MOTHER TERESA WOMEN'S UNIVERSITY

KODAIKANAL – 624 101

M.Sc. CHEMISTRY PROGRAMME

CHOICE BASED CREDIT SYSTEM(CBCS)

(For candidates admitted from the academic year 2021-2022)

DEPARTMENT OF CHEMISTRY

MOTHER TERESA WOMEN'S UNIVERSITY,KODAIKANAL

Mother Teresa Women's University, Kodaikanal
Department of Chemistry
Choice Based Credit System (CBCS)
(2021-2022 onwards)
M. Sc. Chemistry Programme

1. About the Programme

The M.Sc. Degree Programme in Chemistry offeredby Mother Teresa Women's University, Kodaikanal aims at providing advanced and in-depth knowledge in various basic and applied fields of chemistry. The core courses equip the learners with experimental and analytical skills in addition to sound theoretical knowledge in various aspects of chemistry required for employability and research.The electives add additional knowledge about applied aspects of Chemistry and implications in both academia and industry. The non-major electives introduce integration among various interdisciplinary courses. The skillbased courses equip the learners with job and research oriented computer skills.The special course of the programme is "Women empowerment" which imparts the knowledge of Gender & inclusiveness.

2. Programme Educational Objectives (PEOs)

PEO1: To provide a strong foundation in Chemistry with scientific reasoning and analytical problem solving.
PEO2: To inculcate scientific temper and research attitude and provide adequate training in synthesis, characterization and instrumentation.
PEO3: To equip students with subject related skills required for employment & entrepreneurship.
PEO4: To enable the learners to apply the knowledge acquired in frontier areas of chemistry for new research and technology.
PEO5: To enable the learners to utilize the expertise in chemical sciences and solve the problems ofenvironment, green chemistry, ecology, sustainable development, etc.

3. Eligibility

B.Sc. Chemistry degree with Mathematics/Physics /Botany /Zoology as one of the Allied subjects.

4. General Guidelines for PG Programme

i. **Duration:** The programme shall extend through a period of 4 consecutive semesters and the duration of a semester shall normally be 90 days or 450 hours. Examinations shall be conducted at the end of each semester for the respective subjects.
ii. **Medium of Instruction:** English
iii. **Evaluation:** Evaluation of the candidates shall be through Internal Assessment and External Examination.

Evaluation Pattern	Theory		Practical	
	Min	Max	Min	Max
Internal	13	25	13	25
External	38	75	38	75

- **Internal (Theory): Test (15) + Assignment (5) + Seminar/Quiz(5) = 25**
- **External Theory: 75**

- **Question Paper Pattern for External examination for all course papers.**

Max. Marks: 75 **Time: 3 Hrs.**

S.No.	Part	Type	Marks
1	**A**	**10*1 Marks=10** Multiple Choice Questions(MCQs): 2 questions from each Unit	**10**
2	**B**	**5*4=20** Two questions from each Unit with Internal Choice (either / or)	**20**
3	**C**	**3*15=45** Open Choice: Any three questions out of 5 : one question from each unit	**45**
Total Marks			**75**

*** Minimum credits required to pass: 90**

- **Project Report**

A student should select a topic for the Project Work at the end of the third semester itself and submit the Project Report at the end of the fourth semester. The Project Report shall not exceed 75 typed pages in Times New Roman font with 1.5 line space.

- **Project Evaluation**

There is a Viva Voce Examination for Project Work. The Guide and an External Examiner shall evaluate and conduct the Viva Voce Examination. The Project Work carries 100 marks (Internal: 25 Marks; External (Viva): 75 Marks).

5. Conversion of Marks to Grade Points and Letter Grade

(Performance in a Course/Paper)

Range of Marks	Grade Points	Letter Grade	Description
90 – 100	9.0 – 10.0	O	Outstanding
80-89	8.0 – 8.9	D+	Excellent
75-79	7.5 – 7.9	D	Distinction
70-74	7.0 – 7.4	A+	Very Good
60-69	6.0 – 6.9	A	Good

50-59	5.0 – 5.9	B	Average
00-49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

6. Attendance

Students must have earned 75% of attendance in each course for appearing for the examination. Students with 71% to 74% of attendance must apply for condonation in the Prescribed Form with prescribed fee. Students with 65% to 70% of attendance must apply for condonation in the Prescribed Form with the prescribed fee along with the Medical Certificate. Students with attendance lesser than 65% are not eligible to appear for the examination and they shall re-do the course with the prior permission of the Head of the Department, Principal and the Registrar of the University.

7. Maternity Leave

The student who avails maternity leave may be considered to appear for the examination with the approval of Staff i/c, Head of the Department, Controller of Examination and the Registrar.

8. Any Other Information

In addition to the above mentioned regulations, any other common regulations pertaining to the PG Programmes are also applicable for this Programme.

9. Programme Outcomes (POs)

On completion of this Programme the learners will

PO1: understand and appreciate the importance of chemistry as a central science by the knowledge of its diverse applications.
PO2: have sound knowledge of the fundamental and advanced concepts of applications of chemical and scientific theories.
PO3: acquire experimental skills required for employment in chemical and pharmaceutical industry.
PO4: develop analytical and problem-solving skills
PO5: acquire the ability to synthesize, separate and characterize compounds using laboratory and instrumentation techniques.
PO6: identify the major problems of the society and environment for which Chemistry has offered solutions, and get motivated to further work on it by pursuing research with social responsibility.

10. Programme Specific Outcomes (PSOs)

On completion of the M.Sc. Chemistry Program, the students will be able to

PSO1: demonstrate comprehensive knowledge and understanding of both theoretical and experimental/applied chemistry including specialized areas of Organic Chemistry, Inorganic Chemistry, Physical Chemistry, Analytical Chemistry, Medicinal Chemistry, Environmental Chemistry, Chemistry of Natural products, Nano Chemistry, and Elective subjects.

PSO2: use advanced instruments and related soft-wares for in-depth characterization of materials/chemical analysis and separation technology with the help of theoretical knowledge

PSO3: understand the importance of chemistry in societal and environmental contexts for sustainable development.

PSO4: utilize the principles of scientific enquiry and analytical thinking while solving problems and making decisions

PSO5: become skilled project managers to undertake challenging projects for societal development.

PSO6: express the subject through technical writing as well as through oral presentation.

MOTHER TERESA WOMEN'S UNIVERSITY,
KODAIKANAL – 624 101
M.Sc. Chemistry Syllabus

S. No.	Course Code	Course Title	Credits	Hours		Continuous Internal Assessment (CIA)	End Semester Exam (ESE)	Total
				L	P			
Semester I								
1	P21CHT11	Core- I Organic Chemistry-I	4	5	0	25	75	100
2	P21CHT12	Core -2 Inorganic Chemistry –I	4	5	0	25	75	100
3	P21CHT13	Core-3 Physical Chemistry-I	4	5	0	25	75	100
4	P21CHT14	Core-4 Medicinal Chemistry & Drug Design	4	5	0	25	75	100
5	P21CHP11	Core-5 -Practical 1 Organic Chemistry Practical	4	0	6	25	75	100
7	P21CSS11	Supportive Course – I (Skill) Computer Skills for Web Designing and Video Editing	2	2	0	25	75	100
		Total	**22**	**26**		**-**	**-**	**700**
Semester II								
8	P21CHT21	Core -6 Organic Chemistry-II	4	5	0	25	75	100
9	P21CHT22	Core -7 Inorganic Chemistry -II	4	4	0	25	75	100
10	P21CHT23	Core -8 Physical Chemistry-II	4	5	0	25	75	100
11	P21CHT24	Core -9 Analytical Chemistry	4	4	0	25	75	100
12	P21CHP22	Core -10 Practical 2 Inorganic	4	6	6	25	75	100

		Chemistry Practical						
13		**NME**	4	4	0	25	75	100
14	P21CHS22	**Supportive Course II (Skill)** Computational Chemistry	2	4	0	25	75	100
		Total	**26**	**30**		**-**	**-**	**700**
Semester III								
15	P21CHT31	Core -11 Organic Chemistry-III	4	5	0	25	75	100
16	P21CHT32	Core -12 Inorganic Chemistry -III	4	4	0	25	75	100
17	P21CHT33	Core -13 Physical Chemistry-III	4	5	0	25	75	100
18	P21CHT34	Core -14 Environmental Chemistry	4	4	0	25	75	100
19	P21CHT35	Core -15- Chemistry of Natural Products and Bio- Inorganic Chemistry	4	4	0	25	75	100
20	P21CHP33	Core -16 Practical -3 Physical Chemistry Practical	4	6	6	25	75	100
21	P21WSS33	**Supportive Course III**-Women Empowerment	2	2	0	25	75	100
		Total	**26**	**30**				**700**
Semester IV								
22	P21CHE411/ P21CHE412	Elective –I* Green Chemistry/ Chemistry in Everyday Life/MOOC Course[$]	4	4	0	25	75	100
23	P21CHE421 P21CHE422	Elective- II* Industrial Chemistry / Chemistry of Nanoscience and &	4	4	0	25	75	100

		Technology & Supramolecular Chemistry/$						
24	P21CHR41	Project	8	22		25	75	100
		Total	**16**	**30**				**200**
Total			**90**	**112**				**2300**

Non- Major Electives Offered by the Department

S No.	Course Code	Course Title	Credits	Hours L/P		Continuous Internal Assessment (CIA)	End Semester Exam (ESE)	Total
Semester I								
1	P21CHN211/ P21CHN212	Everyday Chemistry/ Agricultural Chemistry	4	4	0	25	75	100

Additional Credit Courses

1. **P21CHV11** - Value Added Program I-Two Credits (First Semester)
2. **P21CHI21** - Internship/Industrial Training – Two Credits- (Second Semester)
3. **P21CHO31** - Online Courses-Two Credits- (Third Semester)
4. **P21CHV42** - Value Added Program II-Two Credits (Fourth Semester)

*Those who have CGPA as 9, and want to do the project in industry/institution during IV semester, may opt for these two papers in III semester.

$Students can take one 4 credit course in MOOC as elective or two 2 credit course in MOOC as elective with the approval of Department committee

Cognitive Level of Course Outcomes

K1: Recall/Know **K2:** Understand **K3:** Apply **K4:** Analyze
K5 Evaluate **K6** Create

VALUE ADDED COURSE I

Course Code	P21CHV11 P21CHV42	Instrumental Methods of Chemical Analysis / Water Treatment	**L**	**T**	**P**	**C**
Credit - 2			**5**	**-**	**-**	**4**

SEMESTER - I

Course Code	P21CHT11	ORGANIC CHEMISTRY – I	L	T	P	C
CORE - I			5	-	-	4

Objectives

1. To enable students, learn the different types of reactive intermediates in organic reactions.
2. To provide understanding of the different types and mechanism of organic reactions
3. To make the students understand and appreciate the basic concepts of stereochemistry
4. To provide understanding of the concept of aromaticity and enable the students to identify aromatic, non-aromatic and anti-aromatic compounds.

Course Outcomes

Upon completing the course, the students will be able to

1. identify the different types of reactive intermediates and appreciate their importance in organic reactions – K5
2. analyze the various mechanisms of organic reactions – K4
3. understand and apply the concepts of stereochemistry -K3
4. identify aromatic, non-aromatic and anti-aromatic compounds-K2

Unit I - Reactive intermediates and Aromaticity

Carbocations, carbanions, carbenes, benzynes and nitrenes-Generation, stability and reactivity.

Aromatic character: Six-, five-, seven-, and eight- membered rings - Other systems with aromatic sextets – Huckel's theory of aromaticity, concept of homoaromaticity and antiaromaticity, Electron occupancy in MO's and aromaticity - NMR concept of aromaticity and antiaromaticity, systems with 2,4,8 and 10 electrons, systems with more than 10 electrons, alternant and non-alternant hydrocarbons (azulene type). Bonding properties of systems with (4n+2)□ □ electrons and 4n□ □ electrons,Heteroaromatic molecules. Annulenes, heteroannulenes, sydnones and fullerenes. Craig's rule, Hammond's postulate

Unit II- Substitution reactions

Nucleophilic Substitution

Aliphatic nucleophilic substitution: S_N1 and S_N2 mechanism – Kinetic and stereochemical characteristics – effects of substrate structure, nature of the nucleophile and leaving group on the rate – solvent effects – examples of S_Ni substitution – Neighbouring group participation-Anchimeric assistance

Aromatic nucleophilic substitution: Benzyne and Meisenheimer intermediates

Electrophilic Substitution

Mechanism of aliphatic electrophilic substitution reaction – S_E1, S_E2, S_Ei reaction.
Mechanism of aromatic electrophilic substitution reactions – complexes – nitration, halogenation, sulphonation, Friedel Craft alkylation and acylation – Reimer Tiemann reaction. Linear free energy relationship – Hammett equation – Significance of the σ and ρ parameters; Taft equation.

Unit III- Addition and Elimination reactions

Addition reactions

Regio and stereochemistry of addition of halogens and halogens acids to carbon – carbon multiple bonds – hydroboration – addition to carbonyl bonds – mechanism of Aldol, Perkin, Stobbe, Dieckmann condensation, Reformatsky and Grignard reaction, Michael addition reaction and Mannich reaction – Formation and Synthetic application of enamines – Stork enamine reaction.

Elimination reactions

E1, E2, E1CB mechanism – structural and solvent effect on these mechanisms – orientation of double bonds (regio and stereoselectivities) – competition between substitution and elimination reaction – cis elimination, pyrolytic eliminations

Unit IV- Rearrangements

Definition – nucleophilic, electrophilic and free radical rearrangements – intramolecular and intermolecular rearrangements – migratory aptitude – Wagner – Meerwin, Benzil – Benzilic acid, Schmidt, Lossen, Curtius, Beckmann, Fries, Baeyer Villeger, Favorski, Stevens and Neber rearrangements.

Unit V - Introduction to stereochemistry

Concept of chirality: specification on configuration by Cahn, Ingold and Prelog system of notation, compounds with more than one chiral centre – calculation of number of stereo-isomers – erythro and threo nomenclature; interconversions of Sawhorse, Fisher and Newman's Projections.

The concept of prochirality: Topicity and pro-stereoisomerism – equivalent, enantiotopic and diasteriotopic ligands and faces. Atropisomerism – concept of axial chirality 'R' and 'S' nomenclature of some axially chiral molecules.
Geometrical isomers – E & Z nomenclature determination of configuration of geometrical isomers by physical and chemical methods.

Reference Books

1. M. B. Smith &J. March , March′s Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, Wiley–Blackwell; 6th Ed., 2007.
2. J.March, Advanced Organic Chemistry, 4thEdn. John Wiley, New York,1992.
3. V.K. Ahluwalia & Rakesh K. Parashar , Organic Reaction Mechanisms, V.K. Ahluwalia&Rakesh K. Parashar , Organic Reaction Mechanisms; 4rth Ed.,2011
4. P.Sykes, A Guide book to Mechanisms in Organic Chemistry,.,Perason Education, 6th Ed.,2003.
5. F.A.Carey and R.J.Sundberg, Advanced Organic Chemistry, Part A and Part B, 5thEd., Springer, 2007

Mapping of COs with POs &PSOs:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	S	S	M	S	M	M	S	M	M	S	M	S
CO2	S	S	M	S	M	M	S	M	M	S	M	S
CO3	S	S	M	S	M	M	S	M	M	S	M	S
CO4	S	S	M	S	M	M	S	M	M	S	M	S

Strongly Correlating(S) - 3 marks **Moderately Correlating (M) - 2 marks**
Weakly Correlating (W) - 1 mark **No Correlation (N) - 0 mark**

Course Code	P21CHT12	INORGANIC CHEMISTRY – I	L	T	P	C
CORE - II			5	-	-	4

Objectives:

1. To provide knowledge of basic and advanced concepts in bonding and enable the students to identify the structure and bonding of simple molecules.
2. To enable students, understand of the various types of solid-state packing and the types of chemical forces
3. To impartknowledge of the structure and bonding of main group elements and their compounds
4. To provide knowledge of polymeric inorganic compounds.

Unit I - Covalent Bonding

V.B. approach to bonding-Hitler-London, Pauling and Slater refinements, Concept of hybridization and structure of molecules, VSEPR theory shapes of molecules. M.O. approach to covalent bonding – symmetry and overlap of atomic orbitals – symmetry of molecular orbitals – sigma, pi and delta bonding – energy levels in homo and hetero nuclear diatomic systems – bond length, bond order and bond energy, Application to small molecules such as $BeCl_2$, BCl_3 and CCl_4, SF_4, ionic character in a covalent bond. The concept of multicenter bonding.

Unit II- Metallic Bonding

Drude Lorentz theorem, merits and demerits – Sommerfield theorem – band theorem – formation of Brillion Zones – conductors and insulators and semiconductors, – Hall effect – super conductors, photoconductivity. Point, line and plane defects in solids – Stoichiometric and non-stoichiometric defects – Frenkel and Schottky defects. Effect of imperfections on physical properties like electrical conductivity, thermal, optical and magnetic phenomena.

Unit III- Solid State – Structure

Cohesive energy and Medelung constants, Van der Waals forces, Close packing of atoms and ions HCP and BCC types of packing voids, radius ratio – derivation – its influence on structures. Lattice energy – Born-Lande equation - Kapustinski equation. Representative structures of AB and AB_2 types of compounds - rock salt, cesium chloride, wurtzite, zinc blende, rutile, fluorite, antifluorite, cadmium iodide and nickel arsenide. Structure of graphite and diamond. Spinels - normal and inverse types and perovskite structures.

Unit IV – Main Group Chemistry

Chemistry of boron – borane, higher boranes, carboranes, borazines and boron nitrides. Chemistry of silicon – silanes, higher silanes, multiple bonded systems, silicon nitrides, siloxanes. P-N compounds, cyclophosphazenes and cyclophosphazanes. S-N compounds – S_4N_4, $(SN)_x$.

Unit V –Interhalogens and Polymeric Inorganic Compounds

Pseudo halogens;Structure and bonding in ClF_3, BrF_3 , BrF_5 , IF_5, IF_7 etc . Oxides and oxoacids of halogens, Isopoly and heteropoly acids – Structure and bonding of 6- and 12 – isopoly andheteropoly anions. Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates – Bonding in Noble gas compounds – $XeCl_2$, XeF_4, $XeOF_4$, XeF_6.,

Text Books

1. J.E. Huheey, Inorganic Chemistry, Pearson Education India; 4th Ed.,2006
2. J.D. Lee, Concise Inorganic Chemistry, Wiley India, 5thEd., 2015.
3. D.E. Douglas, D.H. McDaniel, J.J. Alexander, Concepts and Models in Inorganic Chemistry, Wiley, 3rd Ed., 2006.
1. F.A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry, 6th Ed., John Wiley & Sons, 2007.

6.P. Atkins, T. Overton, J. Rourke, M, Weller, F. Armstrong, Shriver&Atkins Inorganic Chemistry, Oxford University Press, 5th Ed., 2010.

Course Outcomes:

On learning the course, the students will be able to

1. understand the principles of various bonding theories and identify the structure and bonding of simple molecules -K2
2. recognize the various types of solid-state packing and the types of chemical forces-K4
3. explain the structure and bonding of main group elements and their compounds-K4
4. appreciate the existence and application of polymeric inorganic compounds-K5

Mapping of Cos with POs &PSOs:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	S	S	M	S	M	M	S	M	M	S	M	S
CO2	S	S	M	S	M	M	S	M	M	S	M	S
CO3	S	S	M	S	M	M	S	M	M	S	M	S
CO4	S	S	M	S	M	M	S	M	M	S	M	S

Strongly Correlating(S) - 3 marks **Moderately Correlating (M) - 2 marks**
Weakly Correlating (W) - 1 mark **No Correlation (N) - 0 mark**

Course Code	P21CHT13	PHYSICAL CHEMISTRY - I	L	T	P	C
CORE - III			5	-	-	4

Objectives:

1. To enable the students to understand concept and laws of thermodynamics
2. To understand and appreciate the advanced concepts and rate equations in chemical kinetics.
3. To provide knowledge on the concepts and laws of electrochemistry and photochemistry
4. To enable the students to apply the knowledge gained in the above concepts

Unit I - Thermodynamics Chemical and Phase Equilibrium

The second law of thermodynamics – Entropy – thermodynamics of systems of variable compositions – partial molar quantities and their determination – chemical potential – Gibbs-Duhem equation – Activity and Fugacity- determination of fugacity, Nernst equation, Third law of thermodynamics, exceptions and applications. Chemical equilibrium - temperature dependence, Vant-Hoff equation, Non-equilibrium thermodynamics - postulates and methodology. Phase equilibrium-Application to three component system-CH_3COOH, H_2O and $CHCl_3$ system.

Unit II- Chemical Kinetics

Derivation of rate constant for opposing, consecutive and parallel reaction-steady state approximation. Chain reactions: kinetics of decomposition of N_2O_5 – Non stationary chain reaction: H_2O_2 reaction and explosion limits. Grunwald –Winstein equation on reaction rates. Concept of Linear Free Energy Relationships-derivation of Hammett equation-significance of substituent and reaction rate constants - Taft equation - thermodynamic implications of LFER. Experimental methods for the study of fast reaction-flow method-relaxation methods.

Unit III - Electrochemistry – Electrochemistry – I

Mean ion activity and activity coefficient of electrolytes in solution – Ion association - Ionic strength – Debye-Huckel theory – Debye-Huckel limiting law - its validity and limitations – Strong and weak electrolytes – Debye theory of electrolytic conductance – Debye – Huckel – Onsager equation - Verification and limitations - Electrochemical cells and applications of standard potentials. Batteries-Primary and secondary fuel cells – Corrosion and corrosion inhibition

Unit IV - Electrochemistry – II

The electrical double layer – Polarizable and non-polarizable interfaces – Structure of electrical double layer – Electrocapillary and double layer capacity measurements – Double layer models – Helmholtz, Guoy–Chapman and Stern models.

Electrokinetic phenomena: Zeta potential – Electrophoresis Electroosmosis, sedimentation potential and streaming potential, Kinetics of electrode processes – Current–potential curve – Butler–Volmer relation and its approximations – Tafel equation – Charge transfer resistance – Nernst equation from Butler–Volmer equation –Multistep processes – Symmetry factor and transfer coefficient – Electrocatalysis–Hydrogen evolution reaction as a case study.

Unit V - Photochemistry

Absorption of light by molecules, reaction paths of electronically excited molecules – de-excitation pathways, Fluorescence and Phosphoresence – Jablanski diagram – Physical properties of the electronic excited molecules – excited state dipole moments, excited state pKa and redox potentials – Stern – Volmer equation and its application – photosensitization – Chemi Luminescence – Quantum Yield and actinometry.

Reference Books

1. Peter Atkins, Julio de Paula , J. Keeler, Atkins' Physical Chemistry, Oxford University Press,International 11th Ed, 2018
2. J. Rajaram and J.C. Kuriacose,Thermodynamics, ShobhanLal& Co, 3rd Ed., 2013.
3. G.W.Castellan, Physical Chemistry, Narosa, 1996.
4. K.J. Laidler, Chemical Kinetics, 3rd Ed., Pearson Education, 2004.
5. S. Glasstone, Text book of Physical Chemistry, McMillan, 1974.
6. K.K. Rohatgi – Mukherjee, Fundamentals of Photochemistry, New Age Publishers 3rd Ed, 2017.

Course Outcomes:

On learning the course, the students will be able to

1. calculate change in thermodynamic properties, equilibrium constants, partial molar quantities, chemical potential – K5
2. identify factors affecting equilibrium constant- K4
3. understand and appreciate the advanced concepts and rate equations in chemical kinetics-K2, K5
4. understand and apply the concepts and laws of electrochemistry and photochemistry-K

Mapping of Cos with POs &PSOs:

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	S	S	M	S	M	M	S	M	M	S	M	S
CO2	S	S	M	S	M	M	S	M	M	S	M	S
CO3	S	S	M	S	M	M	S	M	M	S	M	S
CO4	S	S	M	S	M	M	S	M	M	S	M	S

Strongly Correlating(S) - 3 marks **Moderately Correlating (M) - 2 marks**
Weakly Correlating (W) - 1 mark **No Correlation (N) - 0 mark**

Course Code	P21CHT14	MEDICINAL CHEMISTRY AND DRUG DESIGN	L	T	P	C
CORE - IV			5	-	-	4

Objectives:

1. To provide knowledge of the various stages of drug development and computer aided drug design.
2. To enable students, appreciate and understand the importance of bio-inorganic compounds and bio- inorganic compounds in medicine
3. To provide knowledge about the structure and function of important vitamins
4. To enable students, understand the structure and mechanism of action of drugs.

Unit I - Computer aided drug design

Stages in drug development-conventional approach-Rational drug design-Target Identification-Sequence to structure - Protein structure prediction - Homology Modeling-Active sites-Lead structure identification, Target – Substrate Docking - Scoring-molecular descriptors - High throughput screening and combinatorial chemistry-Structure-activity relationship (SAR)– Toxicity, Patents

Unit II - Medicinal Bioinorganic Chemistry

Bioinorganic Chemistry of quintessentially toxic metals. Lead, Cadmium, Mercury, Aluminum, Chromium, Iron, Copper, Plutonium. Detoxification by metal chelation. Drugs that act by binding at the metal sites of Metalloenzymes.

Chemotherapy-Chemotherapy with compounds of certain non-essential elements. Platinum complexes in Cancer therapy – Cisplatin and its mode of action – Cytotoxic compounds of other metals – Gold containing drugs as anti-rheumatic agents and their mode of action - Lithium inPschycopharmocological drugs. Molecular channels and transport processes.

Unit III - Medicinal Bioorganic Chemistry

Introduction – Study of drugs – Important terminologies in pharmaceutical chemistry – Classification and nomenclature of drugs – Antibacterial drugs – Sulpha drugs: sulphanilamide,sulphadiazine-Antibiotics: chloraphenicol, penicillin, Analgesics: morphine, heroin – Anticonvulsant: Barbiturates, oxazolindiones, streptomycin, terramycin

Unit IV- Vitamins

Classification of Vitamins, Biochemical function of vitamins, Vitamins -A, B_1, B_2, C, E and H-Sources and Deficiency diseases.Recommended dietary allowance(RDA), Structure elucidation and synthesis, Function

Unit V- Drug Action

Mechanism of action of drugs – Metabolism of drugs – Absorption of drugs, Diabetes: control of diabetes, insulin – Cancer and antineoplastic drugs: antimetabolites, plant products – Cardio vascular drugs: Antiarrhythemic drugs, antihypertension drugs

Reference Books

1. G.L. Patrick, An Introduction to Medicinal Chemistry, Oxford University, Press, 5th Ed., 2013
2. Ashutosh Kar, Medicinal Chemistry, New Age International Publishers; 7th Ed.,2018
3. J. Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand and Co.,
4. New Delhi, 2006.
5. G. Thomas, Fundamentals of Medicinal Chemistry, John Wiley & Sons, 2003

Course outcomes:
On learning the course, the students will be able to

1. comprehend and apply the concept of drug design- K1, K3
2. appreciate the importance of bio-organic compounds and bio- inorganic compounds in medicine-K5
3. illustrate the structure and function of vitamins-K4
4. correlate the structure and pharmacological action of drugs-K4

Mapping of Cos with POs &PSOs:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	S	S	S	M	M	S	S	M	M	S	M	S
CO2	S	S	S	M	M	S	S	M	M	S	M	S
CO3	S	S	S	M	M	S	S	M	M	S	M	S
CO4	S	S	S	M	M	S	S	M	M	S	M	S

Strongly Correlating(S) - 3 marks **Moderately Correlating (M) - 2 marks**
Weakly Correlating (W) - 1 mark **No Correlation (N) - 0 mark**

Course Code	P21CHP11	ORGANIC CHEMISTRY PRACTICALS	L	T	P	C
CORE -V			5	-	-	4

Objectives:

1. To develop understanding in basic chromatographic methods.
2. To learn simple extraction techniques
3. To develop skill in simple organic synthesis
4. To understand and develop the principles of quantitative and qualitative analysis of organic compounds.

1. Purification techniques of organic compounds and their spectroscopic identifications.
   a) Purification of binary mixtures by Thin Layer Chromatography (TLC) and Column chromatography
   b) Purification of tertiary mixture of amino acids by paper chromatography
   (Both experiments demonstration only)

2. Extraction of natural products such as Caffeine, Caesin.

3. Organic preparation: Any 4 preparations (involving two or more than two steps) involving the following representative reactions-
   1) Bromination
   2) Hydrolysis
   3) Nitration
   4) Condensation
   5)Oxidation

4.Qualitativeanalysis – Separation of two component mixture and identification of components by chemical methods (about 4 – 5 mixtures)

5. Quantitative Analysis
   a) Estimation of ascorbic acid
   b) Estimation of glucose

Reference Books

1. J. Mohan, Organic Analytical Chemistry: Theory and Practice; Narosa, 2003.
2. V. K. Ahluwalia, P. Bhagat, and R. Agarwal, Laboratory Techniques in Organic Chemistry; I. K. International, 2005.
3. N. S. Gnanaprakasam and G. Ramamurthy, Organic Chemistry Lab Manual; S.V.Printers, 1987.
4.Vogel's Textbook of Practical Organic Chemistry; 5th Ed., Prentice Hall, 1989

Course Outcomes

On learning the course, the students will be able to carry out (K2,K4)

1. basic chromatographic methods.
2. simple extraction techniques
3. simple organic synthesis
4. quantitative and qualitative analysis of organic compounds.

Mapping of Cos with POs &PSOs:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	S	S	S	S	S	M	S	S	M	S	S	S
CO2	S	S	S	S	S	M	S	S	M	S	S	S
CO3	S	S	S	S	S	M	S	S	M	S	S	S
CO4	S	S	S	S	S	M	S	S	M	S	S	S

Strongly Correlating(S) - 3 marks **Moderately Correlating (M) - 2 marks**
Weakly Correlating (W) - 1 mark **No Correlation (N) - 0 mark**

SEMESTER – II

Course Code	P21CHT21	ORGANIC CHEMISTRY – II	L	T	P	C
CORE - VI			5	-	-	2

Objectives

1. To enable students to understand and appreciate the advanced concepts of stereochemistry and conformational analysis.
2. To provide knowledge and understanding of the various reagents in organic synthesis and important oxidation and reduction reactions.
3. To introduce the concept of asymmetric synthesis.
4. To enable students to apply the knowledge gained in the above concepts.

Unit I - Conformational analysis of acyclic and cyclic system

Definition – restricted rotation about carbon – carbon single bonds – conformations of ethane and n-butane – conformational free energy – conformational isomers and atropisomers – population of conformers – influence of dipole – dipole repulsion, van der Waals attractive force, intramolecular H-bonding on the stability of conformers.

Conformational analysis of cyclohexane systems – stability and isomerism in mono and di substituted cyclohexane – flexible conformers – conformational analysis of cyclohexane and its derivatives, cyclohexanones – alkyl ketone effect - α - halocyclohexanones – anomeric effect, Decalins.

Unit II - Dynamic stereochemistry conformation and reactivity

Conformation and reactivity in acyclic systems – stereo electronic and steric factors – simple examples illustrating E2 and cis eliminations, intramolecular rearrangements and neighbouring group participation, Curtin-Hammett principle. WinsteinElliel Equation, Steric assisted and steric hindered reactionSimple reactions illustrating stereo and stereo-electronic factors – esterfication, oxidation, nucleophilic substitution at ring carbons and elimination reactions - reactions involving intramolecular rearrangements – formation and cleavage of epoxides and neighbouring group participation – reactions of enols and enolates

Unit III - Reagents in organic synthesis

Use of the following reagents in organic synthesis and functional group transformation – Dicyclohexylcarbodiimide, 1,3 dithiane (reactive umpolung), trimethylsilyl iodide, tri-n-butyltin hydride, Woodward and Prevost hydroxylation, DDQ Wilkinson's Catalyst – Wittig reaction

Unit IV - Oxidation and Reduction

Oxidation of organic compounds with reagents based on peroxides, peracids, ozone, oxides of osmium, chromium, iodine and selenium dioxide

Reduction of organic compounds with reagents based on $LiAlH_4$, $NaBH_4$, Raney Ni hydrazine, formic acid and dissolving metals. Clemmenson reaction, Wolf Kishner reduction, Birch Reduction.

Unit V - Asymmetric Synthesis

Importance of asymmetric synthesis – problems with resolution methods – optical purity - enantiomeric excess – diastereomeric excess – chiral, substrate controlled, auxillary controlled, catalyst controlled and solvent controlled asymmetric synthesis, example for each case, synthesis of longifolene by EJ Corey method

Reference Books

1. Ernest L. Eliel , Samuel H. Wilen (Author)Stereochemistry Of Organic Compounds, Wiley; 1st Edition, 2008
2. D. Nasipuri, Stereochemistry of Organic Compounds: Principles and Applications,New Age International Pvt Ltd;4rth Ed., 2020
3. E.L.Eliel, Stereochemistry of Carbon Compounds, McGraw Hill, 1962.
4. R.E.Ireland, Organic Synthesis, Prentice Hall, 1969.
5. S.Turner, Design of Organic Synthesis, Elsevier, 1976.

Course Outcomes

On learning the course, the students will be able to.

1. evaluate the stability of various conformers of acyclic and cyclic systems using steric, electronic and stereo-electronic effects and correlate them to reactivity- K5
2. use various models for determining stereoselectivity of various organic transformation-K3
3. understand and apply the various reagents in organic synthesis and design organic synthetic reactions-K1, K3
4. apply asymmetric transformations in a logical manner for the synthesis of chiral molecules - K6

Mapping of Cos with POs &PSOs:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	S	S	M	S	M	M	S	M	M	S	M	S
CO2	S	S	M	S	M	M	S	M	M	S	M	S
CO3	S	S	M	S	M	M	S	M	M	S	M	S
CO4	S	S	M	S	M	M	S	M	M	S	M	S

Strongly Correlating(S) - 3 marks **Moderately Correlating (M) - 2 marks**
Weakly Correlating (W) - 1 mark **No Correlation (N) - 0 mark**

Course Code	P21CHT22	INORGANIC CHEMISTRY – II	L	T	P	C
CORE - VII			5	-	-	4

Objectives:

1. To familiarize the bonding concepts and isomerism in coordination compounds.
2. To provide thorough understanding of the electronic spectra and reaction mechanisms of coordination compounds.
3. To enable students, understand the structure and bonding in organometallic compounds and pi- acceptor complexes.
4. To enable students, understand &appreciate the importance of organometallic compounds in catalysis.

Unit I - Chemistry of Coordination Compounds

Brief review of the general characteristics of transition elements, nomenclature of coordination complexes, Isomerism in coordination compounds, types of ligands and chelate effect, stepwise and overall formation constants-determination of stability constant by Job's continuous variation method., VB theory and CFT - Splitting of d-orbitals under different geometries – CFSE – evidence for CFSE-factors affecting CFSE – spectrochemical series – Jahn-Teller distortion-application of d-orbital splitting to explain magnetic properties, Limitations of CFT – MO theory – sigma – and pi-bonding in complexes – Nephelauxetic effect

Unit II- Electronic Spectra of Metal Complexes

Term symbols for atoms and ions – splitting of orbitals and terms in crystal fields – characteristics of d-d transitions – energy levels – Orgel and Tanabe – Sugano diagram – effect of Jahn – Teller distortion and spin-orbit coupling on absorption spectra – crystal field spectra of transition metal complexes – calculation of 10Dq and β forCo(II) (O_h and T_d) and Ni(II) (O_h) complexes- charge transfer spectra of bipyridine and related diimine systems

ORD and CD: Chirality and the special nomenclature of chiral coordination compounds - optical activity, ORD and CD – Cotton effect – absolute configurations of chiral coordination compounds.

Unit III - Inorganic Reaction Mechanism

Electron transfer reactions: Outer-sphere and inner sphere electron transfer reactions – The Marcus theory – non-complementary reactions – synthesis of coordination compounds by electron transfer reactions.

Substitution reactions Trans Effect, substitution reactions of square planar complexes of Pt(II) and other d^8 metal complexes – significance of trans-effect – substitution reactions of octahedral complexes – acid and base hydrolysis reactions – anation reactions, the template effect and macrocyclic ligands.

Unit IV– Organometallics

The 18 electron rule – applications and limitations – Isolobal concept and its usefulness Hapticity, Metal alkyl and aryls – olefin and acetylene complexes – Zeise salt – Dewar-Chatt approach to bonding in olefins & cyclobutadiene complexes, cyclopentadiene and benzene complexes of transition metals (preparation, bonding and reactions), – Fluxional molecules. Homogeneous catalysis involving organometallics – oxidative addition and reductive elimination reactions – hydrogenation, isomerization and hydroformylation of olefins – carbonylation of methanol, oxidation of olefins (Wacker process) - heterogeneous catalysis – Ziegler-Natta polymerization of propylene.

Unit V - Pi-acceptor Complexes

Synthesis, structure and bonding of mono nuclear and poly-nuclear carbonyls – nitrosyl complexes – dinitrogen complexes – metal carbonylato complexes, carbonyl hydrides and complex metal cyanides.

Reference Books

1. J.E. Huheey, Inorganic Chemistry, Pearson Education India; 4th edition, 2006
2. J.D. Lee, Concise Inorganic Chemistry, Wiley India, 5th edition, 2015.
3. D.E. Douglas, D.H. McDaniel, J.J. Alexander, Concepts and Models in Inorganic Chemistry, Wiley 3rd Ed. 2006.
4. F.A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry, 6th Ed., John Wiley &
5. Sons, 2007
6. F. Purcell, J. C. Kotz, Inorganic Chemistry, Saunder, 1977.

Course Outcomes

On learning the course, the students will be able to

1. identify and analyze the bonding, structure and reactivity of selected coordination complexes-K1, K4
2. interpret their electronic spectra and magnetic properties-K5
3. connect the principles of transition metal coordination complexes in understanding functions of biological systems-K5
4. understand and correlate the bonding, structure and applications of organometallic compounds -K1, K4

Mapping of Cos with POs &PSOs:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	S	S	M	S	M	S	S	S	M	S	M	S
CO2	S	S	M	S	M	S	S	S	M	S	M	S
CO3	S	S	M	S	M	S	S	S	M	S	M	S
CO4	S	S	M	S	M	S	S	S	M	S	M	S

Strongly Correlating(S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21CHT23	PHYSICAL CHEMISTRY – II	L	T	P	C
CORE -VIII			5	-	-	4

Objectives:

1. To provide a sound knowledge and understanding of the quantum chemical laws and their applications
2. To enable the students to understand and appreciate the importance of the reactions in surface and catalysis
3. To enable the students to appreciate the importance green chemistry and polymer chemistry
4. To enable the students to apply the knowledge gained in the above concepts.

Unit I-Quantum Theory – I

Planck's quantum theory – Bohr atom model - Wave – Particle duality – Uncertainty Principle – Operators and commutation relations – Sums and product of operator, commutator, linear and non-linear operator, Hermitian and Hamiltonian operator, Postulates of quantum mechanics and Schrodinger equation – eigen functions and eigen value, - Free particle – Particle in a box – degeneracy-one and three-dimensional, distortion of the box and Jahn-Teller effect, quantum numbers, zero-point energy, orthogonalisation and normalityfinite potential barrier – tunneling.

Unit II- Quantum Theory – II

Derivation of angular momentum operator, Rigid rotator-Harmonic oscillator. The hydrogen atom – space quantization of electronic orbits – angular and radial part, electron spin - Approximate methods of solving the Schrodinger equation – The perturbation and variation methods – Application to He atom - Angular momentum– spin orbit interaction – vector model of the atom – term symbols - Pauli exclusion principle Slater determinant. Atomic Structure Calculation

Unit III - Quantum Theory – III

Molecular Orbital and valence bond theory of molecules: The Born–Oppenheimer approximation, MO treatment of H_2^+, and MO and VB treatment of H_2 molecule – comparison of MO and VB methods. Bonding in homo and hetero nuclear diatomics (HF, CO, NO) – polyatomic molecules concept of hybridization -Huckel theory of conjugated systems - application to ethylene, butadiene.

Unit IV- Surface Chemistry and Catalysis

Surface Phenomena: Physisorption and chemisorptions,solid- liquid interfaces – contact angle and wetting, Adsorption from solution, , Gibbs adsorption isotherm — solid-gas interface — Freundlich, Langmuir, Temkin, BET isotherms – surface area determination.

Homogeneous catalysis – Acid-base catalysis – Acidity function – Enzyme catalysis – Michaelis–Menten kinetics. Kinetics of bimolecular surface reactions involving adsorbed species –

Langmuir-Hinshelwood mechanism, Langmuir – Rideal mechanism – Rideal –Eley mechanism. Basic aspects of semiconductor catalysis and applications
Solar energy conversion – Photogalvanic cell – Photoelectrochemical cells – Electrolysis of water.

Unit V - Polymer Chemistry

Overview of polymers – Structure and classification of polymers – Degree of polymerization, Kinetics and mechanism of free radical and ionic polymerizations - Coordination polymerization, Zeigler–Natta catalysis Condensation – Self catalysed and Non-catalyzed polycondensation, Copolymerization – Co-polymer - Equation and significance, Molecular weight of polymers– Determination of molecular weight – Lightscattering and viscosity methods - Gel permeation chromatography.
Stereoregularity of polymers- significance of T_g and T_m

Reference Books

1. Donald A. McQuarrie, Quantum Chemistry, Viva books., 2016
2. I. N. Levine, Quantum Chemistry, Pearson Education India; 7th ed., 2016
3. A.K. Chandra, Introductory Quantum Chemistry, 4thEd,. Tata McGraw Hill, 2009.
4. F.W. Billmeyer, Jr., A Text Book of Polymer Science, WileyInterscience 3rd Ed., 1984.
5. V.R. Gowariker, N.V. Viswanathan, J. Sreedhar, Polymer Science, New Age International Publishers, 3rd Ed., 2019.

Course Outcomes

On learning the course, the students will be able to

1. solve the model problems in quantum mechanics and analyze the basis behind the postulatory method of quantum mechanics -K5
2. apply time independent perturbation theory to complex problems of molecular energy levels-K3
3. appreciate and apply the principles of Polymer Chemistry-K5
4. understand and appreciate the importance of the reactions in surface and catalysis-K2,K5

Mapping of Cos with POs &PSOs:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	S	S	M	S	M	M	S	S	M	S	M	S
CO2	S	S	M	S	M	M	S	S	M	S	M	S
CO3	S	S	M	S	M	S	S	S	M	S	M	S
CO4	S	S	M	S	M	M	S	S	M	S	M	S

Strongly Correlating(S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N)

Course Code	P21CHT24	ANALYTICAL CHEMISTRY	L	T	P	C
CORE - IX			5	-	-	4

Objectives:

1. To provide a sound knowledge and understanding of the various chromatographic techniques and their applications
2. To enable students understand the different types of electroanalytical techniques.
3. To familiarize the students with spectrometric and thermal methods of analysis.
4. To enable the students to apply the knowledge gained in the above concepts.

Course Outcomes

On learning the course, the students will be able to

1. perform various chromatographic techniques for separation and analysis of compounds-K5
2. understand and apply the different types of electroanalytical techniques-K4
3. apply AAS, XRD analytical techniques for compound identification and characterization-K5
4. apply thermogravimetric techniques for characterization of compounds-K4

UnitI- Chromatography – I

Introduction to Chromotography,HPLC: Introduction – Column Packing Materials – Solvent – Detectors – Recorder – Terms and Definitions used in HPLC analysis and applications.

Gas Chromatography**:** Introduction – Retention Time – Retention Volume – Efficiency – Career Gases – Preparation of Columns – Solid Supports – Stationary Phases Detectors – Temperature Effect – Quantitative and Qualitative analysis and applications.

Unit II - Chromatography – II

Gel Permeation Chromatography: (GPC)
Introduction – Types of gels – Selection of gels – Gel Preparation – Drying of gels – Packing of the Column Application of the sample – Resolution – Detectors and Applications.

Gas Chromatography Mass Spectrometry: (GCMS)
Introduction – Separators – Carrier gas – Sample Injection – Analyzer and Applications.
Liquid Chromatography Mass Spectrometry: (LCMS)
Introduction – Ionization – Belt Interface – Instrumentation and Applications.

Unit III - Electroanalytical methods

Amperometry-Principles and applications, amperometric titration with examples-comparison with other titration methods-Basic principles of electrogravimetry
Coulometry**:** principles- coulometry at controlled potential- coulometry at constant current-coulometric titrations-advantages and applications

Cyclic Voltammetry**:** Principles and simple analytical applications – Interpretation of cyclic voltammogram.

Unit IV - Spectrometry and thermal methods

Atomic absorption spectrophotometer(AAS)- principle, instrumentations and applications-types of interferences. Flame Emission spectroscopy (FES)- theory, instrumentationand applications, Difference between AAS and FES. Thermal methods of Analysis- principle, instrumentations and applications of TG, DTA and DSC-thermograms of calcium oxalate and $CuSO_4.5H_2O$

Unit V- X-Ray diffraction

Crystal structure -Lattices and symmetries -Reciprocal lattice- Crystal symmetry- Point groups Plane groups and space group -Screw Axis and Glide planes; Diffraction of light – principles X-ray diffraction: geometry; About crystal structures and diffraction patterns, Practical aspects of X-ray diffraction, Powder X-ray diffraction, Principles and application, Interpretation and data collection.

Reference Books

1. D. A. Skoog, S. R. Crouch, F. J. Holler, Principles of Instrumental Analysis, Brooks Cole, 6th Ed., 2014
2. D. C. Harris, Quantitative Chemical Analysis, 4th Ed., W. H. Freeman, 1995
3. G. D.Christian& J. E. O'Reily, Instrumental Analysis, 2nd Ed., Allyn&Balon, 1986.
4. P.J. Wheatley, The Determination of Molecular Structure, (Unit V), Oxford University Press, 1968.

Mapping of Cos with POs &PSOs

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	S	S	S	S	S	M	S	S	S	S	M	S
CO2	S	S	S	S	S	M	S	S	S	S	M	S
CO3	S	S	S	S	S	M	S	S	S	S	M	S
CO4	S	S	S	S	S	M	S	S	S	S	M	S

Strongly Correlating(S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21CHP22	INORGANIC CHEMISTRY PRACTICALS	L	T	P	C
CORE - X			-	-	5	4

Objectives:

1. To develop skill identifying less common metal ions.
2. To develop skill in estimating metal ions through complexometric titrations.
3. To develop skill in estimating metal ions through redox titrations.
4. To develop skill in estimating metal ion through spectrophotometry.

Course Outcomes

On learning the course, the students will be able to

1. identify less common metal ions -K1
2. estimate metal ions through complexometric titrations-K5
3. estimate metal ions through redox titrations-K5
4. estimate metal ion through spectrophotometry-K5

Practical – A : Qualitative Analysis

Less common metal ions – Mo, Se, Te, Ce, W, Ti, Zr, Th, U, V, Li (two metal ions in cationic and anionic forms)

Practical – B : Quantitative Analysis

a) EDTA titrations : Zn(II), Mg(II), Cu(II) and Ni(II)
b) Redox titrations : Fe(II) vs. Ce(IV) , Fe(II) vs. dichromate
NO_2^- vs. Ce(IV)
c) Spectrophotometric methods of analysis :
Fe(II) , Cu(II) .

References

1.A. I. Vogel, Text Book of Quantitative Inorganic Analysis; 6th Ed., Longman, New Delhi, 2000.

Mapping of COs with POs &PSOs:

PO/PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	S	S	S	S	S	M	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S	S	S	S	S	S
CO3	S	S	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	M	S	S	S	S	S	S

Strongly Correlating(S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21CHS22	COMPUTATIONAL CHEMISTRY	L	T	P	C
SUPPORTIVE (SKILL) - II			5	-	-	4

Objectives

1. To enable students to use chemistry softwares and internet for chemical research
2. To enable students, appreciate the importance of computational chemistry
3. To provide knowledge on the various computational chemistry methods
4. To enable students to perform basic quantum chemical calculations and understand the basics of molecular modelling

Course Outcome

At the end of this course the students will be able to

1. use chemistry softwares to analyze and present chemical and spectroscopic data-K3
2. appreciate the importance of computational chemistry-K5
3. perform basic quantum chemical calculations-K5
4. recognize the importance of molecular modelling and understand the basics-K1

Unit I - Operating systems & chemistry structure drawing softwares

General introduction to computers-different components of computer, operating systems-applications and uses of common softwares in chemistry-Origin, Chemsketch and Chemdraw

Unit II - Molecular Mechanics

General Introduction to computational chemistry – scope of computational chemistry - Methods – Molecular Mechanics – Semiempirical Methods – Ab initio method- Density Functional Theory Method – Molecular Dynamics

Unit III - Molecular Modelling

Conceptual background of molecular modelling: -molecular mechanics -Force Fields-Potential Energy functions for molecules-Application of molecular mechanics in chemistry

Unit IV- MO methods

Introduction to MO methods-ab initio methods-DFT methods - Computation of single point energies, Geometry optimization and properties.

Unit IV- Computational chemistry softwares

Computational chemistry softwares- Introduction-Different input formats-Cartesiancoordinates-Internal coordinates. Application of computational chemistry-MOPAC, GAUSSIAN

Reference Books

1. Donald A. McQuarrie, Quantum Chemistry, Viva books., 2016
2. I. N. Levine, Quantum Chemistry, Pearson Education India; 7th ed., 2016
3. F. Jensen Introduction to Computational Chemistry, Wiley-Blackwell, 2nd Ed., 2006
4. Andrew R.Leach Molecular Modelling Principles and applications, Prentice Hall, 2nd Ed., 2001
5. June Gunn Lee, Computational Materials Science: An Introduction, CRC Press, 2011

Mapping of Cos with POs &PSOs:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	S	S	M	S	M	M	S	M	M	S	S	S
CO2	S	S	M	S	M	M	S	M	M	S	S	S
CO3	S	S	M	S	M	M	S	M	M	S	S	S
CO4	S	S	M	S	M	M	S	M	M	S	S	S

Strongly Correlating(S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

SEMESTER - III

Course Code	P21CHT31	ORGANIC CHEMISTRY – III	L	T	P	C
CORE - XI			5	-	-	4

Objectives:

1. To provide understanding of the basic concepts of photochemistry and various organic photochemical reactions.
2. To familiarize the concept of pericyclic reactions.
3. To provide understanding of the principles and applications of spectroscopic techniques
4. To enable students to analyze organic compounds using various spectroscopic techniques.

Course Outcomes

On learning the course, the students will be able to

1. understand the basic concepts of photochemistry and various organic photochemical reactions-K2
2. illustrate the concept of pericyclic reactions-K4
3. apply NMR, IR, MS, UV-Vis spectroscopic techniques in solving structure of organic molecules and in determination of their stereochemistry-K5
4. interpret the above spectroscopic data of unknown compounds-K5

Unit I - Organic Photochemistry

Thermal versus photochemical reactions, basic concepts of organic photochemistry, Jablonski diagram – energy transfer mechanism – photochemical reactions of saturated ketones – Norrish type I and II reactions – photoreduction – Paterno -Buchi reaction – reaction of α, β unsaturated ketones – isomerisations – photochemistry of simple olefins – cis-trans isomerisation – di-π methane rearrangement – photochemical oxidations – oxidative coupling – photochemistry of arenes.

Unit II - Pericyclic reactions

Definition of pericyclic reactions – electrocyclic, cycloaddition and sigmatropic reactions – selection rules and stereochemistry for thermal and photochemical reactions – explanation on the basis of (i) FMO approach (Fukui), (ii) orbital correlation diagram approach (Woodward and Hoffmann) and (iii) aromatic transition state approach (Dewar and Zimmerman) Taking simple systems as example. Diels-Alder reaction, ene reaction, Sommelet – Hauser, Cope and Claisen rearrangements.

Unit III - Application of UV, IR and Mass Spectrometry in organic chemist

UV spectra – types of excitation or transition probability – chromophores and auxochromes – factors affecting intensity and position of absorption bands – Dienes, Polyenes and Enones – Woodward Fischer rules.

IR Spectra – Hooke's law – factors affecting vibrational frequencies – characteristic group frequencies – Finger print region.

Mass spectrometry – basic principles – molecular ion peak, parent peak, fragments, metastable peak, isotope peaks – determination of molecular weight and molecular fragment – fragment pattern of simple organic molecules – McLafforty rearrangement – Retero Diels Alder reaction.

Unit IV- Applications of NMR spectroscopy in organic structural determination

^{1}H NMR spectroscopy – origin of NMR spectra – chemical shift – number of signals – peak areas – multiplicity – geminal, vicinal and long range couplings – factors affecting chemical shifts and coupling constants, Karplus equation.Simplification of complex spectra – double resonance techniques, shift reagents –\ an elementary treatment of NOE phenomenon.

13C NMR Spectroscopy – broad band decoupling – off resonance decoupling –chemical shifts of common functional groups –γ - gauche effect-
DEPT spectra – identification of small compounds based on NMR data – 2Dtechniques: 1H–1H COSY, 1H–13C HETCOSY – NOESY.

Unit V - Organic Synthesis

Importance of synthesis – carbon-carbon bond making reactions – functional group modifications – reterosynthetic analysis – synthons and synthetic equivalents – nucleophilic, electrophilic, electroneutral and free radical synthons – retron, partial retron and super retron - Chiron – umpolung – protection and deprotection – product, chemo, regio and stereoselectivities.

One and two group disconnections – Diels Alder reactions – Robinson annulation method – 1,2- 1,3- 1,4- 1,5- and 1,6- difunctional compounds

Reference Books

1. P.M. Silverstein, F.X. Wester, Spectroscopic Identification of Organic Compounds, Wiley, 8th Ed.2015.
2. W. Kemp, Organic Spectroscopy, Macmillan, 2nd Ed., 2019.
3. J.D. Coyle, Organic Photochemistry, Wiley, 1985.
4. G.R. Chatwal, Organic Photochemistry, Himalaya Publications house, 2010.
5. C.H.Depuy and D.L. Chapman, Molecular Reactions and Photochemistry, Prentice Hall, 1975.
6. S. Sankararaman, Pericyclic Reactions - A Textbook: Reactions, Applications and Theory, Wiley-VCH; 1st edition 2005

Mapping of Cos with POs &PSOs:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
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CO2	S	S	S	S	S	M	S	S	M	S	M	S
CO3	S	S	S	S	S	M	S	S	M	S	M	S
CO4	S	S	S	S	S	M	S	S	M	S	M	S

Strongly Correlating(S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N)

Course Code	P21CHT32	INORGANIC CHEMISTRY – III	L	T	P	C
CORE - XII			5	-	-	4

Objectives:

1. To enable the students to analyze the inorganic compounds using various spectroscopic techniques.
2. To appreciate and understand the importance of nuclear reactions
3. To familiarize the important inorganic photochemical reactions.
4. To enable the students to apply the knowledge gained in the above concepts.

Course Outcomes

On learning the course, the students will be able to

1. analyze inorganic compounds using various spectroscopic techniques-K5
2. understand the principles and applications of nuclear reactions -K2
3. familiarize the important inorganic photochemical reaction-K4
4. apply the knowledge gained in the above concepts-K3

Unit I - Infrared Spectroscopy

Infrared Spectroscopy in the structural elucidation of simple molecules like N_2O, ClF_3, NO_3^-, ClO^-_4 – effect of coordination on ligand vibrations – uses of group vibrations in the structural elucidation of metal complexes of urea, thiourea, cyanide, thiocyanate, nitrate, sulphate and dimethyl sulfoxide

Unit II- NMR Spectroscopy

Examples for different spin systems – chemical shifts and coupling constants (spin-spin coupling) involving different nuclei (^1H, ^{19}F, ^{31}P, ^{13}C) interpretation and applications to inorganic compounds- NMR spectra of P_4S_3,H_3PO_3,H_3PO_2 and HPF_2. ^{19}F NMR spectra of ClF_3, BrF_3 and equimolar mixture of TiF_6 and TiF_4 in ethanol – Effect of quadrupolar nuclei on the ^1H NMR spectra, Satellite spectra.

Systems with chemical exchange - study of fluxional behavior of molecules NMR of paramagnetic molecules – isotropic shifts contact and pseudo-contact interactions – Lanthanide shift reagents.

Unit III- EPR Spectroscopy

Theory of EPR spectroscopy - Spin densities and McConnell relationship –presentation of the spectrum-hyperfine splitting, Applications of ESR to some simple systems such as CH_3, p-

benzosemiquinone, Xe_2^+ - Factors affecting the magnitude of g and A tensors in metal species - Zero-field splitting and Kramers degeneracy – Spectra of VO(II), Mn(II), Fe(III), Co(II), Ni(II) and Cu(II) complexes

Mossbauer Spectroscopy

Theory-Doppler effect - isomer shift-quadruple splitting-magnetic hyperfine splitting-application of MB spectroscopy to inorganic compounds

Unit IV - Nuclear Chemistry

Properties of nucleus – different types of nuclear forces – liquid drop model, shell model of nucleus – nuclear reactions induced by charged particles – Q value – nuclear reaction cross section, significance and determination – theory of nuclear fission – reactor and its components – production of feed materials for nuclear reactors – disposal of radioactive wastes – nuclear fusion, stellar energy. Application of radioisotopes in agriculture, industry and medicine – neutron activation analysis – hot atom chemistry.

Unit V - Inorganic Photochemistry

Elementary ideas on the photosystems I and II - Photochemistry of Cr(III), Co(III) and Ru(II) - coordination compounds – photoaquation – photoanation – photoisomerisation – photo redox reactions – charge transfer photo chemistry – photosensitization – solar energy conversiuon – photogalvanic cell – splitting of water to evolve hydrogen and oxygen – photochemistry of Pt(II) and Pt(IV) complexes.

Reference Books

1. R.S. Drago, Physical Methods in Inorganic Chemistry, 3rd Ed., Wiley Eastern Company, 2012
2. Colin N. Barnwell, E. M. McCash, Fundamentals of Molecular Spectroscopy, McGraw Hill Education, 4rth Ed., 2017
1. K.K. Rohatgi-Mukherjee, Fundamentals of Photochemistry, New Age Publishers, 3rd Ed 2017.
4. E.A.V. Ebsworth, Structural Methods in Inorganic Chemistry ELBS, , 3rd Ed.,1987.
5. H. J. Arniker, Nuclear Chemistry Through Problems, New Age International Private Ltd, 2016
6. R.S. Drago, Physical Methods in Chemistry, W. B. Saunders Company, 1992.

Mapping of Cos with POs &PSOs:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	S	S	M	S	M	S	S	S	M	S	M	S
CO2	S	S	M	S	M	S	S	S	M	S	M	S
CO3	S	S	M	S	M	S	S	S	M	S	M	S
CO4	S	S	M	S	M	S	S	S	M	S	M	S

Strongly Correlating(S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N)

Course Code	P21CHT33	PHYSICAL CHEMISTRY – III	L	T	P	C
CORE - XIII			5	-	-	4

Objectives:

1. To provide a sound knowledge and understanding of the concepts and applications of group theory.
2. To familiarize the theories behind various spectroscopic techniques
3. To provide knowledge and understanding of statistical thermodynamics and its applications.
4. To enable the students to apply the knowledge gained in the above concepts.

Course Outcomes

On learning the course, the students will be able to

1. determine the symmetry operations of any small and medium-sized molecule and apply point group theory to the study of hybridization and spectroscopy- K4, K5
2. apply knowledge of the theories behind spectroscopic techniques for analysis-K3
3. apply the concepts of statistical thermodynamics for the study of equilibrium reactions-K3
4. apply the concepts of statistical thermodynamics for the study of reaction rates-K3

Unit I - Group Theory: Concepts

Elements of symmetry – point group classification of molecules – definition and theorems of group – properties of group with examples - symmetry operations as elements of group – group multiplication table – similarity transformations – sub groups – classes – representation of groups - reducible and irreducible representations – Great orthogonality theorem (derivation and proof excluded) – character table for H_2O and NH_3 molecules – format and significance – direct products and simplified procedure for generating and factoring total representations. Symmetry adapted linear combinations – projection operators.

Unit II- Group Theory: Applications

Molecular vibrations and their symmetry types in typical molecules – IR and Raman activity – bonding with central atom and formation of hybrid atomic orbitals in molecules such a BF_3, $(PtCl_4)_2CH_4$ – simplification of MO calculations – naphthalene, benzene – symmetries of molecular orbitals and electronic configurations – group theoretical selection rules – vanishing matrix elements selection rules for electronic transitions – electronic spectra of the carbonyl chromophore.

Unit III- Spectroscopy – I

General features of spectrum – Experimental techniques – Intensities of spectral lines and linewidths - Rotational spectra - Vibrational spectra – Rotation–Vibration spectra of diatomic and polyatomic molecules – Fermi resonance – Basic concepts of FTIR – Raman spectroscopy –

Rotational Raman and vibrational Raman – Resonance Raman and Laser Raman – Electronic spectra of diatomic molecules – Franck-Condon principle – Vibrational and rotational fine structure – Fortrat diagram – Predissociation.

Unit IV - Spectroscopy – II

NMR – nuclear spins in a magnetic field – Zeeman effect – Larmor precession – Resonance phenomenon – Block equations – Spin - lattice and spin-spin relaxation times – Nuclear shielding and chemical shift – Spin-spin coupling – Basic principles of FT NMR – Inversion recovery and CPMG sequenced for T_1 and T_2 measurements – NMR instrumentation.

ESR – Electronic ZeemanEffect – ESR spectrum of hydrogen atom (first order treatment) - g factors – Hyperfine constants – ESR of organic radicals in solution – McConnell's relation – ESR instrumentation.

Unit V - Statistical Thermodynamics

Thermodynamics probability and entropy – Maxwell-Boltzman, Bose-Einstein and Fermi-Dirac statistics and applications, - partition function and entropies for translational, rotational, vibrational and electronic motions of monoatomic and diatomic molecules – calculations of thermodynamic functions and equilibrium constants – specific heat of solids – Einstein and Debye theories.

Reference Books

1. F.A. Cotton, Chemical Applications of group Theory, 3rd Ed., Wiley Eastern, 2004.
2. R.L. Carter, Molecular Symmetry and Group Theory John Wiley, 1998.
3. C.N. Banwell, E. McCash, Fundamentals of molecular Spectroscopy, 4th Ed., TMH, 2008.
4. B.P. Straughan, S.Walker Spectroscopy Vol.3, Chapman Hall, 1976.
5. G.M. Barrow, Introduction to Molecular Spectroscopy, McGraw Hill, 1964.
6. P.K. Ghosh, Introduction to Photoelectron Spectroscopy, John Wiley, 1989.
7. P.W. Atkins, Physical Chemistry, 7th Ed., Oxford University press, 2002.

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CO2	S	S	M	S	M	M	S	M	M	S	M	S
CO3	S	S	M	S	M	M	S	M	M	S	M	S
CO4	S	S	M	S	M	M	S	M	M	S	M	S

Strongly Correlating(S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N)

Course Code	P21CHT34	ENVIRONMENTAL CHEMISTRY	L	T	P	C
CORE - XIV			5	-	-	4

Objectives:

1.To provide an overview of water, air, soil, radioactiveand noise pollution
2.To insist the need for protecting environment and prevent pollution
3. To impart knowledge on the analysis of pollution
4.To provide knowledge on prevention of pollution and its control measures.

Corse outcomes:

At the end of the course, students will be able to:

1. explain the cause, consequence and cure of various types pollution-K1
2. identify the effect of metals and metallic compounds on human health-K4
3. assess the implication of climate change-K5
4. analyze and suggest methods to control air and water pollution-K4, K6

Unit I - Water Pollution

Types of Water Pollution- ground water and surface water pollution - Sources and harmful effects-sources and effects of major water pollutants-Inorganic pollutants and toxic metals-Oxygen demanding wastes-Organic pollutants-Plant nutrients-detergents-suspended matter-radioactive wastes-Sediments-Thermal pollutants –oilspills– examples

Unit II - Air Pollution

Atmosphere structure-functions and photochemical reactions-sources of air pollution-Natural and manmade-classification and effects of air pollutants -oxides of carbon nitrogen and sulphurhydrocarbon as pollutant- reactions of hydrocarbons and effects - particulate pollutants sources and effects of organic and Inorganic particulates - Greenhouse effect-impact on global climate-control measures-role of CFC's -ozone holes-effects of ozone depletion-smog componentsof photochemical smog-effects of photochemical smog.

Unit III- Soil pollution

Pesticides, classification and mode of action -toxic effects of chlorinated hydrocarbons, organophosphorous compounds and carbamates - alternatives to chemical pesticides-(pheromones, Juvenile harmones, chemo sterilization)
Soil pollutants-sources and effects of industrial wastes-urban wastes-radioactive pollutants-agricultural wastes-solid waste management in cities, soil pollution control measures.

Unit IV - Metal Toxicology and Nuclear Pollution

Effects of metals and metallic compounds toxicology and health risks of iron, arsenic, cadmium, chromium, lead, mercury and nickel.

Nuclear pollution-sources-effects of ionizing and non-ionizing radiation - genetic and somatic effects-effects of Cesium-137, Krypton-85 Iodine-131 and Strontium-90 - storage of nuclear wastes-disposal of nuclear wastes-nuclear disasters and their management-some major nuclear accidents.

Unit V - Analysis and Control

Sampling of polluted water - preservation-main quality characteristics of wateralkalinity, hardness, total solids- TDS - DO, BOD, COD, TOC, fluoride and chloride. Defluoridation techniques-Iron removal-sampling of gaseous pollutants and particulates–adsorption - absorption - scrubbing – cold trapping – filtration - cyclone separator – gravity settling - electrostatic precipitators - thermal precipitators - analysis of CO by gas chromatography, NO by chemiluminescence and SO_2 by spectrophotometer.

References

1. A.K. De Environmental Chemistry, A.K. De, New Age InternationalPublishers 9^{th} Edition, 2018.
2.B.K. Sharma Environmental Chemistry, Goel Publishers, 2001.
3.Environmental Chemistry, M.S. Sethi, Sri SaiPrintographers, 1994.
4.Text book of Environmental Chemistry, C.D. Tyagi and M.Mehra, Anmol Publishers, 1996.
5.Fundamentals of Environmental Pollution, K. Kannan, S. Chand & Co., 1997.
6.AsimK.Das, Environmental Chemistry with Green Chemistry, Books & Allied (P) Ltd, Kolkata, 2012.

Mapping of Cos with POs &PSOs:

PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
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CO2	S	M	M	M	M	S	S	M	S	S	S	S
CO3	S	M	M	M	M	S	S	M	S	S	S	S
CO4	S	M	M	M	M	S	S	M	S	S	S	S

Strongly Correlating(S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21CHT35	CHEMISTRY OF NATURAL PRODUCTS AND BIOINORGANIC CHEMISTRY	L	T	P	C
CORE -XV			5	-	-	4

Objectives

1. To enable the students to understand the structure of organic natural products.
2. To provide knowledge of the structures of metalloproteins and metalloenzymes.
3. To familiarize the importance of natural product and bio-inorganic compounds.
4. To enable the students to know and appreciate the importance of chemistry of nature.

Course Outcomes

On learning the course, the students will be able to

1. understand and illustrate the structure of organic natural products -K2, K5
2. illustrate the structures of metalloproteins and metalloenzymes-K5
3. appreciate the importance of natural products and bio-inorganic compounds-K5
4. know and appreciate the importance of chemistry of nature-K1, K5

Unit I - Proteins, peptides, Nucleic acid, Fats and Lipids

Structure and properties of amino acids and proteins, Zwitterions and purification of proteins

Nucleic acids – nucleotides and nucleosides – structure of purine and pyrimidine bases; Phosphodiester bond, double helical structure of DNA. Structure of RNA (tRNA)

Fatty acids - structure and classification, lipids classification and function (Simple, compound and derived lipids)

Unit II - Terpenoids

Classification of terpenoids with examples – isoprene rules – General methods of structural determination of terpenes – structure and synthesis of alpha-pinene, cadinene, zingeberene and abietic acid

UnitIII -Alkaloids

General methods of structure analysis of alkaloids – Hoffmann, Emde and von Braun degradations – Structure and synthesis of quinine, papavarine, atropine, narcotine, reserpine and lysergic acid.

UnitIV– Steroids

Types of steroids – structure, stereochemistry and synthesis of cholesterol – Structural features of bile acids – Sex harmones – androsterone, testerosterone, estrone, estriol, estradiol, progesterone - Structure of ergosterol.

Circular birefringence, optical rotary dispersion, circular dichroism – Cotton effect curves – octant rule – axial haloketone rule - Applications of chiroptical properties in configurational assignments.

Unit V - Bioinorganic Chemistry

Metal ions in biological systems: heme proteins, hemoglobin, myoglobin, hemerythrin, hemocyanin, ferritin, transferrin, cytochromes and vitamin B12; Iron-sulphur proteins: rubredoxin, ferredoxin and model systems. Classification of copper proteins and examples - Electron transfer (Cu, Zn) – Blue copper proteins

Metalloenzymes: active sites, carboxy peptidase, carbonic anhydrase, superoxide dimutase, xanthine oxidase, peroxidase and catalase; photosynthesis, water oxidation, nitrogen fixation, nitrogenase; ion pump, metallodrugs.

Reference Books

1. I.L. Finar, Organic Chemistry, Vol.II, ELBS 1985
2. S.J. Lippard, J.M. Berg, Principles of Bioinorganic Chemistry, Panima Publishing Company, 1977.
3. Gurdeep R Chatwal,Organic Chemistry Of Natural Products, Volume I , Himalaya Publishing House, 2009
4. L. Stryer, Biochemistry, 4th Ed., W. L. Freeman and Co, New York, 1995.
5. D. L. Nelson, M. M. Cox, Lehninger Principles of Biochemistry, 5th Ed.

Mapping of Cos with POs &PSOs:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
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CO3	S	M	M	M	M	S	S	M	M	S	M	S
CO4	S	M	M	M	M	S	S	M	M	S	M	S

Strongly Correlating(S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

Course Code	P21CHP33	PHYSICAL CHEMISTRY PRACTICALS	L	T	P	C
CORE - XVI			-	-	6	4

Objectives:

1. To develop skill in carrying out kinetics experiments
2. To develop skill in carrying out experiments related to distribution law and study phase diagrams.
3. To impart skill in analysis through conductometry.
4. To develop skill analysis through potentiometry

Course Outcomes

On learning the course, the students will be able to

- explain the principle behind the experiments-K1
- plan and perform experiments-K5
- interpret experimental results-K5
- perform estimation through conductometry and potentiometry-K5

Any 14 experiments out of the following experiments (to be decided by the course teacher):

1. Kinetics – Acid Hydrolysis of Ester – Comparison of strength of acids.
2. Kinetics – Acid Hydrolysis of Ester – Determination of Energy of Activation (E_a).
3. Kinetics – Saponification of Ester – Determination of E_a by conductometry.
4. Kinetics – Persulphate – Iodide Reaction – Determination of order, effect of Ionic strength on rate constant.
5. Adsorption – oxalic Acid\Acetic Acid on charcoal using Freundlich isotherm.
6. Conductometry – Acid – alkali titrations.
7. Conductometry – precipitation titrations.
8. Conductometry - Displacement titrations.
9. Conductometry – Determination of dissociation constant of weak acids.
10. Conductometry – Solubility product of sparingly soluble silver salts.
11. Verification of Onsager equation – conductivity method.
12. Determination of degree of hydrolysis and hydrolysis constant of a substance.
13. Potentiometric titrations – Acid alkali titrations.
14. Potentiometric titrations – Precipitation titration.
15. Potentiometric titrations – Redox Titrations.
16. Potentiometry – Determination of dissociation constant of week acids.
17. Potentiometry- Determination of solubility product and pKa

Reference Books

1. B.P. Levitt, Ed., Findlay`s practical Physical Chemistry, 9th Ed., Longman, 1985.
2. J.N. Gurtu, R. Kapoor, Advanced Experimental Chemistry, Vol.I, S.Chand& Co., 1987.
3. B. Viswanathan and P. S. Raghavan, Practical Physical Chemistry, Viva Books,2009.

Mapping of Cos with POs &PSOs:

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CO3	S	S	S	S	M	M	S	S	S	S	S	S
CO4	S	S	S	S	M	M	S	S	S	S	S	S

Strongly Correlating(S) - 3 marks Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark No Correlation (N) - 0 mark

SEMESTER - IV

Course Code	P21CHE411	GREEN CHEMISTRY	L	T	P	C
ELECTIVE-I			5	-	-	4

Objectives

1.To enable the students to learn the principles and concepts of Green Chemistry
2. To familiarize the concept of green catalysis
3. To equip the students with knowledge about, environmentally benign greener synthesis and greener methods for isolation of bioactive compounds
4. To create a responsibility and awareness about chemicals and solvents used in thepredation and synthesis

Course Outcome:

On learning the course, the students will be able to

1. gainpreliminary knowledge and exposure about greener context in chemistry -K1
2. understand the role of catalysts in greener organic transformation-K2
3. gain knowledge about the designing greener organic synthesis-K3
4. gain knowledge on instrumentation, principle and application of conventional and greener techniques used in extraction and separation of phytoconstituents-K1

Unit I - Introduction to Green Chemistry

Definition, origin, history, needs, goals, twelve principles of green chemistry planning a green synthesis in a chemical laboratory – evaluating the type of reaction involved – rearrangement, addition, substitution, elimination and pericyclic reactions.
Selection of appropriate solvent – aqueous phase reaction – reactions in ionic liquids –organic synthesis in solid state – solid supported organic synthesis – selection ofstarting materials – use of protecting group – use of catalyst – use of microwaves and sonication.

UnitII - Designing of Green Synthesis

Green synthesis, designing, choice of starting materials, choice of reagents, choice of catalysts, bio catalysts, polymer supported catalysts, choice of solvents, synthesis involving basic principles of green chemistry.

Unit III - Phase-Transfer Catalyst Reactions

Phase-transfer catalyst reactions – Heck reaction – Michael addition reaction –oxidation of toluene to benzoic acid – Reimer-Tiemann reaction – Baker-Venkataramansynthesis – Williamson ether synthesis – Dozen reaction.

Unit IV - Sonication Reactions

Sonication reactions – Barbier reaction – Reformatsky reaction – Simmons-Smith reaction – Strecker synthesis – Ullmann coupling reaction – Wurtz reaction –Bouveault reaction. examples synthesis of adipic acid, methylmethacrylate, paracetamol ultrasound assisted reactions, esterification, reduction, coupling reactions.

Unit V - Extraction of Bioactive Compounds by Green Approaches

Instrumentation, principle and application of conventional and green techniques used in extraction and separation of phytoconstituents: hydro extraction, wet steam and dry extraction, head space extraction, super critical fluid extraction, pressurized liquid extraction, Microwave assisted methods, Ultrasonication assisted extraction and simulated moving bed technology.

References

1. V. K. Ahluwalia, Green Chemistry; 2nd Ed., Ane Books Pvt Ltd., New Delhi, 2016.
2. P. T. Anastas and J. C. Warner, Green chemistry Theory and Practice; Oxford University Press, New York, 2005
3. V. K. Ahluwalia and K. Agarwal, Organic Synthesis, Special Techniques; 2nd Ed.,2006.
4. R. A,Sheldon, I.Arends, UIF, Hanefeld.Green Chemistry and Catalysis (Wiley –VCH) 2007.

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CO3	S	S	M	S	M	M	S	S	S	S	M	S
CO4	S	S	M	S	M	M	S	S	S	S	M	S

Strongly correlating :S Moderately Correlating : M
Weakly correlating :W No correlation :N

Course Code	P21CHE412	CHEMISTRY IN EVERYDAY LIFE	L	T	P	C
ELECTIVE - II			5	-	-	4

Objectives

1.To provide knowledge and understanding on Dairy Chemistry
2. Toprovide information on the various chemicals in food, nutrition and food adulteration
3.To inculcate the basic knowledge of minerals, cosmetics and cleansing agents.
4.To learn about the basic chemicals, petrochemicals, polymers, dyes, paints and building materials

Course Outcomes

On learning the course, the students will be able to

1. appreciate the central role of chemistry in our society -K5
2. comprehend the role of chemicals in Food & Nutrition-K2
3.illustratethe role of chemistry in food production-K5
4. understand and explain the role of chemistry in petrochemical, polymer, and cosmetic Industry-K1

Unit I- Dairy chemistry

General composition of milk – constituents of milk lipids, proteins, carbohydrates, vitamins and minerals. Physical properties of milk – colour, odour, acidity, specific gravity, viscosity and conductivity. Factors affecting the composition of milk – pasteurization, homogenization, toning, standardization, reconstitution of milk - adulteration of milk.

Unit II - Chemicals in food:

1. Table salt, sugar, baking powder, baking soda, Preservatives, artificial sweetening agents -common examples
2. Nutrition: Carbohydrates, Proteins, Fats, Minerals and Vitamins –definitions, sources and their physiological importance -balanced diet
3. Food Adulteration:
Adulterants in milk, ghee, oil, coffee, tea, asafetida, chili powder, pulses and turmeric powder -identification. Colorchemicals used in food - soft drinks and its healthhazards

Unit III - Mineral metabolism:
Calcium – source, daily requirement, blood calcium,hypocalcemia, phosphorus – functions of phosphate, requirement, source, normal serum level, functions.
Sodium – normal level of sodium, excretion of sodium, restriction of sodium in diet, hypernatremia.

Cosmetics:

Talcum Powder, Tooth pastes, Shampoos, Nail Polish, , Perfumes -General formulations –possible hazards of cosmetics use

Cleansing agents:

Soaps and detergents, cleansing action, bleaching and stain removal

Unit IV- Chemistry and Industry-I

1. Chemicals in food production:

Fertilizers such as urea, NPK and Super phosphates -uses and hazards Pesticides –definition and examples Fertilizers from natural sources

2. Petrochemicals:

Generations and composition of petrochemicals, Rocket propellants

3. Polymers and Plastics:

Polythene, polyester, PVC, bakelite, resins; Teflon and nylon -their applications Biodegradable polymers and Biopolymers

Unit V - Chemistry and Industry-II

1. Dyes, Paints and Pigments:

Composition, Classification and Applications; Process of dying.

2 Building Materials:

Cement and its manufacture, Mortar, Concrete and R.C.CManufacture of glass, Ceramics

3. Rubber:Natural Rubber-Synthetic rubbers-Vulcanization-definition and its applications.

References

1.Carl H Snyder, The Extraordinary Chemistry of Everyday Things, 4th edition,2003
2.Alfred Vivian,EverydayChemistry,HardpressPublishing,2012
3. John Emsley Chemistry at Home: Exploring the Ingredients in Everyday Products,Royal Society of Chemistry; Illustrated edition, 2015
4.Kirpal Singh, Chemistry in Daily Life: PHI, 3rd Ed., 2010
5. Peter Varelis , Laurence Melton , FereidoonShahidi, Encyclopedia of Food Chemistry ,Elsevier 2019

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CO4	S	S	S	S	S	M	S	M	S	S	M	S

Strongly correlating :S Moderately Correlating : M
Weakly correlating :W No correlation :N

Course Code	P21CHE421	INDUSTRIAL CHEMISTRY	L	T	P	C
ELECTIVE-1II			5	-	-	4

Objectives

1. To enable students to gain knowledge on various industrial wastes& their treatment.
2.To enable studentsunderstandthe chemistry behind petroleum and petrochemicals.
3. To make students aware of the chemistry involved and the different industrial processes involved increment industry &paperindustry
4.To make the students understand the processes involved in the production of soaps, detergents and perfumes.

Course Outcomes

At the end of the course, the students will be able to

1.understand the hazards of various industrial wastes and the ways to treat them-K2
2.comprehend and apply the chemistry behind petroleum and petrochemicals-K3
3.explain the constituents, properties and production of cement-K4
4.explain the involved in the production of soaps, detergents and perfumes-K1

Comment [SJK1]:

Unit I - Basic Ideas and Industrial Wastes

Basics idea about Unit operation – flow chart – chemical conversion – batchversuscontinuous processing – chemical process selection – design – chemicalprocess control.
Types of industrial wastes – treatment of wastes or effluent with organicimpurities – treatment of wastes or effluent with inorganic impurities –treatment of some important chemical wastes.

Unit II - Petroleum and Petrochemicals

Introduction – saturated hydrocarbons from natural gas – uses of saturatedhydrocarbons – unsaturated hydrocarbons – acetylene, ethylene, propylene,butylene – aromatic hydrocarbons – toluene and xylene.Preparation of rectified spirit from beat – methylated spirit – preparation ofabsolute alcohol from rectified spirit – petrochemicals in India.

Unit III- Manufacture of Cement

Introduction – types of cement – high alumina cement, water proof cement, slag cement, acid resisting cement, white cement, coloured cement, Pozzolanacement.Setting of cement – properties of cement – testing of cement – uses of cement –concrete – cement industries in India.

Unit IV - Pulp and Paper and Manufacture of Paper

Introduction – manufacture of pulp – types of pulp – sulphate or craft pulp,soda pulp, Rag pulp – beating, refining, filling, sizing and colouring.Calendaring – uses – paper industries in India.

Unit V- Soaps, Detergents and Perfumes

Introduction – types of soaps – hard and soft soaps – manufacture of soap (hotand continuous process only) – cleansing action of soap – detergents – surfaceactive agents – biodegradability of surfactants, amphoteric detergents.Introduction – production of natural perfumes – flower perfumes – jasmine,rose and lily – production of synthetic perfumes – muscone and nitro-musks.

References

1. Mark Anthony Benvenuto, Industrial Chemistry, Walter de Gruyter, 2013
2. B.K. Sharma, Industrial Chemistry,KrishanPrakashan; 17th Ed., 2014
3. John A. Tyrell, Fundamentals of Industrial Chemistry: Pharmaceuticals, Polymers, and Business, Wiley, 2014
4. M. Ali, Bassam El Ali, Handbook of Industrial Chemistry, McGraw-Hill Education; 1st Ed., 2005
5. J. A. Kent, Riegel's Handbook of Industrial Chemistry, CBS Publishers & Distributors, 1997

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CO3	S	S	S	S	S	M	S	M	S	S	S	S
CO4	S	S	S	S	S	M	S	M	S	S	S	S

Strongly correlating :S Moderately Correlating : M
Weakly correlating :W No correlation :N

Course Code	P21CHE422	CHEMISTRY OF NANOSCIENCE AND TECHNOLOGY & SUPRAMOLECULAR CHEMISTRY	L	T	P	C
ELECTIVE-1V			5	-	-	4

Objectives:

1.To enable students to understand and appreciate the importance of nanomaterials
2. To impart knowledge on synthetic methods & characterization of nanomaterials.
3. To enable students gain understanding on carbon-basednanomaterials&nano devices
4. To introduce the concept of supramolecular chemistry

Course outcomes

At the end of the course, the students will be able to

1.appreciate the the influence of dimensionality of the object at nanoscale on their Properties -K5
2. apply basic synthetic methods of nanomaterials-K3
3. appreciate enhanced sensitivity of nanomaterial-based sensors and their novel applications in industry-K5
4. appreciate the importance of supramolecular chemistry-K5

Unit I - Basics of Nanoscience and Nanotechnology

Definition of Nano dimensional materials, Classification of Nanomaterials – Significance of surface to volume ratio, Size effects - unique properties due to Nano size, quantum dots Importance of Nanomaterials - - Simple examples of unique properties of nanosized materials

Elementary aspects of bio-nanotechnology - Some important recent discoveries in nanoscience and technology, Applications of Nanomaterials

Unit II- Synthesis of Nanomaterials

Introduction – top-down vs bottom-up technique – Lithographic process and its limitations – Non-lithographic techniques : Sputtering, Chemical Vapour Deposition, Pulsed Laser Deposition, Sol-Gel technique-nucleation and growth processes, Electrodeposition, Scanning Probe Microscopy – hydrothermal synthesis,solvothermal synthesis – microwave irradiation–precipitation technologies– reverse micelle synthesis – polymer-mediated synthesis –protein microtubule-mediated synthesis – synthesis of nanomaterials usingmicroorganisms and other biological agents – sonochemical synthesis – hydrodynamiccavitation.Biosynthesis of Nanomaterials. Inorganic nanomaterials – typical examples – nano TiO2/ZnO/CdO/CdS

Unit III - Carbon-based Nanomaterials and Bio-nanomaterials

Carbon: Bonding in Carbon compounds, Discovery of Cubane, Fullerenes: synthesis, chemical reactions and properties, superconductivity in C60 - larger and smaller fullerenes

Carbon Nanotubes: Structure of Single-Walled Carbon nanotubes, physical properties of Single-Walled Carbon nanotubes, synthesis of Carbon nanotubes, growth mechanisms, chemical modification of Carbon nanotubes

Unit IV- Characterization of Nanoscale Materials& Nanodevices

Principles of Atomic Force Microscopy (AFM) – Transmission Electron Microscopy(TEM)Resolution and Scanning Electron Microscopy (SEM)

Nanodevices

DNA as a nanomaterial – DNA – knots and junctions, DNA – nanomechanical devicedesigned by Seeman.

Force measurements in simple protein molecules and polymerase – DNA complexes– molecular recognition and DNA based sensor.

Unit V - Supramolecular Chemistry

Introduction to Supramolecular Chemistry – definitions – concepts – molecular forces - covalent bonding, ion – ion, ion – dipole, dipole – dipole, hydrogen bonding, cation – π, π-π interactions, van der Waals forces, hydrophobic and solvent effects – Common motifs in Supramolecular Chemistry – Host/Guest Chemistry, cation, anion and neutral molecule binding. Molecular receptors and design principles. Principles of molecular association and organization – SAMs, micelles, vesicles and cell membrane –Molecular channels and transport processes - Supramolecular reactivity and catalysis- Molecular devices and Nanotechnology

References

1. C. N. R. Rao, A. Muller and A. K. Cheetham (Eds), The Chemistry ofNanomaterials: Vol. 1 and 2; Wiley-VCH;Germany, Weinheim, 2004.
2. T. Pradeep, Nano: The Essentials in Understanding Nanoscience andNanotechnology; Tata McGraw Hill, New York, 2007.
3. H. Fujita (Ed.), Micromachines as Tools in Nanotechnology; Springer-Verlag,Berlin, 2003.
4. T. Tang and P. Sheng (Eds), Nanoscience and Technology, Novel Structures andPhenomena; Taylor andFrancis, New York, 2003.
5. A.Nabok, Organic and Inorganic Nanostructures; Artech House, Boston, 2005.
6. E. A. Rietman, Molecular Engineering of Nanosystems; Springer-Verlag, New York,2001.
7. Core Concepts in Supramolecular Chemistry and Nanochemistryby Jonathan W. Steed, David R. Turner, and KarlWallaceWiley, 2007.
8. Supramolecular Chemistry (Oxford Chemistry Primers, 74) by Paul D. Beer, Philip A. Gale, and David K. Smith, Oxford Science Publications,1999.

Mapping of Cos with POs &PSOs:

PO/PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	S	S	S	S	S	S	S	M	S	S	M	S
CO2	S	S	S	S	S	S	S	M	S	S	M	S
CO3	S	S	S	S	S	S	S	M	S	S	M	S
CO4	S	S	S	S	S	S	S	M	S	S	M	S

Strongly correlating :S Moderately Correlating : M
Weakly correlating :W No correlation :N

Course Code	P21CHR41	PROJECT	L	T	P	C
Project Work			5	-	-	4

Objectives

1.To impart skills in synthesizing new compounds
2.To enable students to learn and apply characterization techniques including Spectroscopy
3.To familiarize various sources of literature survey
4.To provide knowledge on scientific writing and enable students to present their findings as dissertation

On learning the course, the students will be able to

Course Outcomes

1. analyze the existing problems for which research can provide solutions and Select the problem for research-K4
2. know the various chemical publishers, journals and perform literature survey-K1
3. synthesize new chemical compounds through various methods-K6
4. characterize the compounds using various analytical and spectroscopical studies-K5

Mapping of Cos with POs &PSOs:

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	S	S	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S

Strongly correlating :S Moderately Correlating : M
Weakly correlating :W No correlation :N

Course Code	P21CHV11	INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS	L	T	P	C
VALUE ADDED PROGRAMMES			5	-	-	4

Objectives:

1. To develop knowledge in instrumental methods of chemical analysis,
2. To understand the principles of various separation techniques and learn to apply them
3. To understand basic principles and instrumentation spectrochemical, electrochemical, polarimetric, thermal and radiometric techniques
4. To learn to record UV- Visible, FT-IR spectra and Powder X-ray diffraction pattern

Corse Outcomes:

At the end of the course, students will be able to:

1. describe and adopt suitable separation techniques □
2. identify and assess quantitatively using various spectrochemical and electrochemical methods and what technique should be used for the analysis to solve a particular problem □
3. predict the physical and chemical principles upon which the analytical measurement is based.

Unit I - Separation Techniques

Solvent extraction-ion-exchange method-principle of chromatography-column, thin layer, liquid and gas chromatography- columns, adsorbents, methods, Rf values, McReynold's constants and their uses – HPTLC, HPLC techniques –adsorbents, columns, detection methods, estimations, preparative column –GC-MS techniques – methods, principles and uses.

UnitII - Spectrochemical Techniques –I

UV-Visible Spectroscopy Principle, instrumentation and simple applications- interpretation (quantification, mixtures, absorption vs. fluorescence and the use of time, photoacoustic, fluorescent tags), recording the spectrum**IR spectroscopy** - Principle – Hooke's law – factors affecting vibrational frequencies – characteristic group frequencies – Finger print region., instrumentation and simple applications, recording the spectrum

Unit III - Spectrochemical Techniques –II

Mass spectroscopy: Mass spectrometry – basic principles – molecular ion peak, parent peak, fragments, metastable peak, isotope peaks – determination of molecular weight and molecular fragment – fragment pattern of simple organic molecules – Mclafforty rearrangement – Retero Diels Alder reaction**,** instrumentation**^{1}H NMR spectroscopy** – origin of NMR spectra – chemical shift – number of signals – peak areas – multiplicity – geminal, vicinal and long range couplings – factors affecting chemical shifts and coupling constants, **^{13}C NMR spectroscopy**: Broadband and Off resonance decoupling, comparison of ^{1}H and ^{13}C NMR – factors affecting intensity of signals – chemical shifts - γ - gauche effect **2D Techniques**: ^{1}H-^{1}H COSY ,^{1}H-^{13}C COSY.

Unit IV - Electroanalytical Techniques

Amperometry-Principles and applications, amperometric titration with examples-Basic principles of electrogravimetry

Cyclic Voltammetry**:** Principles and simple analytical applications – Interpretation of cyclic voltammogram.

Unit V - Basics of Crystallography and X-ray diffraction

The periodic table of the elements and interatomic bonds , crystal structure -Lattices and symmetries -Reciprocal lattice- Crystal symmetry- Point groups Plane groups and space group - Screw Axis and Glide planes ; Diffraction of light – principles X-ray diffraction: geometry; About crystal structures and diffraction patterns, Practical aspects of X-ray diffraction, Powder X-ray diffraction, Principles and application, Interpretation and data collection.

References

1. Instrumental methods of chemical analysis, G. Chatwal and S. Anand, Himalaya Publishing House, New Delhi, 1999.
2. H.W. Willard, L.I. Merrit, J.A. Dean and P.A. Settle, Instrumental Methods of Analysis, CBS Publishers, 7th Edn., 1996.

Course Code	P21CHV42	WATER TREATMENT	L	T	P	C
VALUE ADDED PROGRAMMES			5	-	-	4

Objectives

1. To give an in-depth understanding of water quality parameters, ground water and surface water pollution and its control measures.
2. Toprovideknowledge on water treatment methods, sewage and industrial effluent treatment methods and water resources management.
3. To provide understanding of the various water the pollutants and their effect on environment and on human health
4. To provide understanding of water treatment methods for domestic and industrial purposes

Course Outcomes:

At the end of the course, students will be able to

1. understand and protect different sources of water
2. identify water pollutants and their effect on environment and human health
3. describe the analytical methods to determine water quality parameter
4. propose water treatment methods for domestic and industrial purpose

Unit I - Water Sources

Sources of water supply: Rain: hydrological cycle, acid rain, artificial rain, rain water harvesting. Surface water: impounding reservoir, river and tanks – their characteristics and impurities. Ground water; wells and springs. Water borne diseases/substances affecting the portability of water.

Unit II - Impurities in water

Effects of impurities in natural waters: colour taste and odour, turbidity and sediment and microorganism. Dissolved mineral matter – hardness types – estimation (EDTA method) – methods of softening – boiling, addition of lime – addition of sodium carbonate – ion exchange method.

UnitIII - Disinfection of Water

Clarification of water: sedimentation and filtration. Coagulation of water electrochemical coagulation – flocculants – sterilization and disinfection of water: chemical methods and physical methods.

UnitIV - Demineralization & Water Treatment

Demineralization of water – ion exchange process – desalination of sea water: electrodialysis method, reverse osmosis methods.

Water analysis: physical examination – chemical examination bacteriological examination – BOD, COD.

Unit V- Analysis and Control

Sampling of polluted water - preservation-main quality characteristics of wateralkalinity, hardness, total solids- TDS - DO, BOD, COD, TOC, fluoride and chloride. Defluoridation techniques-Iron removal-sampling of gaseous pollutants and particulates–adsorption - absorption - scrubbing – cold trapping – filtration - cyclone separator – gravity settling - electrostatic precipitators - thermal precipitators - analysis of CO by gas chromatography, NO by chemiluminescence and SO_2 by spectrophotometer

Reference Books

1.Environmental Chemistry by B.K. Sharma and H. Kaur, Goel Publishing House.1996.
2.Environmental Chemistry, A. K. De, 5th Edn., New Age International Publisher, 2005.
3.Environmental Chemistry, B. K. Sharma, 11th Edn., Krishna Prakashan media Limited,2007
4.Chemical and Biological Methods for Water Pollution Studies, R.K. Trivedy and P.K.Goel, Environmental Publications, 1986.
5. Engineering Chemistry, P.C. Jain and Monica Jain, DhanpatRai and Sons, 1993.

Course Code	P21CHN211	EVERYDAY CHEMISTRY	L	T	P	C
NON-MAJOR ELECTIVE			5	-	-	4

Objectives

1.To enable students understand and appreciate the chemistry behind DairyIndustry
2. To provide knowledge on the various chemicals in food and food adulteration
3. To inculcate the basic knowledge of minerals, cosmetics and cleansing agents.
4. To enable students gain basic knowledge on petrochemicals, polymers, dyes, paints and building materials

Course Outcomes

On learning the course, the students will be able to

1.appreciate the central role of chemistry in our society
2. comprehendthe role of chemicals in Food & Nutrition
3.realize the role of chemistry in food production.
4.understand andexplain the role ofchemistry in petrochemical, polymer and cosmetic Industry

Unit I- Dairy Chemistry

General composition of milk – constituents of milk lipids, proteins, carbohydrates, vitamins and minerals. Physical properties of milk – color, odour, acidity, specific gravity, viscosity and conductivity. Factors affecting the composition of milk – pasteurization, homogenization, toning, standardization, reconstitution of milk - adulteration of milk.

Unit II- Chemicals in food:

Table salt, sugar, baking powder, baking soda, Preservatives, artificial sweetening agents - common examplesNutrition: Carbohydrates, Proteins, Fats, Minerals and Vitamins –definitions, sources and their physiological importance -balanced diet
Food Adulteration: Adulterants in milk, ghee, oil, coffee, tea, asafoetida, chili powder, pulses and turmeric powder -identification. Colourchemicals used in food - soft drinks and its health hazards.

Unit III- Mineral metabolism:

Calcium – source, daily requirement, blood calcium, hypocalcemia, phosphorus – functions of phosphate, requirement, source, normal serum level, functions.
Sodium – normal level of sodium, excretion of sodium, restriction of sodium in diet, hypernatremia.

Cosmetics:

Talcum Powder, Tooth pastes, Shampoos, Nail Polish, Perfumes -General formulations –possible hazards of cosmetics useCleansing agents:Soaps and detergents, cleansing action, bleaching and stain removal

Unit IV - Chemistry and Industry-I

Chemicals in food production: Fertilizers such as urea, NPK and Super phosphates -uses and hazards Pesticides –definition and examples Fertilizers from natural sources
Petrochemicals: Generations and composition of petrochemicals, Rocket propellants
Polymers and Plastics: Polythene, polyester, PVC, bakelite, resins; Teflon and nylon -their applications Biodegradable polymers and Biopolymers

Unit V- Chemistry and Industry-II

Dyes, Paints and Pigments: Composition, Classification and Applications; Process of dying. Building Materials: Cement and its manufacture, Mortar, Concrete and R.C.C Manufacture of glass, Ceramics Rubber: Natural Rubber-Synthetic rubbers-Vulcanization -definition and its applications

Reference books

1. Carl H Snyder, The Extraordinary Chemistry of Everyday Things, 4th edition 2003
2. Alfred Vivian,Everyday Chemistry,Hardpress Publishing,2012
3. John Emsley Chemistry at Home: Exploring the Ingredients in Everyday Products, Royal Society of Chemistry; Illustrated edition, 2015
4. Kirpal Singh, Chemistry in Daily Life: PHI, 3rd Ed., 2010
5. H-D. Belitz Werner Grosch Peter SchieberleFood Chemistry, Springer; 4th revised and extended Ed., 2009

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CO3	S	S	S	S	S	M	S	S	S	S	M	S
CO4	S	S	S	S	S	M	S	S	S	S	M	S

Mapping of Cos with POs &PSOs:

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Weakly correlating :W No correlation :N

Course Code	P21CHN212	AGRICULTURAL CHEMISTRY	L	T	P	C
NON-MAJOR ELECTIVE			5	-	-	4

Objectives:

1.To enable students understand the chemical composition of soil
2.To provide knowledge on the chemistry behind fertilizers
3.To enable students know and understand the chemistry behind pesticides
4. To enable students analyze and find a suitable method to promote agriculture.

Course Outcomes:

At the completion of the course the students will

1.have Acquired knowledge on the chemical composition of soil
2.be able to understand the chemistry behind fertilizers and pesticides
3.be able to appreciate the chemistry behind agricultural methods
4.be able to find and suggest suitable methods to promote agriculture.

Unit I - Soil Chemistry

Soil analysis. composition of soil: organic and inorganic constituents. Soil acidity : buffering capacity of soils. Absorption of cations and anions: availability of soil nutrients to plants

Unit II – Fertilizers

Difference between fertilizer and manure – Superiority of manure over fertilizers, Peat and organic manures (composts). Role of humus. Effluent form gobar gas plants. Use of fertilizers: urea, DAP, Super phosphate, Gypsum, NPK-mixed fertilizers, Optimal addition of fertilizers to obtain estimated yields.

Unit III - Pesticides,Fungicides, Herbicides And Weedicides

Pesticides: Classification on the basis of mode of action, types of pests and Chemical nature with examples – safety measures while using pesticides. 2.4 Fungicides, Herbicides, Acaricides, Rodenticides, Repellants, Fumigants, Defoliants (Definitions and Examples).

Unit IV- Plant Growth Regulators

3-Indole acetic acid,naphthalene acetic acid, Ethepon (2-chloroethyl phosphoric acid): Alar (succinin acid-2, 2-dimethyhydrzine :) their function. Plant hormones: Gibberlin, Cyclocel, Phosphon, dwarfing compound (CCC: 2-Chlorethyltrimethyl ammonium chloride). Defoliants

Unit V- Insecticides

Basic and newer formulations of insecticides, contact insecticides, fumigants, manufacture and uses of insecticides. DDT, BHC, pyrethrin mention of aldrin, dieldrin, endrin and pentachlorophenol Handling hazards of insecticides – Symptoms of poisoning, first aid and antidotes

Reference books

1. Joseph Scudder Chamberlain Organic Agricultural Chemistry (the Chemistry of Plants and Animals); A Textbook of General Agricultural Chemistry or Elementary Bio-Chemistry for Use in Colleges, AndesitePress, 2015
2. H. ParameshwarHegde, Textbook of Agro-Chemistry, Discovery Publishing Pvt.Ltd, 2009
3. G.T. Austin: Shreve's Chemical Process Industries, 5th edition, Mc-Graw-Hill, 1984
4. B.A. Yagodin (Ed). Agricultural Chemistry, 2 Volumes, Mir Publishers (Moscow), 1976

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CO3	S	S	S	S	S	M	S	S	S	S	M	S
CO4	S	S	S	S	S	M	S	S	S	S	M	S

Strongly correlating :S Moderately Correlating : M
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