energy production. c)Nuclear waste disposal and hazards.	2 2 2	• Chalk and talk • Power point presentation

Course Designed by, Dr. A.Sahaya Raja

Programme	**B.Sc**	**Programme Code**	**UCH**
Course Code	**20UCHC21**	**Number of Hours/Cycle**	**3**
Semester	**II**	**Max. Marks**	**100**
Part	**III**	**Credit**	**3**
Core Course III			
Course Title	**Physical Chemistry-I**		
Cognitive level – Upto K3			

Preamble

The course enables the students to learn and understand the surface phenomena and matter behaviour in liquid, colloid and gaseous state.

Unit I Gaseous State **9 Hours**

Postulates of kinetic theory of gases-Derivation of Ideal gas laws from the expression on the basis of kinetic theory of gases- deviations- equation of state- reduced equation of state-law of corresponding states-compressibility factor for gases- Boyle and inversion temperature of gases- PV isotherm of ideal and real gases- Andrew's experiments- critical state of gases-Determination of critical constant.

Unit II Colloidal State **9 Hours**

Colloids- colloidal state of matter- various types-classification-
Solids in liquids(sols)- properties- kinetics- optical and electrical- stability of colloids and protective action- Hardy Schulze law- gold number- Hofmeister series
Liquids in liquids(emulsion)- types of emulsion- emulsifier with suitable examples
Liquids in solids(gels)- classification- preparation- properties- thixotropy- synergists and inhibition- Donnan membrane equilibrium – application of colloids- Determination of size of colloidal particles.

Unit IIILiquid State **9Hours**

Nature of cohesive forces in liquids – Trouton's rule and its significance.Physical properties and chemical constitution ,Molar volume and its application.Surface tension – influence of temperature on surface tension – Parachor – atomic and structural Parachors – applications.Viscosity – influence of temperature on viscosity – relation to chemical constitution - molecular viscosity – atomic and structural viscosity – Rheochor.Refraction – refractive index – specific refractive index – molar, atomic and structural refraction – applications – liquid crystal – their application.

UnitIV Adsorption **9 Hours**

Definition of various terms – adsorption of gases on solids – characteristics of adsorption of gases on solids – physical adsorption and chemisorptions – factors influencing adsorption – adsorption isotherm – Freundlich adsorption isotherm, Langmuir adsorption isotherm, BET theory of multilayer adsorption– applications of adsorption.

Unit V Catalysis **9 Hours**

Definition – characteristics – theories of catalysis – promoters and poisons – enzyme catalysis – mechanism – Michaleis – Menten equation acid – base catalysis and autocatalysis – application of catalysis- pH-dependence of rate constants of catalyzed reactions- Effect of temperature on enzyme catalysis.

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations

Text Books

1. Puri, Sharma and Pathania,(2015), Principles of Physical Chemistry, Vishal Publishing Co.47th Edition, (2015)
2. Bahl.B.S, ArunBahl(2005), Essentials of Physical chemistry, S.Chand and company Ltd.

Reference Books

1. A.W.Adamson.,(1982)Physical Chemistry of surfaces, Wiley publications,
2. Soni.P.L., (2013),Text book of Physical Chemistry,Sultan Chand & Sons
3. Peter-W.Atkins, (2010), Physical Chemistry, Oxford University Press, 9th edition
4. Glasstone S.,(1948)'A Textbook of Physical Chemistry".

E-Resources

- https://www.pnas.org/content/108/3/917-
- https://www.emedicalprep.com/study-material/chemistry/surface-chemistry/

- http://www.chm.bris.ac.uk/webprojects2002/pdavies/what.html-
- https://www.britannica.com/science/colloid
- https://www.khanacademy.org/science/chemistry/chem-kinetics
- http://butane.chem.uiuc.edu/pshapley/genchem1/L17/1.html
- https://www.grandinetti.org/gaseous-state.

Course outcomes

On completion of the course, students will be able to

CO1	Define and explain gas laws, its deviations from ideal behaviour.
CO2	Explain the various phenomenons involved in colloidal state.
CO3	Interpret the physical behaviour of liquids.
CO4	Catagorize the concept of adsorption in various areas.
CO5	Relate the importance of catalytic activities.

Mapping of Programme outcomeswith Course Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**2**	**1**	**1**
CO2	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**
CO3	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**1**	**1**
CO4	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**
CO5	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**1**

1-Low **2-Moderate** **3-High**

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2 & K2)	K2
2	CO2	Up to K2	2	K1 & K2	2(K2 & K2)	K2
3	CO3	Up to K3	2	K1 & K2	2(K2 & K2)	K3
4	CO4	Up to K3	2	K1 & K2	2(K3 & K3)	K3
5	CO5	Up to K3	2	K1 & K2	2(K2& K2)	K3
No. of Questions to be asked			10		10	5
No. of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1-Remembering and recalling facts with specific answers

K2-Basic understanding of facts and stating main ideas with general answers

K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Open choice)**	**Total Marks**	**% of Marks without choice**	**Consolidated (Rounded off)**
K1	5	-	-	5	5%	5%
K2	5	32	20	57	57%	57%
K3	-	8	30	38	38%	38%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	**Description**	**Hours**	**Mode**
I	A)Postulates of kinetic theory of gases-	**3**	**PPT**

Gaseous State	Derivation of Ideal gas laws from the expression on the basis of kinetic theory of gases- deviations. B) Equation of state- reduced equation of state-law of corresponding states-compressibility factor for gases- Boyle and inversion temperature of gases. C) PV isotherm of ideal and real gases- Andrew's experiments- critical state of gases-Determination of critical constant.	**3** **3**	**presentation, Chalk and Talk, Video presentation**
II Colloidal State	A) Colloids- colloidal state of matter- various types-classification-Solids in liquids(sols)-properties- kinetics- optical and electrical-stability of colloids and protective action. B) Hardy Schulze law- gold number-Hofmeister series Liquids in liquids(emulsion)- types of emulsion- emulsifier with suitable examples. C) Liquids in solids(gels)- classification-preparation- properties- thixotropy- synergists and inhibition- Donnan membrane equilibrium – application of colloids-Determination of size of colloidal particles.	**3** **3** **3**	**PPT presentation, Chalk and Talk, Video presentation**
III Liquid State	A)Nature of cohesive forces in liquids – Trouton's rule and its significance. Physical properties and chemical constitution ,Molar volume and its application.Surface tension. B)Influence of temperature on surface tension – Parachor – atomic and structural Parachors – applications.Viscosity – influence of temperature on viscosity – relation to chemical constitution - molecular viscosity – atomic and structural viscosity. C) Rheochor.Refraction – refractive index – specific refractive index – molar, atomic and structural refraction – applications – liquid crystal – their application.	**3** **3** **3**	**PPT presentation, Chalk and Talk, Video presentation.**
IV Adsorption	A)Definition of various terms – adsorption of gases on solids – characteristics of adsorption of gases on solids. B)Physical adsorption and chemisorptions – factors influencing adsorption – adsorption isotherm – Freundlich adsorption isotherm. C) Freundlich adsorption isotherm, Langmuir adsorption isotherm, BET theory of multilayer adsorption– applications of adsorption.	**3** **3** **3**	**PPT presentation, Chalk and Talk, Video presentation**
V Catalysis	A)Definition – characteristics – theories of catalysis – promoters and poisons – enzyme catalysis – mechanism. B) Michaleis – Menten equation acid – basecatalysis and autocatalysis – application of catalysis. C) pH-dependence of rate constants of catalyzed reactions- Effect of temperature on enzyme catalysis.	**3** **3** **3**	**PPT presentation, Chalk and Talk, Video presentation**

Course Designed By: Dr. J. Sathiyabama, Dr. G.N. Kousalya, Miss. P.Angel

Programme	B.Sc	Programme code	UCH
Course	20UCHC22	Number of Hours/cycle	3
Semester	II	Max.Marks	100
Part	III	Credit	3
Core Course IV			
Course	Organic Chemistry - II		
Cognitive level Upto K3			

Preamble:

This course mainly deals with mechanism of nucleophilic substitution, elimination reaction and heterocyclic compounds.

Unit I: Nucleophilic Substitution **9 Hours**

Nucleophilic substitution reaction mechanisms (with evidence), relative rates & stereochemical features: S_N1, S_N1', S_N2,S_N2' (allylic rearrangement) and S_Ni; effects of solvent, substrate structure, leaving group and nucleophiles substitutions involving NGP; role of crown ethers and phase transfer catalyst.

UnitII: Elimination Reactions **9 Hours**

Elimination reactions: E1, E2, E1CB and Ei formation of alkenes and alkynes; mechanisms, reactivity, regioselectivity and stereoselectivity; comparison between substitution and elimination; importance of Bredt's rule relating to the formation of C=C.

Unit III:Carbonyl and Related Compounds **9 Hours**

General methods of preparation of carbonyl compounds by oxidation reactions, By heating calcium salts of carboxylic acids - Reactivity of carbonyl compounds: Nucleophilic addition reactions Reaction with HCN, Wittings reaction, Reformsky reaction - Oxidation reactions, Reduction reactions Meerwein-Ponndorf-Verley reduction, Wolf-Kishner reduction, Clemmensen reduction.

Unit IV:Heterocyclic Compounds I **9 Hours**

General classification-aromatic and non-aromatic heterocyclics.Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine.Preparation, properties and uses of furan, pyrrole &thiophene.Synthesis and reactions of pyridine comparative studyof basicity of pyrrole, pyridine with amines.

Unit V: Heterocyclic Compounds II **9 Hours**

Condensed five and six membered heterocyclics-preparation ofindole,quinolineandisoquinoline-Fischer indole synthesis, Skraup synthesis and Bischer-Napieralski synthesis-Electrophilic substitution reactions.Ureides and Nucleic acidsUreides-classification-pyrimidines-thymine, uracil and cytosine-purines-adenine and guanine - synthesis.

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations.

Text Books

1. Soni.P.L., (2019),*Text book of Organic Chemistry*,Sultan Chand & Sons
2. Bahl.B.S.,ArunBahl(2019), *Essentials of Physical chemistry*, S.Chand and company Ltd.

Reference Books

1. ArunBahl and Bahl.B.S., (2019),*Text Book for Organic Chemistry*S.Chand& Company Ltd, New Delhi .
2. Jerry March, (2015),*Reaction Mechanism of Organic compounds*. Wiley, India Edition7th

   R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee., (2011), Organic Chemistry, Pearson

Publishers, New Delhi, 7th Ed.,

E-Resources :

- https://chem.libretexts.org/
- https://libguides.reading.ac.uk/chemistry/e-resources.
- https://onlinelibrary.wiley.com/series/1079

- https://libguides.library.usyd.edu.au
- https://global.oup.com

Course outcomes

On completion of the course, students will be able to

CO1	Explain the mechanism of Nucleophilic substitution reactions
CO2	Recall and demonstrate the Elimination reactions and importance of Bredt's rule
CO3	Explain the reactivity of Carbonyl compounds
CO4	Compare and Describe the synthesis of five membered Heterocyclic compounds
CO5	Classify and describe synthesis of Six membered Heterocyclic compouds

Mapping of Programme outcomes with Course Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**
CO2	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO3	**2**	**1**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**1**	**1**
CO4	**1**	**1**	**3**	**2**	**1**	**2**	**1**	**3**	**1**	**1**	**1**	**1**
CO5	**1**	**2**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**

1-Low **2-Moderate** **3-High**

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2 & K2)	K2
2	CO2	Up to K2	2	K1 & K2	2(K2 & K2)	K2
3	CO3	Up to K3	2	K1 & K2	2(K2& K2)	K3
4	CO4	Up to K2	2	K1 & K2	2(K2 & K2)	K2
5	CO5	Up to K3	2	K1 & K2	2(K2 & K2)	K3
No. of Questions to be asked			10		10	5
No. of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1-Remembering and recalling facts with specific answers

K2-Basic understanding of facts and stating main ideas with general answers

K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Open choice)**	**Total Marks**	**% of Marks without choice**	**Consolidated (Rounded off)**
K1	5	-	-	5	5	5%
K2	5	40	30	75	75	75%
K3	-	-	20	20	20	20%
Total Marks	10	40	50	100	100	100%

Lesson Plan

Unit	Description	Hours	Mode
Nucleophilic Substitution	a) Nucleophilic substitution reaction mechanisms (with evidence), relative rates & stereochemical features: S_N1 and S_N2 b) Nucleophilic substitution reaction mechanisms (with evidence), relative rates & stereochemical features: S_N1' and S_N2' c) (allylic rearrangement) and S_Ni d) Effects of solvent, substrate structure, e) Leaving group and nucleophiles substitutions involving NGP; **f)** Role of crown ethers and phase transfer catalyst.	2 2 1 1 1 2	Chalk and talk, Power point presentation
II **Elimination Reactions**	a) Elimination reactions: Introduction b) Formation of alkenes and alkynes; E1, E2, E1cB and Ei mechanisms, c) reactivity, regioselectivity and stereoselectivity. d) Comparison between substitution and elimination; e) importance of Bredt's rule relating to the formation of C=C bond.	1 3 2 1 2	Chalk and talk, Power point presentation
III **Carbonyl and Related Compounds**	a) General methods of preparation of carbonyl compounds, Preparation by oxidation reactions, heating calcium salts of carboxylic acids. b) Reactivity of carbonyl compounds. Nucleophilic addition reactions. c) Reaction with HCN, Wittings reaction. d) Reformsky reaction. e) Reduction reactions, Meerwein-Ponndorf-Verley reduction. f) Wolf-Kishner reduction g) Clemmensen reduction.	2 2 1 1 1 1 1	Chalk and talk, Power point presentation
Unit IV **Heterocyclic Compounds I**	a) General classification-aromatic and non-aromatic heterocyclic compounds. b) Molecular orbital diagram and aromatic characteristics of pyrrole, furan, thiophene and pyridine. c) Preparation, properties and uses of furan, pyrrole &thiophene. d) Synthesis and reactions of pyridine. e) Comparative studyof basicity of pyrrole, pyridine with amines.	2 2 3 1 1	Chalk and talk, Power point presentation
V **Heterocyclic Compounds II**	a) Condensed five and six membered heterocyclic compounds. b) preparation ofindole,quinolineandisoquinoline. c) Fischer indole synthesis, Skraup synthesis. d) Bischer-Napieralski synthesis. e) Electrophilic substitution reactions. f) Ureides and Nucleic acids: Ureides-classification-pyrimidines-thymine, uracil and cytosine-purines-adenine and guanine.	1 2 2 1 1 2	Chalk and talk, Power point presentation, Group Discussion

Course Designed by, Mr. S.Kannan, Mrs. K. Rathika,

Programme	**B.Sc chemistry**	**Programme Code**	**UCH**
Course Code	**20UCHC2P**	**Number of Hours/Cycle**	**2**
Semester	**II**	**Max. Marks**	**100**
Part	**III**	**Credit**	**2**
Core Practical I			
Course Title	**Inorganic Semimicro Qualitative Analysis**		
Cognitive level- K4			

Preamble

The lab course describes the systematic analysis of acid and basic radicals present in a given inorganic compound and also develops the qualitative analysis skill of the students

Analysis of a mixture containing two anions of which one is an interfering ion and two cations - Semi-micro method.

Anions: Carbonate, sulphate, nitrate, fluoride ,chloride, bromide, oxalate ,borate, phosphate, and chromate.

Cations: Lead, bismuth, copper, cadmium, antimony, iron (II & III), aluminium, zinc, manganese, cobalt, nickel, barium, strontium, calcium, magnesium and ammonium.

Course outcomes

On the successful completion of the course, students will be able to

CO1	Analyse the acid radicals present in any given inorganic salt and to identify them
CO2	Determine the interfering acid radicals
CO3	Analyse the acid and basic radical systematically
CO4	Identify and report the radicals systematically and its group

Pedagogy

Chalk and Talk method, Hands on Training, PowerPoint Presentations, demonstration.

Distribution of Marks **(Max. marks – 100)**

Performance in the class : 10 marks Int : 40
Regular Test in the class : 20 marks
Observation notebook : 10 marks

Total : 40 marks

Viva voce - 10 marks
Ext: 60
Record Note book - 10 marks
Four radicals with correct procedures (4 x 10) - 40 marks

TOTAL -60 marks

Programme	**B.Sc/B.A/B.Com**	**Programme Code**	**UCH**
Course Code	**20UCHN21**	**Number of Hours/Cycle**	**2**
Semester	**II**	**Max. Marks**	**100**
Part	**IV**	**Credit**	**2**
Non Major Elective Course II			
Course Title	**Chemistry of Drugs**		
Cognitive level Upto K3			

Preamble

The course enables the students to gain knowledge on chemistry of drugs and biological role of vitamins and minerals.

Unit I Drugs **6 Hours**

Importance of drugs – drugs used in diagnosis, preventing and curing of diseases – Important terminologies, their meaning – Names of drugs – Bacteria – Types of bacteria, virus, fungi.

Unit II Antibiotics **6 Hours**

Definition – Classification – Drug action and side effects of Antibiotics – Important antibiotics - Ampicillin, streptomycin, tetracycline, Rifomycin, Erythromycin (Structure not necessary) – therapeutic uses and side effects.

Unit III Synthetic Drugs **6 Hours**

Antipyretics and Analgesics – Classification - Important synthetic drugs - Paracetamol, Aspirin and Ibuprofen (Structure not necessary) - therapeutic functions.

Anti-inflammatory agents – Sulpha drugs – drug actions - Sulphadiazine and prontosil (Structure not necessary) – therapeutic uses - pain balm

Unit IV Anaesthetics **6 Hours**

Anaesthetics - Definition – Mode of Action – Classification - General Anesthetics – Inhalation anaesthetics – Definition – Mode of action – Cyclopropane and Haloethane – Therapeutic uses - Intravenous anaestthetics – Definition – Thiopental Sodium, Methohexitone and Propanidid –therapeutic uses.

Local anaesthetics – Mode of action – Classification – Natural local anaesthetics – Cocaine – Therapeutic uses – Synthetic local anaesthetics – Procaine, Amethocaine, Benzocaine and Lignocaine – therapeutic uses.

Note: Therapeutic uses only and Structure not necessary

Unit V Vitamins and Minerals **6 Hours**

Definition – Classification of Vitamins – Physiological function of Vitamins – Fat Soluble Vitamins(Structure not necessary) - Vitamin A, Vitamin D, Vitamin E and Vitamin K -source – deficiency diseases – therapeutic uses - Water soluble Vitamins(Structure not necessary) - Vitamin B Complex (B_1, B_2, B_3, Folic acid,B_5,B_6,B_{12}), Vitamin C – source – deficiency diseases – therapeutic uses – Minerals and Trace elements – Biological Role.

Visit to various nearest industries and submission of report

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations

Text Books

1. Jaya Shree Ghosh.,(2008), *Fundamental concepts of applied chemistry*, S.Chand, New Delhi
2. JayashreeGhosh .,(2010),*A Text book of Pharmaceutical Chemistry*,S. Chand ,New Delhi.

Reference Books

1. Sharma.B.K.,(2016),*Industrial Chemistry (Including Chemical Engineering)*, Goel Publishing House, Meerut
2. BagavathiSundari.K., (2008), *Applied Chemistry*, MJP Publishers, Chennai
3. Lakshmi.S.,(2004), *A Textbook of Pharmaceutical Chemistry*, S.Chand, NewDelhi.
4. JayashreeGhosh .,(2010),*A Text book of Pharmaceutical Chemistry*, S. Chand ,New Delhi.

5. PrakashG.,More,(2010),*Comprehensive Industrial Chemistry*, PragatiPrakashan Educational Publishers, Meerut

E-Resources

- https://www.foodsafety.ca/blog/4-types-cleaning-agents-and-when-use-them
- https://dermnetnz.org/topics/antibiotics/
- https://www.psychiatry.org/psychiatrists/education/signature-initiatives/model-curriculum-project-for-substance-use-disorders/basic-principles-of-synthetic-drugs
- https://www.drugs.com/drug-class/general-anesthetics.html.
- https://www.nccih.nih.gov/health/vitamins-and-minerals#:~:text=Vitamins%20and%20minerals%20are%20essential,%2C%20and%20folate%2Ffolic%20acid.

Course outcomes

On the successful completion of the course, students will be able to

CO 1	Define drug and explain the basic idea of terminologies of different drugs
CO2	Determine and compare the different types of antibiotics
CO3	Classify and point out the analgesics, antipyretics and anti-inflammatory agents and their actions
CO4	Classifydifferent kinds of anaesthetics and List out the therapeutic uses of anaesthetics
CO5	Explain the Biological role of Vitamins and Minerals

Articulation Mapping-K Levels with Course Outcomes (COs)

Units	COs	K-Level	Section A		Section B
			Either/ or choice		(Open Choice)
			No. of Questions	K-Level	No. of Questions
1	CO1	Up to K2	2	K1 & K1	1(K2)
2	CO2	Up to K3	2	K2 & K2	1(K3)
3	CO3	Up to K2	2	K1 & K1	1(K2)
4	CO4	Up to K3	2	K2 & K2	1(K3)
5	CO5	Up to K3	2	K2 & K2	1(K3)
No. of Questions to be asked			10		5
No. of Questions to be answered			5		3
Marks for each Question			3		5
Total Marks for each Section			15		15

K1-Remembering and recalling facts with specific answers
K2-Basic understanding of facts and stating main ideas with general answers
K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (Either/or choice)	Section B (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	12	-	12	21.8	22%
K2	18	10	28	50.9	51%
K3	-	15	15	27.2	27%
Total Marks	30	25	55	100	100%

Lesson Plan

Unit	Description	Hours	Mode
I **Drugs**	a)Importance of drugs – drugs used in diagnosis, preventing and curing of diseases. b) Important terminologies, their meaning – Names of drugs – Bacteria – Types of bacteria, virus, fungi.	3 3	Chalk and talk, Power point presentation

II **Antibiotics**	a) Definition – Classification – Drug action and side effects of Antibiotics – Important antibiotics. b) Ampicillin, streptomycin, tetracycline, Rifomycin, Erythromycin (Structure not necessary) – therapeutic uses and side effects.	2 4	Chalk and talk, Power point presentation
III **Synthetic Drugs**	a) Antipyretics and Analgesics – Classification - Important synthetic drugs - Paracetamol, Aspirin and Ibuprofen (Structure not necessary) - therapeutic functions. b) Anti-inflammatory agents – Sulpha drugs – drug actions - Sulphadiazine and prontosil (Structure not necessary) – therapeutic uses - pain balm.	3 3	Chalk and talk, Power point presentation
IV **Anaesthetics**	a) Anaesthetics - Definition – Mode of Action – Classification - General Anesthetics – Inhalation anaesthetics – Definition – Mode of action – Cyclopropane and Haloethane – Therapeutic uses - Intravenous anaestthetics – Definition – Thiopental Sodium, Methohexitone and Propanidid –therapeutic uses. b) Local anaesthetics – Mode of action – Classification – Natural local anaesthetics – Cocaine – Therapeutic uses – Synthetic local anaesthetics – Procaine, Amethocaine, Benzocaine and Lignocaine – therapeutic uses.	4 2	Chalk and talk, Power point presentation
V **Vitamins and Minerals**	a) Definition – Classification of Vitamins – Physiological function of Vitamins. b) Fat Soluble Vitamins (Structure not necessary) - Vitamin A, Vitamin D, Vitamin E and Vitamin K -source – deficiency diseases – therapeutic uses. c) Water soluble Vitamins(Structure not necessary) - Vitamin B Complex (B_1, B_2, B_3, Folic acid,B_5,B_6,B_{12}), Vitamin C – source – deficiency diseases – therapeutic uses – Minerals and Trace elements – Biological Role.	2 2 2	Chalk and talk, Power point presentation

Course Designed by, Dr.A.Sahaya Raja.

Programme	**B.Sc**	**Programme Code**	**UCH**
Course Code	**20UCHA11**	**Number of Hours/Cycle**	**4**
Semester	**I**	**Max. Marks**	**100**
Part	**III**	**Credit**	**4**
Allied Course I			
Course Title	**Inorganic and Organic Chemistry**		
Cognitive level up to K3			

Preamble

The Course provides the basic concepts of atomic structure, hardness of water, chemical bonding, types of organic reactions, classification and biological function of proteins, amino acids.

Unit I Atomic structure and Periodic properties 12 Hours

Atom- Atomic number- Quantum numbers - Arrangement of elements in periodic table-Electronic configuration (upto Z=30)- Definition- atomic size, Ionization energy, electro affinity, electro negativity.

Unit IIWater & classification of Oxides 12 Hours

Oxides: Definition – classification based on chemical behaviour and oxygen content– examples**.**

Water**:** Hardness of water – types of hardness – removal of hardness – industrial implications of hardness in water – estimation by EDTA method (outline only) units of hardness of water.

Unit IIIChemical Bonding 12 Hours

VB. Theory – postulates of VB. theory – application to the formation of simple molecules like H_2 and O_2 – overlap of atomic orbitals – s-s, s-p and p-p overlap – principle of hybridization – sp, sp^2 and sp^3 hybridization – VSEPR theory.

Unit IV Basics of Organic Chemistry 12 Hours

Type of reactions**:** substitution (S_N1 and S_N2) – addition – elimination (E1 and E2) – rearrangement and polymerization – illustration with examples

Reaction intermediates- Definition, types and examples – specific reactions involving these-.detection and estimation of nitrogen and halogens in organic compounds

Unit V Chemistry of Bio Molecules 12 Hours

Classification – synthesis – properties of aminoacids – polypeptides – proteins – classification and biological functions-introduction and classification of carbohydrates-D/L configuration-manufacture of glucose and fructose.

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations

Text Books

1.Puri and Sharma, (2016), *Text Book for Inorganic Chemistry*, S. Chand & company Ltd, New Delhi.

2.Soni. P.L., (2016), *Text Book for Organic Chemistry*, S. Chand &Company Ltd, New Delhi.

Reference Books

1.Jerry March, (2015),*Reaction Mechanism of Organic compounds*. Wiley, India Edition7th

2.Lee. J.D., (2011), *Concise Inorganic Chemistry*, Wiley India (P) Ltd, New Delhi.

3.R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee., (2011), Organic Chemistry, Pearson Publishers, New Delhi, 7th Ed.,

4.F. Albert Cotton, Geoffrey Wilkinson and Paul L. Gaus,(2007) Basic Inorganic Chemistry,, Wiley India Pvt. Ltd. 3rd Ed., .

E- Resources

- https://www.twinkl.co.in/resource/t4-sc-1050-aqa-gcse-atomic-structure-and-the-periodic-table-lesson-7-electronic-structure
- https://edu.rsc.org/resources/testing-the-hardness-of-water/426.article

- https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Modules_and_Websites_(Inorganic_Chemistry)/Chemical_Compounds/Introduction_to_Chemical_Bonding
- https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry_(Petrucci_et_al.)/27%3A_Reactions_of_Organic_Compounds/27.08%3A_Polymers_and_Polymerization_Reactions
- https://faculty.weber.edu/sharley/2104/chemistry-molecules.htm

Course outcomes

On successful completion of the course, students will be able to

CO1	Explain the basic concepts of atomic structure and periodic properties
CO2	Causes of hardness and estimate the hardness of water
CO3	Demonstrate the VSEPR theory and Classify the chemical bonding.
CO4	Classify the types of electrophiles and nucleophiles and their organic reactions
CO5	Apply the biological functions of amino acids and proteins

Mapping of Programme outcomes with Course Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO2	**2**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO3	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO4	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO5	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

1-Low **2-Moderate** **3-High**

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
2	CO2	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
3	CO3	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
4	CO4	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
5	CO5	Up to K3	2	K1 & K2	2(K2& K2)	1(K3)
No. of Questions to be asked			10		10	5
No. of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1-Remembering and recalling facts with specific answers
K2-Basic understanding of facts and stating main ideas with general answers
K3-Application oriented-Solving problems
K4-Examining, analyzing, presentation and make inferences with evidences

Distribution of Section-wise Marks and K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (OpenChoice)**	**Total Marks**	**% of Marks without choice**	**Consolidated (Rounded off)**
K1	5	-	-	5	5%	5%
K2	5	40	20	65	65%	65%
K3	-	-	30	30	30%	30%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
I **Atomic structure and Periodic properties**	**a)** Introduction to Atom- Atomic number **b)** Quantum numbers and types **c)** Arrangement of elements in periodic table **d)** Electronic configuration (upto Z=30) **e)** Definition- atomic size, Ionization energy, electro affinity, electro negativity.	3 2 3 2 2	Chalk and talk, Power point presentation
II **Water & classification of Oxides**	a) OxidesDefinition, classification with examples. b) Types of hardness and causes a) Removable of hardness b) Industrial implications of hardness in water, Units of hardness of water and Estimation by EDTA method.	3 3 3 3	Chalk and talk, Power point presentation
III **Chemical Bonding**	a) Introduction and postulates of valance bond theory. b) Application to the formation of simple molecules like H_2 and O_2. c) Overlap of atomic orbitals – s-s, s-p and p-p overlap and principle of hybridization – sp, sp^2 and sp^3 hybridization. d) VSEPR theory.	3 3 3 3	Chalk and talk, Power point presentation
IV **Basics of Organic Chemistry**	a) Substitution (S_N1 and S_N2) – addition – elimination (E1 and E2). b) Rearrangement and polymerization – illustration with examples. c) Definition, types and examples – specific reactions involving these detection. d) Estimation of nitrogen and halogens in organic compounds.	3 3 3 3	Chalk and talk, Power point presentation
V **Chemistry of Bio Molecules**	a) Classification, synthesis and properties of amino acids. b) Polypeptides – proteins – classification and biological functions. c) Introduction and classification of carbohydrates-D/L configuration. d) Manufacture of glucose and fructose.	3 3 3 3	Chalk and talk, Power point presentation

Course Designed by, Mr. S.Kannan, Dr. M. Pandeeshwaran

Programme	**B.Sc**	**Programme Code**	**UCH**
Course Code	**20UCHA21**	**Number of Hours/Cycle**	**4**
Semester	**II**	**Max. Marks**	**100**
Part	**III**	**Credit**	**4**
Allied Course II			
Course Title	**Inorganic and Physical Chemistry**		
Cognitive level Up to K3			

Preamble

The course enables the students to gain knowledge on preparation and properties of Hydrogen and Hydrogen Peroxide, Nuclear Chemistry, Principles of Colloidal state, importance of Thermodynamics and Dynamics of Chemical Processes.

Unit I Hydrogen & Hydrogen Peroxide 12 Hours

Hydrogen : Isotopes of hydrogen – preparation, properties and uses of heavy hydrogen – ortho- and para-hydrogen – hydrides – definition – classification – examples Hydrogen peroxide– Manufacture, properties, structure and uses – estimation by permanganometry method – strength of hydrogen peroxide.

Unit II Nuclear Chemistry 12 Hours

Composition of the nucleus – nuclear forces – mass defect – binding energy – nuclear stability.Soddy's group displacement law – illustration – law of radioactive disintegration. Nuclear fission : Definition – theories of fusion – application of fission – the principle of atom bomb.Nuclear fusion : Definition – emission of energy – Stellar energy – hydrogen bomb.Application of radioactivity – In medicine, agriculture, industry and analytical fields – carbon dating.

Unit III Colloids 12 Hours

Colloidal state of matter – various types – classification.Sols – dialysis – electro osmosis – electrophoresis – stability of colloids – protective action – Handy Schulze law – gold number. Emulsion: Types of emulsions – emulsifier with examples. Gels: Classification, preparation Application of colloids.

Unit IV Thermodynamics 12 Hours

Importance of thermodynamics – terms used in thermodynamics – open and closed systems, state functions and path functions, extensive and intensive properties, reversible and irreversible processes, statement and mathematical form of first law of thermodynamics – heat capacity at constant volume and pressure, relation between C_p and C_v, Statement of II law of thermodynamics-entropy-Physical significance of entropy-Gibb's free energy and its significance.

Unit V Chemical Kinetics 12 Hours

Reaction rate – order and molecularity of a reaction – zero order – first order. First order rate equation derivative and half life period. Examples of first order reactions – second order reactions – examples. Carbon dating – enzyme catalysis – Michaelis and Menten mechanism.

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations

Text Books

1. Soni, P.L., &Katyal, M.,(2019), *Text Book of Inorganic Chemistry*, Sultan Chand & Sons, New Delhi.
2. Bahl, A., Bhal. B.S., &G.D.Tuli,(2019), *Essentials of Physical Chemistry*, S. Chand Publishing Company, New Delhi.

Reference Books

1. Puri, Sharma and Pathania,(2019), *Principles of Physical Chemistry*, Vishal Publishing Co.47th Edition.
2. Lee. J.D, (2019), *Concise Inorganic Chemistry*, Wiley India (P) Ltd, New Delhi.
3. F. Albert Cotton, Geoffrey Wilkinson, Manfred Bochmann and Carlos Murilla, (2007) Advanced Inorganic Chemistry,, 6th Ed., Wiley India Pvt. Ltd.
4. Peter Atkins, Julio de Paula, and James Keeler, (2017) Atkins' Physical Chemistry, Oxford University Press, UK 11th Ed.,

E-Resources

- https://www2.lbl.gov/abc/wallchart/chapters/02/3.html
- https://www.sciencehq.com/chemistry/group-displacement-law-2.html
- https://www.sciencedirect.com/topics/materials-science/emulsion
- https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_-_The_Central_Science_(Brown_et_al.)/19%3A_Chemical_Thermodynamics/19.2%3A_Entropy_and_the_Second_Law_of_Thermodynamics
- https://www.intechopen.com/books/introducing-the-effective-mass-of-activated-complex-and-the-discussion-on-the-wave-function-of-this-instanton/a-brief-introduction-to-the-history-of-chemical-kinetics

Course outcomes

On successful completion of the course, the students will be able to

CO1	Define the preparation & properties of hydrogen & H_2O_2
CO2	Interpret the basic concept of nuclear chemistry
CO3	Explain the various phenomena involved in colloidal state
CO4	Interpret the concept of law of thermodynamics and its properties
CO5	Describe order of reaction and enzyme catalysis

Mapping of Programme outcomes with Course Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PS011	PSO12
CO1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO2	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO3	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO4	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO5	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

1-Low **2-Moderate** **3-High**

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K2	2	K1 & K2	**2(K2 & K2)**	**K2**
2	CO2	Up to K2	2	K1 & K2	**2(K2 & K2)**	**K2**
3	CO3	Up to K3	2	K1 & K2	**2(K2& K2)**	**K3**
4	CO4	Up to K3	2	K1 & K2	**2(K2 & K2)**	**K3**
5	CO5	Up to K3	2	K1 & K2	**2(K2 & K2)**	**K3**
No. of Questions to be asked			10		**10**	**5**
No. of Questions to be answered			10		**5**	**3**
Marks for each Question			1		**4**	**10**
Total Marks for each Section			10		**40**	**50**

K1-Remembering and recalling facts with specific answers

K2-Basic understanding of facts and stating main ideas with general answers

K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	40	20	65	65%	65%
K3	-	-	30	30	30%	30%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
I **Hydrogen & Hydrogen Peroxide**	a) Isotopes of hydrogen, preparation, properties and uses of heavy hydrogen, and ortho- and para-hydrogen. b) Hydrides definition and classification with examples. c) Hydrogen peroxide – Manufacture, properties, structure and uses. d) Estimation by permanganometry method – strength of hydrogen peroxide.	3 3 3 3	Chalk and talk, Power point presentation
II **Nuclear Chemistry**	a) Composition of the nucleus, nuclear forces, mass defect, binding energy and nuclear stability. b) Soddy's group displacement law, illustration and law of radioactive disintegration. c) Nuclear fission: Definition – theories of fusion – application of fission – the principle of atom bomb. d) Nuclear fusion: Definition – emission of energy – Stellar energy – hydrogen bomb. Application of radioactivity – In medicine, agriculture, industry and analytical fields – carbon dating.	3 3 3 3	Chalk and talk, Power point presentation
III **Colloids**	a) Colloidal state of matter, various types and classification. b) Sols, dialysis, electro osmosis and electrophoresis. c) Stability of colloids, protective action, Handy Schulze law and gold number. d) Emulsion: Types of emulsions, emulsifier with examples. Gels: Classification, preparation Application of colloids.	3 3 3 3	Chalk and talk, Power point presentation
Unit IV **Thermodynamics**	a) Importance of thermodynamics, terms used in thermodynamics, open and closed systems, state functions and path functions, extensive and intensive properties. b) Reversible and irreversible processes, statement and mathematical form of first law of thermodynamics. c) Heat capacity at constant volume and pressure, relation between C_p and C_v, Statement of II law of thermodynamics. d) Entropy, Physical significance of entropy, Gibb's free energy and its significance.	4 3 3 2	Chalk and talk, Power point presentation
Unit V *Chemical Kinetics*	a) Reaction rate, order and molecularity of a reaction and zero order – first order. b) First order rate equation derivative and half life period. Examples of first order reactions. c) Second order reactions – examples. Carbon dating – enzyme catalysis. d) Michaelis and Menten mechanism.	3 4 3 2	Chalk and talk, Power point presentation

Course Designed by, Mr. T. Srinivasan, Dr.M. Pandeeswaran

Programme	**B.Sc Chemistry**	**Programme Code**	**UCH**
Course Code	**20UCHA2P**	**Number of Hours/Cycle**	**2**
Semester	**II**	**Max. Marks**	**100**
Part	**III**	**Credit**	**2**
Allied Practical - I			
Course Title	**Volumetric Analysis**		
Cognitive Level - Up to K4			

Preamble

The lab course describes the practical procedure for the quantitative estimation of inorganic compound by volumetric method.

LIST OF EXPERIMENTS

A double titration involving the making up of the solution to be estimated and the preparation of a primary standard.

I. ACIDIMETRY AND ALKALIMETRY

1) Estimation of Hydrochloric acid
2) Estimation of Sodium hydroxide
3) Estimation of Sodium carbonate
4) Estimation of Nitric acid

II. REDOX TITRATIONS

Permanganometry

1) Estimation of ferrous ammonium sulphate
2) Estimation of potassium permanganate
3) Estimation of ferrous sulphate
4) Estimation of oxalic acid

III. EDTA TITRATION

1) Estimation of Total Hardness of water using EDTA

Course outcomes

On the successful completion of the course, students will be able to

CO 1	Define the various terms in volumetric analysis
CO2	Apply acidimetric and alkalimetric method for the quantitative volumetric estimation of acids and bases
CO3	Examine the strength of unknown solutions by titrimetry methods
CO4	Estimate the quantity present permanganometrically by performing the volumetric analysis
CO5	Analyze the hardness of any water samples

Pedagogy

Demonstrate, Chalk and Talk method, Hands on Training, and Group discussion.

Distribution of Marks (Max. marks – 100)

Duration of examination: 3 hrs

Regular Practical in the Class	:	10 Marks	**Int: 40**
Regular Test in the class	:	20 Marks	
Observation note book	:	10 marks	

Total	:	40 marks	

Viva voce	-	10 marks	**Ext: 60**
Record Notebook	-	10 marks	
Procedure writing	-	10 marks	
Volumetric estimation	-	30 marks	

TOTAL	-	60 marks	

Programme	**B.Sc.Chemistry**	**Programme Code**			**UCH**
Course Code	**20UCHC31**	Number of Hours/Cycle			**4**
Semester	**III**	Max. Marks			**100**
Part	**III**	**Credit**			**4**
Core Course V					
Course Title	**Inorganic ChemistryII**		**L**	**T**	**P**
Cognitive Level		**Up to K3**	**60**	**-**	**-**

Preamble

The course enables the students to gain knowledge on conceptsof metallurgy, chemistry of oxides,Study of varioustheory,understand the types of metal carbonyls and its structure and bonding. Acquire the detail knowledge on transition and inner transition elements.

Unit I	**Metallurgy**	**12Hours**
	Metallurgy – occurrence of metals – minerals and ores – mineral wealth of India – refining of metals – zone refining – electrolytic refining – van Arkel – de Boer process – important ores and extraction of the following metals – titanium, thorium, molybdenum, cobalt and platinum – their important alloys and applications.	
Unit II	**Chemistry of Oxides**	**12 Hours**
	Preparation, properties and uses of some important compounds – titanium oxide, thorium oxide, ammonium molybdate – vanadium pentoxide, sodium cobalti nitrate, chloroplatinic acid.	
Unit III	**Coordination Compounds**	**12 Hours**
	Introduction – Nomenclature – isomerism in complexes – geometrical and optical – Werner's theory – Sidgwick theory – EAN rule – Valence bond theory – low spin and high spin complexes – magnetic properties – Limitations of VB theory – Crystal field theory – Octahedral and square planar complexes – Color of coordination complexes – Modified CFT – ligand field theory.	
Unit IV	**Metal Carbonyls, Carbides, Intercalation Compounds and Silicates**	**12 Hours**
	Bonding and structure of Fe, Co ,Ni and Cr carbonyls,Metal Carbides –types-preparation and applications, Intercalation compounds of graphite-preparation-properties and uses ,Silicates-types-structure-mica, beryl,clay, zeolite and quartz	
Unit V	**Transition and Inner Transition Elements**	**12 Hours**
	Transition Metals- General characteristics- Metallic character, oxidation states, size, density, melting points, boiling points, ionization energy, color, magnetic properties, reducing properties, catalytic properties, non-stoichiometric compounds, complex formation and alloy formation. Difference between first row and other two rows. Lanthanides-Electronic configuration and general characteristics – Occurrence of lanthanides -– Isolation of lanthanides from monazite sand - Separation by ion-exchange method. Lanthanide contraction: Causes and consequences. Industrial importance of lanthanides. Actinides- Electronic configuration and general characteristics – Comparison with lanthanides.	

Pedagogy

Chalk and Talk method.GroupDiscussions,Assignments,Quiz,Brainstorming Activities, Seminar and Powerpoint Presentations.

Text Books

1. Soni P.L., &KatyalM.,(2019), *Text Book of Inorganic Chemistry*, Sultan Chand
2. Madan R.D.,(2010), *Modern Inorganic chemistry*, S.Chand and sons.

Reference Books

1. Lee. J.D, (2019), Concise Inorganic Chemistry, Wiley India P. Ltd, New Delhi.
2. F. Albert Cotton, Geoffrey Wilkinson, Manfred Bochmann and Carlos Murilla, (2007) Advanced Inorganic Chemistry,, 6th Ed., Wiley India Pvt. Ltd.
3. Puri and Sharma, (2016), *Text Book for Inorganic Chemistry*, S. Chand & company Ltd,
4. Malik, Tuli and Madan,(2013), *Selected topics in Inorganic chemistry*, S.Chand and company Ltd.

E-Resources

- https://chem.libretexts.org/Bookshelves/General_Chemistry/
- https://frontiesin.org>articles>full
- http://www.breslyn.org/chemistry/bonding/3-Theories/index-theories.php
- https://www.enrjchem.com>article>view
- https://www.brightstorm.com/science/chemistry/the-periodic-table/transition-metals-inner-transition-metals/

Course Outcomes

After completion of this course, the students will be able to:

CO1	Identify the methods of extraction and refining techniques of metals from ores.
CO2	Acquire the knowledge on the preparation, properties and uses of important oxides.
CO3	Interpret the theories of coordination compounds and calculate the CFSE values for octahedral and square planar compounds.
CO4	Outline the preparation, structure, properties and uses of metal carbonyls, carbides, intercalation compounds and silicates.
CO5	Discuss the periodic trends, separation, uses of lanthanides and students learn about extraction of lanthanides.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	PS O2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PS O 10	PS O 11	PS O 12
CO1	2	2	3	2	3	2	3	3	1	1	1	1
CO2	2	2	2	2	1	2	1	3	2	1	1	1
CO3	2	2	3	2	2	2	2	3	-	2	2	3
CO4	2	2	1	2	1	2	1	3	2	-	1	1
C05	2	2	1	2	3	2	1	3	2	1	1	2

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

(Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/ or Choice	Open Choice
			No. of Questions	K-Level	No. of Question	No.of Question
1	CO1	Up to K2	2	(K1 & K2)	2(K2& K2)	1(K2)
2	CO2	Up to K2	2	(K1 & K2)	2(K2& K2)	1(K2)
3	CO3	Up to K3	2	(K1 & K2)	2(K2& K2)	1(K3)
4	CO4	Up to K3	2	(K1 & K2)	2(K2& K2)	1(K3)
5	CO5	Up to K3	2	(K1 & K2)	2(K2& K2)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		40	50

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without Choice
K1	5	-	-	5	5
K2	5	40	20	65	65
K3		-	30	30	30
Total Marks	10	40	50	100	100

Lesson Plan

Unit I	**Metallurgy**	**12 Hours**	**Mode**
	a. Introduction of Metallurgy,occurrence of metals, minerals and ores	**2**	PPT presentation, Chalk and Talk.
	b. mineral wealth of India, refining of metals, zone refining	**2**	
	c.electrolytic refining, van Arkel – de Boer process	**3**	
	d. important ores and extraction of the following metals, titanium.	**2**	
	e. thorium, molybdenum, cobalt and platinum, their important alloys and applications.	**3**	
Unit II	**Chemistry of Oxides**	**12 Hours**	**Mode**
	a. Preparation, properties and uses of some important compounds	**2**	Chalk and Talk, Group
	b. titanium oxide, thorium oxide	**3**	

	c. ammonium molybdate	**2**	Discussion and PPT presentation.
	d. vanadium pentoxide,	**2**	
	e. vanadium pentoxide, sodium cobalti nitrate, chloroplatinic acid.	**3**	
Unit III	**Coordination Compounds**	**12 Hours**	**Mode**
	a.Introduction , Nomenclature, isomerism in complexes, geometrical and optical.	**2**	Chalk and Talk, PPT Presentation.
	b. Werner's theory, Sidgwick theory, EAN rule , Valence bond theory, low spin and high spin complexes.	**3**	
	c. magnetic properties, Limitations of VB theory.	**2**	
	d. Crystal field theory, Octahedral and square planar complexes.	**3**	
	e.Color of coordination complexes ,Modified CFT – ligand field theory.	**2**	
Unit IV	**Metal Carbonyls, Carbides, Intercalation Compounds and Silicates**	**12 Hours**	**Mode**
	a. Bonding and structure of Fe, Co ,Ni and Cr carbonyls Metal Carbides.	**2**	Chalk and Talk, PPT Presentation.
	b. carbonyls, Metal Carbides	**2**	
	c. types-preparation and applications	**2**	
	d. Intercalation compounds of graphite, preparation-properties and uses ,Silicate	**3**	
	e. ,Silicates-types-structure-mica, beryl,clay, zeolite and quartz .	**3**	
Unit V	**Transition and Inner Transition Elements**	**12 Hours**	**Mode**
	a. Transition Metals- General characteristics-Metallic character, oxidation states, size, density, melting points, boiling points, ionization energy, color, magnetic properties, reducing properties, catalytic properties, non-stoichiometric compounds, complex formation and alloy formation.	**2**	Chalk and Talk, PPT Presentation,Group Discussion.
	b. . Difference between first row and other two rows. Lanthanides-Electronic configuration and general characteristics –	**2**	
	c. Occurrence of lanthanides , Isolation of lanthanides from monazite sand -,Separation by ion-exchange method.	**3**	
	d. Lanthanide contraction: Causes and consequences. Industrial importance of lanthanides	**2**	
	e. . Actinides- Electronic configuration and general characteristics , Comparison with lanthanides.	**3**	

Course designed by
Dr.J.Sathiyabama, Dr.G.N.Kousalya and Mrs.S.Sulochana

Programme	**B.Sc.Chemistry**	**Programme Code**		**UCH**	
Course Code	**20UCHC41**	Number of Hours/Cycle		**4**	
Semester	**IV**	Max. Marks		**100**	
Part	**III**	**Credit**		**4**	
Core Course					
Course Title	**Physical Chemistry-II**		**L**	**T**	**P**
Cognitive Level		**Up to K3**	**60**	**-**	**-**

Preamble

To study and understand the importance of first law of thermodynamic and its applications, entropy changes in predicting the feasibility of reactions and physical transformation.

Unit I	**Solid State**	**12 Hours**
	Laws of crystallography – law of constancy of interfacial angle, law of symmetry, law of rational indices – Miller indices – symmetry elements in a crystal. X-ray diffraction – Bragg's equation – experimental method of determination of interplanar spacing – X ray specrophotometer – the Debye – Scherrer method. Types of crystals – ionic, molecular, covalent and metallic crystals. Ionic crystals Structure of NaCl, KCl. CsCl,Molecular crystals – Water and ammonia. Covalent crystals – Diamond and graphite,Metallic crystals – Metallic bond in metals, Frankel and Schottky defects.	
Unit II	**Chemical Kinetics**	**12 Hours**
	Introduction – rate of reaction – rate law and rate constant – order and molecularity of a reaction. Reaction of first and pseudo unimolecular reactions. Catalytic decomposition of hydrogen peroxide – Decomposition of dinitrogen pentoxide. Inversion of can sugar and hydrolysis of ester by acid. Second, third and zero order reactions – examples – rate equation – half lifeperiod . Influence of temperature on the rate of reaction – Arrhenius rate equation and its significance. Theory of reaction rates: Bimolecular collision theory – unimolecular theory – Lindemann's hypothesis – Absolute Reaction Rate theory. Influence of ionic strength on reaction rate – primary and secondary salt effect – kinetics of fast reactions – relaxation method.	
Unit III	**First Law of Thermodynamics And its Applications**	**12 Hours**
	First Law- statement – mathematical formulation – internal energy – enthalpy or heat content – heat changes at constant volume and at constant pressure conditions – relationship between C_p and C_v – work done, heat change and enthalpy change for reversible isothermal expansion and compression of an ideal gas – calculation of q, w, ΔE, ΔH for reversible adiabatic expansion of an ideal gas – relation between T, V and P of an ideal gas undergoing adiabatic reversible expansion comparison of work done in isothermal and adiabatic reversible expansion of an ideal gas. Types of heat(enthalpy) reactions– Joule Thomson effect – Joule Thomson coefficient in the case of ideal and real gases – inversion temperature – Hess' law of heat summation – Kirchoff's equation	
Unit IV	**Second Law of Thermodynamics and its Applications**	**12Hours**
	Second law of thermodynamics: Limitations of first law and the need for the second law. Formulation of the second law of thermodynamics on the basis of Carnot cycle- various	

	statements of the second law of thermodynamics- Carnot theorem- Thermodynamic principle of the working of refrigerator .Concept of entropy- entropy changes for physical transformations- entropy and probability. Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G and A with T, V and P - Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state. Criteria of spontaneity. Changes in S, G and A as criteria for spontaneous process Partial molar properties- Chemical potential-variation of chemical potential with temperature and pressure-Gibbs – Duhem equation	
Unit V	**Third Law of Thermodynamics and its Applications**	**12Hours**
	Application of thermodynamics to various type of equilibria – equilibrium constant and free energy changes – van'thoff reaction isotherm and van't Hoff isochore – thermodynamic interpretation of law of mass action and LeChatelier principle. Thermodynamics III – Nernst heat theorem and its applications third law of Thermodynamics-Experimental verifications of third law of thermodynamics.	

Pedagogy

Chalk and Talk method,Group Discussion,Assignments,Quiz,Brainstorming Activities,Seminar , Powerpoint presentations and problem solving.

Text Books

1. Bahl.B.S, G.D.Tuli.G.D and Arun Bahl,(2011), Essentials of physical chemistry, 12th Ed., S.Chand&company Ltd, New Delhi
2. Puri.B.R,Sharma.L.R and M.S.Pathania.(2016), Principles of Physical Chemistry, 47thEdn., Vishal Publishing Co.,

Reference Books

1. Atkins Physics Chemistry, Peter Atkins, Julio de Paula, and James Keeler, Oxford University Press, UK 11th Ed.,2017.
2. Van Samuel Glasstone D.,2002, Thermodynamics, 5th edition, Eastern, Wiley Publication, London,U.K.
3. Glasstone S.(1948) 'A Textbook of Physical Chemistry.

E-Resources

- www.springer.com.
- https://solidstateformen.com/.
- http://chemed.chem.purdue.edu/genchem/topicreview/bp/ch22/rate.php.
- http://www.gre.nasa.gov/www/12/airplain/thermol.html.
- http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/seelaw.html

Course Outcomes

After completion of this course, the students will be able to:

CO1	To inculcate knowledge on the importance of types of crystal structure and detects
CO2	Examine various order of reactions and half life period
CO3	Aquant with the fundamental knowledge of first law of thermodynamics and thermochemistry
CO4	Gain knowledge on the second law of thermodynamics and its applications
CO5	Acquire the concept of third law of Thermodynamics and its applications

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	2	3	3	1	3	2	1	-	1	-	1
CO2	3	2	2	3	2	2	2	1	-	2	-	1
CO3	2	2	2	3	1	2	1	1	-	1	-	1
CO4	3	2	1	3	2	3	1	2	-	1	-	1
C05	2	2	1	3	1	2	2	1	-	2	-	1

3. High; 2. Moderate ; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Question**	**No. of Question**
1	CO1	Up to K2	2	K1&K2	2(K2&K2)	1(K2)
2	CO2	Up to K2	2	K1&K2	2(K2&K2)	1(K2)
3	CO3	Up to K3	2	K1&K2	2(K2&K2)	1(K3)
4	CO4	Up to K3	2	K1&K2	2(K2&K2)	1(K3)
5	CO5	Up to K3	2	K1&K2	2(K2&K2)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		40	50

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	**Section A (No Choice)**	**Section B (Either/or)**	**Section C (Open Choice)**	**Total Marks**	**% of Marks without Choice**	**Consolidated (Rounded off)**
K1	5	-	-	5	5	5%
K2	5	40	20	65	65	65%
K3	-	-	30	30	30	30%
Total Marks	10	40	50	100	100	100%

Lesson Plan

UnitI	**Solid State**	**12 Hours**	**Mode**
	a. Laws of crystallography , law of constancy of interfacial angle, law of symmetry, law of rational indices	**3**	Chalk and Talk,PPT Presentation
	b. Miller indices , symmetry elements in a crystal. X-ray diffraction , Bragg's equation	**3**	
	c. experimental method of determination of interplanar spacing , X ray specrophotometer , the Debye , Scherrer method	**3**	
	d. Types of crystals , ionic, molecular, covalent and metallic crystals. Ionic crystals Structure of NaCl, KCl. CsCl,Molecular crystals , Water and ammonia. Covalent crystals	**2**	
	e. Diamond and graphite,Metallic crystals , Metallic bond in metals, Frankel and Schottky defects.	**1**	
UnitII	**Chemical Kinetics**	**12 Hours**	**Mode**
	a.Introduction , rate of reaction , rate law and rate constant , order and molecularity of a reaction.	**2**	Group Discussion, Chalk and Talk, PPT Presentation**.**
	b. Reaction of first and pseudo unimolecular reactions. Catalytic decomposition of hydrogen peroxide , Decomposition of dinitrogen pentoxide	**3**	
	c. . Inversion of cane sugar and hydrolysis of ester by acid. Second, third and zero order reactions , examples , rate equation , half life period (no derivation required).	**3**	
	d. Influence of temperature on the rate of reaction , Arrhenius rate equation and its significance. Theory of reaction rates: Bimolecular collision theory , unimolecular theory , Lindemann's hypothesis	**2**	
	e. Absolute Reaction Rate theory. Influence of ionic strength on reaction rate ,primary and secondary salt effect , kinetics of fast reactions – relaxation method.	**2**	
UnitIII	**First Law of Thermodynamics and its Applications**	**12 Hours**	**Mode**
	a. First Law- statement ,mathematical formulation ,internal energy ,enthalpy or heat content	**2**	Chalk and Talk,Group Discussion.
	b. heat changes at constant volume and at constant pressure conditions , relationship between C_p and C_v –	**2**	
	c. work done, heat change and enthalpy change for reversible isothermal expansion and compression of an ideal gas , calculation of q, w, ΔE , ΔH for reversible adiabatic expansion of an ideal gas –	**3**	
	d. calculation of q, w, ΔE , ΔH for reversible adiabatic expansion of an ideal gas , relation between T, V and P of an ideal gas undergoing adiabatic reversible expansion comparison of work done in isothermal and adiabatic reversible expansion of an ideal gas.	**3**	
	e. Joule effect , Joule Thomson effect , Joule Thomson coefficient in the case of ideal and real gases , inversion temperature , Hess' law of heat summation – Kirchoff's equation	**2**	
UnitIV	**Second Law of Thermodynamics and its Applications**	**12 Hours**	**Mode**
	a. Second law of thermodynamics: Limitations of first	**2**	

	law and the need for the second law.		Chalk and Talk, PPT Presentation, Video Lectures.
	b. Formulation of the second law of thermodynamics on the basis of Carnot cycle ,various statements of the second law of thermodynamics-	**3**	
	c. - Carnot theorem- Thermodynamic principle of the working of refrigerator .Concept of entropy-entropy changes for physical transformations- entropy and probability.	**3**	
	d. Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G and A with T, V and P ,Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state. Criteria of spontaneity.	**2**	
	e. . Changes in S, G and A as criteria for spontaneous process Partial molar properties, Chemical potential-variation of chemical potential with temperature and pressure-Gibbs ,Duhem equation	**2**	
Unit V	**Third law of thermodynamics and its applications**	**12 Hours**	**Mode**
	Application of thermodynamics to various type of equilibria	**2**	Lecture Method, PPT Presentation**.**
	b. equilibrium constant and free energy changes	**2**	
	c.Van'thoff reaction isotherm and Van't Hoff isochore	**3**	
	d. thermodynamic interpretation of law of mass action and Lechatelier principle	**3**	
	e. Thermodynamics III , Nernst heat theorem and its applications third law of Thermodynamics.	**2**	

Course designed by Dr.J.Sathiyabama, Dr. G.N.KousalyaandMs.P.Angel

Programme	B.Sc.Chemistry	Programme Code		UCH	
Course Code	20UCHC4P	Number of Hours/Cycle		2	
Semester	IV	Max. Marks		100	
Part		Credit			
Core Practical II					
Course Title	Volumetric analysis		L	T	P
Cognitive Level	Upto K4				30

Preamble

The lab course describes the practical procedure for the quantitative estimation of inorganic compound by volumetric method.

List of Experiments

A double titration involving the making up of the solution to be estimated and the preparation of a primary standard.

I. Acidimetry and Alkalimetry

1. Estimation of HCl
2. Estimation of Na_2CO_3
3. Estimation of NaOH / KOH
4. Estimation of oxalic acid

II. Redox Titrations

A. Permanganimetry

1. Estimation of ferrous ion
2. Estimation of oxalic acid
3. Estimation of calcium (direct method)

B. Dichrometry

1. Estimation of ferrous ion
2. Estimation of ferrous ion by external indicator method

III. Iodometry And Iodimetry (Demonstration only)

1. Estimation of potassium dichromate
2. Estimation of potassium permanganate
3. Estimation of copper Sulphate
4. Estimation of arseneous oxide

IV Argentimetry

1. Estimation of potassium chloride

V. Complexometric Titration (Demonstration only)

1. Estimation of Hardness of water using EDTA
2. Estimation of Calcium using EDTA
3. Estimation of Magnesium using EDTA

Course Outcomes

After completion of this course, the students will be able to:

CO1	Prepare standard solution.
CO2	Write short procedure
CO3	Calculate normality of the given solution
CO4	Estimate volumetrically the amount of unknown substance

Scheme of Evaluation (Max.marks100)
Internal Assessment 40 Marks

Regularity	10 marks
Class Test	20 marks
Observation Note	10 marks
Total	40 marks

External Examination: 60 Marks (3 hours)

Record Note Book	10 Marks
Procedure	10 Marks
Estimation : 30 Marks	
< 3 %	30 Marks
3 - 4%	25 Marks
4- 5%	20 Marks
> 5%	10 Marks
Viva-Voce	10Marks

Value Added Courses

Programme	**B.Sc.Chemistry**	**Programme Code**			**UCH**
Course Code	**20CCHE31**	Number of Hours/Cycle			**2**
Semester	**IV**	Max. Marks			**30**
Part	**III**	**Credit**			
Value Added Course I					
Course Title	**Sugar Technology**		**L**	**T**	**P**
Cognitive Level			**30**	**-**	**-**

Preamble

To understand the various steps involved in sugar manufacturing and to learn the testing and estimation of Sugar and its applications

Unit I		**6Hours**
	Sugar Industry in India – Sugarcane and Sugar Beet – Manufacture of cane sugar.	
Unit II		**6 Hours**
	Extraction of Juice – Concentration – Separation of crystals – Recovery of glucose from molasses Defection.	
Unit III		**6 Hours**
	Sulphitation and carbonation – Testing and Estimation of Sugar	
Unit IV		**6 Hours**
	Double Sulphitation Process, Double Carbonation process	
Unit V		**6 Hours**
	Preparation of Alcohol from Molasses, Preparation of Absolute Alcohol Manufacture of Wine, Beer, Methylated Spirit, Power Alcohol.	

Pedagogy

Chalk and Talk method,Group Discussion,Assignments,Quiz,Brainstorming Activities,Seminar and Powerpoint presentations

Text Book

1. Sharma B.K (2016), Industrial Chemistry (Including Chemical Engineering), 16th Revised and Enlarged Edition, Goel Publishing House, Meerut

Reference Books

1. Sharma B.K (2016), Industrial Chemistry (Including Chemical Engineering), 16th Revised and Enlarged Edition, Goel Publishing House, Meerut
2. Bhal Arun (2016), Advanced Organic Chemistry, S.Chand and Company Limited, New Delhi

Programme	**B.Sc.Chemistry**	**Programme Code**			**UCH**
Course Code	**20CCHE41**	Number of Hours/Cycle			**2**
Semester	**IV**	Max. Marks			**30**
Part		**Credit**			
Value Added Course II					
Course Title	**Perfume Chemistry**		**L**	**T**	**P**
Cognitive Level			**30**	**0**	**0**

Preamble

To understand the various Process involved in the Perfume Chemistry and the Chemical Composition of Perfume

Unit I		**6 Hours**
	Introduction – Esters – Esters of benzyl alcohol, Esters of cinnamic acid, Methyl Cinnamate and Ethyl Cinnamate	
Unit II		**6 Hours**
	Alcohols – Citronellol –Terpineols, Linalool,Geraniol,Citral and Nerol – Ketones – Civetone-Muscone-Ionones-α,β and γ ionones –Nitromusks	
Unit III		**6 Hours**
	Aldehydes – Vanillin –Cinnamic Aldehyde-Anisaldehyde – Diphenyl Methane-Heliotropin	
Unit IV		**6 Hours**
	Production of natural Perfumes - Flower perfumes - Jasmine – Lily - Orange blossom – Rose.	
Unit V		**6 Hours**
	Artificial flavours - -Banana Compounds – Grape Compounds, Apple compounds and Pine apple compounds	

Pedagogy

Chalk and Talk method, Group Discussion, Assignments, Quiz, Brainstorming Activities, Seminar and Powerpoint presentations

Text Book

1. Sharma B.K., (2016), Industrial Chemistry (Including Chemical Engineering) Goel Publishing House, 16th Revised and Enlarged Edition.

Reference Book

1. Sharma B.K., (2016), Industrial Chemistry (Including Chemical Engineering) Goel Publishing House, 16th Revised and Enlarged Edition.

Allied Courses Offered to Other Departments
(For students of zoology and physics admitted from the academic year 2020—2021 onwards)

Programme	**B.Sc**	**Programme Code**	**UCH**		
Course Code	**20UCHA31**	Number of Hours/Cycle	**4**		
Semester	**III**	Max. Marks	**30**		
Part	**III**	**Credit**	**4**		
Allied Course					
Course Title	**Organic and Physical Chemistry**		**L**	**T**	**P**
Cognitive Level		**Up to K3**	**60**	**-**	**-**

Preamble

The course enables the students to learn and provide the basic concepts of heterocyclic compounds, Alkaloids, Antibiotics, Vitamins, Adsorption, Basic principle of chromatography technique and catalysis

Unit I	**Heterocyclic compounds**	**12 Hours**
	Definition - Classification - Five membered ring compounds - Preparation of Pyrrole and Furan- reactions - electrophilic substitutions, oxidation and reduction. Six membered ring compound - Preparation of Pyridine – reactions - electrophilic and nucleophilic substitutions, oxidation and reduction. Condensed ring compounds - Quinoline and Isoquinoline – reactions - electrophilic and nucleophilic substitutions, oxidation and reduction	
Unit II	**Alkaloids, Antibiotics & Vitamins**	**12 Hours**
	Alkaloids - Pharmacological properties and importance of the following alkaloids – nicotine, quinine, piperine and cocaine (Structural elucidation not necessary). **Antibiotics -**Classification and biological functions of antibiotics – penicillin, chloroamphenicol, streptomycin and tetracycline. **Vitamins -** Classification and biological functions of vitamins A,B_1,B_2,B_3,B_5,B_6,B_{12},Biotin,Folic acid, C, D, E and K, (Structural elucidation not required).	
Unit III	**Adsorption**	**12 Hours**
	Definition – difference between adsorption and absorption – adsorbate, adsorbent, sorption, desorption – Characteristics of adsorption – physical adsorption – chemical adsorption – differences between these two types. Adsorption of gases on solids - factors influencing adsorption of gases on solid surface – nature of solid, nature of gas, effect of temperature and effect of pressure. Adsorption of solutes from solutions – factors influencing adsorption of solutes from solution – effect of temperature and concentration – effect of surface area- nature of the solute – differentiate negative adsorption and positive adsorption. Adsorption isotherm - Freundlich isotherm & Langmuir isotherm (no derivation, statement only). Applications of adsorption.	
Unit IV	**Basic Principle of Chromatography Technique**	**12 Hours**
	Definition – classification – general applications of chromatography. Adsorption Chromatography (Liquid – Solid Chromatography (LSC)) – Column chromatography and Ion exchange chromatography – applications.Partition	

	chromatography (Liquid – Liquid Chromatography (LLC)) – Paper chromatography and Thin layer chromatography (TLC) – applications.Gas chromatography (GC) - gas-solid chromatography (GSC) and gas-liquid chromatography (GLC) – High performance liquid chromatography (HPLC) - applications	
Unit V	**Catalysis**	**12 Hours**
	Definition – Catalyst – Positive catalyst, Negative catalyst. Catalysis - Effect of a catalyst- characteristics or criteria of catalysis - theories of catalysis – Intermediate compound formation theory and Adsorption theory. Different types of catalysis- Enzyme catalysis – lock and key theory - examples of enzyme catalysis – characteristics of enzyme catalysis - factors affecting enzyme catalysis. Homogeneous catalysis – acid-base catalysis – Heterogeneous catalysis - surface catalytic reactions - differences between homogeneous catalysis and heterogeneous catalysis – Auto catalysis. Definition and examples – catalytic poisoning – catalytic promoters. Application of catalysis – catalytic converter	

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations.

Text Books

3. Arun Bahl and Bahl.B.S., (2019), A *Text Book of Organic Chemistry,* S.Chand& Company Ltd, New Delhi.
4. Soni.P.L.,Dharmarha.O.P.,Dash.U.N.,(2016),*Textbook of Physical Chemistry*, Sultan Chand & Sons

Reference Books

1. Bahl.B.S., Arun Bahl., Tuli.G.D., (2019), *Essentials of Physical chemistry*, S.Chand and company Ltd.
2. Puri., Sharma., Pathania., (2018), *Principles of physical Chemistry*, Vishal Publishing Co
3. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee., (2018), *Organic Chemistry*, Pearson
4. Jain.M.K., Sharma.S.C., (2018),*Modern Organic Chemistry*, Vishal Publishing Co

E-Resources:

- https://www.uou.ac.in/lecturenotes/science/MSCCH-17/CHEMISTRY%20LN%208%20NATURAL%20PRODUCTS-converted.pdf
- https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/heterocy.htm
- https://oer.unimed.edu.ng/LECTURE%20NOTES/3/2/RASAQ-NURUDEEN-OLAJIDE-UNIMED-BCH-222-VITAMINS.pdf
- http://classes.biology.ucsd.edu/bimm118.WI16/PPT%20Lecture%20Notes/Lecture%2016.pdf
- http://www.chem.gla.ac.uk/staff/stephenc/teaching/HeterocycleLectures2011_2C12.pdf
- http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000665/M026467/ET/1515661910CHE_P10_M21_etext.pdf
- http://www.vpscience.org/materials/US04EICH04%20Chromatography.pdf
- https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod5.pdf
- https://stannescet.ac.in/cms/staff/qbank/CSE/Notes/CY8151-Engineering%20Chemistry-431878289-unit_2%20(1).pdf

Course Outcomes

After completion of this course, the students will be able to:

CO1	Outline the preparation, structure, properties of heterocyclic compounds
CO2	Understand the role of Alkaloids, Antibiotics and Vitamins in biological systems and medicine
CO3	Recall their knowledge on surface chemistry concepts
CO4	Apply purification methods of organic molecules by Chromatographic techniques
CO5	Explain different types of catalysts and reaction mechanism of catalysis

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO1	3	1	1	2	1	3	3	1	-	1	-	-
CO2	3	3	1	3	2	3	3	1	-	2	-	-
CO3	3	2	2	2	1	3	2	1	-	1	-	-
CO4	3	2	3	2	1	3	3	2	-	1	-	1
C05	3	2	2	2	2	3	2	2	-	3	-	-

3. High; 2. Moderate; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**(Open Choice)**
			No. of Questions	**K-Level**	**No. of Question**	**No. of Question**
1	CO1	Up to K3	2	K1 & K2	2 K2 & K2)	K3
2	CO2	Up to K2	2	K1 &K1	2 (K2& K2)	K2
3	CO3	Up to K3	2	K1 & K2	2 (K2 & K2)	K3
4	CO4	Up to K2	2	K1 &K1	2 (K2 & K2)	K2
5	CO5	Up to K3	2	K1 & K2	2 (K2 & K2)	K3
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		40	50

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problem

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	7		-	7	7	15%
K2	3	40	20	63	63	55%
K3	-	-	30	30	30	30%
Total Marks	10	40	50	100	100	100%

Lesson Plan

UnitI	**Heterocyclic Compounds**	**12 Hours**	**Mode**
	a. Definition and Classification of Heterocyclic compounds	**1**	PPT presentation, Chalk and Talk, Video presentation
	b. Five membered ring compounds - Preparation of Pyrrole- reactions - electrophilic substitutions, oxidation and reduction.	**2**	
	c.Preparation of Furan - reactions - electrophilic substitutions, oxidation and reduction.	**2**	
	d. Six membered ring compound - Preparation of Pyridine – reactions - electrophilic and nucleophilic substitutions, oxidation and reduction.	**3**	
	e. Condensed ring compounds - Quinoline and Isoquinoline – reactions - electrophilic and nucleophilic substitutions, oxidation and reduction.	**4**	
UnitII	**Alkaloids, Antibiotics & Vitamins**	**12 Hours**	**Mode**
	a. Alkaloids - Pharmacological properties and importance of the following alkaloids – nicotine, quinine, piperine and cocaine (Structural elucidation not necessary).	**4**	PPT presentation, Chalk and Talk, Video presentation
	b. Antibiotics -Classification and biological functions of antibiotics – penicillin, chloroamphenicol, streptomycin and tetracycline.	**4**	
	c. Vitamins - Classification and biological functions of vitamins A, B_1, B_2, B_3, B_5, B_6, B_{12}, Biotin, Folic acid, C, D, E and K, (Structural elucidation not required).	**4**	
UnitIII	**Adsorption**	**12 Hours**	**Mode**
	a. Definition – difference between adsorption and absorption – adsorbate, adsorbent, sorption, desorption – Characteristics of adsorption.	**2**	PPT presentation, Chalk and Talk, Video presentation
	b. Physical adsorption – chemical adsorption – differences between these two types.	**2**	
	c. Adsorption of gases on solids - factors influencing adsorption of gases on solid surface – nature of solid, nature of gas, effect of temperature and effect of pressure.	**2**	
	d. Adsorption of solutes from solutions –	**2**	

	factors influencing adsorption of solutes from solution – effect of temperature and concentration – effect of surface area- nature of the solute – differentiate negative adsorption and positive adsorption.		
	e. Adsorption isotherm - Freundlich isotherm & Langmuir isotherm (no derivation, statement only). Applications of adsorption.	**4**	
UnitIV	**Basic Principle of Chromatography Technique**	**12 Hours**	**Mode**
	a. Definition – classification – general applications of chromatography.	**3**	PPT presentation, Chalk and Talk, Video presentation
	b. Adsorption Chromatography (Liquid – Solid Chromatography (LSC)) – Column chromatography and Ion exchange chromatography – applications.	**3**	
	c. Partition chromatography (Liquid – Liquid Chromatography (LLC)) – Paper chromatography and Thin layer chromatography (TLC) – applications.	**3**	
	d. Gas chromatography (GC) - gas-solid chromatography (GSC) and gas-liquid chromatography (GLC) – High performance liquid chromatography (HPLC) – applications.	**3**	
UnitV	**Catalysis**	**12 Hours**	**Mode**
	a. Definition – Catalyst – Positive catalyst, Negative catalyst. Catalysis	**1**	PPT presentation, Chalk and Talk, Video presentation
	b. . Catalysis - Effect of a catalyst- characteristics or criteria of catalysis	**2**	
	c. Theories of catalysis – Intermediate compound formation theory and Adsorption theory.	**2**	
	d. Different types of catalysis- Enzyme catalysis – lock and key theory - examples of enzyme catalysis – characteristics of enzyme catalysis - factors affecting enzyme catalysis. Homogeneous catalysis – acid-base catalysis – Heterogeneous catalysis - surface catalytic reactions - differences between homogeneous catalysis and heterogeneous catalysis – Auto catalysis.	**4**	
	e. Definition and examples – catalytic poisoning – catalytic promoters. Application of catalysis – catalytic converter	**3**	

Course designed by

Dr. G.N. Kousalya, Dr.A.Sahaya Raja and Dr.M.Pandeeswaran

Programme	**B.Sc**	**Programme Code**	**UCH**		
Course Code	**20UCHA41**	Number of Hours/Cycle	**4**		
Semester	**IV**	Max. Marks	**100**		
Part	**III**	**Credit**	**4**		
Allied Course					
Course Title	**Organic, Inorganic and Physical Chemistry**		**L**	**T**	**P**
Cognitive Level		**Up to K3**	**60**	**-**	**-**

Preamble

The course enables the students to gain knowledge on basic concepts, theories and applications of Electrochemistry, Photochemistry, Polymers, Coordination compounds and organic spectroscopy .

Unit I	**Electrochemistry**	**12 Hours**
	Electrolysis- Faraday's law of electrolysis – specific and equivalent conductance – electrochemical cell – Nernst equation – convention regarding the sign of EMF of a cell. Electrodes – types of electrodes - Metal – Metal ion electrodes – Metal – Metal insoluble salt electrodes – gas electrodes – glass and Ion selective electrode (membrane potential). Reference electrodes – hydrogen electrode, calomel electrode. Determination of pH using glass electrode – Hydrogen - Oxygen fuel cell	
Unit II	**Photochemistry**	**12 Hours**
	Comparison of thermal and photochemical reactions – definition of photochemical reactions – laws of photochemistry – Grottus – Draper law – Einstein law – quantum efficiency – reasons for low and high quantum yield with examples- consequence of light absorption by atoms and molecules - differences between the primary and secondary process in a photochemical reaction. Photophysical processes - Luminescence – Jablonsky diagram – fluorescence – phosphorescence – comparison and applications of fluorescence and phosphorescence – chemiluminescence – bioluminescence – thermoluminescence. Photochemical reactions – photosensitization - biological applications of photochemistry.	
Unit III	**Polymers**	**12 Hours**
	Definition – classification of polymers – properties of polymers - Polymerisation – addition and condensation polymerization reactions with examples – differences between these two types – Copolymerisation. Rubber – natural rubber - Preparation and drawbacks of polyisoprine – Synthetic rubber - preparation, properties and applications of Butyl rubber and styrene butadiene rubber (SBR) – distinguish natural rubber and synthetic rubber – vulcanization of rubber. Plastic - difference between Thermo and Thermosetting plastics. – Important plastics – preparation, properties and applications of PVC, polystyrene, Teflon, PET, Nylon – 6:6, Bakelite.	
Unit IV	**Coordination compounds**	**12 Hours**
	Definition – nomenclature – definition of various terms involved in coordination chemistry. Stereoisomerism in complexes – geometrical isomerism and optical isomerism. Theories of co –ordination compounds – sidgwick's theory – EAN rule – Werner's theory – VB theory – postulates –	

	octahedral complexes. Metal carbonyls – Nickel carbonyl – Chromium carbonyl.	
Unit V	**Spectroscopy**	**12 Hours**
	Definition - Spectroscopy – Spectrum - types of Spectroscopy – **UV spectroscopy** - Basic principles of UV spectroscopy – energy level diagram (electronic transition) – Important terms used in UV – visible spectroscopy – Chromophore – Auxochrome – bathochromic shift – hypsochromic shift – hyperchromic effect – hypochromic effect – application of UV spectroscopy.**IR spectroscopy** – Theory of IR spectroscopy - Stretching and bending vibration of linear and non – linear molecule - example – application of IR spectroscopy- identification of simple organic molecules - ethanol and dimethyl ether, acetaldehyde and acetone, ethylene and acetylene, cis – 2 – butene and trans – 2 – butene, methylamine, dimethyl amine and trimethylamine.	

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations

Text Books

1. Soni.P.L., Dharmarha.O.P., Dash.U.N.,(2018),*Textbook of Physical Chemistry*, Sultan Chand & Sons
2. Arun Bahl and Bahl.B.S., (2019), A *Text Book of Organic Chemistry,* S.Chand& Company Ltd, New Delhi.
3. Puri. B.R., Sharma. L.R. and Kalia. K.C., (2019) *Principles of Inorganic Chemistry*,Vishal Publishing Co.

Reference Books

1. Bahl.B.S., Arun Bahl., Tuli.G.D., (2019), *Essentials of Physical chemistry*, S.Chand and company Ltd.
2. Puri., Sharma., Pathania., (2018), *Principles of physical Chemistry*, Vishal Publishing Co
3. Madan R.D,(2018), *Modern Inorganic chemistry*, S.Chand and sons.
4. Malik.W.U., Tuli.G.D., and Madan.R.D.,(2018), *Selected topics in Inorganic chemistry*, S.Chand and company Ltd.
5. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee., (2018), *Organic Chemistry*, Pearson
6. Jain.M.K., Sharma.S.C., (2018),*Modern Organic Chemistry*, Vishal Publishing Co

E-Resources:

1. http://vazecollege.net/wp-content/uploads/2016/08/ggp-ybsc_electrochemistry_10feb14.pdf
2. https://science.maheshtutorials.com/images/mhtcet_2016_notes/chemistry/Electrochemistry.pdf
3. https://www.ch.ntu.edu.tw/~sfcheng/HTML/material94/Polymer-1.pdf
4. https://www2.chemistry.msu.edu/courses/cem151/chap24lect_2009.pdf
5. https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf
6. https://www.lehigh.edu/~kjs0/carey-13.PDF
7. http://www.stpius.ac.in/crm/assets/download/Photochemistry.pdf

Course Outcomes

After completion of this course, the students will be able to:

CO1	Understand the basic concepts, theories and applications of electrochemistry
CO2	Explain various photochemical processes
CO3	Summarise the preparation, general properties and application of various inorganic polymers
CO4	Name the basic terms and isomerism involved in coordination compounds and explain various theories of coordination compounds
CO5	Attain awareness about the application of spectral techniques in analysing organic molecules.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO 10	PSO 11	PSO 12
CO 1	3	2	2	1	1	3	2	1	-	1	-	1
CO 2	3	2	-	2	1	3	2	1	-	-	-	-
CO 3	3	2	1	1	1	3	1	1	-	1	-	1
CO 4	3	1	1	-	-	3	1	1	-	1	-	-
CO 5	3	2	3	2	-	3	2	2	-	-	-	1

3. High; 2. Moderate; 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/ or Choice**	**Either / or Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	(K1&K1)	2 (K2&K2)	1(K2)
2	CO2	Up to K2	2	(K1 &K1)	2 (K2&K2)	1(K2)
3	CO3	Up to K3	2	(K1 & K2)	2 (K2&K2)	1(K3)
4	CO4	Up to K3	2	(K1 & K2)	2 (K2&K2)	1(K3)
5	CO5	Up to K3	2	(K1 & K2)	2 (K2&K2)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		40	50

K1 – Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (open Choice)	Total Marks	% of Marks without Choice
K1	7	-	-	7	7%
K2	3	40	20	63	63%
K3	-		30	30	30%
Total Marks	10	40	50	100	100%

Lesson Plan

UnitI	**Electrochemistry**	**12 Hours**	**Mode**
	a. Electrolysis- Faraday's law of electrolysis – specific and equivalent conductance	**3**	PPT presentation, Chalk and Talk, Video presentation
	b. Electrochemical cell – Nernst equation – convention regarding the sign of EMF of a cell.	**2**	
	c. Types of electrodes - Metal – Metal ion electrodes – Metal – Metal insoluble salt electrodes – gas electrodes – glass and Ion selective electrode (membrane potential).	**2**	
	d. Reference electrodes – hydrogen electrode, calomel electrode. Determination of pH using glass electrode – Hydrogen - Oxygen fuel cell	**5**	
UnitII	**Photochemistry**	**12 Hours**	**Mode**
	a. Comparison of thermal and photochemical reactions – definition of photochemical reactions	**2**	PPT presentation, Chalk and Talk, Video presentation
	b. Laws of photochemistry – Grottus – Draper law – Einstein law – quantum efficiency – reasons for low and high quantum yield with examples- consequence of light absorption by atoms and molecules - differences between the primary and secondary process in a photochemical reaction.	**4**	
	c. Photophysical processes - Luminescence – Jablonsky diagram – fluorescence – phosphorescence – comparison and applications of fluorescence and phosphorescence – chemiluminescence – bioluminescence – thermoluminescence.	**4**	
	d. Photochemical reactions – photosensitization - biological applications of photochemistry.	**2**	
UnitIII	**Polymers and Macromolecules**	**12 Hours**	**Mode**
	a. Definition – classification of polymers – properties of polymers	**3**	PPT presentation, Chalk and Talk, Video presentation
	b. Polymerisation – addition and condensation polymerization reactions with examples – differences between these two types – Copolymerisation.	**2**	
	c. Rubber – natural rubber - Preparation and drawbacks of polyisoprine – Synthetic rubber - preparation, properties and applications of Butyl rubber and styrene butadiene rubber (SBR) – distinguish natural rubber and	**3**	

	synthetic rubber – vulcanization of rubber.		
	d. Plastic - difference between Thermo and Thermosetting plastics. – Important plastics – preparation, properties and applications of PVC, polystyrene, Teflon, PET, Nylon – 6:6, Bakelite.	**4**	
UnitIV	**Coordination compounds**	**12 Hours**	**Mode**
	a. Definition – nomenclature – definition of various terms involved in coordination chemistry.	**3**	PPT presentation, Chalk and Talk, Video presentation
	b. Stereoisomerism in complexes – geometrical isomerism and optical isomerism.	**2**	
	c. Theories of co –ordination compounds – sidgwick's theory – EAN rule – Werner's theory – VB theory – postulates – octahedral complexes.	**5**	
	d. Metal carbonyls – Nickel carbonyl – Chromium carbonyl.	**2**	
UnitV	**Spectroscopy**	**12 Hours**	**Mode**
	a. Definition - Spectroscopy – Spectrum - types of Spectroscopy – UV spectroscopy - Basic principles of UV spectroscopy – energy level diagram (electronic transition) .	**3**	PPT presentation, Chalk and Talk, Video presentation
	b. Important terms used in UV – visible spectroscopy – Chromophore – Auxochrome – bathochromic shift – hypsochromic shift – hyperchromic effect – hypochromic effect – application of UV spectroscopy.	**3**	
	c. IR spectroscopy – Theory of IR spectroscopy - Stretching and bending vibration of linear and non – linear molecule - example – application of IR spectroscopy.	**3**	
	d. Identification of simple organic molecules - ethanol and dimethyl ether, acetaldehyde and acetone, ethylene and acetylene, cis – 2 – butene and trans – 2 – butene, methylamine, dimethyl amine and trimethylamine.	**3**	

Course designed by

Dr. G.N. Kousalya, Dr.A.Sahaya Raja and Dr.M.Pandeeswaran

Programme	**B.Sc.Chemistry**	**Programme Code**	**UCH**		
Course Code	**20UCHA4P**	Number of Hours/Cycle	**2**		
Semester	**IV**	Max. Marks	**100**		
Part		**Credit**			
Allied Practical					
Course Title	**Organic Analysis**		**L**	**T**	**P**
Cognitive Level		**Upto K4**	**-**	**-**	**30**

Preamble

The lab course describes the analysis of organic compounds and presence of elements and its characteristics to develop the skill of experimenting.

Qualitative Analysis of Organic Compounds

a. Identification of acidic, basic, phenolic, and neutral organic substances.
b. Detection of N, S 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) Halogen compounds f. Preparation of derivatives for the functional groups

After completion of this course, the students will be able to:

CO1	Identify aliphatic and aromatic compounds
CO2	Detect the elements
CO3	Differentiate saturation and unsaturation compounds
CO4	Confirm the functional groups

Scheme of Evaluation (Max.marks100)

Internal Assessment 40 Marks

Regularity	**10 marks**
Class Test	**20 marks**
Observation Note	**10 marks**
Total	**40 marks**

External Examination: 60 Marks (3 hours)

Record Note	**10 Marks**
Element present	**8 Marks**
Aliphatic/Aromatic	**6 Marks**
Saturated/Unsaturated	**6Marks**
Functional group	**15 Marks**
Viva voce	**10 Marks**
Report	**5 Marks**

Programme	B.Sc. Chemistry	Programme Code	UCH
Course Code	20UCHC51	Number of Hours/Cycle	4
Semester	V	Max. Marks	100
Part	III	Credit	4

Core Course VII				
Course Title	Organic Chemistry-III	L	T	P
Cognitive Level	Up to K3	60	-	-

Preamble

This Course mainly deals with Aromatic Hydrocarbons, Molecular Rearrangements, Aromatic Aldehydes, Phenols, Acids, Principles and Application of Spectroscopy, Alkaloids and Terpenoids, will be conducted in detail.

Unit I	Aromatic Hydrocarbons	12Hours
	a.Aromaticity – Definition, criteria for aromaticity and Huckel's rule b. Preparation of benzene from phenol, acetylene and by decarboxylation reactions: Mechanism of Electrophilic substitution reaction- nitration, sulphonation, halogenations, Friedel-Crafts alkylation and acylation c. Mechanism of aromatic nucleophilic substitution, unimolecular, bimolecular and benzyne mechanisms. d. Directive influence of substituents based on electronic effects: Disubsititution reactions of aromatic compounds, orientation and reactivity - Trisubstituted benzenes – Steric hindrance and rules for trisubstitution in benzene. e. Preparation, properties and uses of Toluene, Xylene and Mesitylene. f. Aryldiazoniumsalts:Preparation and synthetic applications of benzene diazonium chloride	
Unit II	**Molecular Rearrangements**	**12 Hours**
	a.Rearrangements to Electron Deficient Carbon: Pinacol – Pinacolone, Benzil-Benzilic acid, Wagner- Meerwein,Dienone – Phenol and Wolff rearrangements. b.Rearrangement to Electron Deficient Nitrogen:Beckmann,Hofmann, Curtius, Lossen and Schmidt rearrangement c. Rearrangement to Electron Deficient Oxygen: Baeyer-Villiger oxidation, cumenehydroperoxide - phenol rearrangement, Dakin reaction. d. SigmatropicRearrangements:Benzidine, Cope and Oxy – Cope rearrangement e.Aromatic Rearrangementsfrom oxygen to ring Carbon:Fries and Claisenrearrangement f. Rearrangement to Carbanion intermediate: Favorskii rearrangement.	
Unit III	**Aromatic Aldehydes: Aromatic Phenols, Aromatic Acids**	**12 Hours**

	a. Aromatic aldehydes: Benzaldehyde – mechanism of cannizzaro, perkins, claisen, knoevenagal reaction and benzion condensation. b. Phenols: Acidity of phenols – effect of substituents on the acidity of phenol mechanism of Kolbe's reaction, Reimer Tiemann reaction and Gatterman synthesis. c. Aromatic carboxylic acids: Effect of substituents on acidic character - preparation, properties of salicylic acid, anthranilic acid, phthalic acid and cinnamic acid. d. Aromatic sulphonic acids: preparation, properties and uses of benzene sulphonic acid, saccharin, chloramine – T	
Unit IV	**Principles and Application of Spectroscopy**	**12 Hours**
	a. UV : Introduction - Types of electronic transition – absorption laws – bathochromic shift and hypsochromic shift – hyperchromic and hypochromic effect – applications of UV to organic compounds – Woodward Fieser rule – calculation of λ_{max} . b. IR: Introduction - Instrumentation – Mode of vibration – overtone and combination bands – applications of IR to organic compounds – finger print region – effect of hydrogen bond. c. NMR: Introduction – chemical shift – shielding and deshielding effects – factors influencing chemical shift – solvent used – splitting of signals – coupling constants NMR spectra of ethanol and anisole. Simple problems involving the application of UV, IR and PMR spectroscopy.	
Unit V	**Alkaloids and Terpenoids**	**12 Hours**
	a. Alkaloids: Definition – occurrence and extraction of alkaloids-general methods for determining the structure of alkaloids – classification of alkaloids – structure and synthesis of following alkaloids – conine, piperine, nicotine and papavarine. b. Terpenoids:Introduction, classification, occurrence and isolation – general properties – isoprene rule – general methods of determining structure – synthesis. Properties and structure of citral, geranial, terpeniol, menthol and camphor.	

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations.

Text Books

1. Soni P.L., (2019),*Text book of Organic Chemistry,*Sultan Chand & Sons
2. Arun Bahl and Bahl B.S., (2019),*Text Book for Organic Chemistry,* S.Chand& Company Ltd, New Delhi.

Reference Books

1. M.K.Jain,S.C.Sharma, *Modern Organic Chemistry* (Vishal Publications) New Delhi
2. K.S.Tewari and N.K.Vishnoi, (2011), *Textbook of Organic chemistry,*Vikas Publishing House Pvt Ltd
3. Jerry March, (2015),*Reaction Mechanism of Organic compounds*. Wiley, India Edition7th
4. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee., (2011), *Organic Chemistry*, Pearson Publishers, New Delhi, 7th Ed.,
5. Y.R.Sharma 4th*Edition Elementary Organic Spectroscopy* S.Chand& Company Ltd,

E-Resources:

1. https://uscibooks.aip.org/wp-content/uploads/mcquarrie_interH_final.pdf
2. https://nptel.ac.in/content/storage2/courses/104101005/downloads/LectureNotes/chapter%2011.pdf
3. https://ncert.nic.in/textbook/pdf/lech203.pdf
4. https://mazams.weebly.com/uploads/4/8/2/6/48260335/spectroscopyovrview.pdf
5. https://link.springer.com/book/10.1007/978-94-011-2144-6

Course outcome

On completion of the course, students will be able to

CO1	Explain the basic concept of aromaticity,aromatic electrophilic substitution and synthesis of some important aromatic compounds
CO2	Reveal the types of rearrangement reactions and its synthetic applications
CO3	Gain knowledge of mechanism,preparations,properties and importance of Aromatic aldehydes,Phenols,Aromatic carboxylic acids,Aromatic sulphonic acids
CO4	Gain knowledge on general basic principles of spectroscopy.Students can acquire knowledge on UV,IR,NMR spectroscopy and its applications
CO5	Gives about the classification,structure and properties of Alkaloids,Terpenoids

Mapping of Programme outcomes with Course Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	1	1	2	2	2	2	1	1	1	1	1	1
CO2	2	2	1	2	2	2	1	1	1	1	1	1
CO3	2	2	2	2	2	3	1	2	1	1	1	1
CO4	1	2	3	2	2	2	1	2	1	2	1	1
CO5	2	1	2	2	3	2	1	2	1	1	1	1

1-Low 2-Moderate 3-High

Articulation Mapping-K Levels with Course Outcomes (COs)

Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K2	2	K1 & K2	K2 & K2	1(K2)
2	CO2	Up to K3	2	K1 & K2	K2 & K2	1(K3)
3	CO3	Up to K2	2	K1 & K2	K2& K2	1(K2)
4	CO4	Up to K3	2	K1 & K2	K2 & K2	1(K3)
5	CO5	Up to K3	2	K1 & K2	K2& K2	1(K3)

No. of Questions to be asked	10		10	5
No. of Questions to be answered	10		5	3
Marks for each Question	1		4	10
Total Marks for each Section	10		20	30

K1-Remembering and recalling facts with specific answers
K2-Basic understanding of facts and stating main ideas with general answers
K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (open choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	40	20	65	65%	65%
K3		-	30	30	30%	30%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit I	Aromatic Hydrocarbons	12 Hours	Mode
	a.Aromaticity – Definition, criteria for aromaticity, Huckel's rule.	2	Chalk and talk, Power point presentation
	b. Preparation of benzene from phenol, acetylene and by decarboxylation reactions: Mechanism of Electrophilic substitution reaction- nitration, sulphonation, halogenations, Friedel-Crafts alkylation and acylation	2	
	c. Mechanism of aromatic nucleophilic substitution, unimolecular, bimolecular and benzyne mechanisms.	2	
	d. Directive influence of substituents based on electronic effects: Disubsititution reactions of aromatic compounds, orientation and reactivity - Trisubstituted benzenes – steric hindrance and rules for trisubstitution in benzene.	2	
	e. Preparation, properties and uses of toluene, xylene and mesitylene.	2	
	f. Aryldiazoniumsalts: Preparation and synthetic applications of benzene diazonium chloride	2	
Unit II	**Molecular Rearrangements**	**12 Hours**	
	a. Rearrangements to Electron Deficient Carbon: Pinacol – Pinacolone, Benzil-Benzilic acid, Wagner- Meerwein, Dienone – Phenol and Wolff rearrangements.	3	

II	b. Rearrangement to Electron Deficient Nitrogen: Beckmann, Hofmann, Curtius, Lossen and Schmidt rearrangement	3	Chalk and talk, Power point presentation
	c. Rearrangement to Electron Deficient Oxygen: Baeyer-Villiger oxidation, cumenehydroperoxide - phenol rearrangement, Dakin reaction.	2	
	d. Sigmatropic rearrangements: Benzidine, Cope and Oxy – Cope rearrangement	1	
	e.Aromatic Rearrangements from oxygen to ring Carbon: Fries and Claisen rearrangement	2	
	f. Rearrangement to Carbanion intermediate: Favorskii rearrangement.	1	
Unit III	**Aromatic aldehydes, Aromatic phenols, Aromatic Acids**	**12 Hours**	
	(a)Aromatic aldehydes : Benzaldehyde – mechanism of cannizzaro, perkins, claisen, knoevenagal reaction and benzion condensation.	3	Chalk and talk, Powerpoint presentation
	b. Phenols: Acidity of phenols – effect of substituents on the acidity of phenol mechanism of Kolbe's reaction, Reimer Tiemann reaction and Gatterman synthesis.	3	
	c. Aromatic carboxylic acids: Effect of substituents on acidic character - preparation, properties of salicylic acid, anthranilic acid, phthalic acid and cinnamic acid.	3	Chalk and talk, Powerpoint presentation
	d. Aromatic sulphonic acids: preparation, properties and uses of benzene sulphonic acid, saccharin, chloramine – T.	3	
Unit IV	**Principles and Application of Spectroscopy**	**12 Hours**	
	a. (i)UV : Introduction: Type of electronic transition – absorption laws – bathochromic shift and hypsochromic shift – (ii)hyperchromic and hypochromic effect – applications of UV to organic compounds – Woodward Fieser rule – calculation of λ_{max} .	4	Chalk and talk, Power point presentation
	b. (i)IR : Introduction : Instrumentation – Mode of vibration – overtone and combination bands –	4	
	(iii)Applications of IR to organic compounds – finger print region – effect of hydrogen bond.		
	c. NMR : Introduction – chemical shift – shielding and deshielding effects – factors influencing chemical shift – solvent used – splitting of signals – coupling constants	4	
	NMR spectra of ethanol and anisole. Simple problems involving the application of UV, IR and PMR spectroscopy.		
Unit V	**Alkaloids And Terpenoids**	**12 Hours**	

	a.(i)Alkaloids: Definition – occurrence and extraction of alkaloids-	6	Chalk and talk, Power point presentation
	(ii)general methods for determining the structure of alkaloids –		
	(iii) Classification of alkaloids – structure and synthesis of following alkaloids – conine, piperine, nicotine and papavarine.		
	b.(i) Terpenoids :Introduction, classification, occurrence and isolation –	6	
	(ii) General properties – isoprene rule		
	(iii) General methods of determining structure – synthesis. Properties and structure of citral, geranial, terpeniol, menthol and camphor.		

Course Designed byMr.S.Kannan,, Dr.A.Sahaya Raja and Mrs.V.Vanitha

Programme	**B.Sc. Chemistry**	**Programme code**	**UCH**		
Course Code	**20UCHC52**	**Number of Hours/cycle**	**4**		
Semester	**V**	**Max.Marks**	**100**		
Part	**III**	**Credit**	**4**		
Core Course VIII					
Course Title	**Inorganic Chemistry III**		**L**	**T**	**P**
Cognitive level upto K3			**60**	**-**	**-**

Preamble:

The objective of the course is to understand the concept of Nuclear reaction and application of radioisotopes, fundamentals and importance of Bio-inorganic chemistry, and also known about the Stereochemistry of Inorganic complexes and preparation, properties of Interhalogen compounds and Pseudohalogens.

Unit 1	**Nuclear Chemistry I**	**12 Hours**
	Introduction – composition of nucleus and nuclear forces – nuclear stability – mass defect – binding energy – packing fraction – N/P ratio – magic numbers – nuclear models – liquid drop – Shell and collective model. Isotopes – detection and separation – deviation of atomic weights from whole numbers – isobars, isotones and isomers – Radioactive decay and equilibrium – nuclear isomerism – internal conversion. Nuclear Q-value – threshold energy – cross sections, types of reactions – fission and fusion – modes of radioactive decay.	
Unit 1I	**Nuclear Chemistry II**	**12 Hours**
	Natural and induced radioactivity – radioactive decay – half-life period – radioactive displacement law – radioactive series – Radioactive techniques – radioactive series including neptunium series – group displacement law – Rate of disintegration and half-life period – Average life period. Artificial radioactivity – induced radioactivity – uses of radioisotopes – nuclear energy – nuclear reactors – nuclear fission and fusion – fission products and fission yields – Spallation – photonuclear and thermo nuclear reactions – energy source of the sun and stars – carbon dating – rock dating - Radioactive waste disposal – applications of nuclear science in agriculture, biology and medicine – Atomic power projects in India.	
Unit 1II	**Bio-Inorganic Chemistry**	**12 Hours**
	Myoglobin and Hemoglobin – role of Myoglobin in biological systems - Cooperative effect, Hill constant, Bohr effect– Explanation for cooperative effect in hemoglobin – metalloenzymes – Inhibition and poisoning of enzymes – Role of alkali and alkaline earth metal ions in biological systems – Sodium-Potassium pump – Calcium pump – Biological functions and toxicity of some elements – 4 biological fixation of nitrogen.	
Unit 1V	**Non- Aqueous Solvents**	**12 Hours**
	Classification of solvents – Characteristic properties of a solvent – Liquid ammonia – Chemical reactions in liquid ammonia – Solutions of alkali metals in liquid ammonia – Liquid hydrogen fluoride – Chemical reactions in liquid hydrogen fluoride – Sulphuric acid – Chemical reactions of sulphuric acid – Liquid dinitrogen tetroxide – Liquid sulphur	

	dioxide – Molten salts as non-aqueous solvents.	
Unit V	**Interhalogen Compounds And Pseudohalogens**	**12 Hours**
	Basic properties of Iodine – Interhalogen compounds, some important interhalogen compounds – polyhalide ions and polyhalides – pseudohalide ions, pseudohalides and pseudohalogens – Cynogen $(CN)_2$ – Thiocyanogen $(SCN)_2$ – Selenocyanogen $(SeCN)_2$ – Oxycyanogen $(OCN)_2$.	

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations.

Text Books:

1. B.R. Puri, L.R. Sharma and K.C. Kalia, (2002), Principles of Inorganic Chemistry, 33rd Edition, Vishal Publication.
2. Satya Prakash, (2018), Advanced Inorganic Chemistry, R.D.Madan, Volume 1, S. Chand and Sons, New Delhi.
3. R. Gopalan, (2020), Text book of Inorganic Chemistry, Kindle Edition, Universities Press India Ltd., Hyderabad.
4. P.L. Soni, M. Katyal, (2019), Text Book of Inorganic Chemistry, Sultan Chand & Sons.

Reference Books

5. J.E. Huheey, E.A. Keitler and R.L. Keitler, (2013), Inorganic Chemistry – Principles of Structure and Reactivity, 4th Edition, Pearson Education, New Delhi.
6. F.A. Cotton and G. Wilkinson, (2021), Advanced Inorganic Chemistry, An Indian Adaptation, Wiley India Pvt.Ltd., New Delhi.
7. R.D. Madan, (2019), Modern Inorganic chemistry, S.Chand and Sons.

E-Resources

https://web.gccaz.edu/~lisys52871/00152note/nuclearchangnotes.pdf
https://schools.aglasem.com/55790/
https://www.youtube.com/watch?v=VFHFPdYzQZE
https://www.youtube.com/watch?v=4gLlIZ8b2Ps
https://www.youtube.com/watch?v=0hjUdZ2nIhQ

Course outcomes

On completion of the course, students will be able to

CO1	Become familiar with the concepts of nuclear reactions.
CO2	Gain knowledge about atom bomb, hydrogen bomb and applications of radioisotopes.
CO3	Learn the fundamentals of bioinorganic chemistry.
CO4	Gain knowledge in the concept of stereochemistry in inorganic complexes.
CO5	Learn about preparation and properties of interhalogen compounds.

Mapping of Programme outcomes with Course Outcomes

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	PSO 9	PSO10	PSO11	PSO12
CO 1	2	2	3	2	2	2	1	1	1	1	1	1
CO 2	2	1	1	2	1	2	2	1	1	1	1	1
CO 3	2	1	1	1	2	1	1	2	1	1	1	1
CO 4	2	2	3	2	2	2	2	3	1	1	1	1
CO 5	2	2	3	2	3	2	1	2	2	1	1	1

Articulation Mapping-K Levels with Course Outcomes (COs)

Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K3	2	K1 & K2	K2 & K2	K3
2	CO2	Up to K3	2	K1 & K2	K2 & K2	K3
3	CO3	Up to K3	2	K1 & K2	K2 & K2	K3
4	CO4	Up to K3	2	K1 & K2	K2 & K2	K3
5	CO5	Up to K3	2	K1 & K2	K2 & K2	K3
No. of Questions to be asked			10		10	5
No. of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1-Remembering and recalling facts with specific answers

K2-Basic understanding of facts and stating main ideas with general answers

K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (open choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	40	-	45	45%	45%
K3	-	-	50	50	50%	50%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Nuclear Chemistry I	12 Hours	Mode
I	a) Introduction – composition of nucleus and nuclear forces – nuclear stability – mass defect	2	Chalk and talk, Power point presentation
	b) Binding energy – packing fraction – N/P ratio – magic numbers – nuclear models – liquid drop – Shell and collective mode	2	
	c) Isotopes – detection and separation – deviation of atomic weights from whole numbers – isobars, isotones and isomers	2	
	d) Radioactive decay and equilibrium – nuclear isomerism – internal conversion.	2	
	e) Nuclear Q-value – threshold energy – cross sections	2	
	f) Types of reactions – fission and fusion – modes of radioactive decay.	2	
	Nuclear Chemistry II	**12 Hours**	
II	a) Natural and induced radioactivity – radioactive decay – half-life period – radioactive displacement law	2	Chalk and talk, Power point presentation
	b) Radioactive series – Radioactive techniques – radioactive series including neptunium series – group displacement law	2	
	c) Rate of disintegration and half-life period – Average life period. Artificial radioactivity – induced radioactivity – uses of radioisotopes – nuclear energy – nuclear reactors	2	
	d) Nuclear fission and fusion – fission products and fission yields – Spallation – photonuclear and thermo nuclear reactions	2	
	e) Energy source of the sun and stars – carbon dating – rock dating - Radioactive waste disposal	2	
	f) Applications of nuclear science in agriculture, biology and medicine – Atomic power projects in India.	2	
	Non-Aqueous Solvents	**12 Hours**	
III	a) Classification of solvents – Characteristic properties of a solvent – Liquid ammonia	3	Chalk and talk, Power point presentation
	b) Chemical reactions in liquid ammonia - Solutions of alkali metals in liquid ammonia	3	
	c) Liquid hydrogen fluoride - Chemical reactions in liquid hydrogen fluoride – Sulphuric acid – Chemical reactions of sulphuric acid	3	
	d) Liquid dinitrogen tetroxide – Liquid sulphur dioxide – Molten salts as non-aqueous solvents.	3	

	Inter halogen compounds and Pseudohalo-gens	**12 Hours**	
V	a) Basic properties of iodine – Interhalogen compounds.	2	Chalk and talk, Power point presentation, Group Discussion
	b) Some important interhalogen compounds – polyhalide ions and polyhalides.	2	
	c) Pseudohalide ions, pseudohalides and pseudohalogens.	2	
	d) Cynogen $(CN)_2$ – Thiocyanogen $(SCN)_2$.	3	
	e) Selenocyanogen $(SeCN)_2$ – Oxycyanogen $(OCN)_2$.	3	

Course Designed by:Mr.T.Srinivasan

Programme	**B.Sc.Chemistry**	**Programme Code**		**UCH**	
Course Code	**20UCHE51**	**Number of Hours/Cycle**		**4**	
Semester	**V**	**Max. Marks**		**100**	
Part	**III**	**Credit**		**4**	
Core Elective Course I A					
Course Title	**Nanoscience and Technology**		**L**	**T**	**P**
Cognitive Level	**Up to K3**		**60**	**-**	**-**

Preamble

The course enables the students to provide the basic idea about Nanochemistry, Nanomaterials, Fabrication of Nanostructured materials, Synthesis of Nanomaterials and Tools & Techniques of Nanomaterials and its applications.

Unit I	**Introduction to Nanotechnology**	**12Hours**
	Introduction – Basics of Nanochemistry – Definitions of Nanoparticles, Nanomaterials, Nanochemistry (Nanoscience) and Nanotechnology – Richard Feynman's idea of Nanotechnology – Characteristics of Nanotechnology – Distinction between Nanoparticles, Molecules and Bulk materials – Applications of Nanotechnology – Risk (Toxic effects) of nanomaterials.	
Unit II	**Nanomaterials**	**12 Hours**
	Nanomaterials – Classification based on dimensions – One dimensional (1D),Two dimensional (2D), Three dimensional (3D) and Zero dimensional (0D) Nanostructured materials – Classification based on pore dimensions–Microporous materials, Mesoporous materials and Macroporous materials - Size dependent properties – Chemical properties, Thermal properties, Electronic properties, Optical properties and Magnetic properties – Some important Nanomaterials - Fullerenes, Carbon Nanotubes (CNTs), Quantum Dots, Dendrimers, Nanocomposites, and Nanomachine.	
Unit III	**Fabrication of Nanostructured Materials**	**12 Hours**
	Techniques to synthesize Nanomaterials – Top Down Approach and Bottom up Approach – Comparison of the Two approaches –Top Down approach process – High energy ball milling – Lithography– Epitaxy– Chemical vapour Deposition (CVD) – Types of Chemical vapour Deposition process – Physical Vapour Deposition – Evaporation,Sputtering and Laser ablation – Electro deposition – Bottom up approach process – Sol -gel process(Precipitation process) – gas-phase Condensation – Chemical Vapour Condensation (CVC) – Thermolysis – Solvothermal methods and Hydrothermal methods– Self Assembly of Materials – Molecular self-assembly– Self-assembled monolayers (SAMs) – Types of SAMs – Preparation of SAMs and Application of SAM	
Unit IV	**Synthesis and Applications of Nanomaterials**	**12 Hours**

	Synthesis of Nanomaterials: Introduction – Types of nanomaterials – Preparation, properties and applications of Nanorods, Nanoclusters, Nanofibers, Nanoclays andTypes of Nanoparticles – Gold, Silver, Zinc oxide (ZnO),Copper oxide (CuO) and Titania(TiO_2) –Synthesis of Nanoparticlesby chemical reduction method –Nanoporous materials– Synthesis by sol-gel method– Nanowires– Synthesis by VLS mechanism. **Applications of Nanomaterials:** Applications of Nanomaterials inTextile Industry, Nanomedicine, Biological applications and Nanomaterials in Communication sector	
Unit V	**Carbon Nanostructures and Tools of Nanomaterials**	**12 Hours**
	Carbon Nanostructures: Carbon Nanotubes (CNTs) – Types of Carbon nanotubes – Singled -walled nanotubes (SWNTs) and Multi - walled nanotubes (MWNTs) – Synthesis of Carbon Nanotubes – Pyrolysis of hydrocarbons, Laser evaporation, carbon arc method and Chemical vapour deposition – Properties of Carbon Nanotubes – Application of Carbon nanotubes. **Tools of Nanomaterials:** Electron microscopes – Scanning Electron microscopy (SEM) – Transmission electron microscopy(TEM) – Difference between SEM and TEM –Atomic Force microscopy (AFM) – Advantages and Disadvantages of AFM over SEM – Ultraviolet-Visible spectroscopy – X-ray Diffraction (XRD) – Light Scattering methods – Dynamic light Scattering (DLS) and Zeta Potential (**Note:** Basic Principles and Instrumentation only)	

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations

Text Books

2. Thomas Vaghese, Balakrishna.K.M, (2021), *Nanotechnology (An Introduction to synthesis, properties and Applications of Nanomaterials)*, Atlantic Publishers & Distributors (P) Ltd, New Delhi.
3. Choudhary.K.K,(2018) *Nanoscience and Nanotechnology*, Narosa Publishing House Pvt. Ltd, New Delhi

Reference Books

4. Rakesh Rathi.Er,(2018), *Nanotechnology (Technology Revolution of 21st Centur)*, S.Chand and Company Ltd, New Delhi
5. Jain and Jain.,(2018), *Engineering chemistry*, Dhanpat Rai Publications Pvt. Ltd., New Delhi.
6. Manasi Karkare.,(2017), *Nanotechnology* (*Fundamentals and Applications)*, I.K.International Publishing House Pvt.Ltd, New Delhi

E-Resources:

1.https://www.kth.se/social/upload/54062f97f2765416cecdfd74/HT14-2655_Lecture%201.pdf

2.http://www.gcekjr.ac.in/pdf/lectures/2020/7166--_2nd%20Semester_ALL.pdf

3.https://ccsuniversity.ac.in/bridgelibrary/pdf/L3%20Synthesis%20of%20Nanostructured%20Materials%20Prof%20BPS.pdf

4.https://ocw.mit.edu/courses/mechanical-engineering/2-674-micro-nano-engineering-laboratory-spring-2016/lecture-notes/MIT2_674S16_Lec7Nano.pdf

5.https://www.researchgate.net/publication/324931176_Characterization_Tools_and_Techniques for_Nanomaterials

Course outcome

On the successful completion of the course, students will be able to

CO1	Clearly brings about the Concepts and applications Nanotechnology
CO2	Classify the Nanomaterials and explain the characteristics, Properties and uses of Nanomaterials
CO3	Reveals the types of Fabrication of Nanostructured Materials
CO4	List out the different methods of Synthesis Nanomaterials and its applications
CO5	Explain the Working principles of Tools and Techniques of Nanomaterials

Mapping of Programme outcomes with Course Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**	**PSO11**	**PSO12**
CO1	**3**	**1**	**2**	**2**	**1**	**3**	**2**	**1**	**-**	**1**	**-**	**-**
CO2	**3**	**2**	**1**	**2**	**1**	**3**	**2**	**1**	**-**	**1**	**-**	**-**
CO3	**3**	**2**	**2**	**2**	**1**	**3**	**3**	**2**	**-**	**1**	**-**	**1**
CO4	**3**	**2**	**2**	**2**	**1**	**3**	**3**	**2**	**-**	**1**	**-**	**1**
CO5	**3**	**1**	**1**	**2**	**1**	**3**	**1**	**2**	**-**	**1**	**-**	**1**

1- Low 2 - Moderate 3 - High

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
2	CO2	Up to K2	2	K1 & K2	K2 & K2	1(K2)
3	CO3	Up to K3	2	K1 & K2	K2 & K2	1(K3)
4	CO4	Up to K3	2	K1 & K2	K2 & K2	1(K3)
5	CO5	Up to K3	2	K1 & K2	K2& K2	1(K3)
No. of Questions to be asked			10		10	5
No. of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1-Remembering and recalling facts with specific answers

K2-Basic understanding of facts and stating main ideas with general answers

K3-Application Oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C Open choice	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-		5	5%	5%
K2	5	40	20	65	65%	65%
K3			30	30	30%	30%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit I	Introduction to Nanotechnology	12 Hours	Mode
	a)Introduction – Basics of Nanochemistry – Definitions of Nanoparticles, Nano- materials, Nanochemistry (Nanoscience) and Nanotechnology	3	Chalk and Talk PPT presentation Seminar Group discussion
	b)Richard Feynman's idea of Nanotechnology – Characteristics of Nanotechnology	3	
	c)Distinction between Nanoparticles, Molecules and Bulk materials - Size dependent properties of Nanomaterials	3	
	Applications of Nanotechnology – Risk (Toxic effects) of nanomaterials.	3	
Unit II	**Nanomaterials**	**12 Hours**	**Mode**
	a)Nanomaterials – Classification based on dimensions –One dimensional (1D),Two dimensional (2D), Three dimensional (3D) and Zero dimensional (0D) nanostructured materials	4	Chalk and Talk PPT presentation Seminar Group discussion
	b)Classification based on pore dimensions– Microporous materials, Mesoporous materials and Macroporous materials - Size dependent properties – Chemical properties, Thermal properties, Electronic properties, Optical properties and Magnetic properties	4	
	Some important Nanomaterials - Fullerenes, Carbon Nanotubes (CNTs), Quantum Dots, Dendrimers, Nanocomposites, and Nanomachine..	4	
Unit III	**Fabrication of Nanostructures Materials**	**12 Hours**	**Mode**
	a)Techniques to synthesize Nanomaterials – Top Down Approach and Bottom up Approach – Comparison of the Two approaches	2	Chalk and Talk PPT presentation Seminar Group discussion
	c)Top Down approach process – High energy ball milling – Lithography– Epitaxy– Chemical vapour Deposition (CVD) – Types of Chemical vapour Deposition process – Physical Vapour Deposition – Evaporation,	2	
	c)Bottom up approach process – Sol -gel process(Precipitation process) – gas-phase Condensation – Chemical Vapour Condensation (CVC) – Thermolysis – Solvothermal methods and Hydrothermal methods	4	

	d) Self Assembly of Materials – Molecular self-assembly– Self-assembled monolayers (SAMs) – Types of SAMs – Preparation of SAMs and Application of SAM	4	
Unit IV	**Synthesis and Applications of Nanomaterials**	**12 Hours**	**Mode**
	a) Synthesis of Nanomaterials: Introduction – Types of nanomaterials – Preparation, properties and applications of Nanorods, Nanoclusters, Nanofibers, Nanoclays	3	Chalk and Talk PPT presentation Seminar Group discussion
	b)Types of Nanoparticles – Gold, Silver, Zinc oxide (ZnO), Copper oxide (CuO) and Titania (TiO_2) – Synthesis of Nanoparticles by chemical reduction method –Nanoporous materials– Synthesis by sol-gel method– Nanowires– Synthesis by VLS mechanism.	5	
	c) Applications of Nanomaterials: Applications of Nanomaterials Textile Industry, Nanomedicine, Biological applications and Nanomaterials in Communication sector.	4	
Unit V	**Carbon Nanostructures and Tools of Nanomaterials**	**12 Hours**	**Mode**
	a) Carbon Nanostructures: Carbon Nanotubes (CNTs) – Types of Carbon nanotubes – Singled - walled nanotubes (SWNTs) and Multi - walled nanotubes (MWNTs)	2	Chalk and Talk PPT presentation Seminar Group discussion
	b)Synthesis of Carbon Nanotubes – Pyrolysis of hydrocarbons, Laser evaporation, carbon arc method and Chemical vapour deposition – Properties of Carbon Nanotubes – Mechanical properties, Electrical properties, Thermal properties, Vibrational properties and Kinetic properties – Application of Carbon nanotubes.	3	
	c) Tools of Nanomaterials: Electron microscopes – Scanning Electron microscopy (SEM) – Transmission electron microscopy(TEM) – Difference between SEM and TEM – Atomic Force microscopy (AFM) – Advantages and Disadvantages of AFM over SEM	4	
	d)Ultraviolet-Visible spectroscopy – X-ray Diffraction (XRD) – Light Scattering methods – Dynamic light Scattering (DLS) and Zeta Potential.	3	

Course Designed by: Dr.A.Sahaya Raja and Mr.C.Siva Kumar

Programme	**B.Sc.Chemistry**	**Programme Code**		**UCH**	
Course Code	**20UCHE52**	**Number of Hours/Cycle**		**4**	
Semester	**V**	**Max. Marks**		**100**	
Part	**III**	**Credit**		**4**	
Core Elective Course IB					
Course Title	**Analytical Chemistry**		**L**	**T**	**P**
Cognitive Level	**Up to K3**		**60**	**-**	**-**

Preamble

The course enables the students to provide the basic idea about handling the laboratory techniques, instrumental analysis and analytical techniques, along with the methods of separation techniques and its applications in Analytical Chemistry

Unit I	**Introduction To Analytical Chemistry**	**12Hours**
	a) Laboratory Hygiene and Safety: Storage and handling of chemicals – carcinogenic chemicals – toxic and poisonous chemicals – waste disposal – fume disposal – general precaution for avoiding accidents – first aid techniques – poisoning – methods to avoid poisoning – treatment for specific poison – laboratory safety measures.	
	b) Methods of Purification: Steam distillation, Vacuum distillation, Fractional distillation, Solvent extraction, Crystallization and Sublimation	
	c) Error Analysis: Mean – Median – Standard deviation – Coefficient of variation – Precision– Accuracy – Errors – Types of Errors – Determinate Errors and Indeterminate Errors – Rules for improving accuracy of Data – Students Q test – Rejection of experimental data –Confidence limit –Significant figures – graphical method of data analysis – Curve fitting – Methods of least square – Correlation Coefficient and Computation rules.	
Unit II	**Qualitative And Quantitative Analysis**	**12 Hours**
	a) Volumetric Analysis: Principle– Estimation using double titration-Acidimetry and Alkalimetry – Redox Titrations – Permanganometry – Precipitation titration – Mohr method– Complexometric titration– EDTA titration.	
	b) Gravimetric Analysis: Methods of obtaining the precipitate –Condition for Precipitation Choice of precipitant – Advantages and Disadvantages of using organic precipitants – Types of organic precipitants –Specific and Selective precipitants –Sequestering Agents (Masking Agents) –Theory of precipitation-Paneth- Fajans- Hahn law –Steps of Gravimetric analysis – Formation of precipitate (Precipitation) – Precipitation from Homogeneous solution – Factors influencing the solubility of precipitate – Contamination of precipitates –Co-precipitation –Post precipitation – Digestion of precipitate – washing of precipitate – drying and ignition of precipitate	

	c) Semimicro Qualitative Analysis: Aims of semi micro qualitative analysis – types of reactions involved in qualitative analysis – dry reactions – precipitation reactions - complexation reactions - oxidation and reduction reactions – Spot tests – Principles of Qualitative Analysis – Common ion effect – Solubility product –Application of solubility product – Interfering radicals–Removal of interfering ions in the analysis of cations – Oxalate, tartrate, borate, fluoride, chromate, phosphate, arsenite and arsenate – Preparation of solution for cation testing on semi micro scale – Apparatus used in Semimicro analysis	
Unit III	**Electroanalytical And Thermoanalytical Methods**	**12 Hours**
	a) Electroanalytical Methods: Potentiometric Titrations – Principle –Redox Titration ($FeSO_4$ Vs $K_2Cr_2O_7$) – Precipitation Titration ($AgNO_3$ Vs NaCl) – Advantages of Potentiometric titrations – Conductometric Titration – Principle –Acid -Base Titration (Strong acid (HCl) Vs Strong base (NaOH)) – Advantages and Disadvantages of conductometric titration	
	b) Thermoanalytical Methods: Thermogravimetric Analysis (TGA) – Principle – Characteristics of good thermobalance design –Thermal analysis of Silver Nitrate – methods of obtaining Thermograms – Derivative Thermogravimetry (DTG) curve for copper sulphate pentahydrate ($CuSO_4.5H_2O$) – Factors which influence the thermogram – TGA instrument representation – Precautions needed in the uses of Thermobalance – Applications of Thermogravimetry – Thermogravimetric analysis of Calcium Oxalate Monohydrate ($CaC_2O_4.H_2O$) - Differential Thermal Analysis (DTA) – DTA instrument representation DTA of Calcium Oxalate Monohydrate – Thermal Analysis of calcium Acetate Monohydrate – Study of Organic reactions, Study of Catalysts, Decomposition of Complexes and Trends in Ligand stabilities.	
Unit IV	**Separation Techniques**	**12 Hours**
	Definition-classification- general applications of chromatography. Adsorption chromatography (Liquid-Solid chromatography) –Column Chromatography and Ion Exchange Chromatography –Applications. Partition chromatography (Liquid- Liquid chromatography) – Paper Chromatography - R_fValue – Types of Paper Chromatography – Ascending Paper Chromatography, Descending Paper Chromatography and Radial Paper Chromatography –Thin Layer Chromatography (TLC) -Applications. Gas Chromatography –Gas-Solid Chromatography (GSC) and Gas-Liquid Chromatography (GLC) – Comparison between GSC and GLC – Applications – High Performance Liquid Chromatography (HPLC) – Applications.	
Unit V	**Analytical Techniques**	**12 Hours**
	Colorimetry – Principle – Instrumentation and Working of Colorimeter – Estimation of Iron by Colorimetry – Applications of Colorimetry. Flame Photometry – Principle – Instrumentation and Working of Flame Photometer– Estimation of Sodium by Flame Photometry – Applications,	

	Interference and limitations of flame photometry. UV-Visible Spectroscopy – Principle – Energy Level diagram – Types of Electronic transition involved in Organic Molecules– Important terms used in UV-Visible spectroscopy – Chromophores,Auxochrome – Some important definition related to change in wavelength and intensity(Red Shift, Blue Shift, Hyperchromic and Hypochromic effect) – Instrumentation and Working of UV-Visible Spectrophotometer – Applications. Infrared (IR) spectroscopy –Principle– Range of Infrared radiation – Molecular Vibrations – Fingerprint region – Types of Stretching and Bending vibrations – For Non-linear molecule (Illustration of Water) andFor linear molecule (Illustration of Carbondioxide) – Instrumentation and Working of IR Spectrophotometer – Applications. Atomic Absorption Spectroscopy (AAS) – Principle –Instrumentation and working of Atomic Absorption Spectrophotometer –Estimation of Nickel by Atomic Absorption Spectroscopy – Application and Limitations of AAS.	

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations

Text Books

1. Gopalan.R., Subramanian.P.S., & Rengarajan.K., (2019), "*Elements of Analytical Chemistry*", Sultan Chand & Sons, New Delhi.
2. Sharma.B.K.,(2016), "*Instrumental Methods of Chemical Analysis*", Goel Publishing House, Meerut.

Reference Books

1. Khopkar S.M.,(2012),*Basic concepts of Analytical chemistry)*, New Age International Publishers, New Delhi
2. Kealey D and Haines P.J., (2002), *Instants Notes Analytical Chemistry*, Viva Books Pvt. Ltd, New Delhi Chennai
3. Douglas A. Skoog, DonaldM. West, F. James Holler and StanelyRCrouch, (2004), "*Fundamentals of Analytical Chemistry*", Thompson Books, Bangalore.
4. Willard H.H., Merrit D. and John A Dean, (1966), "*Instrumental methods of Analysis*", D. Van Nostrand Company, New York.

E-Resources

1. https://www.ncbs.res.in/sitefiles/labsafety.pdf
2. https://www.embibe.com/exams/methods-of-purification-of-organic-compounds/
3. https://www.inorganicventures.com/icp-guide/accuracy-precision-mean-and-standard-deviation
4. http://copharmacy.nahrainuniv.edu.iq/am/wp-content/uploads/2017/02/3-Lec-Ana-Ch-1st-2010-Volumetric-Analysis.pdf
5. https://faculty.ksu.edu.sa/sites/default/files/unit_14-_gravimetric_analysis-subjects_autosaved.pdf
6. http://www.iscnagpur.ac.in/study_material/dept_chemistry/4.1_MIS_and_NJS_Manual_for_Inorganic_semi-micro_qualitative_analysis.pdf
7. https://www2.chemistry.msu.edu/courses/cem434/Chapter%2022%20%E2%80%93%20Introduction%20to%20Electroanalytical%20Chemistry.pdf

8. https://soe.unipune.ac.in/studymaterial/ashwiniWadegaonkarSelf/621%20Unit%202.pdf
9. https://soe.unipune.ac.in/studymaterial/ashwiniWadegaonkarSelf/222%20Chapter%204.pdf
10. https://kanchiuniv.ac.in/coursematerials/LECTURENOTESEIEPHASE2/Analytical%20Instrumentation_KS.pdf

Course outcomes

On the successful completion of the course, students will be able to

CO1	Gives the safety measurements towards the laboratory techniques and brings about terms and methods of finding error analysis towards analytical results
CO2	Do titrimetric techniques of acid/base titration, complexometric titration, redox titration andbrings about the methods of gravimetric analysis and Semimicro Qualitative Analysis
CO3	Gives the principles, Concepts and methods of Electroanalytical and Thermoanalytical techniques
CO4	Explain the theoretical principles of various separation techniques in chromatography and typical applications of chromatographic techniques
CO5	Clearly brings about the principles, Concepts and instrumentation of selected analytical techniques and their applications

Mapping of Programme outcomes with Course Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**	**PSO11**	**PSO12**
CO1	**3**	**2**	**2**	**2**	**1**	**3**	**3**	**2**	**-**	**1**	**-**	**1**
CO2	**3**	**3**	**2**	**3**	**1**	**3**	**3**	**1**	**-**	**1**	**-**	**1**
CO3	**3**	**2**	**2**	**2**	**1**	**3**	**3**	**2**	**-**	**1**	**-**	**-**
CO4	**3**	**2**	**3**	**2**	**1**	**3**	**3**	**2**	**-**	**1**	**-**	**-**
CO5	**3**	**2**	**2**	**2**	**1**	**3**	**3**	**2**	**-**	**1**	**-**	**-**

1- Low 2 - Moderate 3 - High

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**	**Section C**
			MCQs		**Either/or Choice**	**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
2	CO2	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
3	CO3	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
4	CO4	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
5	CO5	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
No. of Questions to be asked			10		10	5
No. of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1-Remembering and recalling facts with specific answers
K2-Basic understanding of facts and stating main ideas with general answers
K3-Application Oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C Open choice	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-		5	5%	5%
K2	5	40	10	55	55%	55%
K3			40	40	40%	40%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hours	Mode
I	**Introduction to Analytical Chemistry**		
	a) Laboratory Hygiene and Safety: Storage and handling of chemicals – carcinogenic chemicals – toxic and poisonous chemicals – waste disposal – fume disposal – general precaution for avoiding accidents – first aid techniques – poisoning – methods to avoid poisoning – treatment for specific poison – laboratory safety measures.	4	Chalk and Talk PPT presentation Seminar Group discussion
	b) Methods of Purification: Steam distillation, Vacuum distillation, Fractional distillation, Solvent extraction, Crystallization and Sublimation	4	
	c) Error Analysis: mean – Median – Standard deviation – Coefficient of variation – Precision– Accuracy – Errors – Types of Errors – Determinate Errors and Indeterminate Errors – Rules for improving accuracy of Data – Students Q test – Rejection of experimental data – Confidence limit – Significant figures – graphical method of data analysis – Curve fitting – Methods of least square – Correlation Coefficient and Computation rules.	4	
Unit II	**Qualitative and Quantitative Analysis**		
	a) Volumetric Analysis: Principle – Estimation using double titration -Acidimetry and Alkalimetry – Redox Titrations – Permanganometry and Dichrometry – Precipitation titration – Mohr method – Iodometry – Estimation of Copper– Complexometric titration – EDTA titration.	4	Chalk and Talk PPT presentation Seminar Group discussion
	b) Gravimetric Analysis: Methods of obtaining the precipitate – Condition for Precipitation Choice of precipitant – Advantages and Disadvantages of using organic precipitants – Types of organic precipitants – Specific and Selective precipitants – Sequestering Agents (Masking Agents) – Theory of precipitation - Paneth- Fajans- Hahn law – Steps of Gravimetric analysis – Formation of precipitate (Precipitation) – Precipitation from Homogeneous solution – Factors influencing the solubility of precipitate – Contamination of precipitates – Co-precipitation – Post precipitation – Digestion of precipitate – washing of precipitate – drying and ignition of precipitate	4	

	c) Semimicro Qualitative Analysis: Aims of semi micro qualitative analysis – types of reactions involved in qualitative analysis – dry reactions – precipitation reactions - complexation reactions - oxidation and reduction reactions – Spot tests – Principles of Qualitative Analysis – Common ion effect – Solubility product – Application of solubility product – Interfering radicals – Removal of interfering ions in the analysis of cations – Oxalate, tartrate, borate, fluoride, chromate, phosphate, arsenite and arsenate – Preparation of solution for cation testing on semi micro scale – Apparatus used in Semimicro analysis.	4	
Unit III	**Electroanalytical and Thermoanalytical Methods**		
	a) Electroanalytical Methods: Potentiometric Titrations – Principle – Redox Titration ($FeSO_4$ Vs $K_2Cr_2O_7$) – Precipitation Titration ($AgNO_3$ Vs NaCl) – Advantages of Potentiometric titrations – Conductometric Titration – Principle – Acid - Base Titration (Strong acid (HCl) Vs Strong base (NaOH)) – Advantages and Disadvantages of conductometric titration.	4	Chalk and Talk PPT presentation Seminar Group discussion
	b) Thermoanalytical Methods: Thermogravimetric Analysis (TGA) – Principle – Characteristics of good thermobalance design –Thermal analysis of Silver Nitrate – methods of obtaining Thermograms – Derivative Thermogravimetry (DTG) curve for copper sulphate pentahydrate ($CuSO_4 .5H_2O$) – Factors which influence the thermogram – TGA instrument representation – Precautions needed in the uses of Thermobalance – Applications of Thermogravimetry – Thermogravimetric analysis of Calcium Oxalate Monohydrate ($CaC_2O_4.H_2O$).	4	
	Differential Thermal Analysis (DTA) – DTA instrument representation DTA of Calcium Oxalate Monohydrate – Thermal Analysis of calcium Acetate Monohydrate – Study of Organic reactions, Study of Catalysts, Decomposition of Complexes and Trends in Ligand stabilities.	4	
Unit IV	**Separation Techniques**		
	Definition-classification- general applications of chromatography. Adsorption chromatography (Liquid-Solid chromatography) – Column Chromatography and Ion Exchange Chromatography – Applications.	4	Chalk and Talk PPT presentation Seminar Group discussion
	Partition chromatography (Liquid- Liquid chromatography) – Paper Chromatography - R_f Value – Types of Paper Chromatography – Ascending Paper Chromatography, Descending Paper Chromatography and Radial Paper Chromatography – Thin Layer Chromatography (TLC) - Applications.	3	
	Gas Chromatography – Gas-Solid Chromatography (GSC) and Gas-Liquid Chromatography (GLC) – Comparison between GSC and GLC – Applications.	3	
	High Performance Liquid Chromatography (HPLC) –	2	

	Applications.		
Unit V	**Analytical Techniques**		
	Introduction – Type of Spectroscopy – Spectrum – Photophysical law – Lamberts's Law and Beer-Lambert's law – Application and Limitations of Beer-Lambert's law – Colorimetry – Principle – Instrumentation and Working of Colorimeter – Estimation of Iron by Colorimetry – Applications of Colorimetry.	2	Chalk and Talk PPT presentation Seminar Group discussion
	Flame Photometry – Principle – Instrumentation and Working of Flame Photometer– Estimation of Sodium by Flame Photometry – Applications, Interference and limitations of flame photometry.	2	
	UV-Visible Spectroscopy – Principle – Energy Level diagram – Types of Electronic transition involved in Organic Molecules – Important terms used in UV-Visible spectroscopy – Chromophores, Auxochrome – Some important definition related to change in wavelength and intensity (Red Shift, Blue Shift, Hyperchromic and Hypochromic effect) – Instrumentation and Working of UV-Visible Spectrophotometer – Applications.	3	
	Infrared (IR) spectroscopy –Principle – Range of Infrared radiation – Molecular Vibrations – Fingerprint region – Types of Stretching and Bending vibrations – For Non-linear molecule (Illustration of Water) and For linear molecule (Illustration of Carbon dioxide) – Instrumentation and Working of IR Spectrophotometer – Applications.	3	
	Atomic Absorption Spectroscopy (AAS) – Principle – Instrumentation and working of Atomic Absorption Spectrophotometer – Estimation of Nickel by Atomic Absorption Spectroscopy – Application and Limitations of AAS	2	

Course Designed by Dr.A.Sahaya Raja . Mrs.C.Kavitha and Mrs.M.Deepa

Programme	B.Sc.Chemistry	Programme Code			UCH
Course Code	20UCHE53	Number of Hours/Cycle			4
Semester	V	Max. Marks			100
Part	III	Credit			4
Core Elective Course I C					
Course Title	Medicinal Chemistry		L	T	P
Cognitive Level		Up to K3	60	-	-

Preamble

To know the different systems of medicine, Analgesics, Antipyretics drugs Chemotherapy and application of a few drugs. The definition and classification of hormones, vitamins and importance of Anesthetics.

Unit I	**Systems of medicine**	**12Hours**
	. Important terminologies used their meaning –molecular pharmacology - pharmacodynamics, pharmacophore. metabolites,antimetabolits— Introduction of drugs -definition-important drugs dosage– History of medicinal chemistry – Discovery of drugs – Types of medicine – Ayush – Ayurveda – Yoga – Unani – Siddha – Homeopathy.	
Unit II	**Analgesics and Antipyretics**	**12 Hours**
	Introduction of Analgesics –Synthesis,properties, Classification and applications – Narcotic analgesic – Morphine and derivatives. Non – Narcotic Analgesics - Pethidine and Methadone. Introduction of antipyretics – Salicyclic acid derivatives, Indol derivatives and P-amino phenol derivatives (Medicinal uses and structure only)	
Unit III	**Chemotherapy and application of a few drugs**	**12 Hours**
	Introduction of Chemotherapy – Types - Sulpha drugs – Sulphadiazine, prontosil and prontosil-S, Antimalarials – quinine and its derivatives, Arsenical drugs – salvarasan – 606 – Neosalvarsan Antibiotics: Definition, Penicillin – Tetracycline (Auromycine and Tetramycin) – Streptomycin and Chloromyceitin – drug action and uses	
Unit IV	**Anaesthetics**	**12 Hours**
	Definition and Classification of Anesthetics-Gaseous anaesthetics – Vinyl ether – Cyclopropane – Halohydrocarbons – Chloroform – Haloethane – Trichloro ethylene – Intravenous anaesthetics – Thiopentone – Local anaesthetics – Cocaine and its derivatives. **Note: Therapeutic use only.**	
Unit V	**Pandemic and Epidemic Diseases**	**12 Hours**
	Symptoms and causes of Cardiovascular disorders – Angiogram – Angioplasty-MRI. A symptom causes Prevention and Treatment of Diabetes- Covid-19- Chikungunya -Swine flu-Dengue fever.	

Pedagogy

Chalk and Talk method. Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and Power point Presentations.

Text Books

1. Text book of Phrama Chemistry by Jayashree Ghosh. S. Chand Company (Latest Edition 2008).
2. Pharmaceutical Chemistry Dr.S. Lakshmi Sultan Chand & Sons 2004.

Reference Books

1. Industrial Chemistry including Chemical Engineering – B.K.Sharma – Goel Publishing House. 13th Revised and Enlarged Edition.
2. Grodman and Gilman's "The Pharmacological basis of therapeutics".
3. Pharmacology, Mary J. Mycek and Richard a. Harvey 2nd Edition 2000.
4. Foy's Principles of Medicinal Chemistry, David A. Williams and Thomas L. Lemke Edn, V, 2002.
5. Hand book of experimental Pharmacology S.K. Kulkarni, 3rd Edn 1999.
6. Industrial Chemistry, B.K.Sharma Goel Publishing house, Edn XIII, 2008.
7. Pharmaceutical Manufacturing encyclopedia, Vol. I and II 2nd Edn 2000.
8. Unit Process in organic synthesis, Grogging 5th Edn, 2000.
9. Biopharmaceutics and Pharmokinetics D.M. Brahamanikav and Sunil, B.Jaiswal, Edn XIX, 2004.

E-Resources

1. https://remixeducation.in/introduction-to-medicinal-chemistry/
2. https://ccsuniversity.ac.in/bridge-library/pdf/Principle-Organic-Medicine-Chemistry.pdf
3. https://lastbenchpharmacist.blogspot.com/p/semester-4.html
4. https://www.sciencecoverage.com/2021/02/bpharmacy-2nd-year-notes-books-pdf.html
5. http://www.jiwaji.edu/pdf/ecourse/pharmaceutical/physicochemical%20properties%20part%201.pdf

Course Outcomes

After completion of this course, the students will be able to:

CO1	Understand the role of drugs, medicinal chemistry and medicine in biological systems and medicine
CO2	Acquire the knowledge on the preparation, properties and uses of important analgesic and antipytes.
CO3	Explain different types of chemotherapy, derivatives, drug action and uses.
CO4	To understand the definition, characterization and biological important of vitamins and hormones.
CO5	Explain various anesthetics processes

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	1	1	2	1	3	3	1	1	1	1	1
CO2	3	3	1	3	2	3	3	1	1	2	1	1
CO3	3	2	2	2	1	3	2	1	1	1	1	1
CO4	3	2	3	2	1	3	3	2	1	1	1	1
CO5	3	2	2	2	2	3	2	2	1	3	1	1

3. High;2. Moderate;1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

(Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/ or Choice	Open Choice
			No. of Questions	K-Level	No. of Question	Noof Question
1	CO1	Upto K2	2	(K1 &K2)	K2& K2	1(K2)
2	CO2	Up to K2	2	(K1 &K2)	K2& K2	1(K2)
3	CO3	Up to K3	2	(K1 &K2)	K2& K2	1(K3)
4	CO4	Up to K3	2	(K1 &K2)	K2& K2	1(K3)
5	CO5	Up to K3	2	(K1 &K2)	K2& K2	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without Choice
K1	5	-	-	5	5%
K2	5	40	20	65	65%
K3		-	30	30	30%
Total Marks	10	40	50	100	100%

Lesson Plan

UnitI	Systems of medicine	12 Hours	Mode
	a.Important terminologies used their meaning – molecular pharmacology.	**2**	PPT presentation, Chalk and Talk.
	b pharmacodynamics,pharmacophore-metabolites,antimetabolits	**2**	
	c.Introduction of drugs -definition-important drugs dosage	**3**	
	d. History of medicinal chemistry, Discovery of drugs	**2**	
	e. Types of medicine ,Ayush – Ayurveda – Yoga – Unani – Siddha – Homeopathy	**3**	
UnitII	**Analgesics and Antipyretics**	**12 Hours**	**Mode**
	a.Introduction Synthesis,properties, applications of Analgesics,	**2**	Chalk and Talk, Group Discussion and PPT presentation.
	b.Classification – Narcotic analgesic – Morphine and derivatives	**3**	
	c.Non – Narcotic Analgesics - Pethidine and Methadone.	**2**	
	d Introduction of antipyretics**.**,	**2**	
	e.Salicyclic acid derivatives, Indol derivatives	**3**	

UnitIII	**Chemotherapy and application of a few drugs**	**12 Hours**	**Mode**
	a.. Introduction of Chemotherapy	**2**	Chalk and Talk, PPT Presentation.
	b.. Types – drugs and its derivatives	**3**	
	c.. Arsenical drugs	**2**	
	d. Antibiotics	**3**	
	e. drug action and uses	**2**	
Unit IV	**Anaesthetics**	**12 Hours**	**Mode**
	aDefinition and Classification of Anesthetics	**2**	Chalk and Talk, PPT Presentation.
	b.Gaseous anaesthetics	**2**	
	c.Vinyl ether– Cyclopropane – Halohydrocarbons – Chloroform – Haloethane	**2**	
	d.Trichloro ethylene – Intravenous anaesthetics	**3**	
	e.Thiopentone – Local anaesthetics – Cocaine and its derivatives.	**3**	
Unit V	**Pandemic and Epidemic Diseases**	**12 Hours**	**Mode**
	Symptoms and causes of Cardiovascular disorders	**2**	Chalk and Talk, PPT Presentation, .
	Angiogram , Angioplasty and MRI	**2**	
	A symptom causes Prevention and Treatment of Diabetes	**3**	
	Covid-19 and Chikungunya	**2**	
	Swine flu and Dengue fever	**3**	

Course designed by Dr.M.Pandeeswaran and Mrs.K.Rathika

Programme	B.Sc,Chemistry	Programme Code		UCH	
Course Code	20UCHP51	Number of Hours/Cycle			
Semester	V	Max. Marks		100	
Part	III	Credit		2	
Course Title	Core Project		L	T	P
Cognitive Level	Up to K4		-	-	-

L-Lecture Hours, T-Tutorial Hours, P-Practical Hours

Course Outcomes

Upon successful completion of this project work the students will be able to:

CO1	Enhance the analytical skills on handling instruments.
CO2	Carryout scientific experiments
CO3	Solve the environmental issues that impact the society
CO4	Develop the skills of entrepreneurship

Project work:

- Each faculty will be allotted a group of **(3-5)** students for their research project in any one of the areas of Chemistry in consultation with their guide and the Head of the Department.
- The topic/area of work will be finalized at the end of IV semester, allowing scope for the students to gather relevant literature during the vacation.
- The project report should be submitted to the Head of the Department of Chemistry through the Guide one week prior to the commencement of the summative examination.
- They shall submit **THREE** copies of their project report for valuation.
- The topic for the project can be chosen from a wide range of subjects, but a text or topic prescribed in the syllabus should be strictly avoided.

Area of work:

Corrosion, Environmental Chemistry, Nano-Synthesis, Green Chemistry, Pharmaceutical and Adsorption

Each project should contain the following details:

Brief introduction on the topic

Materials and Methods

Results and Discussions

Conclusion / Summary

Bibliography

The project should be at least 25 pages excluding bibliography and appendices.

The marks will be allotted on the prescribed basis as given below:

A. Continuous Internal Assessment

Regularity	15 Marks
Strength of the independent work (utilizing theory and methodology)	25Marks
Total	**40 Marks**

B. End Semester Examination (Viva Voce)

Individual Presentation	30 Marks
Answering the queries	30 Marks
Total	**60 Marks**

Programme	B.Sc. Chemistry	Programme Code	UCH		
Course Code	20UCHS51	Number of Hours/Cycle	2		
Semester	V	Max. Marks	50		
Part	IV	Credit	2		
Skill Based Course I					
Course Title	Water Technology		L	T	P
Cognitive Level Up to K3			30	-	-

Preamble

This course deals with the source of water, parameters, alkalinity, hardness, chemical hazards, removal of hardness and purification of water.

Unit I	**Water Chemistry**	**6 Hours**
	Introduction of water - sources of water - shape and geometry of water - impurities in water - types of water - soft and hard water. Units of Hardness, Calcium carbonate equivalents - Industrial implication of hard water – water born diseases – acid rain – artificial rain – rain water harvesting.	
Unit II	**Physical, Chemical and Biological Parameters**	**6 Hours**
	Water quality parameter – physical parameters – colour - Taste – odour - Turbitity and sediment - electrical conductance - chemical parameters - Alkalinity – Acidity - pH - total dissolved solids - chemical oxygen demand – dissolved oxygen –Biological oxygen demand - biological parameters - water quality standards – WHO – ICMR.	
Unit III	**Analysis of Water**	**6 Hours**
	Estimation of Alkalinity - Acidity – pH – Hardness – Estimation of temporary, permanent and total hardness by EDTA methods - total dissolved solids – chemical oxygen demand – dissolved oxygen – estimation of Ca^{2+} and Mg^{2+} ions in water.	
Unit IV	**Softening of Water**	**6 Hours**
	Removal of hardness – softening methods - temporary hard water removal methods – permanent hard water removal methods – Lime soda method, Zeolite process- Ion-Exchange process – desalination of salt water - electrodialysis reverse osmosis methods.	
Unit V	**Treatment Processes**	**6 Hours**
	Waste water – industrial waste water treatment – domestic waste water treatment – treatment processes - primary – secondary – tertiary treatment – sedimentation – coagulation and flocculation – activated sludge – sand filters – break point chlorination – decholrination - by chloramines – by Ozone – sewage water treatment.	

Pedagogy

Class Room Lectures, Power Point Presentation, Group Discussion, Seminar, Quiz, Assignments, Experience Sharing, Case Study.

Text Books

1. A.K. De, Environmental Chemistry, 5th Edition, New Age International Publisher, 2005.
2. B.K. Sharma, Environmental Chemistry, 11th Edition, Krishna Prakashan Media Limited, 2007.

Reference Books

1. Aney E. R. 2007 water quality handbook. McGrawhill.
2. Vigil K. 2003 clean water An Introduction to water quality and water pollution control. Oregon state university.
3. Reid R. water quality and systems. Fairmont press 2004.
4. Merkel. B. J. and Planer- Friedrich B. 2008 Groundwater geochemistry, Springer. 6- Foster et al 2002 Groundwater quality protection. World Bank Calhoun Y. 2005, Water Pollution Chelsea House.

E-Resources

1. https:// www.researchgate.net
2. https://www.mainerwa.org
3. https:// www.mostreamteam.org
4. https://www.mdpi.com

Course Outcomes

On successful completion of the course, the student will be able to

CO1	Recall of water, source of water and characteristics of water.
CO2	Explain the Physico- chemical parameters and biological parameters.
CO3	Demonstrate Alkalinity, total dissolved solids and chemical oxygen demand dissolved oxygen experiments.
CO4	Perform the softening and desalination methods of hard water.
CO5	Apply the knowledge on domestic waste water treatment.

Mapping of Programme specific outcomes with Course Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**	**PSO11**	**PSO12**
CO1	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**
CO2	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**`1**	**1**
CO3	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**1**	**2**
CO4	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**
CO5	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

1-Low ; 2-Moderate ; 3-High

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	**COs**	**K-Level**	**Section A**		**Section B**
			Either or Choice		**Open Choice**
			No. of Questions	**K-Level**	**No. of Questions**
1	CO1	Up to K2	2	K1 & K2	1(K2)
2	CO2	Up to K2	2	K1 & K2	1(K2)
3	CO3	Up to K2	2	K1 & K2	1(K2)
4	CO4	Up to K3	2	K1 & K2	1(K3)
5	CO5	Up to K3	2	K1 & K2	1(K3)
No. of Questions to be asked			10		5
No. of Questions to be answered			5		3
Marks for each Question			3		5
Total Marks for each Section			15		15

K1-Remembering and recalling facts with specific answers
K2-Basic understanding of facts and stating main ideas with general answers
K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	**Section A (Either or Choice)**	**Section B (Open Choice)**	**Total Marks**	**% of Marks without choice**	**Consolidated (Rounded off)**
K1	15	-	15	27.2%	27%

K2	15	15	30	54.5%	55%
K3		10	10	18.1%	18%
Total Marks	30	25	55	100%	100%%

Lesson Plan

Unit	Water Chemistry	6 Hours	Mode
Unit I	**a**.Introduction of water - sources of water - shape and geometry of water - impurities in water - types of water - soft and hard water.	2	Chalk and talk, Power point presentation, Group Discussion
	b.Units of Hardness, Calcium carbonate equivalents - Industrial implication of hard water.	2	
	c.Water born diseases – acid rain – artificial rain – rain water harvesting.	2	
	Physical, Chemical and Biological Parameters	**6 Hours**	
Unit II	**a**.Water quality parameter – physical parameters – colour - Taste – odour - Turbitity and sediment - electrical conductance –	2	Chalk and talk, Power point presentation
	b. Chemical parameters - Alkalinity – Acidity - pH - total dissolved solids chemical oxygen demand – dissolved oxygen –	2	
	c.Biological oxygen demand - biological parameters - water quality standards – WHO – ICMR.	2	
	Analysis of Water	**6 Hours**	
Unit III	**a**.Estimation of Alkalinity - Acidity – pH – Hardness –	2	Chalk and talk, Power point presentation
	b.Estimation of temporary, permanent and total hardness by EDTA methods - total dissolved solids –	2	
	c.Chemical oxygen demand – dissolved oxygen – estimation of Ca^{2+} and Mg^{2+} ions in water.	2	
	Softening of Water	**6 Hours**	
Unit IV	**a**.Removal of hardness – softening methods - temporary hard water removal methods	2	Chalk and talk, Power point presentation
	b.Permanent hard water removal methods – Lime soda method, Zeolite process-	2	
	c.Ion-Exchange process – desalination of salt water - electrodialyses reverse osmosis methods.	2	
	Treatment Processes	**6 Hours**	
Unit V	**a**.Waste water – industrial waste water treatment – domestic waste water treatment.	2	Chalk and talk, Power point presentation,
	b.Treatment processes - primary – secondary – tertiary treatment – sedimentation – coagulation and flocculation – activated sludge –	2	
	c. Sand filters – break point chlorination – decholrination - by chloramines – by Ozone – sewage water treatment.	2	

Course Designed by: Dr.G.N.Kousalya

Programme	B.Sc.Chemistry	Programme Code		UCH	
Course Code	20UCHS52	Number of Hours/Cycle		2	
Semester	V	Max. Marks		50	
Part	IV	Credit		2	
Skill Based Course II					
Course Title	Food Chemistry		L	T	P
Cognitive Level		Up to K3	30	-	-

Preamble

The course provides the basic knowledge in Food chemistry; inculcate culinary techniques and nutritional benefits of food. Aquire information about various food laws and health science.

Unit I	Food Constituents and Health	6 Hours
	Food – Classification of food – Malnutrition – Under nutrition – Over nutrition – Good nutrition - The nutrition composition of the body – Amount of nutrients in the body – Functions of food – Metabolism – Digestion. Minerals and Vitamins- minerals- Sources- functions and deficiency of the following minerals.Calcium, Iron, Iodine, fluorine, sodium and potassium. Vitamins-sources, classification, functions and deficiencies of fat- soluble vitamins-(A,D,E, and K), water- soluble vitamins-(C, thiamin, niacine, riboflavin, B complex- B_6, Folic acid and B_{12}).	
Unit II	**Food Processing**	**6 Hours**
	Introduction – Cooking methods– Effect of cooking on nutrients – effect of cooling on various food stuff Food preservation – Refrigeration and freezing – canning – dehydration- salting- pickling- pasteurizing-fermenting-carbonating-cheese making – irradiation – Preservation using chemical preservatives.	
Unit III	**Food additives**	**6 Hours**
	Chemistry of sweeteners - intense sweeteners – Bulk sweeteners. Chemistry of food colour- – List of permitted colourants (natural colours and synthetic colours) Flavouring agents – Antioxidants-emulsifiers-flavour enhancer.	
Unit IV	**Food adulteration and testing**	**6 Hours**
	Common food adulterants – Analysis of Adulterants in edible oils, Ghee, Tea, Coffee powder, Chili powder, Turmeric powder, milk, pepper, honey, cereals, pulses, nuts, fruit jam, Meat – Harmful effects of the Adulterants.	
Unit V	**Practical rules for good sanitation of food**	**6 Hours**
	Food laws and standards – Food Safety and Standards Authority of India (fssai) - Bureau of Indian Standards (BSI) – AGMARK – Consumer Protection act-International standards for the safe use of food additives.	

Course Outcomes

On successful completion of the course, the students will be able to

CO1	Classify and perceive the important food constituents.
CO2	Compare and relate the various type of food processing and preservation

	techniques.
CO3	Explain the effect of food additives and their health benefits.
CO4	Demonstrate and apply food adulteration testing methods.
CO5	Explain various food laws of Indian standards.

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and laboratory and testing metal.

Text Books

1. Ramani.V., (2009), *Food Chemistry by Alex*, MJP Publications.
2. Jaya Shree Ghose H.S., (2006), *Fundamental concepts of Applied chemistry*, S.ChandCompany(P) Ltd, New Delhi.

Reference Books

1. Sharma B.K., (2016), *Industrial Chemistry* (Including Chemical Engineering) Goel Publishing House, 16th Revised and Enlarged Edition.
2. Ramani.V., (2009), *Food Chemistry by Alex*, MJP Publications.
3. Swaminathan M.,(1993), *Advanced Text Book on Food and Nutrition* , volume I and II Printing and Publishing Co., Ltd., Bangalore.

E- Resources

1. https://library.iitbbs.ac.in/e-resources-a2z.php?alpha=F
2. https://www.sciencedirect.com/journal/food-chemistry/special-issue/102GX2354P2
3. https://www.sciencedirect.com/journal/food-chemistry/special-issue/104LRT8DJ9N
4. https://www.foodqualityandsafety.com/article/food-regulations-what-is-the-current-scenario-in-india-2/#:~:text=In%20India%20the%20Food%20Safety,is%20the%20apex%20food%20regulator.&text=The%20FSSAI%20implements%20and%20enforces,known%20as%20the%20Food%20Act.
5. https://globalfoodsafetyresource.com/food-adulteration/

Mapping of Programme specific outcomes with Course Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	**1**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**
CO2	**2**	**1**	**2**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**1**
CO3	**1**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**1**	**2**	**1**	**1**
CO4	**2**	**3**	**3**	**2**	**3**	**1**	**3**	**1**	**1**	**2**	**1**	**2**
CO5	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

1-Low 2-Moderate 3-High

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	COs	K-Level	Section A		Section B
			Either/or Choice		Open Choice
			No. of Questions	K-Level	No. of Questions
1	CO1	Up to K2	2	K1 & K2	1(K2)
2	CO2	Up to K2	2	K1 & K2	1(K2)
3	CO3	Up to K2	2	K1 & K2	1(K2)
4	CO4	Up to K3	2	K1 & K2	1(K3)
5	CO5	Up to K3	2	K1 & K2	1(K3)
No. of Questions to be asked			10		5
No. of Questions to be answered			5		3
Marks for each Question			3		5
Total Marks for each Section			15		15

K1-Remembering and recalling facts with specific answers

K2-Basic understanding of facts and stating main ideas with general answers
K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (Either/or)	Section B (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	15	-	15	27.2%	27%
K2	15	15	30	54.5%	55%
K3		10	10	18.1%	18%
Total Marks	30	25	55	100%	100%

Lesson Plan

Unit I	**Food Constituents and Health**	**Hours**	**Mode**
	a.Food – Classification of food – Malnutrition – Under nutrition – Over nutrition – Good nutrition - The nutrition composition of the body – Amount of nutrients in the body – Functions of food – Metabolism – Digestion.	2	Chalk and talk Power point presentation Seminar Group discussion
	b.Minerals and Vitamins- minerals- Sources-functions and deficiency of the following minerals.Calcium, Iron, Iodine, fluorine, sodium and potassium. Vitamins-sources.	2	
	c.Classification, functions and deficiencies of fat-soluble vitamins-(A,D,E, and K), water- soluble vitamins-(C, thiamin, niacine, riboflavin, B complex- B_6, Folic acid and B_{12}).	2	
Unit II	**Food Processing**	**Hours**	**Mode**
	a.Introduction – Cooking methods– Effect of cooking on nutrients – effect of cooling on various food stuff.	2	Chalk and talk Power point presentation Seminar Group discussion
	b.Food preservation – Refrigeration and freezing – canning – dehydration- salting- pickling-pasteurizing-fermenting.	2	
	c.Carbonating - cheese making – irradiation – Preservation using chemical preservatives.	2	
Unit III	**Food additives**	**Hours**	**Mode**
	a.Chemistry of sweeteners - intense sweeteners – Bulk sweeteners.	2	Chalk and talk Power point presentation Seminar Group discussion
	b.Chemistry of food colour- – List of permitted colourants (natural colours and synthetic colours)	2	
	c.Flavouring agents–Antioxidants emulsifiers-flavour enhancer.	2	
Unit IV	**Food adulteration and testing**	**Hours**	**Mode**
	a.Common food adulterants – Analysis of Adulterants in edible oils.	2	Chalk and talk

	b.Ghee, Coffee powder, Chili powder, Turmeric powder, milk pepper, honey, cereals, pulses, nuts, fruit jam, Meat.	2	Power point presentation Seminar Group discussion
	c.Harmful effects of the Adulterants.	2	
Unit V	**Practical rules for good sanitation of food**	**Hours**	**Mode**
	a.Food laws and standards Food Safety and Standards		Chalk and talk Power point presentation Seminar Group discussion
	b.Authority of India (fssai) Bureau of Indian Standards (BSI) –AGMARK		
	c.Consumer Protection act-International standards for the safe use of food additives.		

Course designed byDr.J.Sathiyabama, Dr. G.N.Kousalya and Miss.P.Angel

Programme	B.Sc.Chemistry	Programme Code		UCH	
Course Code	20UCHC61	Number of Hours/Cycle		4	
Semester	VI	Max. Marks		100	
Part	III	Credit		4	
Core Course IX					
Course Title	Physical Chemistry-III		L	T	P
Cognitive Level		Up to K3	60	-	-

Preamble

The students are enabled to have knowledge on phase rule , group theory, photochemistry, electrochemistry and spectroscopy.

Unit I	Phase Rule	12 Hours
	Definitions of terms – Gibb's phase rule – one component system – water, carbon dioxide and sulphur – polymorphism – two component system – reduced phase rule – simple eutectic system – Pb-Ag system – KI-water system - Fe_2Cl_6- Partially miscible liquid system – CST – completely immiscible liquid system- Distribution law: Mathematical formulation – experimental verification – condition under which the law is obeyed.	
Unit II	**Group Theory**	**12 Hours**
	Molecular symmetry elements and symmetry operations – operations – products of symmetry operations – properties of a group - classes and sub groups – H_2O, NH_3groups multiplication table – C_{2v} Point groups – classification of molecules into point groups – C_{2v}, C_{3v}, C_{2h}, D_{2h}, D_{3h}, D_{4h}, D_{6h}, T_d and O_h – example only. Vector and matrix algebra – symmetry operations and transformation matrices- matrices representation for rotation reflection, improper rotation, identity and inversion.	
Unit III	**Photochemistry**	**12 Hours**
	Definition of photochemical reactions – comparative study of thermal and photochemical reactions – laws of photochemistry – Lambert and Beer law – Grothus – Draper law – Stark – Einstein law – quantum efficiency and its determination – consequence of light absorption by atoms and molecules – photophysical processes – fluorescence, phosphorescence and other deactivating processes – Jablonski diagram- Photochemical processes – kinetics of photochemical reactions. Gaseous reactions : Hydrogen – halogen reactions (Formation of HCI and HBr and decomposition of HI). Photochemical equilibrium – flash photolysis – photosensitization, chemiluminescence – bioluminescence.	
Unit IV	**Electrochemistry**	**12 Hours**
	Electrolytic conduction- Kohlrausch's law-Applications - Applications of conductance measurements- conductometric titrations. Concepts of electrochemical cell – cell diagram and terminology – conventions regarding signs of cell e.m.f– Single	

	electrode potentials - standard electrode potential - Nernst equation. Cell emf measurement of single electrode potential – types of electrodes – reference electrodes — electrochemical series – experimental determination of cell emf – Westom cadmium cell. Applications of emf measurements- Determination of pH using glass electrode.- Potentiometric titrations.Commercial cells – primary and secondary cells – dry cell – lead storage cell – fuel cell – H_2 - O_2 cell.	
Unit V	**Spectroscopy**	**12 Hours**
	Introduction – electromagnetic radiation – different regions – absorption spectroscopy – molecular spectra – types of molecular spectra. Rotational spectra of diatomic molecules – rigid rotator – selection rule – determination of moment of inertia and bond length – intensities of spectral lines. Vibrational spectra –Modes of vibration in polyatomic molecules – vibrational spectra of H_2O and CO_2. Raman spectra – Raman effect – stokes and anti stokes lines – quantum theory of Raman effect – experimental study – comparison between IR and Raman spectra – applications of Raman spectra. Electronic spectra – Franck – Condon principle. Nuclear magnetic resonance spectroscopy – principle, instrumentation – interpretation of nmr spectra – spectra of ethanol. Electron spin resonance spectroscopy – principle – difference between nmr and esr – hyperfine structure in esr spectrum – selection rule, hydrogenatom, Methyl radical esr spectrum.	

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations.

Text Books

3. Puri, Sharma and Pathania,(2015), Principles of Physical Chemistry, Vishal Publishing Co.47th Edition, (2015)
4. Bahl.B.S, ArunBahl(2005), Essentials of Physical chemistry, S.Chand and company Ltd.

Reference Books

5. A.W.Adamson.,(1982)Physical Chemistry of surfaces, Wiley publications,
6. Peter-W.Atkins, (2010), Physical Chemistry, Oxford University Press, 9th edition
7. Glasstone S.,(1948)'A Textbook of Physical Chemistry".

E-Resources

1. https://serc.carleton.edu/research_education/equilibria/phaserule.html
2. http://soft-matter.seas.harvard.edu/index.php/Phase_Rule
3. https://pubs.rsc.org/en/content/articlelanding/2016/ob/c6ob00842a
4. https://www.mdpi.com/journal/molecules/sections/photochemistry
5. https://crypto.stanford.edu/pbc/notes/group/group.html
6. http://www.advgrouptheory.com/GTNews.html
7. https://pubs.acs.org/doi/10.1021/cr500023c

8. https://chem.pg.edu.pl/documents/175289/4235721/Electrochemistry-supplement%20text.pdf
9. https://astronomy.swin.edu.au/cosmos/s/Spectroscopy
10. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/spectrpy/spectro.htm

Course Outcomes

After completion of this course, the students will be able to:

CO1	Gain knowledge in phase rule and its applications.
CO2	Attain the awareness about the group theory and point groups.
CO3	Explain photochemical, photophysical processes and its mechanisms
CO4	Acquire the basic concept, theories and applications of electrochemistry
CO5	Attain awareness on usage of spectral techniques on UV, IR, NMR and ESR.

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**1**
CO2	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**	**1**
CO3	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**1**
CO4	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**3**	**1**	**1**	**1**	**1**
CO5	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**

1-Low 2-Moderate 3-High

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/ or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K3	2	K1&K2	2(K2&K2)	1(K3)
2	CO2	Up to K3	2	K1&K2	2(K2 & K2)	1(K3)
3	CO3	Up to K3	2	K1&K2	2(K2 & K2)	1(K3)
4	CO4	Up to K3	2	K1&K2	2(K2 & K2)	1(K3)
5	CO5	Up to K3	2	K1&K2	2(K2 & K2)	1(K3)
No of Questions to be asked			10		10	5
No of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	40	-	45	45%	45%
K3	-	-	50	50	50%	50%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit I	**Phase Rule**	**12 Hours**	**Mode**
	a.Definitions of terms – Gibb's phase rule – one component system – water, carbon dioxide and sulphur.	3	Chalk and Talk, PPT Presentation
	b.polymorphism – two component system – reduced phase rule – simple eutectic system – Ph-Ag system	2	
	c.KI-water system-Partially miscible liquid system	2	
	d.CST-– completely immiscible liquid system	2	
	e.Distribution law: Mathematical formulation – experimental verification – condition under which the law is obeyed.	3	
Unit II	**Group Theory**	**12 Hours**	**Mode**
	a.Molecular symmetry elements and symmetry operations	2	Group Discussion, Chalk and Talk, PPT Presentation**.**
	b.operations – products of symmetry operations – properties of a group	2	
	c.classes and sub groups – groups multiplication table – $C_{2v.}$	2	
	d.Point groups – classification of molecules into point groups – $C_{2v,}$ $C_{3v,}$ C_{2h}, $D_{2h,}$ D_{3h}, D_{4h}, D_{6h}, T_d and O_h.	3	
	e.Vector and matrix algebra – symmetry operations and transformation matrices.	3	
Unit III	**Photochemistry**	**12 Hours**	**Mode**
	a.Definition of photochemical reactions – comparative study of thermal and photochemical reactions – laws of photochemistry – Lambert and Beer law – Grothus – Draper law – Stark – Einstein law.	3	Chalk and Talk, Group Discussion.
	b.quantum efficiency and its determination – consequence of light absorption by atoms and molecules – photophysical processes.	2	
	c.fluorescence, phosphorescence and other deactivating processes – Jablonski diagram	2	
	d.Photochemical processes – kinetics of photochemical reactions. Gaseous reactions : Hydrogen – halogen reactions (Formation of HCI and HBr and decomposition of HI)	3	
	e. Photochemical equilibrium – flash photolysis – photosensitization, chemiluminescence – bioluminescence.	2	
Unit IV	**Electrochemistry**	**12 Hours**	**Mode**
	a.Electrolytic conduction- Kohlrausch's law-Applications of Kohlrausch's law-Applications of conductance measurements- conductometric titrations.	2	Chalk and Talk, PPT Presentation, Video Lectures.
	b.Concepts of electrochemical cell – cell diagram and terminology – conventions regardingh signs of cell e.m.f. – calculation of cell e.m.f. from single electrode potential – standard emf of the cel	3	
	c.Nernst equation. Single electrode potentials and	2	

	cell emf measurement of single electrode potential – types of electrodes – reference electrodes – standard electrode potential		
	d.electrochemical series – experimental determination of cell emf – Westom cadmium cell. Applications of emf measurements Determination of pH using glass electrode . Potentiometric titrations.	3	
	e.Commercial cells – primary and secondary cells – dry cell – lead storage cell – fuel cell – H_2O_2 cell.	2	
Unit V	**Spectroscopy**	**12 Hours**	**Mode**
	a.Introduction – electromagnetic radiation – different regions – absorption spectroscopy – molecular spectra – types of molecular spectra. Rotational spectra of diatomic molecules – rigid rotator – selection rule – determination of moment of inertia and bond length – intensities of spectral lines.	2	Lecture Method, PPT Presentation**.**
	b.Vibrational spectra –Modes of vibration in polyatomic molecules – vibrational spectra of H_2O and CO_2.	2	
	c.Raman spectra – Raman effect – stokes and anti stokes lines – quantum theory of Raman effect – experimental study – comparison between IR and Raman spectra – applications of Raman spectra. Electronic spectra – Franck – Condon principle.	3	
	d.Nuclear magnetic resonance spectroscopy – principle, instrumentation – interpretation of nmr spectra – spectra of ethanol.	3	
	e.Electron spin resonance spectroscopy – principle – difference between nmr and esr – hyperfine structure in esr spectrum – selection rule, hydrogen atom esr spectrum.	2	

Course designed by Dr.J.Sathiyabama, Dr. G.N.Kousalya and Ms.P.Angel

Programme	B.Sc. Chemistry	Programme code	UCH		
Course Code	20UCHC62	Number of Hours/cycle	4		
Semester	VI	Max. Marks	100		
Part	III	Credit	4		
Core Course X					
Course Title	Applied Chemistry III		L	T	P
Cognitive level upto K3			60	-	-

Preamble:

The objective of the course is to know the importance of Agricultural chemistry like role of fertilizers, manufacture of pesticides, insecticides and fungicides, know the various protective coating processes and also get more knowledge about match industry, pyrotechnics, explosives, paint, silicate, processing and tanning of leather.

Unit I	Chemistry in Agriculture	12 Hours
	Fertilizers: Definition – Nutrients for plants – role of various elements in plants growth – natural and chemical fertilizers – classification of chemical fertilizers – Urea, Super phosphate and Potassium nitrate – mixed fertilizer – Fertilizer industry in India. **Pesticides**: Definition – classification – inorganic pesticides: Lead arsenate, Paris green, Hydrocyanic acid. **Insecticides**: Stomach poisons, contact insecticides, fumigants, manufacture and uses of insecticides. DDT, BHC (gammexane: conformation of gamma isomer). **Fungicides**: Bordeaux mixture, mention of lime sulphur, creosote oil and formula	
Unit II	**Protective Coating**	**12 Hours**
	Introduction, coating process, Hot dipping, Metal cladding – Electrodeposition – Application of electroplating – factors influencing the nature of deposition – Requirements of electrolyte – Electrical energy required for electro deposition – Electroplating of same metals – Displacement or immersion plating – Impregnated coating or cementation metal spraying of metalized coatings – Vapour deposition – chemical conversation coatings – organic coatings.	
Unit III	**Match industry and Explosives**	**12 Hours**
	Match Industry: Raw materials - Types of matches - Composition of match head striking surface manufacture of safety matches - Pyrotechnics - Colored matches. **Explosives**: Classification of explosives, Requirements and classification of a good explosives TNT, RDX , Picric acid, Ammonium picrate, Nitroglycerine, Dynamite, Lead azide, Dinol, Gun powder, Ammonium nitrate, PETN and PENTHRIT.	
Unit IV	**Paint and Silicate industry**	**12 Hours**
	Paints: Paints and pigments - formulation, composition and related properties. Oil paint – Vehicle - Modified oils – Pigments - Toners - Lakes pigments – Filler – Thinner – Enamels. **Silicate industry**: Cement – Classification of cement, ingredients and their role – Manufacture of cement and the setting process, quick setting cements **Glass**: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses:	

	Soda lime glass, lead glass, armoured glass, Safety glass, borosilicate glass, fluorosilicate, coloured glass.	
Unit V	**Tanning of Leather**	**12 Hours**
	Processing of Leather: Structure and composition of animal skin-terminology involved in leather tanneries chemistry of beam house processes-soaking, liming, unhairing, deliming, bating and pickling preservation of animal skin-salt curing and brine curing. **Materials and Methods of Tanning**: Vegetable tans- catechol tans- pyrogallol tans-vegetable tanning process and applications of vegetable tanned leather-Chrome tanning-chemicals used-method-type of leather obtained and its uses- aldehyde tanning- Artificial leather- Corfam - synthetic tans.	

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations.

Text Books

1. B. K Sharma, (2016), Industrial Chemistry, GOEL publishing.
2. Jayashree Ghosh, (2006), Fundamental concepts of Applied Chemistry, S. Chand &Company.
3. Acharya, B. Samantaray, (2016), Textbook on Applied Chemistry, Pearson; 1st edition

Reference Books

1. K. Bagavathi Sundari, (2019), Applied Chemistry, MJP Publisher.
2. D.N.Dhar, (2020), Applied Chemistry I, Veiindia.

E-Resources

https://www.vedantu.com/chemistry/agricultural-chemistry
https://byjus.com/jee/corrosion/
https://en.wikipedia.org/wiki/Pyrotechnics
https://www.slideshare.net/hzharraz/silica-sand-and-glass-industry
http://wwwchem.uwimona.edu.jm/courses/CHEM2402/Textiles/Leather.html

Course outcomes

On completion of the course, students will be able to

No.	Course outcome
CO1	Learn about the importance of fertilizer, pesticides, insecticides and fungicides.
CO2	Understand the various process of productive coating.
CO3	Gain knowledge about the match industry, pyrotechnics and explosives.
CO4	Understand about silicate industry and industrial coating.
CO5	Learn about the processing of leather and understand the materials and methods of tanning.

Mapping of Programme outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	1	1	2	1	1	1	1	1
CO2	2	2	2	2	1	1	1	1	1	1	1	1
CO3	2	1	2	2	1	2	1	2	1	1	1	1
CO4	1	1	3	2	1	2	1	3	1	1	1	1
CO5	1	2	4	2	2	2	1	1	1	1	1	1

Articulation Mapping-K Levels with Course Outcomes (COs)

Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
2	CO2	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
3	CO3	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
4	CO4	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
5	CO5	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
No. of Questions to be asked			10		10	5
No. of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1-Remembering and recalling facts with specific answers
K2-Basic understanding of facts and stating main ideas with general answers
K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (open choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	40	-	45	45%	45%
K3	-	-	50	50	50%	50%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit I	Chemistry in Agriculture	Hours	Mode
	a) **Fertilizers**: Definition – Nutrients for plants – role of various elements in plants growth – natural and chemical fertilizers	3	Chalk and talk, Power point presentation
	b) Classification of chemical fertilizers – Urea, Super phosphate and Potassium nitrate – mixed fertilizer – fertilizer industry in india.	1	
	c) **Pesticides**: Definition – classification – inorganic pesticides: Lead arsenate, Paris green, Hydrocyanic acid.	3	
	d) **Insecticides**: Stomach poisons, contact insecticides, fumigants, manufacture and uses of insecticides. DDT, BHC (gammexane: conformation of gamma isomer).	3	
	e) Fungicides: Bordeaux mixture, mention of lime sulphur, creosote oil and formula.	2	
Unit II	**Protective Coating**	**Hours**	**Mode**
	a) Introduction, coating process, Hot dipping, Metal cladding.	2	Chalk and talk, Power point presentation
	b) Electrodeposition – Application of electroplating	2	
	c) Factors influencing the nature of deposition – Requirements of electrolyte – Electrical energy required for electro deposition.	2	

	d) Electroplating of same metals – Displacement or immersion plating.	2	
	e) Impregnated coating or cementation metal spraying of metalized coatings.	2	
	f) Vapour deposition – chemical conversation coatings – organic coatings.	2	
Unit III	**Match industry and Explosives**	**Hours**	**Mode**
	a) **Match Industry:** Raw materials - Types of matches	2	Chalk and talk, Power point presentation
	b) Composition of match head striking surface manufacture of safety matches - Pyrotechnics - Colored matches.	2	
	c) **Explosives**: Classification of explosives, Requirements and classification of a good explosives TNT	2	
	d) RDX, Picric acid, Ammonium picrate	2	
	e) Nitroglycerine, Dynamite, Lead azide, Dinol	2	
	f) Gun powder, Ammonium nitrate, PETN and PENTHRIT.	2	
Unit IV	**Paint and Silicate industry**	**Hours**	**Mode**
	a) **Paints**: Paints and pigments - formulation, composition and related properties.	2	Chalk and talk, Power point presentation
	b) Oil paint – Vehicle - Modified oils – Pigments - Toners - Lakes pigments – Filler – Thinner – Enamels.	2	
	c) **Silicate industry**: Cement – Classification of cement, ingredients and their role – Manufacture of cement and the setting process, quick setting cements	2	
	d) **Glass**: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass.	2	
	e) Composition and properties of the following types of glasses: Soda lime glass, lead glass	2	
	f) Armoured glass, Safety glass, borosilicate glass, fluorosilicate, coloured glass.	2	
Unit V	**Tanning of Leather**	**Hours**	**Mode**
	a) **Processing of Leather**: Structure and composition of animal skin-terminology involved in leather tanneries chemistry of beam house processes	3	Chalk and talk, Power point presentation, Group Discussion
	b) Soaking, liming, unhairing, deliming, bating and pickling preservation of animal skin-salt curing and brine curing.	3	
	c) **Materials and Methods of Tanning**: Vegetable tans- catechol tans- pyrogallol tans-vegetable tanning process and applications of vegetable tanned leather.	3	
	d) Chrome tanning-chemicals used-method-type of leather obtained and its uses- aldehyde tanning-Artificial leather- Corfam - synthetic tans.	3	

Course Designed byMr.T.Srinivasan

Programme	**B.Sc.Chemistry**	**Programme Code**		**UCH**	
Course Code	**20UCHE61**	**Number of Hours/Cycle**		**4**	
Semester	**VI**	**Max. Marks**		**100**	
Part	**III**	**Credit**		**4**	
Core Elective Course II A					
Course Title	**Industrial Chemistry**		**L**	**T**	**P**
Cognitive Level	**Up to K3**		**60**	**-**	**-**

Preamble

The course enables the students to gain knowledge on concepts of various Industrial techniques and its applications & significant impacts on industries

Unit I	**Extractive and Powder Metallurgy**	**12Hours**
	a) Extractive Metallurgy: Introduction – Flux and Slags– Types of Slags and Fluxes– Uses of Slag and fluxes– Extraction of Metal from its Ore – Crushing – Concentration of the ore – Gravity Separation , Electromagnetic Separation, Froth Flotation Process and Chemical methods – Extraction of the Metals from the Concentration ores –Pyrometallurgy, Hydrometallurgy and Electrometallurgy –Methods involved in extraction process – Calcination, Cupellation, Smelting, Fire refining, Distillation metallurgy, Halide metallurgy, Vacuum metallurgy and Aluminothermic reduction	
	Powder Metallurgy (P/M): Introduction – Definition – Principles of Powder Metallurgy –Characteristics of metal powders – Advantages and Disadvantages of powder metallurgy – Methods of producing metal powders – Mechanical Pulverization, Atomization, Electrolytic deposition and Chemical methods – Methods of powder metallurgy–Various steps involved in powder metallurgy process – Applications of powder metallurgy.	
Unit II	**Materials In Industry**	**12 Hours**
	a) Refractories: Refractories – Classification – acidic, basic and neutral refractories – properties – refractoriness, refractoriness under load (RUL), dimensional stability, porosity and thermal spalling – Manufacture of refractories– Alumina, Magnesite and Zirconia bricks.	
	b) Abrasives: Abrasives – natural and synthetic abrasives–Quartz, Corundum, emery, garnet, diamond, silicon, carbide and boron carbide – Application of abrasives.	
	c) Lubricants: Lubricants – mechanism of lubrication, Liquid lubricants, properties – viscosity index, flash and fire point, cloud and pour point, oiliness– Solid lubricants – graphite and molybdenum sulphide	
Unit III	**Drugs, Soaps And Detergents**	**12 Hours**

	a) Drugs: Drugs – Classification – Drug action – Importance of Drugs – Drugs used in Diagnosis of diseases, preventing diseases and curing diseases – Side effects of Drugs –Terminology in Medicinal chemistry – Naming of Drugs – manufacture of Drugs – Acetanilide, Paracetamol, Aspirin and Chloramphenicol	
	b) Soaps: Soaps – Definition – manufacture of soap – Kettle Process and Hydrolyser Process – Types of Soaps – Cleansing action of Soap.	
	c) Detergents: Detergents – Definition – classification of Detergents – Anionic detergents, Cationic detergents, Non – Ionic detergents and Amphoteric detergents – Soft vs Hard Detergents – Advantages and limitation of Detergents over Soaps – Impact of detergents on environment – Distinguish between Soaps and Detergent.	
Unit IV	**Petrochemical Industry**	**12 Hours**
	a) Petrochemicals Process and Analysis: Introduction – Classification of fuels – coal – analysis of coal – Proximate analysis and Ultimate analysis – carbonization – manufacture of metallurgical coke – Otto Hoffmann method – Petroleum – Refining of Petroleum Cracking – Types of Cracking – Thermal cracking (Liquid phase and Vapour phase thermal cracking) and Catalytic cracking (Fixed bed and Moving bed Catalytic cracking) – Advantages of Catalytic cracking over thermal cracking - Synthetic Petrol – manufacture of synthetic petrol –Bergius process and Fischer –Tropsch process. Knocking – Octane number – Gasoline oil– Leaded petrol – Cetane number– Diesel oil – Diesel index – comparison of gasoline oil and diesel oil– Manufacture of Power alcohol and Biodiesel – Natural gas – compressed natural gas (CNG) – liquefied petroleum gases (LPG) – Manufacture of Producer Gas and Water Gas	
	b) Combustion of fuels: Combustion - Definition – calorific value – higher and lower calorific values – theoretical calculation of calorific value- ignition temperature – spontaneous ignition temperature– explosive range – flue gas analysis – ORSAT method – Carbon emission – carbon foot print.	
Unit V	**Energy Sources And Storage Device**	**12 Hours**
	a) Energy sources Nuclear fission – Characteristics of Nuclear fission – nuclear fusion – differences between nuclear fission and fusion – nuclear chain reactions – nuclear energy – Nuclear reactor – Light water nuclear power plant – Breeder reactor. Solar energy conversion – Thermal Conversion Photoconversion – Solar cell (Photogalvanic cell) – Application of Solar cells – Advantages and disadvantages of solar cells – Recent development in solar cell materials. Wind energy – Methods of harnessing wind energy – Advantages and disadvantages of wind energy – Geo - Thermal energy.	

	b) Storage Device: Batteries - Types of battery – primary battery – dry cell – secondary battery – lead-acid battery, NICAD battery and lithium battery – Solid State lithium battery – lithium-Sulphur battery and lithium - ion battery (LIB) - Fuel cells – Hydrogen- oxygenfuel cell – Microbial fuel cells (MFCs) – Super capacitor – Electric Vehicles (EV) – Working principle – Components of EV – plug-in electric vehicles – Types of plug- in electric vehicles – Battery Electric vehicles (BEV) and Hybrid type vehicles – Hybrid electric vehicle (HEV), Plug - in Hybrid Electric Vehicle (PHEV) and Fuel cell Electric vehicles – Advantages and disadvantages of electric vehicles.	

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and PowerPoint Presentations

Text Books:

1. Sharma.B.K.,(2016),*Industrial Chemistry* (Including Chemical Engineering), Goel Publishing House, Meerut
2. Krishnamurthy.N., Vallinayagam. P., Jeyasubramanian, K., (2008) *Applied Chemistry*, Tata McGraw – Hill publishing Company Ltd. New Delhi

Reference Books

1. Dr.Prakash G. More, (2012) *Comprehensive Industrial Chemistry*, Pragati Prakashan Edition, New Delhi
2. Jain and Jain,(2018), *Engineering chemistry*, Dhanpat Rai Publications Pvt. Ltd., New Delhi.
3. Bagavathi Sundari, K,(2007),*Applied Chemistry*, S.Chand, New Delhi
4. Jaya Shree Ghosh.,(2008), *Fundamental concepts of applied chemistry*, S.Chand, New Delhi

E-Resources

1. https://www3.nd.edu/~amoukasi/CBE30361/Lecture_Alloys_2014.pdf
2. http://www.vpscience.org/materials/unit4metallurgy.pdf
3. https://www.iare.ac.in/sites/default/files/lecture_notes/EC-Lecture%20Notes_7.pdf
4. https://nios.ac.in/media/documents/313courseE/L35A.pdf
5. http://www.chymist.com/Soap%20and%20detergent.pdf
6. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004132159500424ranvijay_engg_Fuels.pdf
7. https://stannescet.ac.in/cms/staff/qbank/CSE/Notes/CY8151-Engineering%20Chemistry-1911864891-unit_5.pdf

Course outcome

On the successful completion of the course, students will be able to

CO1	Recognize the chemical composition of alloys and brings about the methods of metallurgy and powder metallurgy process.
CO2	Explain the characteristics, Properties and uses of Refractories, Abrasives and Lubricants
CO3	Brings about important terminologies of different drugs and Compare the Soaps and detergents and their cleansing action
CO4	Identify and outline the characteristics, Properties and uses of Petrochemicals
CO5	Compare nuclear and Chemical reactions and list out the types of batteries and their advantages and disadvantages

On the successful completion of the course, the students will be able to gain knowledge on concepts of Chemistry and its impacts on Industries

Mapping of Programme outcomes with Course Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	**2**	**1**	**2**	**2**	**1**	**3**	**2**	**1**	**-**	**1**	**-**	**-**
CO2	**2**	**2**	**1**	**2**	**1**	**3**	**2**	**1**	**-**	**1**	**-**	**-**
CO3	**3**	**2**	**1**	**2**	**1**	**3**	**3**	**1**	**-**	**1**	**-**	**1**
CO4	**3**	**1**	**1**	**2**	**1**	**3**	**3**	**1**	**-**	**1**	**-**	**1**
CO5	**3**	**2**	**3**	**2**	**1**	**3**	**2**	**2**	**-**	**1**	**-**	**1**

1- Low 2 - Moderate 3 - High

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
2	CO2	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
3	CO3	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
4	CO4	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
5	CO5	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
No. of Questions to be asked			10		10	5
No. of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1-Remembering and recalling facts with specific answers
K2-Basic understanding of facts and stating main ideas with general answers
K3-Application Oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C Open choice	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-		5	5%	5%
K2	5	40	20	65	65%	65%
K3	-		30	30	30%	30%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Extractive And Powder Metallurgy	12 Hours	Mode
I	**a) Extractive Metallurgy:** Introduction – Flux and Slags– Types of Slags and Fluxes– Uses of Slag and fluxes– Extraction of Metal from its Ore – Crushing	2	**Chalk and Talk PPT presentation Seminar Group discussion**
	Concentration of the ore – Gravity Separation, Electromagnetic Separation, Froth Flotation Process and Chemical methods	2	
	Extraction of the Metals from the Concentration ores – Pyrometallurgy, Hydrometallurgy and Electrometallurgy Methods involved in extraction process –	2	
	Calcination, Cupellation, Smelting, Fire refining, Distillation metallurgy, Halide metallurgy, Vacuum metallurgy and Aluminothermic reduction.		
	b) Powder Metallurgy (P/M): Introduction – Definition – Principles of Powder Metallurgy – Characteristics of metal powders – Advantages and Disadvantages of powder metallurgy	1	
	Methods of producing metal powders – Mechanical Pulverization, Atomization, Electrolytic deposition and Chemical methods – Methods of powder metallurgy–Various steps involved in powder metallurgy process – Applications of powder metallurgy.	3	
	Materials In Industry	**12 Hours**	**Mode**
II	**a) Refractories:** Refractories – Classification – acidic, basic and neutral refractories – properties – refractoriness, refractoriness under load (RUL), dimensional stability, porosity and thermal spalling –Manufacture of refractories– Alumina, Magnesite and Zirconia bricks.	4	**Chalk and Talk PPT presentation Seminar Group discussion**
	b) Abrasives: Abrasives – natural and synthetic abrasives–Quartz, Corundum, emery, garnet, diamond, silicon, carbide and boron carbide – Application of abrasives.	4	
	c) Lubricants: Lubricants – mechanism of lubrication, Liquid lubricants, properties – viscosity index, flash and fire point, cloud and pour point, oiliness– Solid lubricants – graphite and molybdenum sulphide	4	
	Drugs, Soaps And Detergents	**12 Hours**	**Mode**

III	**a) Drugs:** Drugs – Classification – Drug action – Importance of Drugs – Drugs used in Diagnosis of diseases, preventing diseases and curing diseases – Side effects of Drugs – Terminology in Medicinal chemistry – Naming of Drugs – manufacture of Drugs – Acetanilide, Paracetamol, Aspirin and Chloramphenicol	4	**Chalk and talk** **Power point presentation** **Seminar** **Group discussion**
	b) Soaps: Soaps – Definition – manufacture of soap – Kettle Process and Hydrolyser Process – Types of Soaps – Cleansing action of Soap.	4	
	c) Detergents: Detergents – Definition – classification of Detergents – Anionic detergents, Cationic detergents, Non – Ionic detergents and Amphoteric detergents – Soft vs Hard Detergents – Advantages and limitation of Detergents over Soaps – Impact of detergents on environment – Distinguish between Soaps and Detergent.	4	
	Petrochemical Industry	**12 Hours**	**Mode**
IV	**a) Petrochemicals Process and Analysis:** Introduction – Classification of fuels – coal – analysis of coal – Proximate analysis and Ultimate analysis	2	**Chalk and talk** **Power point presentation** **Seminar** **Group discussion**
	carbonization – manufacture of metallurgical coke – Otto Hoffmann method – Petroleum – Refining of Petroleum Cracking – Types of Cracking – Thermal cracking (Liquid phase and Vapour phase thermal cracking) and Catalytic cracking (Fixed bed and Moving bed Catalytic cracking) – Advantages of Catalytic cracking over thermal cracking	2	
	Synthetic Petrol – manufacture of synthetic petrol –Bergius process and Fischer –Tropsch process. Knocking – Octane number – Gasoline oil– Leaded petrol – Cetane number– Diesel oil – Diesel index – comparison of gasoline oil and diesel oil	2	
	Manufacture of Power alcohol and Biodiesel – Natural gas – compressed natural gas (CNG) – liquefied petroleum gases (LPG) – Manufacture of Producer Gas and Water Gas	2	
	Combustion of fuels: Combustion **-** Definition – calorific value – higher and lower calorific values – theoretical calculation of calorific value- ignition temperature – spontaneous ignition temperature– explosive range – flue gas analysis – ORSAT method – Carbon emission – Carbon foot print	4	

	Energy Sources And Storage Devic	12 Hours	Mode
V	**a) Energy sources:** Nuclear fission – Characteristics of Nuclear fission – nuclear fusion – differences between nuclear fission and fusion – nuclear chain reactions – nuclear energy – Nuclear reactor – Light water nuclear power plant – Breeder reactor.	2	**Chalk and talk** **Power point presentation** **Seminar** **Group discussion**
	Solar energy conversion – Thermal Conversion Photoconversion – Solar cell (Photogalvanic cell) – Application of Solar cells – Advantages and disadvantages of solar cells – Recent development in solar cell materials.	2	
	Wind energy – Methods of harnessing wind energy – Advantages and disadvantages of wind energy – Geo - Thermal energy.	2	
	b) Storage Device: Batteries - Types of battery – primary battery – dry cell – secondary battery – lead-acid battery, NICAD battery and lithium battery – Solid State lithium battery – lithium-Sulphur battery and lithium - ion battery (LIB) - Fuel cells – Hydrogen- oxygen fuel cell – Microbial fuel cells (MFCs) – Super capacitor	3	
	Electric Vehicles (EV) – Working principle – Components of EV – plug- in electric vehicles – Types of plug- in electric vehicles – Battery Electric vehicles (BEV) and Hybrid type vehicles – Hybrid electric vehicle (HEV), Plug - in Hybrid Electric Vehicle (PHEV) and Fuel cell Electric vehicles – Advantages and disadvantages of electric vehicles.	3	

Course Designed byDr.A.Sahaya Raja

Programme	B.Sc.Chemistry	Programme Code	UCH		
Course Code	20UCHE62	Number of Hours/Cycle	4		
Semester	VI	Max. Marks	100		
Part	III	Credit	4		
Core Elective Course II B					
Course Title	Bio-Chemistry		L	T	P
Cognitive Level Up to K3			60	-	-

Preamble

To enable the student to develop a sound knowledge of fundamental concepts in bio chemistry and the various aspects of metabolism and interrelationship of metabolic events..

Unit I	**Carbohydrates**	**12Hours**
	Introduction, Properties, Functions – Classification –Reducing and Non Reducing Sugar –Glucose Structure-Conformation-Stability -Hetero Saccharide (hyaletronic acid and heparin)Structure only Metabolism-Glycolysis and its reversal,TCA Cycle ,Relation between Glycolysis and respiration.Principles of Bio energetics,Electron transport chain and oxidative phosphorylation	
Unit II	**Lipids**	**12 Hours**
	Introduction Properties, Biological importants – Classification – Simple Lipids – Compounds Lipids – Derived Lipids – Phospho Lipids – Glyco Lipids. Fatty acids-Saturated,Unsaturated Fatty acids,Properties-Hydrolysis-Acid number,saponification number Cholesterol-Bio synthesis, Bile salts derived from Cholesterol	
Unit III	**Amino Acids**	**12 Hours**
	Introduction –Definition of Amino acids-Synthesis of amino acids- Essential – Non essential of Amino acids – Function, Structure, Classification and Properties of Amino acids(Solubility, Melting point,Iso - Electric point,Ampholytes or Amphoteric nature, Zwitterions, Formation of esters, Ninhydrin reaction (oxidative deamination), Reduction, Darkin – west reaction).	
Unit IV	**Enzymes**	**12 Hours**
	Nomenclature ,Introduction – Classification ––Properties – specificity,factors influencing enzyme action.Mechanism of enzyme action –lock and key model and induced fit model.Coenzymes-Co factors-Prosthetic groups of enzyme(TPP,NAD,NADP,FAD,ATP) their importance in enzymes actions . Mechanism of Enzyme inhibition ,Competitive, un competitive and allosteric-Structure of Peptides and Proteins	
Unit V	**Nucleic Acids**	**12 Hours**

	Nucleosides and Nucleotides-Purine and pyrimidine bases,Nucleic acids –Difference between DNA and RNA – Clasification of RNA -Replication-Bio synthesis of mRNA-Transcription.Genetic code –Mutations and Mutants.DNA sequencing and PCR ,Recombinant DNA Technology,DNA polymorphism.	

Pedagogy

Chalk and Talk method. Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and Power point Presentations.

Text Books

1. Clinical Bio-Chemistry by Varley. Sulthan Chand, 2005.
2. Fundamental of Bio-Chemistry, Voet and Voet- provide necessary details on lastest edition.
   Edited by Prof.Hiren K Das(JNU).

Reference Books

1. Lehninger: Priniciples of Bio- Chemistry(2013) 6th ed ; Nelson, D.L. and Cox,M.M., W.H. Freeman and Company(New York), ISBN:13:978-1-4641-0962-1/ ISBN: 10:1-4292-3414-8.
2. Textbook of Bio-Chemistry with Clinical Correlations (2011) 7th ed., Devlin,T.M.,John.
3. Enzymes, Malcolm Dixon, Edwin Clifford Webb-provide necessary details.

E-Resources

1. http://site.iugaza.edu.ps/fsharif/files/2010/02/Kaplan-molecular-genetics-lecture-notes-2004.pdf
2. https://www.qmul.ac.uk/library/media/library/using-the-library/media-folder-images-library/Principles-Of-Biochemistry-Introductory-Series.pdf
3. https://www.helpforag.app/2018/02/plant-biochemistry.html
4. http://site.iugaza.edu.ps/fsharif/files/2010/02/Kaplan-molecular-genetics-lecture-notes-2004.pdf
5. https://www.vanderbilt.edu/AnS/Chemistry/Rizzo/Chem220b/Ch28.pdf

Course Outcomes

After completion of this course, the students will be able to:

CO1	Understand the structure of organic natural products.
CO2	Learn the properties, biological importants of lipids
CO3	Explain the various types,function, structure and properties of amino acids.
CO4	Understand the importance of enzymes and enzymes action.
CO5	Learn the classification and synthesis of nucleic acids

Mapping of Course Outcomes (COs) with Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	3	1	1	2	1	3	3	1	1	1	1	1
CO2	3	3	1	3	2	3	3	1	1	2	1	1
CO3	3	2	2	2	1	3	2	1	1	1	1	1
CO4	3	2	3	2	1	3	3	2	1	1	1	1
CO5	3	2	2	2	2	3	2	2	1	3	1	1

3. High; 2. Moderate 1. Low

Articulation Mapping - K Levels with Course Outcomes (COs)

Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Either/or Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
2	CO2	Up to K3	2	K1 & K2	2(K2 & K2)	1(K2)
3	CO3	Up to K2	2	K1 & K2	2(K2 & K2)	1(K3)
4	CO4	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
5	CO5	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
No. of Questions to be asked			10		10	5
No. of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1 – Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving problems

Distribution of Section - wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Open Choice)	Total Marks	% of Marks without Choice	Consolidated (Rounded off)
K1	5	-	-	5	5%	5%
K2	5	40	20	65	65%	65%
K3	-	-	30	30	30%	30%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit	Description	Hour	Mode
UnitI	**Carbohydrates**	**12Hours**	PPT presentation, Chalk and Talk.
	a.Introduction,Properties,Functions,Classification –Reducing and Non Reducing Sugar	2	
	b.Glucose Structure-Conformation-Stability - Hetero Saccharide (hyaletronic acid and heparin)Structure only	2	
	c.Metabolism-Glycolysis and its reversal,TCA Cycle	3	
	d.Relation between Glycolysis and respiration.Principles of Bio energetics	2	
	e.Electron transport chain and oxidative phosphorylation	3	
UnitII	**Lipids**	**12 Hours**	**Mode**
	a.Introduction Properties, Biological importants	2	

	– Classification – Simple Lipids		Chalk and Talk, Group Discussion and PPT presentation.
	b.Compounds Lipids – Derived Lipids – Phospho Lipids – Glyco Lipids.	3	
	c.Fatty acids-Saturated,Unsaturated Fatty acids,Properties	2	
	d.Hydrolysis-Acid number,saponification number	2	
	e.Cholesterol-Bio synthesis, Bile salts derived from Cholesterol	3	
UnitIII	**Amino Acids**	**12 Hours**	**Mode**
	a.Introduction –Definition of Amino acids-Synthesis of amino acids- Essential – Non essential of Amino acids	2	Chalk and Talk, PPT Presentation.
	b.Function, Structure, Classification of Amino acids	3	
	c.Properties of Amino acids-Solubility,Melting point of Amino acids	2	
	d.Iso Electric point,Ampholytes or Amphoteric nature, Zwitterions	3	
	e.Formation of esters, Ninhydrin reaction (oxidative deamination), Reduction, Darkin – west reaction).	2	
UnitIV	**Enzymes**	**12 Hours**	**Mode**
	a.Nomenclature ,Introduction – Classification – —Properties –specificity,factors influencing enzyme action .	2	Chalk and Talk, PPT Presentation.
	b.Mechanism of enzyme action –lock and key model and induced fit model.Coenzymes-Co factors-	2	
	c.Prosthetic groups of enzyme(TPP,NAD,NADP,FAD,ATP) their importance in enzymes actions .	2	
	d.Mechanism of Enzyme inhibition ,	3	
	e.Competitive, un competitive and allosteric-Structure of Peptides and Proteins	3	
UnitV	**Nucleic Acids**	**12 Hours**	**Mode**
	a.Nucleosides and Nucleotides-Purine and pyrimidine bases	2	Chalk and Talk, PPT Presentation,Grou p Discussion.
	b.Nucleic acids –Difference between DNA and RNA	2	
	c.Clasification of RNA-Replication	3	
	d.Bio synthesis of mRNA-Transcription.Genetic code	2	
	Recombinant DNA Technology -DNA polymorphism.	3	

Course designed by Dr.M.Pandeeswaran and Mrs.K.Rathika

Programme	B.Sc Chemistry	Programme Code	UCH		
Course Code	20UCHE63	Number of Hours/Cycle	4		
Semester	VI	Max. Marks	100		
Part	III	Credit	4		
Core Elective Course II C					
Course Title	Green Chemistry		L	T	P
Cognitive Level Up to K3			60	-	-

Preamble

This course deals the concept of various principles, green analytical methods, bio catalytic reaction and future trends in chemistry

Unit I	**Introduction to Green Chemistry**	**12Hours**
	Definition – introduction to green chemistry - principles of green Chemistry – use of safer reagents – benefits of green chemistry – why do we need green chemistry - green synthesis of diethanol amine - the roots of innovation – atom economy – limitations.	
Unit II	**Green Analytical Methods**	**12 Hours**
	Future trends in green chemistry - green analytical methods - redox reagents - green catalysts - green nano – synthesis - green polymer chemistry - exploring nature – biomimetic, Proliferation of solvent-less reactions; Non-covalent derivatization, Biomass conversion, emission control	
Unit III	**Bio Catalytic Reactions**	**12 Hours**
	Green chemistry using bio catalytic reactions – introduction – supported metal catalysts – types of catalysis - fermentation – bio-fertilizers – bio-insecticides – bio-herbicides – use of greener catalyst.	
Unit IV	**Microwave Mediated Organic Synthesis**	**12 Hours**
	Microwave mediated organic synthesis – microwave activation – mechanism of microwave – microwave assisted synthesis in green techniques – advantages of microwave radiation – solvent free synthesis - functional group transformation – condensation – oxidation – reduction – multi component reaction.	
Unit V	**Ionic Liquids**	**12 Hours**
	Ionic liquids – definition – examples - application of ionic liquid – in alkylation – in epoxiedation- synthesis of ether – Friedelcraft reaction – Diels – Alder reaction – Knoevenagel condensation – Witting reaction – phase transfer catalyst – synthesis - application	

Pedagogy:

Class Room Lectures, Power point presentation, Group Discussion, Seminar, Quiz, Assignments, Experience Sharing, Case Study.

Text Books

1. V. Kumar, "An Introduction to Green Chemistry" Vishal publishing Co. Reprint Edition 2010
2. Rashmi Sanghi, M.M Srivastava "Green Chemistry" Fourth Reprint - 2009 References Book
3. Anastas & Warner, Green Chemistry: Theory & Practice, Oxford Univ. Press,New York,1998

Reference books

1. Green chemistry- environment friendly alternatives- editiors: Rashmisanghi. MM. Sri vasta fourth re-print 2009. Norosa publishing house pvt. Ltd.

2. Ahluwalia V.K. and Kidwal, M.R. New Trends in Green chemistry,Anamalaya Publishers 2005.

E-Resources:

1. https:// www.chem.pg.gda.pl
2. https://www.mdpi.com
3. https:// www.asdlib.org
4. https://www.researchgate.net
5. https:// scripps.edu

Course outcomes

On successful completion of the course, students will be able to

No.	Course outcome
CO1	Outline the principles of green chemistry
CO2	Identify the analytical methods of green chemistry
CO3	Acquire the knowledge of bio catalytic reactions
CO4	Relate the knowledge Microwave mediated organic synthesis
CO5	Gain the knowledge of ionic liquids and organic synthesis.

Mapping of Programme outcomes with Course Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**
CO2	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO3	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO4	**1**	**2**	**3**	**2**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**1**
CO5	**2**	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**1**

1-Low **2-Moderate** **3-High**

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	COs	K-Level	Section A		Section B	Section C
			MCQs		Either/or Choice	Open Choice
			No. of Questions	K-Level	No. of Questions	No. of Questions
1	CO1	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
2	CO2	Up to K2	2	K1 & K2	2(K2 & K2)	1(K2)
3	CO3	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
4	CO4	Up to K3	2	K1 & K2	2(K2 & K2)	1(K3)
5	CO5	Up to K3	2	K1 & K2	2(K2& K2)	1(K3)
No. of Questions to be asked			10		10	5
No. of Questions to be answered			10		5	3
Marks for each Question			1		4	10
Total Marks for each Section			10		20	30

K1-Remembering and recalling facts with specific answers
K2-Basic understanding of facts and stating main ideas with general answers
K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (No Choice)	Section B (Either/or)	Section C (Either/or)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	5	-		5	5%	5%
K2	5	40	20	65	65%	65%
K3			30	30	30%	30%
Total Marks	10	40	50	100	100%	100%

Lesson Plan

Unit I	Introduction to Green Chemistry	12 Hours	Mode
	a)Green Chemistry – Definition – Principles of Green Chemistry	**2**	Chalk and talk, Power point presentation, Group Discussion
	b)Why is this new area of Chemistry getting to much attention	**3**	
	c)Why should chemist pursue the Goals of Green Chemistry	**3**	
	d)The roots of innovation	**2**	
	e)Atom economy – Limitations	**2**	
Unit II	**Green Analytical Methods**	**12 Hours**	
	a)Future trends in Green Chemistry Green analytical methods, Redox reagents, b)Green catalysts; Green nano-synthesis,	**2** **2** **2**	Chalk and talk, Power point presentation
	c)Green polymer chemistry,	**2**	
	d)Exploring nature, Biomimetic, Proliferation of solvent-less reactions;	**2**	
	e)Non-covalent derivatization, Biomass conversion, emission control	**2**	
Unit III	**Bio Catalytic Reactions**	**12 Hours**	
	a)Green Chemistry Using Bio Catalytic Reactions – Introduction	**2**	Chalk and talk, Power point presentation
	b) Fermentation and Bio transformations.	**2**	
	c) Production of Bulk and fine chemicals by microbial fermentation Antibiotics.	**3**	
	d)Vitamins - Bio catalyses synthesis of industrial chemicals by bacterial constructs.	**3**	
	e)Future Tends.	**2**	
Unit IV	**Microwave Mediated Organic Synthesis**	**12 Hours**	
	a)Solvent free microwave- assisted organic synthesis: Introduction.	**3**	Chalk and talk, Power point presentation
	b)Solvent – free techniques microwave activation.	**2**	
	c)Benefits and limitations of microwave assisted synthesis.	**3**	
	d)Non- traditional (greener alternatives to functional group transformation, condensation, oxidation and reduction reaction	**4**	
Unit V	**Ionic Liquids**	**12 Hours**	
	a)Ionic liquids: definition- examples- synthesis tunable Physical properties	**3**	Chalk and talk, Power point presentation,
	Application in organic synthesis- hydroformylation of	**3**	
	b) olefins, carbonylation, aryl halides, dimerisation of 15 butadiene	**3**	
	c)Diels Alder reaction and total synthesis of pravadoline. General uses of liquids.	**3**	

Course Designed by Dr.M.Pandeeswaran

Programme	B.Sc Chemistry	Programme Code	UCH
Course Code	20UCHC6P	Number of Hours/Cycle	3
Semester	VI	Max. Marks	100
Part		Credit	4

Core Practical III				
Course Title	Gravimetric Analysis and Organic Preparation	L	T	P
Cognitive Level	Upto K4			30

Preamble

The practical course describes molecular weight determination, phase diagrams, kinetic studies, thermal and electrochemical experiments.

List of Experiments

I. Graveimetric Analysis

1. Estimation of lead as lead chromate.
2. Estimation of barium as barium chromate
3. Estimation of calcium as calcium oxalate monohydrate
4. Estimation of copper as cuprous thiocyanate.
5. Estimation of nickel as Ni DMG.

II. Organic Preparation / Separation

1. Nitration
   i. m-dinitrobenzene from nitrobenzene
   ii. Picric acid from phenol

2. Bromination: p-bromoacetanilide from acetanilide.

3. Hydrolysis: Aromatic acid from (a) an ester (b) an amide.

4. Oxidation : Benzonic acid from benzaldehyde.

5. Benzoylation: (a) Amine (b) phenols

6. Acetylation : (a) Amine (b) phenols

Separation of mixtures

A mixture containing an acid or a base and a neutral compound (Acid or alkali separation)

III. To analyse Micronutrients of Soil sample of our college campus. (Demo)

After completion of this course, the students will be able to:

CO1	Recognise many functional groups and their reactivity.
CO2	Critically evaluate data collected to determine the identity, purity and yield of products.
CO3	Perform common laboratory techniques, including reflux, distillation, recrystallization, vacuum filtration and aqueous extraction.

Scheme of Evaluation (Max.marks100)

Internal Assessment 40 Marks

Regular Test in the Class	30 Marks
Observation note book	10 marks
Total	40 marks

External Examination: 60 Marks (3 hours)

Record Note book	10 marks
Viva voce	10 marks
Organic preparation (10 marks)	
Procedure	2 marks
Crude sample	6 marks
Recrystallised sample	2 marks
Gravimetric Estimation (30 marks)	
Procedure	10 marks
Estimation	20 marks
Less than 2% Error	20 marks
2-3% Error	18 marks
3-4% Error	16 marks
3-5% Error	14 marks
Greater than 5% Error	8 marks

Programme	**B.Sc.Chemistry**	**Programme Code**		**UCH**	
Course Code	**20UCHC6Q**	Number of Hours/Cycle		**2**	
Semester	**VI**	Max. Marks		**100**	
Part		**Credit**		**4**	
Core Practical IV					
Course Title	**Organic Analyses And Estimations**		**L**	**T**	**P**
Cognitive Level	**Upto K4**				**30**

Preamble

The lab course describes the analysis of organic compounds and presence of elements and its characteristics to develop the skill of experimenting.

I. Organic Analysis

Analysis of an organic compound containing one or two functional groups and confirmation by the preparation of a solid derivative – acids, phenols, aldehydes, ketones, esters, nitrocompounds, amines (primary, secondary and tertiary), amides, anilides, aliphatic diamide, side chain and nuclear halogen compounds, aliphatic diamide containing sulphur and monosaccharides.

II. Organic Estimation

a. Estimation of phenol
b. Estimation of aniline
c. Estimation of glucose.

III. Chromatographic Techniques (Demo)

a. Identification of Amino Acids by TLC
b. Separation of Leaf Pigments by Column Chromatography

After completion of this course, the students will be able to:

CO1	To predict the outcome and mechanism of some simple organic reaction reactions using understanding relative reactivity of functional groups
CO2	Estimate the amount of Phenol and Aniline

Scheme of Evaluation (Max.marks100)
Internal Assessment 40 Marks

Regular Test in the Class	30 Marks
Observation note book	10 marks
Total	40 marks

External Examination: 60 Marks (3 hours)

Record Note book	10 marks
Viva voce	10 marks
Organic estimation (20 marks)	
Procedure	5 marks
Estimation	15
Less than 3% Error	15

3-4% Error	13
4-5% Error	10
5-6% Error	8
Organic analysis (20 marks)	
Preliminary reaction	2 marks
Elements present	4 marks
Aliphatic or aromatic	3 marks
Saturated/Unsaturated	3 marks
Functional group	6 marks
Derivative	2marks

Programme	B.Sc,Chemistry	Programme Code	UCH
Course Code	**20UCHC6R**	Number of Hours/Cycle	**3**
Semester	**VI**	Max. Marks	**100**
Part		**Credit**	**4**

Core Practical V				
Course Title	**Experiments in Physical Chemistry**	**L**	**T**	**P**
Cognitive Level	**Up to K4**			**30**

Preamble

The practical course describes molecular weight determination, phase diagrams, kinetic studies, thermal and electrochemical experiments.

List of Experiments

1. Determination of molecular weight by

a. Transition temperature method – sodium thiosulphate pentahydrate, strontium chloride hexahydrate and sodium acetate trihydrate.
b. Cryoscopic method – Rast method – camphor and naphthalene.

2. Phase diagram involving

a. Simple Eutectic and
b. Compound formation

3. Critical solution temperature

Determination of CST of phenol – water system and effect of impurity on CST – strength of sodium chloride.

4. Thermo chemistry

Heat of solution – potassium dichromate, ammonium oxalate and oxalic acid.

5. Kinetics

Determination of rate constant - Hydrolysis of Ester.

6. Electrochemistry

a) Conductivity
   i) Determination of cell constant of the cell and equivalent conductance of solution.
   ii) Conductivity titration between an acid and a base (HCl vs NaOH)

b) Potentiometric titrations
   1. $KMnO_4$ Vs $FeSO_4$
   2. $K_2Cr_2O_7$ Vs $FeSO_4$
   3. HCl vs NaOH

c) pH
   HCl Vs NaOH

7. Adsorption

Adsorption of acetic acid on activated carbon charcoal

After completion of this course, the students will be able to:

CO1	Develop the skill on molecular weight determination.
CO2	Perform kinetic experiments
CO3	Demonstrate thermal and electrochemical experiments.

Scheme of Evaluation (Max.marks100)
Internal Assessment 40 Marks

Regular Test in the Class	30 Marks
Observation note book	10 marks
Total	40 marks

External Examination: 60 Marks (3 hours)

Viva voce	10 marks
Record Notebook	10 marks
For completion of the experiment	20 marks
Short procedure	10 marks
Result	10 marks
Total	60 marks

Programme	B.Sc.Chemistry	Programme Code		UCH	
Course Code	20UCHS61	Number of Hours/Cycle		2	
Semester	VI	Max. Marks		50	
Part	IV	Credit		2	
Skill Based Course III					
Course Title	Polymer Chemistry		L	T	P
Cognitive Level		Up to K3	30	-	-

Preamble

The course provides the basic knowledge in Chemistry of Polymerization, Moulding process techniques, Inorganic and Commercial polymers, Natural and Synthetic rubbers.

Unit I	**Introduction and Classification of Polymers**	**6 Hours**
	Basic concepts-Classification of polymers-Nomenclature-Natural and Synthetic polymers- Organic and Inorganic polymers-Thermoplastics and thermo sets-Plastics, elastomers, fibers and liquid resins-Addition polymers and condensation polymers-homopolymers-linear, branched and cross linked polymers-graft and block co-polymers- Basic concept of monomers-Functionality.	
Unit II	**Polymerization and MouldingTechniques**	**6 Hours**
	Addition polymerization-Free radical polymerization-Initiation, Propagation and Termination-Ionic polymerization-Cationic and Anionic co-ordination polymerization-Ziegler natta catalysis. Moulding process Technique: Compression moulding, Injection moulding, Transfer moulding, Extrusion moulding.	
Unit III	**Inorganic Polymers**	**6 Hours**
	General properties-Classification-Glass transition temperature from important inorganic polymers-Boron based polymers-Polymeric boron nitride-Polycarboranes-Phosphorus basedpolymers-Polyphosphonitrilic chloride-Polyphosphoric acids-Phosphorus based network polymers-Silicon based polymers-Dimethyl-silicon dichloride, Trimethyl silicon chloride, Monomethyl silicon chloride. Sulphur-based inorganic polymers – Linear chain polymers, Chalcogenide glass	
Unit IV	**Commercial Polymers**	**6 Hours**
	Plastics-Thermoplastics and thermosets: Manufacture , properties and application of the following plastics-LDPE, polypropylene, polystyrene PVC, PMMA, PAN, Polyacrylic acid, Polymethacrylic acid. Polyamides- Nylon 6.6 and Nylon 6. Polycarbonates. Nomex, Kevlar. Polyesters- PET - Novalac formation-Urea-formaldehyde resin.	
Unit V	**Natural and Synthetic Rubbers**	**6 Hours**
	Natural rubber-Vulcanisation-Manufacture, General properties and applications of SBR, Polyisoprene, Polybutadiene, Butyl	

	rubber, Ethylene-Propylene rubber, Neoprene rubber, Speciality rubbers: Silicon rubbers, Nitrile rubbers, Polyacrylic rubbers-Polyurethane rubber-Hypalon-Fluorocarbon elastomers-Thermoplastic elastomer, Reclaimed rubber, Foam rubber.	

Course Outcomes

On successful completion of the course, the students will be able to

CO1	Classify the different kinds of polymers.
CO2	Explain the polymerization and moulding process techniques.
CO3	Acquire knowledge on inorganic polymers.
CO4	Recognize the commercial polymers.
CO5	Relate the detailed knowledge of Natural and Synthetic rubbers.

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and laboratory and testing metal.

Text Books

1. Sharma B. K., (2000), Polymer Chemistry, Goel Publishing House, Meerut.
2. Gowarikar V.R., Viswanathan N.V., (2003), Polymer science, New age International.

Reference Books

1. Sharma B.K., (2016), *Industrial Chemistry* (Including Chemical Engineering) Goel Publishing House, 16th Revised and Enlarged Edition.
2. Jain P.C., Monika Jain., (2012), Engineering chemistry, Dhanpat Rai Publishing Company.
3. Billmeyer Jr. F.W., (2007), Text book of Polymer Science, Wiley, India.

E- Resources

1. https://funscience.in/classification-of-polymers/
2. https://www.hardiepolymers.com/knowledge/polymer-manufacturing-processes/
3. https://polymerdatabase.com/polymer%20classes/Inorganic%20Polymers.html
4. https://www.askiitians.com/iit-jee-solutions-colligative-properties/polymers-of-commercial-importance/
5. https://www.mdpi.com/2073-4360/12/4/905
6. https://www.jagranjosh.com/general-knowledge/list-of-some-common-manmade-polymers-and-their-uses-1482487493-1

Mapping of Programme specific outcomes with Course Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	2	2	2	2	2	2	1	2	1	1	1	1
CO2	3	2	2	3	3	3	2	2	1	1	`1	1
CO3	2	2	2	2	2	2	1	1	1	1	1	1
CO4	2	2	2	3	3	2	2	2	1	1	1	1
CO5	3	2	3	2	2	2	1	1	1	1	1	1

1-Low 2-Moderate 3-High

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	COs	K-Level	Section A		Section B
			Either/or Choice		Open Choice
			No. of Questions	K-Level	No. of Questions
1	CO1	Up to K2	2	K1 & K2	1(K2)
2	CO2	Up to K3	2	K1 & K2	1(K3)
3	CO3	Up to K2	2	K1 & K2	1(K2)
4	CO4	Up to K2	2	K1 & K2	1(K2)
5	CO5	Up to K3	2	K1 & K2	1(K3)
No. of Questions to be asked			10		5
No. of Questions to be answered			5		3
Marks for each Question			3		5
Total Marks for each Section			15		15

K1-Remembering and recalling facts with specific answers
K2-Basic understanding of facts and stating main ideas with general answers
K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (Either/or Choice)	Section B (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	15	-	15	27.2	27%
K2	15	15	30	54.5	55%
K3		10	10	18.1	18%
Total Marks	30	25	55	100	100%

Lesson Plan

Unit I	**Introduction and Classification of Polymers**	**6 Hours**	**Mode**
	a)Basic concepts-Classification of polymers-Nomenclature-Natural and Synthetic polymers-	2	Chalk and talk Power point presentation Seminar Group discussion
	b)Organic and Inorganic polymers Thermoplastics and thermo sets-Plastics, elastomers, fibers and liquid resins-Addition polymers and condensation polymers-homopolymers-linear, branched and cross linked polymers	2	
	c)Graft and Block co-polymers- Basic concept of monomers-Functionality	2	
Unit II	**Polymerization and Moulding Techniques**	**5 Hours**	**Mode**
	a)Addition polymerization-Free radical polymerization-Initiation, Propagation and Termination-Ionic polymerization	2	Chalk and talk Power point presentation Seminar Group
	b)Cationic and Anionic co-ordination polymerization-Ziegler natta catalysis. Moulding process Technique: Compression	2	

	c)moulding, Injection moulding, Transfer moulding, Extrusion moulding	2	discussion
Unit III	**Inorganic Polymers**	**6 Hours**	**Mode**
	a)General properties-Classification-Glass transition temperature from important inorganic polymers-Boron based polymers-Polymeric boron nitride Polycarboranes-Phosphorus based polymers-Polyphosphonitrilic chloride-Polyphosphoric acids-Phosphorus based network polymers	2	Chalk and talk Power point presentation Seminar Group discussion
	b)Silicon based polymers-Dimethyl-silicon dichloride, Trimethyl silicon chloride, Monomethyl silicon chloride.	2	
	c)Sulphur-based inorganic polymers – Linear chain polymers, Chalcogenide glass	2	
Unit IV	**Commercial Polymers**	**6 Hours**	**Mode**
	a)Plastics-Thermoplastics and thermosets: Manufacture , properties and application of the following plastics-LDPE, polypropylene, polystyrene PVC	2	Chalk and talk Power point presentation Seminar Group discussion
	b)PMMA, PAN, Polyacrylic acid, Polymethacrylic acid. Polyamides- Nylon 6.6 and Nylon 6. Polycarbonates.	2	
	C)Polyesters-PET-Novalac formation-Urea-formaldehyde resin.	2	
Unit V	**Natural and Synthetic Rubbers**	**6 Hours**	**Mode**
	a)Natural rubber-Valcanisation-Manufacture, General properties and applications of SBR,	2	Chalk and talk Power point presentation Seminar Group discussion
	b)Polyisoprene. Polybutadiene, Butyl rubber, Ethylene-Propylene rubber, Neoprene rubber, Speciality rubbers: Silicon rubbers, Nitrile rubbers, Polyacrylic rubbers.	2	
	c)Polyurethane rubber-Hypalon-Fluorocarbon elastomers-Thermoplastic elastomer, Reclaimed rubber, Foam rubber.	2	

Course designed byDr. G.N.Kousalya

Programme	B.Sc.Chemistry	Programme Code		UCH	
Course Code	20UCHS62	Number of Hours/Cycle		2	
Semester	VI	Max. Marks		50	
Part	IV	Credit		2	
Skill Based Course III					
Course Title	Dairy Chemistry		L	T	P
Cognitive Level		Up to K3	30	-	-

Preamble

The course provides the basic knowledge of Milk, Composition, Standards, Manufacturing Process of Cream, Butter, Paneer, Cheese, Ice-cream, Dahi, Condensed milk, Evaporated milk, Milk powder, Quality and food safety.

Unit I	**Composition Of Milk**	**6 Hours**
	Definition of Milk - Composition of Milk - Preservation of Milk - Grading of Milk - Milk Processing - Pasteurisation - Phosphatase enzyme - Homogenisation - Fat Separation – Standardisation of Milk - Nutritive value of milk - Energy value - Effect of heat - temperature and acidity on milk - Carbohydrates of Milk - Lactose Structure - properties - browning reaction.	
Unit II	**Milk Products - I**	**6 Hours**
	Cream: Introduction - Definition - Classification - Cream Neutralization - Standardization of cream - Pasteurization of Cream - Packaging and storage. **Butter**: Introduction - Composition of Butter – Definition – Production - Classification of butter. **Paneer**: Introduction – Standards – Physico-Chemical changes during manufacturing - Paneer from Cow milk - recent developments in Paneer manufacturing - Factors affecting quality and yield of Paneer.	
Unit III	**Milk Products - II**	**6 Hours**
	Cheese: Introduction - World market of Cheese - Definition-Classification - Manufacture **Ice cream:** Introduction - Definition and standards-Production – Classification – Ingredients -methods of manufacturing. **Dahi:** Introduction - Food safety and standards regulation - Industrial method of making Dahi – Standardisation – Homogenization - Packaging and fermentation – Storage - Packaging of Dahi.	
Unit IV	**Milk Products - III**	**6 Hours**
	Condensed and Evaporated milk: Introduction - Evaporation unit and classification of Evaporators - Processing and storage of sweetened condensed milk - Defects in sweetened condensed milk - processing-packaging and storage of Evaporated milk - Defects in Evaporated milk **Milk powders:** Introduction - Definition-Processing - Packaging and storage - Spray Drying of milk - Classification of Spray Drier operatios -salient features of SMP and WMP production - Packaging of SMP and WMP	
Unit V	**Quality and Food Safety**	**6 Hours**

	Proteins in milk - Physical and chemical properties of protein – Enzymes - Milk borne diseases - Vitamins and Minerals in milk - Evaporated milk - Physical and chemical properties of Dried Milk - Clean in Progress (CIP) - Quality and Food Safety System - HACCP – Types of microbes in milk - Microbiology - Bacteriological - Milk borne diseases.	

Text Books

1. Rubesh Nandan, 2011,A Textbook of Dairy Chemistry,Random Publications.
2. Shukla A.N, 2010, Textbook of Dairy chemistry,DPH.

Reference Books

1. Alex.V. Ramani, 2010,Food Chemistry, MJP Publishers.
2. Dr. Jayashree Ghose, 2013, Fundamental Concepts of Applied Chemistry, S.Chand Publications.

E- Resources

1. https://www.researchgate.net/publication/347950961_Milk_Nutritional_Composition_and_Its_Role_in_Human_Health
2. https://www.fao.org/3/i3396e/i3396e.pdf
3. https://en.wikipedia.org/wiki/Curd
4. https://www.agrimoon.com/wp-content/uploads/Condensed-and-Dried-Milk.pdf
5. https://ncert.nic.in/textbook/pdf/lehe106.pdf.

Course outcomes

On successful completion of the course, students will be able to

No.	Course outcome
CO1	Explain the Composition of milk, Preservation, Homogenisation, Nutritive value, Acidity on milk.
CO2	Acquire the knowledge about Cream, Butter and Paneer.
CO3	Gain the basic concept of Cheese, Ice-cream and Dahi
CO4	Explain the classification, processing packaging and storage of condensed, evaporated milk and milk powder.
CO5	Identify the knowledge of physical and chemical properties of protein – enzymes, milk born diseases, and quality and food safety.

Mapping of Programme outcomes with Course Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	1	1	2	2	2	2	1	1	1	1	1	1
CO2	2	2	1	2	2	2	1	1	1	1	1	1
CO3	2	2	2	2	2	2	1	2	1	1	1	1
CO4	1	2	3	2	2	2	1	2	1	2	1	1
CO5	2	1	2	2	2	2	1	2	1	1	1	1

1-Low; 2-Moderate; 3-High

Articulation Mapping-K Levels with Course Outcomes(COs)

Units	COs	K-Level	Section A		Section B
			Either/or Choice		Open Choice
			No. of Questions	K-Level	No. of Questions
1	CO1	Up to K2	2	K1 & K2	1(K2)
2	CO2	Up to K3	2	K1 & K2	1(K3)
3	CO3	Up to K2	2	K1 & K2	1(K2)
4	CO4	Up to K3	2	K1 & K2	1(K3)

5	CO5	Up to K2	2	K1 & K2	1(K2)
No. of Questions to be asked			10		5
No. of Questions to be answered			5		3
Marks for each Question			3		5
Total Marks for each Section			15		15

K1-Remembering and recalling facts with specific answers
K2-Basic understanding of facts and stating main ideas with general answers
K3-Application oriented-Solving problems

Distribution of Section-wise Marks and K Levels

K Levels	Section A (Either/or Choice)	Section B (Open Choice)	Total Marks	% of Marks without choice	Consolidated (Rounded off)
K1	15	-	15	27.2%	27%
K2	15	15	30	54.5%	55%
K3		10	10	18.1%	18%
Total Marks	30	25	55	100%	100%%

Lesson Plan

Unit I	**Composition Of Milk**	**6 Hours**	**Mode**
	a) Definition of Milk - Composition of Milk - Preservation of Milk - Grading of Milk	**2**	Chalk and talk, Power point presentation, Group Discussion
	b) Milk Processing - Pasteurisation - Phosphatase enzyme - Homogenisation - Fat Separation – Standardisation of Milk - Nutritive value of milk - Energy value	**2**	
	c) - Effect of heat - temperature and acidity on milk - Carbohydrates of Milk - Lactose Structure - properties - browning reaction.	**2**	
Unit II	**Milk Products - I**	**6 Hours**	**Mode**
	a) **Cream**: Introduction - Definition - Classification - Cream Neutralization - Standardization of cream - Pasteurization of Cream - Packaging and storage.	2	Chalk and talk, Power point presentation
	b)Butter: Introduction - Composition of Butter – Definition – Production - Classification of butter.	2	
	c) Paneer: Introduction – Standards – Physico-Chemical changes during manufacturing - Paneer from Cow milk - recent developments in Paneer manufacturing - Factors affecting quality and yield of Paneer.	2	
Unit III	**Milk Products - II**	**6 Hours**	**Mode**

	a) **Cheese:** Introduction - World market of Cheese - Definition-Classification - Manufacture	2	Chalk and talk, Power point presentation
	b) Ice cream: Introduction - Definition and standards-Production – Classification – Ingredients -methods of manufacturing.	2	
	c)Dahi: Introduction - Food safety and standards regulation - Industrial method of making Dahi – Standardisation – Homogenization - Packaging and fermentation – Storage - Packaging of Dahi.	2	
Unit IV	**Milk Products – III**	**6 Hours**	**Mode**
	a)Condensed and Evaporated milk: Introduction - Evaporation unit and classification of Evaporators - Processing and storage of sweetened condensed milk –	2	Chalk and talk, Power point presentation
	b)Defects in sweetened condensed milk - processing-packaging and storage of Evaporated milk - Defects in Evaporated milk **c)Milk powders:** Introduction - Definition-Processing - Packaging and storage - Spray Drying of milk - Classification of Spray Drier operatios -salient features of SMP and WMP production - Packaging of SMP and WMP	2 2	
Unit V	**Quality And Food Safety**	**6 Hours**	**Mode**
	a)Proteins in milk - Physical and chemical properties of protein – Enzymes	2	Chalk and talk, Power point presentation,
	b)Milk borne diseases - Vitamins and Minerals in milk - Evaporated milk - Physical and chemical properties of Dried Milk - Clean in Progress (CIP)	2	
	c) Quality and Food Safety System - HACCP – Types of microbes in milk - Microbiology - Bacteriological - Milk borne diseases.	2	

Course Designed byDr.M.Pandeeswaran, Mrs.V.Vanitha and Mr.C.Sivakumar

Value Added Courses

Programme	B.Sc. Chemistry	Programme Code		UCH	
Course Code	20CCHE51	Number of Hours/Cycle		2	
Semester	V	Max. Marks		50	
Part		Credit			
Value Added Course III					
Course Title	Paper &Pulp Technology		L	T	P
			30	-	-

Preamble

To understand the various methods of pulp manufacture and the process involved in paper manufacture.

Unit	Description	Hours
I	Introduction, Manufacture of Pulp, Various raw materials used for the preparation of Pulp.	6 Hours
II	Preparation of Sulphite Pulp, Soda pulp, Rag Pulp	6 Hours
III	Various processes: Beating, Refining, Filling sizing and colouring.	6 Hours
IV	Manufacture of paper, calendaring, uses.	6 Hours
V	Various Paper industries in India.	6 Hours

Pedagogy

Chalk and Talk method, Group Discussion, Assignments, Quiz, Brainstorming Activities, Seminar and Powerpoint presentations

Text Book

2. Sharma B.K (2016), Industrial Chemistry (Including Chemical Engineering), 16th Revised and Enlarged Edition, Goel Publishing House, Meerut

Reference Books

1. Sharma B.K., (2016), "*Industrial Chemistry (Including Chemical Engineering)*", Goel Publishing House, 16th Revised and Enlarged Edition
2. Soni P.L., (2014), "*Organic Chemistry*". Sultan Chand & Sons
3. Arun Bahl and Bahl.B.S., (2016), "*Text Book for Organic Chemistry*", Sulthan Chand & Company Limited, New Delhi.

Programme	All	Programme Code		UCH	
Course Code	**20CCHE61**	Number of Hours/Cycle		**2**	
Semester	**VI**	Max. Marks		**50**	
		Credit		**2**	
Value Added Course -IV					
Course Title	**Leather Technology**		**L**	**T**	**P**
			30	**-**	**-**

Preamble

The course provides the basic knowledge in manufacturing of leather,varios process and pollution problems caused by tanneries and controlling methods.

Units	Description	Hours
Unit I		**6 Hours**
	History of tanning industry in India – Conventional tanning process – Animal skin.	
Unit II		**6 Hours**
	Manufacture of leather, preparation of hides for tanning, use of various inorganic and organic chemicals for tanning process.	
Unit III		**6 Hours**
	Various processes of tanning – soaking, liming, deliming, dehairing and bating.	
Unit IV		**6 Hours**
	Vegetable tanning – synthetic tanning, chrome tanning, finishing of leather	
Unit V		**6 Hours**
	Pollution problems caused by tanneries and its control. Treatment of tannery effluents by primary Secondary and tertiary processes, Use of reverse Osmosis system for the treatment of polluted water.	

Pedagogy

Chalk and Talk method, Group Discussions, Assignments, Quiz, Brainstorming Activities, Seminar and laboratory and testing metal.

Text Books:

6. Sharma B.K., (2016), *Industrial Chemistry* (Including Chemical Engineering) Goel Publishing House, 16th Revised and Enlarged Edition

Reference Books::

1. Kanagasabai, S. (2010). Textbook on Environmental Studies, PHI Learning Private Limited, New Delhi, India.

EVALUTION PATTERN (OBE)

Examination Pattern for Core and Allied Courses to be implemented from the Academic Year 2021-2022

Two Continuous Internal Assessment (CIA) and One End Semester Examination (ESE) is conducted .The marks are distributed as follows:

Nature of Study	CIA	ESE	Total
Theory	40	60	100
Practical	40	60	100

Continuous Internal Assessment (CIA) – UG

The pattern of question paper for Continuous Internal Assessment (CIA) for UG for III and IV semesters is as follows. The duration for the Internal test is 1½ hours. Equal importance is given to all the units.

Blue Print of the Question Paper (CIA) Maximum Marks: 30

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Multiple Choice Questions	6	6	1	6
B	Paragraph Questions (Inbuilt choice)	3	3	4	12
C	Essay Questions (Open choice)	3	2	6	12
Total					30

Continuous Internal Assessment components are:

1. Two internal assessment is conducted for 30 marks each
   (The average of the marks of two internal assessments will be taken
   ((**30 + 30 / 2)** = 30)
2. Two Assignment to be submitted for 5 marks each
   (The average of two assignments is taken for 5 marks)
3. Seminar / Quiz / Group Discussion – 5 marks
   (If Quiz is conducted, the average of two quizzes is taken for 5 marks)
4. Third test may be allowed for absentees of anyone of the two assessments for genuine reasons.

Continuous Internal Assessment (CIA) – PG

The pattern of question paper for Continuous Internal Assessment (CIA) for PG for III and IV is as follows. The duration for the assessment is 2 hours. Equal importance is given to all the units.

Blue Print of the Question Paper (CIA) Maximum Marks: 45

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Multiple Choice Questions	6	6	1	6
B	Paragraph Questions (Inbuilt choice)	5	5	3	15
C	Essay Questions (Open choice)	5	3	8	24
Total					45

Continuous Internal Assessment components are:

1. Two internal assessment is conducted for 45 marks each
   (The marks of two internal assessments will be converted into 30 marks (**(45+45)/3)** = 30)
2. Two Quizzes is to be conducted for 5 marks each
   (The average of two quizzes is taken for 5 marks)
3. Seminar / Group Discussion – 5 marks
4. Third test may be allowed for absentees of anyone of the two assessments for genuine reasons.

End Semester Examinations (ESE)

Duration of the End Semester Examination is 3 Hours. Equal importance is given to all the units. The pattern of Question Paper for the End Semester Examination is as follows:

Blue Print of the Question Paper (UG & PG) Maximum Marks: 60

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Multiple Choice Questions	10	10	1	10
B	Paragraph Questions (Inbuilt choice)	5	5	4	20
C	Essay type Questions (Open choice)	5	3	10	30
Total					60

Evaluation Pattern

Under Graduate

1. Passing minimum is 35% in external examination, out of 60 i.e. 21 out of 60 will be taken as pass mark for UG students.
2. An aggregate of 40 marks for UG (sum of Continuous Internal Assessment and End Semester Examination).

Post Graduate

1. A Passing minimum of 45% in external examination out of 60 i.e. 27 out of 60 will be taken as pass mark for PG students.
2. An aggregate of 50 marks for PG (sum of Continuous Internal Assessment and End Semester Examination).

Examination Pattern for Part IV Courses

As regards Part IV courses such as Skill Based, Non Major Elective. Value Education, and Environmental Studies Two Continuous Internal Assessment (CIA) and One End Semester Examination (ESE) is conducted .The marks are distributed as follows:

Nature of Study	CIA	ESE	Total
Theory	20	30	50
Practical	20	30	50

Continuous Internal Assessment (CIA) - UG

The pattern of question paper for Continuous Internal Assessment (CIA) for UG is as follows. The duration for the internal test is 1 hour. Equal importance is given to all the units.

Blue Print of the Question Paper (CIA) Maximum Marks: 15

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Paragraph Questions	5	5	2	10
B	Essay type Questions (open choice)	2	1	5	5
Total					15

Continuous Internal Assessment components are:

1. Two internal tests are conducted for 15 marks each
   (The average of the marks of two internal assessments will be taken ((**15+15) / 2)** = 15)
2. One Assignment is to be submitted for 5 marks

End Semester Examinations (ESE)

Duration of the End Semester Examination is 2 Hours. Equal importance is given to all the units. The pattern of Question Paper for the End Semester Examination is as follows:

Blue Print of the Question Paper (UG) Maximum Marks: 30

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Paragraph Questions	5	5	3	15
B	Essay type Questions (open choice)	5	3	5	15
Total					30

Evaluation Pattern

Under Graduate

1. Passing minimum is 35% in external examination, out of 30 i.e. 11 out of 30 will be taken as pass mark for UG students.
2. An aggregate of 20 marks for UG (sum of Continuous Internal Assessment and End Semester Examination).

Examination Pattern for Value Added Courses

As regards Extra Credit Value Added Courses, the study martial will be prepared by the course teacher. One Internal Assessment will be conducted for 20 marks and the End Semester Examination will be conducted for 30 marks and the evaluation will be made by the course teacher. The marks are distributed as follows:

Nature of Study	IA	ESE	Total
Theory	20	30	50
Practical	20	30	50

Internal Assessment (IA)

The pattern of question paper for Internal Assessment (IA) is as follows. The duration for the internal test is 1 hour. Equal importance is given to all the units.

Blue Print of the Question Paper (IA) **Maximum Marks: 15**

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Paragraph Questions	5	5	2	10
B	Essay type Questions (open choice)	2	1	10	10
Total					20

End Semester Examinations (ESE)

Duration of the End Semester Examination is 2 Hours. Equal importance is given to all the units. The pattern of Question Paper for the End Semester Examination is as follows:

Blue Print of the Question Paper **Maximum Marks: 30**

Sections	Types of questions	No. of questions	No. of questions to be answered	Marks for each question	Total Marks
A	Paragraph Questions	5	5	3	15
B	Essay type Questions (open choice)	5	3	5	15
Total					30

Evaluation Pattern

Under Graduate

1. Passing minimum is 35% in external examination, out of 30 i.e. 11 out of 30 will be taken as pass mark for UG students.
2. An aggregate of 20 marks for UG (sum of Internal Assessment and End Semester Examination).