CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

NATIONALLY ACCREDITED WITH "A" GRADE BY NAAC
TIRUCHIRAPPALLI

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

M.Sc., Chemistry

Syllabus

2024-2025 and Onwards

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)
PG AND RESEARCH DEPARTMENT OF CHEMISTRY

VISION

- To progress into a centre of superiority in Chemistry that will blend state-of-the-art practices in professional teaching in a communally enriching way, with the holistic progress of the students as its prime emphasis.

MISSION

- To produce graduates committed to integrity, professionalism and lifelong learning by widening their knowledge horizons in range and depth.
- To awaken the young minds and discover talents to achieve personal academic potential by creating an environment that promotes frequent interactions, independent thought, innovations, modern technologies and increased opportunities.
- To enhance the quality through basic and applied research frameworks, and encourage the students to take part in entrance and competitive examinations for higher studies and career.
- To enhance services to the community and build partnerships with the industry.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs	Statements
PEO1	**LEARNING ENVIRONMENT** To facilitate value-based holistic and comprehensive learning by integrating innovative learning practices to match the highest quality standards and train the students to be effective leaders in their chosen fields.
PEO2	**ACADEMIC EXCELLENCE** To provide a conducive environment to unleash their hidden talents and to nurture the spirit of critical thinking and encourage them to achieve their goal.
PEO3	**EMPLOYABILITY** To equip students with the required skills in order to adapt to the changing global scenario and gain access to versatile career opportunities in multidisciplinary domains.
PEO4	**PROFESSIONAL ETHICS AND SOCIAL RESPONSIBILITY** To develop a sense of social responsibility by formulating ethics and equity to transform students into committed professionals with a strong attitude towards the development of the nation.
PEO5	**GREEN SUSTAINABILITY** To understand the impact of professional solutions in societal and environmental contexts and demonstrate the knowledge for an overall sustainable development.

PROGRAMME OUTCOMES FOR M.Sc., Mathematics, M.Sc., Physics, M.Sc., Chemistry PROGRAMMES

PO No.	Programme Outcome On completion of M.Sc., Programme, the students will be able to
PO1	**Problem analysis**: Provide opportunities to develop innovative design skills, including the ability to formulate problems, to think creatively, to synthesize information, and to communicate effectively.
PO2	**Scientific skills**: Create and apply advanced techniques and tools to solve the societal environmental issues.
PO3	**Environment and Sustainability**: Ascertain eco-friendly approach for sustainable development and inculcate scientific temper in the society.
PO4	**Ethics**: Imbibe ethical and social values aiming towards holistic development of learners.
PO5	**Lifelong learning:** Instill critical thinking, communicative knowledge which potentially leads to higher rate of employment and also for higher educational studies.

PROGRAMME SPECIFIC OUTCOMES FOR M.Sc. CHEMISTRY

PSO NO.	Programme Specific Outcomes` Students of M.Sc., Chemistry will be able to	POs Addressed
PSO1	Acquire knowledge in basic concepts, fundamental principles, and applications of chemical and scientific theories and their relevancies in the day-to-day life.	PO1 PO2
PSO2	Design experiments, analyze, synthesize and interpret data to provide solutions to different industrial problems by working in the pure, inter and multi-disciplinary areas of chemical sciences.	PO1 PO2 PO3
PSO3	Attain maneuver in diverse contexts with Global Perspective	PO3 PO4
PSO4	Gain a thorough Knowledge in the subject to be able to work in projects at different research as well as academic institutions.	PO1 PO2 PO5
PSO5	Afford Global level research opportunities to pursue Ph.D programme targeted approach of CSIR – NET examination	PO1 PO2 PO3 PO4 PO5

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

M.Sc. CHEMISTRY

(For the Candidates admitted from the Academic year 2024 - 2025 and onwards)

Semester	Course	Course Title	Course Code	Inst. Hrs. / week	Credits	Exam			Total
						Hrs.	Marks		
							Int.	Ext.	
I	Core Course– I (CC)	Organic Reaction Mechanism – I	23PCH1CC1	6	5	3	25	75	100
	Core Course – II (CC)	Structure and bonding in Inorganic compounds	23PCH1CC2	6	5	3	25	75	100
	Core Course –III (CC)	Molecular Spectroscopy	23PCH1CC3	6	5	3	25	75	100
	Core Practical - I (CP)	Organic Chemistry – I (P)	24PCH1CC1P	6	5	6	40	60	100
	Discipline Specific Elective Course-I (DSE)	A. Analytical Instrumentation Techniques (P)	24PCH1DSE1AP	6	3	6	40	60	100
		B. Nanoscience and Nanotechnology (P)	22PCH1DSE1BP						
		C. Biochemistry (P)	22PCH1DSE1CP						
	Total			**30**	**23**				**500**
15 Days INTERNSHIP during Semester Holidays									
II	Core Course– IV (CC)	Physical Chemistry – I	23PCH2CC4	6	5	3	25	75	100
	Core Practical – II (CP)	Organic Chemistry – II (P)	22PCH2CC2P	6	5	6	40	60	100
	Core Choice Course– I (CCC)	A. Organic Reaction Mechanism – II	23PCH2CCC1A	6	4	3	25	75	100
		B. Chemistry of Natural Products	23PCH2CCC1B						
		C. Molecular Rearrangement	23PCH2CCC1C						
	Core Practical – III (CP)	Inorganic Chemistry– I (P)	22PCH2CC3P	6	5	6	40	60	100
	Discipline Specific Elective Course-II (DSE)	A. Green Chemistry	23PCH2DSE2A	6	3	3	25	75	100
		B. Forensic Chemistry	23PCH2DSE2B						
		C. Analytical Chemistry	23PCH2DSE2C						
	Internship	Internship	23PCH2INT	-	2	-	-	100	100
	Extra Credit Course	SWAYAM	As per UGC Recommendation						
	Total			**30**	**24**				**600**

III	Core Course– V (CC)	Physical Chemistry- II	23PCH3CC5	6	5	3	25	75	100
	Core Course- VI (CC)	Inorganic Chemistry	23PCH3CC6	6	5	3	25	75	100
	Core Practical – IV (CP)	Inorganic Chemistry –II (P)	23PCH3CC4P	6	4	6	40	60	100
	Core Choice Course– II (CCC)	A. Cyber Security	22PGCS3CCC2A	5	4	3	25	75	100
		B. Photochemistry and Advanced Chemical Kinetics	22PCH3CCC2B						
		C. Electro Chemistry	22PCH3CCC2C						
	Discipline Specific Elective Course-III (DSE)	A. Chemistry for Competitive Examinations	22PCH3DSE3A	4	3	2	-	100	100
		B. Bioorganic Chemistry	22PCH3DSE3B			3	25	75	
		C. Pharmaceutical Chemistry	22PCH3DSE3C						
	Generic Elective Course - I (GEC)	Renewable Energy and Energy Harvesting	23PCH3GEC1	3	2	3	25	75	100
	Extra Credit Course	SWAYAM	As per UGC Recommendation						
	Total			**30**	**23**				**600**
IV	Core Course–VII (CC)	Physical Methods in Chemistry	23PCH4CC7	6	5	3	25	75	100
	Core Choice Course– III (CCC)	A. Chemistry of Nanoscience	22PCH4CCC3A	6	4	3	25	75	100
		B. Biofuels	22PCH4CCC3B						
		C. Bioinorganic Chemistry	22PCH4CCC3C						
	Core Practical – V (CP)	Physical Chemistry - II (P)	23PCH4CC5P	6	5	6	40	60	100
	Generic Elective Course-II (GEC)	Corrosion and Pollution Management	22PCH4GEC2	3	2	3	25	75	100
	Project	Project Work	23PCH4PW	9	4	-	-	100	100
	Total			**30**	**20**				**500**
	Grand Total			**120**	**90**				**2200**

Courses & Credits for PG Science Programmes

S. No	Courses	No. of Courses	No. of Credits	Marks
1.	Core Course – (CC)	6	30	600
2.	Core Choice Course– (CCC)	3	12	300
3.	Core Practical - (CP)	6	29	600
4.	Discipline Specific Elective-(DSE)	3	09	300
5.	Generic Elective Course -(GEC)	2	04	200
6.	Project	1	04	100
7.	Internship	1	02	100
	Total	**22**	**90**	**2200**

The internal and external marks for theory and practical papers are as follows:

Subject	Internal Marks	External Marks
Theory	25	75
Practical	40	60

Separate passing minimum is prescribed for Internal and External

For Theory:

a) The passing minimum for CIA shall be 40% out of 25 marks (i.e. 10 marks)

b) The passing minimum for End Semester Examinations shall be 40% out of 75 marks (i.e.30 marks)

c) The passing minimum not less than 50% in the aggregate.

For Practical:

a) The passing minimum for CIA shall be 40% out of 25 marks (i.e. 16 marks)

b) The passing minimum for End Semester Examinations shall be 40% out of 75 marks (i.e.24 marks)

c) The passing minimum not less than 50% in the aggregate.

For Project:

Marks for Dissertation: 80

Marks for Viva Voce : 20

Total marks 100

Internal Component (Theory)

Component	Marks
Library	03
Attendance	03
Assignment & Seminar	04
CIA -I	7.5
CIA-II	7.5
Total	**25**

Internal Component (Practical)

Component	Marks
Observation	05
Record	10
Continual performance	10
Model	15
Total	**40**

Question Paper Pattern

PART A (10 X 2=20)
Answer all the questions

PART B (5 X 5=25)
Answer all the questions

PART C (3 X 10=30)
Answer any three questions

Semester I	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
23PCH1CC1	**ORGANIC REACTION MECHANISM-I**	**CORE**	**6**	**5**

Course Objective

- To learn the basic concepts of aromaticity and stereochemistry of various organic molecules.
- To understand the feasibility and the mechanism of various organic reactions.
- To comprehend the techniques in the determination of reaction mechanisms.
- To understand the concept of stereochemistry involved in organic compounds.
- To correlate and appreciate the differences involved in the various types of organic reaction Mechanisms.

Prerequisites

Aromaticity, oxidation, reduction and symmetry

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recall and summarize the fundamentals of reaction intermediates, electrophilic and nucleophilic substitution reactions, aromaticity, and stereochemistry.	K1, K2
CO2	Interpret the concept to Huckels theory, thermodynamic and kinetic requirements of reactions: conformation analysis and substitution reactions	K3
CO3	Categorize the determination of intermediates, aromaticity, configuration and reactivity of aliphatic and aromatic compounds towards substitution reaction.	K4
CO4	Evaluate aromatic character, stereo analysis, pathway of reaction mechanism.	K5
CO5	Predict the intermediate, conditions and product of substitution mechanism.	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2	3	1	1	1	3
CO2	3	2	1	3	2	2	3	1	1	2
CO3	3	3	1	1	2	3	2	2	2	3
CO4	3	3	2	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	1	2

"1"– Slight (Low) Correlation "2"–Moderate (Medium)Correlation

"3"–Substantial (High) Correlation "-"indicates there is no correlation.

SYLLABUS

UNIT	CONTENT	HOURS	COs	CONGNITIVE LEVEL
I	**Methods of Determination of Reaction Mechanism:** Reaction intermediates-transition state-energy profile diagrams - Thermodynamic and kinetic requirements of reactions – Hammond's postulate - Methods of determining mechanism: non-kinetic methods - product analysis - determination of intermediates – isolation - detection and trapping. Cross-over experiments - isotopic labelling - isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism- Effect of structure on reactivity- Hammett and Taft equations - Linear free energy relationship - partial rate factor- substituent and reaction constants.	**18**	**CO1, CO2, CO3, CO4, CO5**	**K1, K2, K3, K4, K5, K6**
II	**Aromaticity:** Aromatic character: Huckel's theory of aromaticity - three, four, five, six, seven and eight membered rings– other systems with aromatic sextet- concept of homo aromaticity and anti-aromaticity- Craig'srule – applications - consequences of aromaticity non-alteration in bond length -Huckel's MO calculation - Electron occupancy in -NMR concept of aromaticity and anti-aromaticity.	**18**	**CO1, CO2, CO3, CO4, CO5**	**K1, K2, K3, K4, K5, K6**
III	**Stereochemistry and Conformational Analysis:** Stereoisomerism–optical activity and chirality – types of molecules exhibiting optical activity – R, S and E, Z configuration -	**18**	**CO1, CO2, CO3, CO4, CO5**	**K1, K2, K3, K4, K5, K6**

	absolute configuration – chirality in molecules with non-carbon stereo centres (N, S and P) – molecules with more than one chiral centre. Biphenyls, allenes, spiranes and analogues- Atropisomerism- Helicity and chirality- Resolution–methods of resolution - Conformations of mono and di substituted cyclohexane system and decalin. Quantitative correlation between conformation and reactivity.			
IV	**Aromatic and Aliphatic Electrophilic Substitution:** Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation - Halogen electrophiles: chlorination and bromination- Carbon electrophiles: Friedel- Crafts alkylation, acylation and arylation reactions- Aliphatic electrophilic substitution Mechanisms: S_E1, S_E2 and S_Ei-Mechanism and evidences.	**18**	**CO1, CO2, CO3, CO4, CO5**	**K1, K2, K3, K4, K5, K6**
V	**Aromatic and Aliphatic Nucleophilic Substitution**: Aromatic nucleophilic substitution: Mechanisms - S_NAr, S_N1 and Benzyne mechanisms - Evidences - reactivity Effect of structure - leaving group and attacking nucleophile. Reactions: Oxygen and Sulphur-nucleophiles -Bucherer and	**18**	**CO1, CO2, CO3, CO4, CO5**	**K1, K2, K3, K4, K5, K6**

	Rosenmund reactions, von Richter, Sommelet-Hauser and Smiles rearrangements - S_N1, ion pair, S_N2 mechanisms and evidences. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon. Swain- Scott, Grunwald- Winstein relationship - Ambident nucleophiles			
VI	**Self-Study for Enrichment:** **(Not to be included for External Examination)** Rules of resonance–tautomerism -steric effects- Enantiomers and diastereomers- Bredt's rule- neighbouring group participation.	-	**CO1, CO2 CO3**	**K1, K2, K3, K4**

Text Books

1. Mukherji, S. M Singh. S. P. (2015). Reaction Mechanism in Organic Chemistry (Revised Edition): Trinity; New Delhi.
2. Kalsi. P.S. (1993). Stereochemistry. Wiley eastern limited; New Delhi.
3. Jagdamba Singh. (2016). Organic synthesis: Pragati Prakashan.
4. Bansal. R. K. (1975). Organic Reaction Mechanisms. Tata McGraw Hill.

Reference Books

1. March and Smith. M. B March's Advance Organic Chemistry Reactions, Mechanisms and Structure,7thEdition. (2013), Wiley, New York.
2. Finar. I. R,Organic Chemistry Vol.II 7th edition. (2009), Pearson, New Delhi.
3. Nasipuri. D, Stereo chemistry of organic compounds Principles, 2ndEdition. (2002), New Age International and applications.
4. Lowry. T. H. E and Richardson. K. S, Mechanism and Theory in Organic chemistry, 3rdedition. (1997), Benjamin Cummings Publishing, USA.

5. Carey. F. A and Sundberg. R. J, Advanced Organic chemistry Part A and B,5th edition. (2007), Springer, Germany.

Web References

1. https://openstax.org/books/chemistry-2e/pages/12-6-reaction-mechanisms.
2. http://courses.washington.edu/medch562/pdf/MEDCH400_Stereochem.pdf
3. https://universe.bits-pilani.ac.in/uploads/Dubai/rusalraj/Substitution%20Reactions.pdf
4. https://iscnagpur.ac.in/study_material/dept_chemistry/5.1_RRT_ARSN.pdf.

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar

Course Designers

Dr. C. Rajarajeswari

Semester I	Internal Marks: 25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRs/ WEEKS**	**CREDITS**
23PCH1CC2	**STRUCTURE AND BONDING IN INORGANIC COMPOUNDS**	**CORE**	6	**5**

Course Objective

- To articulate the learning of solid state in chemistry
- The subject lays a foundation to clusters and organometallic compounds

Prerequisites

Clusters, Solid state, organometallic compounds, Band theory

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course students will be able to	Cognitive Level
CO1	Outline the geometry of inorganic compounds	K1, K2
CO2	Identify the nature of binding and packing of ions in solids	K3
CO3	Classify the structure of clusters, metal carbonyls and crystals	K4
CO4	Compare the structural features of various inorganic compounds	K5
CO5	Predict the radius ratio and defects of crystals	K6

Mapping with Programme Out comes

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**2**
CO2	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**3**	**3**	**3**
CO3	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
CO4	**3**	**3**	**2**	**1**	**2**	**3**	**2**	**3**	**3**	**2**
CO5	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**3**	**2**

"1" – Slight or No Correlation "2" –(Moderate(/Medium) correlation

"3" – Substantial (High) Correlation "-" – indicates No Correlation

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Structure of main group compounds and clusters:** VB theory – Effect of lone pair and electro negativity of atoms (Bent's rule) on the geometry of the molecules; Structure of silicates - applications of Pauling's rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three- dimensional silicates. Structure of silicones, Structural and bonding in B-N(Boron nitride, Borazine) S-N (S_4N_4, S_2N_2, $(SN)_x$), P-N (Di and Triphosphazenes,), Poly acids – types, examples and structures- Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes; Wade's rule to predict the structure of borane cluster.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	**Organometallic Compounds:** Hapticity of ligands- 18 Electron rule and its limitation- Classification of organometallic compounds – structure of methyl lithium, Zeise's salt and Ferrocene- Metal carbonyls – EAN rule – Mono and poly nuclear carbonyls – preparation, reactions and structure ($Ni(CO)_4$, $Fe(CO)_5$, $Cr(CO)_6$, $Mn_2(CO)_{10}$, $Co_2(CO)_8$and $Fe_2(CO)_9$ – Bonding in metal Carbonyls – Metal-ethylenic complexes – methods of formation- bonding-chemical properties.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

III	**Solid state Chemistry – I** Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Crystal systems and Bravis lattices, Symmetry operations in crystals, glide planes and screw axis; point group and space group; Solid state energetics: Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant.	**18**	**CO1** **CO2** **CO3** **CO4** **CO5**	**K1** **K2** **K3** **K4** **K5** **K6**
IV	**Solid state Chemistry – II** Structural features of the crystal systems: Rock salt, zinc blende &wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels -normal and inverse types and perovskite structures. Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.	**18**	**CO1** **CO2** **CO3** **CO4** **CO5**	**K1** **K2** **K3** **K4** **K5** **K6**
V	**Band theory and defects in solids** Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors; Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser and phosphors; Linear defects and its effects due to dislocations.	**18**	**CO1** **CO2** **CO3** **CO4** **CO5**	**K1** **K2** **K3** **K4** **K5** **K6**

VI	**Self-Study for Enrichment** **(Not to be included for External Examination)** High-valent metal Clusters and halide Clusters-Bragg's law, powder diffraction pattern. X-ray diffraction and Electron diffraction comparison		**CO1** **CO2**	**K2,** **K3**

Text Books

1. Greenwood. (1996). Chemistry of the Elements, United Kingdom, Elsevier Science & Technology Books.
2. Kaesz, H., Adams, R., Shriver, D., Kaesz, H., Adams, R.,Shriver,D.(1990).The Chemistry of Metal Cluster Complexes.
3. Sharma, L. R., Puri, B. R., Sharma, L. R., Puri, B. R. (1976). Principles of Inorganic Chemistry: For B.Sc. and B.Sc. (Hons.) Classes of Indian Universities. India:S.Nagin.
4. Cotton, F. A., Wilkinson, G., Cotton, F. A., Wilkinson. (2007). Advanced Inorganic Chemistry,6th Edition, India: Wiley India Pvt. Limited.
5. Keiter, E.A. (2006). Inorganic Chemistry: Principles of Structure and Reactivity. India: Pearson Education.
6. Arthur, W. Adamson Paul, D. (1975).Fleischauer, Concepts of Inorganic Photochemistry. United Kingdom: Wiley.
7. West, A. R., (2014). Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd.,.
8. Bhagi, A.K., Chatwal, G. R. (2001). A textbook of inorganic polymers, Himalaya Publishing House.
9. Smart, L., Moore E. (2012). Solid State Chemistry – An Introduction, 4th Edition, CRC Press.
10. Purcell, K. F., Kotz, J. C. (1977). Inorganic Chemistry; W.B. Saunders company: Philadelphia.
11. Huheey, J. E., Keiter, E. A., Keiter R. L. (1983). Inorganic Chemistry; 4th ed.; Harper and Row: NewYork.

Reference Books

1. Lee, J.D., (2008). ConciseInorganicChemistry,5th Edition. (2008).India:Wiley India Pvt. Limited.
2. Gurdeep Raj, (2020). Advanced Inorganic ChemistryVol-1, KrishnaPrakashan.
3. Ferraudi, G. J., Ferraudi, G. J. (1988). Elements of Inorganic Photochemistry. United Kingdom: Wiley.
4. Pearson, R. G., Basolo, F., Pearson, R. G., Basolo, F. (1967). Mechanisms of Inorganic Reactions:A

Study of Metal Complexes in Solution. United Kingdom: Wiley.

5. Sharma, R.K., Sharma, R. K. (2007). Inorganic Reaction mechanisms. India: Discovery Publishing House.
6. Douglas, D. E. McDaniel, D.H., Alexander, J. J. (1994). Concepts and Models in Inorganic Chemistry, 3rd Ed, John Wiley & Sons, Inc., New York.
7. Tilley, R. J. D., (2013). Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication.
8. Rao, C. N. R., Gopalakrishnan, J., (1997). New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press.

Web References

1. https://www2.chemistry.msu.edu/courses/cem151/chap24lect_2019.pdf
2. http://www.vpscience.org/materials/Unit%203%20B%20Coordination%20chemistry.pdf
3. https://www.usb.ac.ir/FileStaff/2896_2019-4-18-0-9-32.pdf
4. https://www.uou.ac.in/sites/default/files/slm/BSCCH-101.pdf
5. https://www.chem.uci.edu/~lawm/11-16.pdf
6. https://www.usb.ac.ir/FileStaff/5269_2018-9-18-10-21-39.pdf

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar

Course Designers

Dr. K. Shenbagam

Semester I	Internal Marks:25		External Marks:75	
COURSECODE	**COURSETITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
23PCH1CC3	**MOLECULAR SPECTROSCOPY**	**CORE COURSE**	**6**	**5**

Course Objective

- To understand, rotational and vibrational level transition in polyatomic molecules.
- To know the significance of Franck-Condon principle to interpret the selection rule, intensity and types of electronic transitions
- To interpret first and second order splitting pattern NMR signals of the molecules using correlation techniques such as COSY, HETCOR, NOESY.
- To learn the principle of ESR, EPR and Raman spectroscopy.
- To understand fragmentation pattern of molecules in Mass spectroscopy.
- To predict the structure of molecules using various spectral data.

Prerequisites

Electromagnetic radiation, molecular energy level, non-Rigid rotor, selection rules for spectroscopy

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Understand principle of various spectral techniques involving molecular absorption and emission of electromagnetic radiations.	K1, K2
CO2	Apply NMR and MS spectroscopic techniques in solving structure of organic molecules.	K3
CO3	Explain the principle, rules to analyses, compare and identify the structure of organic molecules using various spectral techniques.	K4
CO4	Discriminate structural and stereoisomers of compound using NMR, ESR and mass spectral techniques.	K5
CO5	Evaluate energy of rotational levels, isotopic mass of the elements.	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2	3	1	1	1	3
CO2	3	2	1	3	2	2	3	1	1	2
CO3	3	3	1	1	2	3	2	2	2	3
CO4	3	3	2	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	1	3

"1"–Slight (Low)Correlation "2"–Moderate (Medium)Correlation

"3"–Substantial (High)Correlation "-" indicates there is no correlation

SYLLABUS

UNIT	CONTENT	HOURS	COs	CONGNITIVE LEVEL
I	**Rotational and Raman Spectroscopy:** Rotational spectra of diatomic and polyatomic molecules- intensities of rotational spectral lines - isotopic substitution effect - non-rigid rotators Raman effect - pure rotational Raman spectra of linear and asymmetric top molecules - stokes and anti-Stokes lines- Vibrational Raman spectra - rule of mutual exclusion- rotational fine structure O and S branches - Polarization of Raman scattered photons.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
II	**Vibrational Spectroscopy:** Vibrations of molecules - harmonic and anharmonic oscillators - energy expression - vibrational wave functions – symmetry - selection rules - energies of spectral lines - hot bands - effect of isotopic substitution - Diatomic vibrating rotorvibrational - rotational spectra of polyatomic molecules - symmetry properties - overtone - combination frequencies- P, Q and R branches - parallel and perpendicular vibrations of linear and symmetric top molecules.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
III	**Electronic spectroscopy**: Electronic spectroscopy of diatomic molecules Frank-Condon principle - dissociation and pre-dissociation spectra- $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules - Photoelectron Spectroscopy: Principle - photoelectron spectra of simple molecules - X-ray photoelectron spectroscopy	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5

	(XPS) - Lasers: Laser action population inversion - properties of laser radiation examples of simple laser systems.			
IV	**NMR and Mass spectrometry:** NMR spectroscopy - Principle -Chemical shift, Factors influencing δ- shielding and deshielding. spin-spin interactions- spin decoupling- Nuclear over Hauser effect (NOE)- Factors influencing coupling constants- 2D NMR – COSY, NOESY Mass Spectrometry: Ionization techniques isotope abundance- molecular ion -base peak meta stable ions -fragmentation processes of organic molecules- deduction of structure through mass spectral fragmentation.	**18**	**CO1 CO2 CO3 CO4 CO5**	**K1 K2 K3 K4 K5**
V	**ESR and Mossbauer Spectroscopy**: ESR-principle-selection rule- g value-hyperfine coupling parameter (A) –zero field splitting - Kramer's degeneracy – isotropy and anisotropy in g value- application of ESR to organic and inorganic system (H, CH3, p-benzo semiquinone and bis (salicylaldimine) copper (II) complex)- Principle of Mossbauer spectroscopy: Doppler shift - recoil energy. Isomer shift, quadrupole splitting - magnetic interactions - applications: high and low spin Fe and Sn compounds.	**18**	**CO1 CO2 CO3 CO4 CO5**	**K1 K2 K3 K4 K5**
VI	**Self-study: (Not for final examination)** Problems based on joint application, PMR, CMR, and Mass. (Including reaction sequences), DEPT, INTEPT, Chemical spin decoupling of rapidly exchangeable protons (OH, SH, COOH, NH, NH2).	-	**CO1 CO2**	**K1 K2**

Text Books

1. Banwell C.N (2017), Fundamentals of molecular Spectroscopy, 4th edition, McGraw Hill, New Delhi.
2. Silverstein. P. M and Western. F.X (2014), Spectroscopic Identification of Organic compounds, 8th edition, John Wiley, New York
3. Kalsi. P. S (2016), Spectroscopy of Organic Compounds, 7th edition, New Age International Publishers, New Delhi
4. William Kemp (2019), Organic spectroscopy, 3rd edition, Macmillan publisher Pvt, Bangalure.
5. Williams D.H and Fleming I, Spectroscopic Methods in Organic Chemistry, 4 th Ed., Tata McGraw-Hill Publishing Company, New Delhi, 1988.
6. Drago R. S, Physical Methods in Chemistry; Saunders: Philadelphia, 1992

Reference Books

1. Drago R.S (2012), Physical Methods in Inorganic Chemistry; Affiliated East-West press Pvt. Ltd, New Delhi.
2. Kaur. K, (2014), Spectroscopy, 16th edition, Pragati Prakashan Educational Publisher.
3. Sharma Y. R (2016), Elementary organic spectroscopy, revised 4th edition, S. Chand &Co Ltd, New Delhi.
4. Atkins P.W and de Paula J, Physical Chemistry, 7th Ed., Oxford University Press, Oxford, 2002.
5. Rahman A, Nuclear Magnetic Resonance-Basic Principles, Springer-Verlag, New York,1986.
6. Levine N.I, Molecular Spectroscopy, John Wiley & Sons, New York, 1974.

Web References

1. http://www.organic-chemistry.org/
2. http://www.organicworldwide.net/
3. http://www.ccdc.cam.ac.uk/products/csd/
4. http://www.nou.ac.in/econtent/Msc%20Chemistry%20Paper%20IX/MSc%20Chemistry%20Paper- IX%20 Unit-pdf
5. http://www.rcsb.org/pdb/home/home.do
6. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
7. https://www.digimat.in/nptel/courses/video/104106122/L14.html

Pedagogy

Chalk and talk, PPT, E-content, Discussion, Assignment, Demo, Quiz, Seminar

Course Designers

Dr. V. Sangu.

Semester I	Internal Marks: 40			External Marks: 60
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
24PCH1CC1P	**ORGANIC CHEMISTRY-I (P)**	**CORE**	**6**	**5**

Course Objectives

- To perform the qualitative analysis of a given organic mixture and to carry out the preparation of organic compounds.

Pre-requisites

Separation of components, Qualitative analysis

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Apply the principles of separation in organic mixtures.	K1
CO2	Prepare the organic compounds by single stage method.	K2
CO3	Identify various functional group in organic compounds.	K3
CO4	Develop skills in separating techniques	K3
CO5	Analyze the nature of organic mixture containing two components.	K4

Mapping of CO with PO and PSO

CCOs	O1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO 1	3	2	2	2	2	2	1	3	2	1
CO2	2	3	2	2	2	3	2	1	3	2
CO3	2	3	3	2	3	1	1	1	2	1
CO4	3	2	2	3	2	2	3	2	3	2
CO5	2	3	3	3	2	1	2	2	2	2

"1" – Slight (Low) Correlation
"2" – Moderate (Medium) Correlation
"3" – Substantial (High) Correlation
"-" indicates there is no correlation.

SYLLABUS

I. QUALITATIVE ANALYSIS OF AN ORGANIC MIXTURE CONTAINING TWO COMPONENTS

Mixtures containing two components are to be separated (pilot separation) and purified (bulk separation).

II PREPARATION OF ORGANIC COMPOUNDS (SINGLE STAGE)

1. Methyl-*m*-nitrobenzoate from methyl benzoate (nitration)
2. Glucose pentaacetate from glucose(acetylation)
3. Resacetophenone from resorcinol(acetylation)
4. Benzophenone oxime from benzophenone (addition)
5. *o*-Chlorobenzoic acid from anthranilic acid (Sandmayer reaction)
6. *p*-Benzoquinone from hydroquinone (oxidation)
7. Phenylazo-2-naphthol from aniline(diazotization)

Text Books

1. Mohan. J (2003), Organic Analytical Chemistry: Theory and Practice, Narosa
2. Ahluwalia. V. K Bhagat. P, And Agarwal. R (2005), Laboratory Techniques in Organic Chemistry, I.K. International

Reference Books

1. Gnanaprakasam, N.S and Ramamurthy. G (1987), Organic Chemistry Lab Manual, S. V. Printers
2. Vogel. A. I Tatchell. A. R Furniss B.S Hannaford. A. Jand Smith P. W. G, (1989), Vogel's Textbook ofPractical Organic Chemistry, 5th Ed., Prentice Hall

Web References

1. https://authors.library.caltech.edu/25034/10/BPOCchapter9.pdf
2. http://do.chem.uni.wroc.pl/system/files/Preparatory%20classes.pdf.

Pedagogy

Demonstration and practical sessions

Course Designers

Dr. P. Pungayee Alias Amirtham

Dr. R. Subha

Semester I	Internal Marks: 40			External Marks: 60
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
24PCH1DSE1AP	**ANALYTICAL INSTRUMENTATION TECHNIQUES (P)**	**DISCIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Objectives

- Gain proficiency in the use of analytical pipettes, volumetric measurements, and analytical instruments.
- Learn how to correctly use a UV/Vis spectrophotometer.
- Gain familiarity with a new technique.
- Perform quantitative analytical methods including titrations, pH measurements, spectrophotometry, and chromatography.

Prerequisites

Chromatography, qualitative analysis and spectroscopy

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Become familiar with fundamental concepts of instruments.	K1
CO2	Observe the application of Instrumentation Techniques	K2
CO3	Equipped with knowledge and skills in lab safety, preparation of solutions numerically.	K3
CO4	Develop the core skills to parse existing chromatographic protocols and identify the key factors influencing a chromatography experiment	K4
CO5	Acquire expertise in calibration techniques.	K5

Mapping of CO with PO and PSO

Cos	PSO1	PSO 2	PSO3	PSO 4	PSO5	PO1	PO 2	PO3	PO 4	PO 5
CO1	2	3	3	3	3	2	3	2	3	3
CO2	2	2	2	1	2	2	2	3	2	2
CO3	3	2	2	2	2	1	2	2	2	2
CO4	3	2	3	2	2	3	2	2	2	3
CO5	2	3	2	3	3	2	2	2	2	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" indicates there is no correlation.

Syllabus

1. Use and calibration of volumetric equipment (volumetric flasks, pipette's and burette's).
2. Separation of monosaccharide present in a given mixture by paper chromatography.
3. Determination of chlorine in water using colorimetry.
4. Analysis of soil
    i) Determination of pH of soil.
    ii) Determination of total soluble salts by conductometry
5. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
6. Separation of a mixture of metals by TLC.
7. Determining the concentration of citric acid in soft drink using titration.
8. Determination of equilibrium constant by colorimetry.
9. Verification of Beer-Lambert's law by colorimetry.
10. Determination of ascorbic acid in lime juice by titration.
11. Spectrophotometric determination of iron in vitamin tablets.
12. Estimation of aspirin from tablet using titration method.
13. Determination of strength of commercial vinegar by conductometry.
14. Analysis of potassium permanganate by UV/visible spectrophotometer.
15. Estimation of sugar by titrimetric method.

Text Books

1. Fifield, F.W. (2011). Principles and Practice of Analytical Chemistry. United States: Springer US.
2. Lundanes, E., Reubsaet, L., Greibrokk, T., Lundanes, E., Reubsaet, L., Greibrokk, T. (2013). Chromatography: Basic Principles, Sample Preparations and Related Methods. Germany: Wiley.
3. Franson, S., Mary, H. (2007). Standard Methods for the Examination of Water and Wastewater. United States: American Public Health Association.

Reference Books

1. Harris, D. C. (2012). Exploring Chemical Analysis: International Edition. United Kingdom: Macmillan Learning.
2. Dilts, R. V. (2010). Analytical Chemistry: Methods of Separation. United Kingdom: Van Nostrand.
3. Harris, D. C., Lucy, C. A. (2019). Quantitative Chemical Analysis. United States: W. H. Freeman.
4. Mikeš, O., Mike S, O., Chalmers, R. A. (2007). Laboratory Handbook of Chromatographic Methods. United Kingdom: Van Nostrand.

Web References

1. https://www.epa.gov/sites/default/files/2015-12/documents/9214.pdf
2. https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/General_Chemistry_Labs/Online_Chemistry_Lab_Manual/Chem_10_Experiments/11%3A_Titration_of_Vinegar_(Experiment)
3. https://www.lacitycollege.edu/Departments/Chemistry/documents/Chemistry-101-Experiments-Documents/E12B_titration2016
4. https://www.uobabylon.edu.iq/eprints/publication_10_11891_250.pdf

Pedagogy

Table Work

Course Designer

Dr. G. Sivasankari

Semester I	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
22PCH1DSE1BP	**NANOSCIENCE AND NANOTECHNOLOGY (P)**	**DISCIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Course Objectives

- Covers the whole spectrum of nanomaterials ranging from overview, synthesis, properties, and characterization of nano phase materials to application including some new developments in various aspects.
- Provides introduction to the theory and practice on Nanomaterials and various techniques used for the fabrication and characterization of nanostructures.

Prerequisites

Precipitation, reduction and absorption methods.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Exhibit proficient knowledge of the Nanoscience and related fields	K1
CO2	Understand in broad outline of Nanoscience and Nanotechnology.	K2
CO3	Acquire an understanding the Nanoscience and Applications	K3
CO4	Apply principles of basic science concepts in understanding, analysis and prediction of matter at Nano scale.	K3
CO5	Synthesis nanomaterials and explore their application and the impact of nanomaterials on environment	K4

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2	2	1	3	2	2
CO2	2	3	2	3	2	3	2	1	3	2
CO3	2	3	3	2	3	1	1	2	2	1
CO4	3	2	2	3	2	2	3	2	2	2
CO5	2	3	3	3	2	1	2	2	2	2

"1" – Slight (Low) Correlation ¬"2" – Moderate (Medium) Correlation ¬
"3" – Substantial (High) Correlation ¬"-" indicates there is no correlation.

SYLLABUS

1. Synthesis of CuO nano particles by sonochemical method.
2. Synthesis of ZnO nano particles by sonochemical method
3. Synthesis of Carbon nano particles by Microwave Irradiation Method.
4. Characterization of nanoparticles by UV- Visible Spectrophotometer.
5. Synthesis of Silver Nanoparticles by Chemical reduction method and their UV-VIS absorption studies.
6. Synthesis of Iron Oxide Nanoparticles by Polyol method and their UV-VIS absorption studies.
7. Synthesis of ZnO Nanoparticles by Co-Precipitation Method.
8. Preparation of thiolated silver nanoparticles.
9. Synthesis of Nanoparticles from plant materials by Sono chemical Method.

Text Books

1. Edelstein, A.S., Cammaratra, R.C. (2017). Nanomaterials: Synthesis, Properties and Applications, Second Edition. United Kingdom: Taylor & Francis.
2. Wiederrecht, G. (2010). Handbook of Nanofabrication. Italy: Elsevier Science.
3. Altavilla, C., CilibertoE.(2017). Inorganic Nanoparticles: Synthesis, Applications, and Perspectives. United Kingdom: CRC Press.

Reference Books

1. Fritzsche, W., Köhler, M., Fritzsche, W., Köhler, M. (2008). Nanotechnology: An Introduction to Nanostructuring Techniques. Germany: Wiley.
2. Muller, A., A.K., Cheetham., Rao C.N.R. (2006). The Chemistry of Nanomaterials: Synthesis, Properties and Applications. Germany: Wiley.

Web References

1. https://www.researchgate.net/publication/229419482_Sonochemical_synthesis_size_controlling_and_gas_sensing_properties_of_NiO_nanoparticles
2. https://www.sciencedirect.com/science/article/pii/S1569441018301445
3. https://pubs.rsc.org/en/content/articlelanding/2019/nj/c9nj01360a
4. https://www.researchgate.net/publication/231240704_UreaMelt_Assisted_Synthesis_of_NiNiO_Nanoparticles_Exhibiting_Structural_Disorder_and_Exchange_Bias

Pedagogy

Table Work

Course Designers

1. Dr. G. Sivasankari
2. Dr. R. Subha

Semester I	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs/Week**	**CREDITS**
22PCH1DSE1CP	**BIOCHEMISTRY(P)**	**DISCIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Course Objectives

- To expertise the student to identify and isolate various biomolecules.
- To acquire training to estimate the quantity of biomolecules present by applying biochemical techniques.

Prerequisites

Chromatographic techniques, biomolecules and plant pigments.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recall and understand the techniques involved in isolation, separation and estimation of various biomolecules	K1 & K2
CO2	Develop and apply the skills in handling various chromatographic and colorimetric techniques	K3
CO3	Qualitatively and quantitatively analyze the biomolecules	K4
CO4	Exemplify in handling various chromatographic techniques of biomolecules.	K5
CO5	Interpret the importance of technical analysis required for various Biomolecules	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	3	2	2	3	2	2	3
CO2	3	3	2	3	3	3	3	2	2	3
CO3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	2	3	3	3	3	2	2	3
CO5	3	3	3	3	3	2	3	3	3	3

"1"–Slight (Low) Correlation "2"–Moderate (Medium)Correlation

"3"–Substantial (High) Correlation "-"indicates there is no correlation.

Syllabus

I. EXTRACTION OF BIOMOLECULES

1. Starch from potato.
2. Casein from milk.
3. Oil from oil seeds.
4. Cellulose from plant material.

II. BIOCHEMICAL TECHNIQUES

1. Identification of amino acid by circular and ascending paper chromatography.
2. Separation of amino acids and carbohydrates in a mixture by paper chromatography.
3. Separation of lipids by thin layer chromatography.
4. Separation of a mixture of proteins and salt by column chromatography.
5. Separation of plant pigments using Chromatography techniques - TLC, Paper chromatography.

III. QUALITATIVE ANALYSIS OF BIOMOLECULES

1. Carbohydrate–Glucose, Fructose, Sucrose, Lactose and Starch.
2. Proteins – Precipitation reactions of proteins, Colour reactions of proteins, colour reactions of amino acids like tryptophan, tyrosine, cysteine, methionine, arginine, proline and histidine.
3. Lipids–solubility, acrolein test, Salkowski test, Lieberman-Burchard test.
4. Qualitative tests for nucleic acid.

IV. COLORIMETRIC ESTIMATION

1. Glucose by DNS method.
2. Protein by Biuret/Bradford and Lowry’s method.
3. Uric acid.
4. Urea by DAM method.
5. Creatinine by Jaffe’s method.
6. Phosphorous by Fiske and Subbarow’s method.

Text Books

1. Rajan, S. & Selvi Christy. R. (2018). Experimental Procedures in Life Sciences. CBS Publishers & Distributors.
2. Wilson, K. & Walker, J. (2000). Principles and Techniques of Practical Biochemistry. Fifth edition. Cambridge University Press.
3. Upadhyay & Upadhyay Nath (2016). Biophysical Chemistry: Principles and Techniques. Himalaya Publishing House.

Reference Books

1. Hofmann, A. & Clokie, S. (2018). Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. 8thedition. Cambridge University Press.
2. Wood, W. B.(1981).Biochemistry-A problem Approach. Addison Wesley.

Web References

1. http://nec.edu.np/Publications/Chemistry_LAB_Manual/Experiment%204.pdf
2. https://www.mlsu.ac.in/econtents/1616_Biochemical%20Tests%20of%20Carbohydrate, %20protein,%20lipids%20and%20salivary%20amylase.pdf
3. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files /2% 20 ESTIMATION% 20 OF%20PROTEIN%20BY%20LOWRY.pdf
4. https://orbitbiotech.com/estimation-of-reducing-sugars-by-dnsa-method/
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8575183/
6. http://atlas-medical.com/upload/productFiles/208011/Creatinine%20Package%20Insert.pdf

Pedagogy

Demonstration and practical sessions

Course Designers

Dr. P. Pungayee Alias Amirtham

Semester II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. / Week**	**CREDITS**
23PCH2CC4	**PHYSICAL CHEMISTRY - I**	**CORE**	**6**	**5**

Course Objectives

- To under quantum mechanical operators, thermodynamic probability.
- To understand and compare theories of chemical kinetics.
- To learn symmetry operation and point group of simple molecules.
- To predict the vibrational modes, hybridization using he concepts of group theory.

Prerequisites

Schrodinger equation, factors affecting rate of the reactions, probability, entropy, adsorption, absorption and adsorption isotherm.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recall postulates of quantum theory- operator- thermodynamic probability- and types of adsorption.	K1, K2
CO2	Solve Schrodinger equation, character table, various statistical models, theories of reaction rate and surface theories.	K3, K4
CO3	Explain Hermitian of operators, theories of unimolecular reactions, ensembles and microstates.	K4
CO4	Deduce wave equation for particle in a box, rigid rotor, harmonic oscillator, classical and quantum statistics.	K5
CO5	Evaluate angular and radial function, character table, unimolecular reactions and kinetic models for catalysis	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2	3	3	3	1	3
CO2	3	2	2	3	2	2	3	3	3	2
CO3	3	3	3	1	2	3	2	2	2	3
CO4	3	3	3	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	3	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" Indicates there is No Correlation

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Quantum Chemistry:** Quantum mechanical operators - linear and non-linear operators - Hermitian operators - postulates of quantum mechanics - time dependent and independent Schrodinger wave equation - solution of the Schrodinger equation for bounded states such as particle-in-one dimensional - box - harmonic oscillator - rigid rotor - solution of the Schrodinger equation for the hydrogen atom - radial - angular probability distributions - atomic orbitals - electron spin.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
II	**Group Theory:** Definition of a mathematical group - properties - group multiplication table - cyclic groups - subgroups - classes - symmetry elements - symmetry operation - determination of point group of simple molecules (H_2O, CO_2, NH_3, BF_3, HCHO, C_2H_4 and XeF_4 like molecules) - definition of reducible and irreducible representations - great orthogonality theorem - consequences (statement only proof not needed) - determinations of the characters for irreducible representation of C_2v - C_3v point groups using the orthogonality theorem to construct the character table.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
III	**Chemical Kinetics:** Theories of reaction rates - Arrhenius theory - hard - sphere collision theory of gas - phase reactions - activated complex theory or absolute reaction rate theory (ARRT) for ideal gas reactions (in terms of partition functions) - relation between activated	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5

	complex theory and hard sphere collision theory - thermodynamic formulations of activated complex theory - Lindeman's - Hinshelwood theory of unimolecular reactions.			
IV	**Catalysis and surface phenomenon:** Homogenous and heterogeneous catalysis -effect of pH - temperature on enzyme catalysis - kinetics of heterogeneous catalysis - Langmuir - Hinshelwood and Langmuir - Rideal - Eley mechanism - adsorption - free energy relation at interfaces - Gibb's adsorption isotherm - physisorption – chemisorption - adsorption isotherms - Freundlich, - Langmuir.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
V	**Statistical Thermodynamics:** Thermodynamic probability - most probable distribution - ensemble -postulates of ensemble overlapping - canonical - grand canonical - micro canonical ensembles - sterling approximation derivation - Maxwell-Boltzmann distribution law - Maxwell's distribution of molecular velocity - Maxwell-Boltzmann statistics - applications - Bose-Einstein - Fermi Dirac statistics - comparison of MB, FD and BE statistics	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
VI	Self-study: (Not for final examination) Eigen value - eigen function - applications of quantum mechanics -black body radiation - photoelectric effect - hydrogen spectrum - need for quantum mechanics - postulates.		CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5

Text Books

1. Prasad, R. K. (2006). Quantum Chemistry (3rd ed), New Delhi, New Age International Publishers.
2. Bhattacharya, P.K (2014), Group Theory and its Chemical Application, New Delhi, Himalaya Publishing House.
3. Laidler, K.J. (2003). Chemical Kinetics (3rd ed), India, Pearson Education.

4. Gupta, M.C. (2003). Statistical Thermodynamics (2nd Ed), New Delhi, New Age International Publishers.
5. Puri, Sharma & Pathania (2018) Principles of Physical Chemistry (47th Ed), Jalandhar, Vishal publication.

Reference Books

1. McQuarrie, D. A. (2015). Quantum Chemistry, India, Viva Books.
2. Chandra, A.K. (1994), Introduction to Quantum Chemistry, (4th Ed.), India, Tata-McGraw-Hill.
3. Mahendra R. Awode (2002) Quantum Chemistry, (New Delhi), S. Chand and Co. Ltd.
4. Raj, G. Bhagi, A. and Jain, V. (2010). Group Theory and Symmetry in Chemistry, (3rd Ed.,), India, Krishna Prakashan.
5. Gurdeep Raj. (2016), Advanced Physical Chemistry, (4th Ed), Meerut, Krishna prakashan media.
6. Raman, K.V. (1990), Group theory and its applications to chemistry (3rd Ed), McGraw-Hill Education.

Web References

1. e-PG Pathshala – P-02- Physical Chemistry- I (Quantum Chemistry)
2. e-PG Pathshala – P-06- Physical Chemistry- I (Statistical thermodynamics, chemical dynamics, electrochemistry)
3. https://www.bdu.ac.in/cde/SLM/M.Sc.%20Chemistry/Chemistry%20I%20Year/Physical_Chemistry/Unit1.doc.
4. https://youtu.be/ALwziZSRiqM
5. https://youtu.be/ACY-Wbudg0o
6. https://youtu.be/yO8v0nszUz8
7. https://nptel.ac.in/courses/104101124
8. https://ipc.iisc.ac.in/~kls/teaching.html

Pedagogy

Chalk and talk, PPT, E-content, Discussion, Assignment, Demo, Quiz, and seminar

Course Designer

Dr. V. Sangu

Semester II	Internal Marks:40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH2CC2P	**ORGANIC CHEMISTRY -II (P)**	**CORE PRACTICAL**	**6**	**5**

Course Objectives

To perform the quantitative analysis of a given organic compounds and to carry out the preparation of organic compounds.

Prerequisites

Hydrolysis, Acetylation, bromination, nitration and oxidation/ reduction

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Explain the quantitative estimation and double stage preparation of organic compounds.	K2
CO2	Demonstrate the methods employed in the organic preparation	K2
CO3	Distinguish the crude and purified samples.	K3
CO4	Analyze the various types of organic reagents and reactions.	K4
CO5	Choose the purification techniques such recrystallisation and steam distillation.	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2	2	1	3	2	1
CO2	2	3	2	2	2	3	2	1	3	2
CO3	2	3	3	2	3	1	1	1	2	1
CO4	3	3	3	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	3	3

"1"–Slight (Low) Correlation "2"–Moderate(Medium)Correlation

"3"–Substantial (High)Correlation "-"indicates there is no correlation

Syllabus

I QUANTITATIVE ANALYSIS OF ORGANIC COMPOUNDS

1. Estimation of phenol
2. Estimation of aniline
3. Estimation of ketone
4. Estimation of glucose
5. Estimation of nitrobenzene
6. Estimation of glycine
7. Estimation of iodine value of oil

II PREPARATION OF ORGANIC COMPOUNDS (DOUBLE STAGE)

1. Acetylsalicylic acid from methyl salicylate (hydrolysis and acetylation)
2. 1,3,5-Tribromobenzene from aniline (bromination, diazotization and hydrolysis)
3. p-Nitroaniline from acetanilide (nitration and hydrolysis)
4. Benzilic acid from benzoin (rearrangement)
5. p-Aminobenzoic acid from p-nitrotoluene (oxidation and reduction)
6. Benzanilide from benzophenone (rearrangement)
7. m-Nitroaniline from nitrobenzene (nitration and reduction)

Text Books

1. Mohan.J (2003), Organic Analytical Chemistry: Theory and Practice, Narosa

2. Ahluwalia.V.K Bhagat.P & Agarwal.R (2005), Laboratory Techniques in Organic Chemistry, I.K. International

Reference Books

1. Gnanaprakasam, N.S &Ramamurthy.G(1987), Organic Chemistry Lab Manual,S.V.Printers
2. Vogel.A.IT atchell. A.R, Furniss B.S, Hannaford.A. J &SmithP.W. G, (1989), Vogel's Textbook of Practical Organic Chemistry, 5th Ed., Prentice Hall.

Web References

1. *http://rushim.ru › books › praktikum › Mann*
2. http://do.chem.uni.wroc.pl/system/files/Preparatory%20classes.pdf.

Pedagogy

Chalk and talk, PPT, E-content, Discussion, Assignment, Demo, Quiz, Seminar

Course Designers

Dr. K. Shenbagam

Semester II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. / Week**	**CREDITS**
23PCH2CCC1A	**ORGANIC REACTION MECHANISM-II**	**CORE CHOICE COURSE**	**6**	**4**

Course Objectives

- To learn about the oxidising and reducing agent.
- Enable the students to acquire surplus knowledge about the addition, elimination mechanism, pericyclic reactions and the chemistry behind the photolytic reactions.
- Guide the students to know the role of heterocyclic compounds in drug development.

Prerequisites

Addition, Elimination, cycloaddition, photoreaction and Heterocycles.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Outline the synthesis, reactivity of organic compounds, nature of reagents, and fundamentals of photochemistry.	**K1 & K2**
CO2	Interpret the reaction mechanism of various organic reactions including photochemical, pericyclic, redox and heterocycles.	**K3**
CO3	Classify the different types of addition, elimination, photolytic reactions and heterocyclic compounds.	**K4**
CO4	Categorize the reaction pathways and naming reactions.	**K5**
CO5	Predict the mechanism and products of organic reactions.	**K6**

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2	3	2	1	1	3
CO2	3	2	1	3	2	3	3	1	1	2
CO3	3	3	2	1	2	3	3	2	2	3
CO4	3	3	2	2	3	3	3	2	2	3
CO5	3	3	2	3	3	3	2	1	1	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" Indicates there is No Correlation.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Addition and Elimination:** Addition to carbon - carbon multiple bonds – electrophile - nucleophile - free radical addition - addition to carbonyl - conjugated carbonyl system with mechanisms - Knoevengal - Stobbe - Darzen's glycidic ester condensation - Reformatsky reaction - elimination reaction - mechanism of E1, E2, E1CB – stereochemistry - Hoffmann's - Zaitsev's rules - pyrolytic cis elimination - Chugaev reaction - Hoffmann exhaustive methylation - Cope elimination - Bredt's rule.	18	CO1, CO2, CO4, CO5	K1, K2, K3, K4, K5
II	**Organic Photochemistry:** Fundamental concepts - energy transfer - characteristic of photoreaction - photoreduction- photooxidation – photosensitization - classification of photo reactions of Ketones - enones - Norrish type I and II - Paterno-Buchi reaction - photo-Fries rearrangement - photochemistry of alkenes - aromatic compounds – Zimmerman's di-pi methane rearrangement -reaction of unactivated centres- photochemistry of α, β - unsaturated carbonyl compounds - Barton Reaction.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**Pericyclic Reactions:** Concerted reactions- stereochemistry - orbital symmetry - correlation diagram - Frontier molecular orbital approach- Woodward-Hoffmann rules- electrocyclic reactions - cycloaddition reactions- selection rules - sigmatropic rearrangements- selection rules with examples- 1,3 and 1,5 hydrogen shifts - Cope - Claisen rearrangements.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

IV	**Reagents in Organic Synthesis**: Oxidation- Baeyer-Villiger-Jacobsen epoxidation - Shi epoxidation- Jones reagent-PCC-PDC- IBX-DMP-CAN-Cu(OAC)$_2$-Bi$_2$O$_3$-Swern oxidation- Sommelet reaction- Elbs reaction- oxidative coupling -Prevost reaction - Woodward modification - reduction-palladium - platinum - rhodium - nickel based heterogeneous catalysts for hydrogenation -Wilkinson's catalyst -Noyori asymmetric hydrogenation- Luche reduction- Red-Al- $NaBH_4$ -$NaCNBH_3$- trialkylsilanes -trialkylstannane.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**Heterocycles:** Nomenclature - synthesis - reactivity of aromatic heterocycles - pyrazole- isothiazole- triazole- pyrimidine- purines- triazines- pyridazines – pyrazines - synthesis - reactivity of non-aromatic heterocycles - tetra hydro furan- pyrrolidine -piperidine- oxirane- oxetane- oxazole -imidazole.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self-Study for Enrichment:** (Not to be included for External Examination) Markovnikov's - Anti-Markovnikov's rule - syn-anti addition – elimination - Jablonski diagram - thermal - photochemical reactions - chemistry of simple heterocycles.	-	CO1, CO2, CO3	K1, K2, K3, K4

Text Books

1. Pine S.H, Hendrickson J B, Cram and Hammond, (1980), Organic Chemistry, McGraw Hill, New York, 4th edition.
2. March J, and Smith M.B,(2020), Advanced Organic Chemistry, Reactions, mechanisms and Structure, Wiley, 8th edition.
3. Carey F A and Sundberg R J,(2007), Advanced Organic Chemistry, Part A and Part B, Springer,5th Corrected edition.
4. Bansal. R .K, (1990), Reaction mechanism in Organic Chemistry, Tata McGraw Hill.
5. Finar I L, (2009), Organic Chemistry, Pearson Education Ltd., 6th edition.

Reference Books

1. Peter sykes (2009), A guide book to mechanism in Organic Chemistry, Pearson Education, 6th edition.
2. Raj K Bansal. (2009), Heterocyclic Chemistry, New Age International Publishers. 4th edition.
3. Gurdeep. R. Chatwal, (2015), Reaction Mechanism and Reagents in Organic Chemistry, Himalaya Publishing House.

Web References

1. **https://www.chemistrylearner.com/addition-reaction.html.**
2. **http://www-oc.chemie.uni-regensburg.de/OCP/ch/chb/oc5/Photochemie-08.pdf.**
3. **https://edscl.in/pluginfile.php/2878/mod_resource/content/1/teachers%20notes.pdf.**

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar.

Course Designer

- Dr. A. Sharmila

Semester II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. / Week**	**CREDITS**
23PCH2CCC1B	**CHEMISTRY OF NATURAL PRODUCTS**	**CORE CHOICE COURSE**	**6**	**4**

Course Objectives

- By the end of this course, the student will be familiar with definition, isolation and uses of natural products.
- The students will be able to know the general properties and methods of preparation of naturalproducts chemically and biosynthetically.

Prerequisites

Isolation, addition, elimination, substitution, oxidation, reduction reactions.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Differentiate the different types of alkaloids, terpenes, steroids, flavonoids and vitamins.	**K1**
CO2	Know the basic terms in natural product chemistry and their physiological significance.	**K2**
CO3	Evaluate the different methods of preparation of natural products.	**K3**
CO4	Recognize the most important building blocks employed in the biosynthesis of natural products.	**K4**
CO5	Elaborate general methods of structural elucidation of compounds of natural origin.	**K5**

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2	3	1	1	1	3
CO2	3	2	1	3	2	2	3	1	1	2
CO3	3	3	1	1	2	3	2	2	2	3
CO4	3	3	2	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	1	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" Indicates there is No Correlation.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Alkaloids**: Categorization of alkaloids- general methods of structural determination of alkaloids -synthesis - biogenesis of nicotine - quinine – morphine - atropine - sertonin.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**Terpenoids and Carotenoid**: Classification of terpenoids - isoprene rules- structural elucidation - synthesis of geraniol- α-pinene - camphor - diterpenoids - carotenoid- introduction - structure - synthesis of β-carotene - lycopene.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Steroids:** Introduction - nomenclature of steroids - Blanc's rule - Barbier-Wieland degradation -oppenauer oxidation - Diel's hydrocarbon - chemistry of cholesterol - ergosterol -Vitamin-D.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Flavonoids and Isoflavonoids:** Occurrence, nomenclature and general methods of structure determination, isolation - structure elucidation -synthesis of kaempferol - quercetin - cyanidin-genestein.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**Vitamins:** Classification - structure of water soluble - fat-soluble vitamins - plant and animal sources- vitamins as coenzymes-deficiency of vitamins and their effects.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment:** (Not to be included for External Examination) Definition - isolation and purification of alkaloids-terpenes - flavonoids.	-	CO2, CO3	K2, K3

Text Books

1. Chatwal G.R, (1990), Natural Products Chemistry-Vol. I & II, Himalaya Bombay.
2. Agarwal, O.P, Goel Gorakhpur (1985), Chemistry of Natural Products-Vol. I & II:
3. Longmann E.L, London B.S, (2000), Organic Chemistry-Vol. I-II: I. L. Finar.
4. Sujatha V. Bhat, Nagasampige B.A & Sivakumar M, (2006), Chemistry of Natural Products:, 2nd reprint, Springer.

Reference Books

1. Dewick P.M (2009), Medicinal Natural Products: A Biosynthetic Approach", 2nd Edition, Wiley& Sons.
2. Graham Solomons T.W, Craig B. Fryhle, Scott A. Snyder (2013), Organic Chemistry, 11th Edition, International Student Version, John Wiley &Sons. Himalaya Publishing House.

Web References

1. https://chemnote.weebly.com/uploads/2/5/8/6/25864552/alkaloids.pdf.
2. https://www.vedantu.com/biology/steroid.
3. https://www.slideshare.net/TareqAspirant/a-short-note-on-vitamins.
4. https://www.tuscany-diet.net/2014/01/22/flavonoids-definition-structure-classification.
5. https://www.intechopen.com/chapters/62573.
6. https://gcwgandhinagar.com/econtent/document/1588068142ch-1.pdf.

Pedagogy

Chalk and talk, PPT, E-content, Discussion, Assignment, Demo, Quiz, Seminar

Course Designer

- Dr. C. Rajarajeswari

Semester II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. / Week**	**CREDITS**
23PCH2CCC1C	**MOLECULAR REARRANGEMENT**	**CORE CHOICE COURSE**	**6**	**4**

Course Objectives

- To learn about the reactions intermediates involved in rearrangement reactions.
- To learn about the basic concepts about the electrophilic and nucleophilic rearrangement reactions.
- To learn the concept and mechanism of rearrangement reactions.

Prerequisites

Reaction intermediates, nitrenes, carbenes, electrophilic, nucleophilic, naming reactions**.**

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Know the outline for determining nature of rearrangements.	**K1, K2**
CO2	Interpret the reaction mechanism in various organic reactions.	**K2**
CO3	Classify the different types of intermediates involving in organic rearrangement reactions.	**K3**
CO4	Recognize the technique of identifying reaction mechanism in various naming reactions.	**K4**
CO5	Predict the mechanism, different intermediates and product of molecular rearrangement reactions.	**K5**

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2	3	1	1	1	3
CO2	3	2	1	3	2	2	3	1	1	2
CO3	3	3	1	1	2	3	2	2	2	3
CO4	3	3	2	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	1	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

3" – Substantial (High) Correlation "-" Indicates there is No Correlation.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Molecular Rearrangements:** Introduction - intermolecular - intra molecular rearrangement - intermediates - classification based on migration origin and migration terminus - rearrangement to electron - deficient carbon - Wagner - Meerwein rearrangement - pinacol rearrangement - Wolff rearrangement - benzyl - benzilic acid rearrangement - allylic rearrangement - Sommelet - Hauser rearrangement - Tiffeneau - Demjanov rearrangement.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**Rearrangement to electron-deficient nitrogen:** Beckmann rearrangement - Schmidt rearrangement - Hofmann rearrangement -Curtius rearrangement - Lossen rearrangement -Neber rearrangement - Stieglitz rearrangement - rearrangements with acyl carbenes - Arndt-Eistert Reaction - diazo ketone reactions.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Rearrangement to electron-deficient oxygen:** Baeyer - Villiger oxidation - cumene hydroperoxide rearrangement - phenol rearrangement - Dakin reaction - free radical rearrangements - sigmatropic rearrangement – classification - [1,2] shift - [1,3] shift - [3,3] shift - Claisen rearrangement - Cope rearrangement.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Migration from N- to ring carbon rearrangement:** Hoffmann Martius rearrangement - Orton rearrangement - benzidine - semidine rearrangement - Bamberger rearrangement - migration to electron rich carbon center - Fries rearrangement - Favorski rearrangement.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

V	**Free radical rearrangement** Introduction - addition - substitutions - fragmentations - homolysis and free radical displacement - Hunsdieker reaction - Birch reduction - acyloin condensation – Homobenzylic rearrangement - Barton rearrangement- Hoffmann-Loffler-Freytag reaction.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment:** (Not to be included for External Examination) Aldol condensation - allylic rearrangement -Ullmann reaction - Sandmeyer reaction - Perkin reaction - photochemical reaction - thermal fission reaction - oxidation - reduction reaction.	-	CO1, CO2	K1 K2, K3

Text Books

1. Tewari, .K.S, Vishil, N.K, & Mehotra N.S (2001), A text book of org. chem – 1st edition, Vikas Publishing House Pvt Ltd., New Delhi.
2. Soni P.L (2005), Text Book of Organic chemistry, Sultans Chand, 1991, New Delhi.
3. Bahl & Arun Bahl (2005), Organic Chemistry, S. Chand and Sons, New Delhi.
4. Agarwal O.P (2002), Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House.
5. Gurdeep Chatwal (2002), Chemistry of Organic Natural Products, Vol 1 and 2, Goel Pub. House.

Reference Books

1. Sharma, Y.R & Vig O.P (1997), Elementary organic absorption spectroscopy – 1st edition, Goel Pulishers, Meerut.
2. Morrison R.T & Boyd R.N (1992), Organic Chemistry, 6th edition, PHI Limited, New Delhi.
3. Jerry March (1992), Advanced Organic Chemistry, 4th edition, John Wiley and Sons, New York.
4. Pine S.H (1987), Organic Chemistry, 5th edition, McGraw Hill International Edition, Chemistry Series, New York.

Web References

1. https://tmv.ac.in/ematerial/chemistry/kpb/SEM_IV_Honours_Rearrangement%20final.pdf.
2. https://pt.slideshare.net/ranianjali/molecular-rearrangements-involving-electron-deficient-nitrogen-as-an-intermediate.
3. https://tmv.ac.in/ematerial/chemistry/kpb/SEM_IV_Honours_Rearrangement.pdf.
4. https://www.slideshare.net/RakeshAmrutkar/molecular-rearrangement-182395340.
5. https://www.slideshare.net/VIKASMATHAD1/free-radicals-84891258.

Pedagogy

Chalk and talk, PPT, E-content, Discussion, Assignment, Demo, Quiz, Seminar.

Course Designer

- Dr. K. Uma Sivakami

Semester II	Internal Marks:40		External Marks:60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH2CC3P	**INORGANIC CHEMISTRY -I (P)**	**CORE PRACTICAL**	**6**	**5**

Course Objectives

To perform the semi-micro qualitative analysis and to estimate the metal ions using photoelectric colorimeter.

Prerequisites

Separation of cations and anions, qualitative analysis

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Explain the preparation of original solution and separation of mixture into cations.	K2
CO2	Demonstrate the estimation of metal ions using spectrophotometer	K2
CO3	Identify the cations using appropriate test and reagents	K3
CO4	Differentiate various concentration terms and to draw calibration curve	K4
CO5	Apply the laws of absorption for calculating the concentration of unknown solution.	K4

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2	2	1	3	2	1
CO2	2	3	2	2	2	3	2	1	3	2
CO3	2	3	2	2	2	1	1	2	2	1
CO4	3	3	2	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	1	3

"1"–Slight (Low)Correlation "2"–Moderate (Medium)Correlation

"3"–Substantial (High)Correlation "-"indicates there is no correlation

Syllabus

1. Semi-micro qualitative analysis of a mixture containing two common cations (Pb, Bi, Ca, Cd, Fe, Cr, Al, Co, Ni, Mn, Zn, Ba, Sr, Ca, Mg,) and two less common cations (W, Tl, Se, Te, Mo, Ce, Th, Zr, Ti, V, U, Li).

2. Quantitative Estimation of copper,iron, nickel, chromium and manganese ions using photoelectric colorimeter

Text Books

1. Vogel.A.I (2000), Text Book of Quantitative Inorganic Analysis, Longman.
2. RamanujamV.V (1988), Inorganic Semimicro Qualitative Analysis, National Pubs.
3. Svehla.G. (1987), Text Book of Macro and Semimicro Qualitative Inorganic analysis, Longman.

1. Vogel.A.IT atchell. A.R, Furniss B.S, Hannaford.A. J &SmithP.W. G, (1989), Vogel's Textbook of Practical Organic Chemistry, 5th Ed., Prentice Hall.

Web References

1. https://iscnagpur.ac.in/study_material/dept_chemistry/4.1_MIS_and_NJS_Manual_for_Inorganic_semi-micro_qualitative_analysis
2. https://byjus.com/chemistry/systematic-analysis-of-cations
3. https://www.uou.ac.in/sites/default/files/slm/MSCCH-505L.pdf

Pedagogy

E-content, Demo, Hands on training

Course Designers

Dr. K. Shenbagam

Semester II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. / Week**	**CREDITS**
23PCH2DSE2A	**GREEN CHEMISTRY**	**DISCIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Course Objectives

- To know about twelve principles of green chemistry, eco-friendly synthesis using microwave, ionic liquid and phase transfer catalyst.
- To know the synthesis of organic compounds in greener way.
- To gain knowledge about the use of environmentally friendly practices in reducing pollution.

Prerequisites

Pollution, hazardous chemicals, toxic chemicals. catalyst, condensation, substitution, elimination, oxidation, reduction.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Describe the basics of green chemistry and organic synthesis.	**K1**
CO2	Understand the importance of solvents, solid-state reactions, phase transfer catalyst and alternative energy sources.	**K2**
CO3	Apply green synthesis for synthesizing different organic compounds.	**K3**
CO4	Analyze the applications of green synthesis.	**K4**
CO5	Create a new route for the synthesis of organic compounds.	**K5**

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	2	2	2	2	2
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" Indicates there is No Correlation.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Introduction to Green Chemistry:** Introduction - need of green chemistry - twelve principles of green chemistry - planning a green synthesis - percentage atom utilization - evaluating the type of the reaction involved - selection of appropriate solvents - selection of starting materials - use of catalyst - international organizations promoting green chemistry.	18	CO 1, CO 2, CO 3, CO 4, CO 5	K1, K2, K3, K4, K5
II	**Organic Synthesis in Green Solvents:** Introduction, reactions in water - pericyclic reactions - Claisen rearrangement - Wittig-Horner reaction - Knoevenagel reactions - pinacol coupling - aldol condensation - benzoin condensation - Heck reaction - Wurtz reaction - Mannich reactions - organic synthesis in supercritical carbon dioxide - Diels-Alder reaction - Kolbe-Schmitt synthesis - reaction in ionic liquids - types - preparations - synthetic applications.	18	CO 1, CO 2, CO 3, CO 4, CO 5	K1, K2, K3, K4, K5
III	**Organic synthesis using ionic liquids:** Introduction - types of ionic liquids - preparation of ionic liquids - applications - conversion of epoxides to halohydrins - thiocyanation of alkyl halides - Biginelli reaction - synthesis of homoallylic amines - cyclic carbonates - tonalid - traseolide - 1-acetyl naphthalene - biotransformation in ionic liquids - transesterification reactions - ammoniolysis of carboxylic acids - synthesis of Z-aspartame.	18	CO 1, CO 2, CO 3 CO 4, CO 5	K1, K2, K3, K4, K5

IV	**Alternate Energy Processes in Chemical Synthesis:** Microwave assisted organic synthesis – introduction - reactions in water - Hofmann elimination - hydrolysis of benzyl chloride -benzamide - coupling reactions - reactions in organic solvents - Baylis - Hillman reaction – esterification - Fries rearrangement - synthesis of chalcones - ultrasound assisted organic synthesis - introduction - homogenous sonochemical reactions - Curtius rearrangement - organometallic reactions - addition reactions - heterogenous liquid - liquid reactions - solid-liquid reactions.	18	CO 1, CO 2, CO 3 CO 4, CO 5	K1, K2, K3, K4, K5
V	**Phase Transfer Catalysts:** Introduction - mechanism of phase transfer reaction - types - advantages of phase transfer catalyst - applications of phase transfer catalyst in organic synthesis - Darzen reaction - Michael addition - Benzoin condensation - Wittig reaction - oxidation reactions using permanganate - chromate - hypochloride -osmium tetraoxide - potassium ferricyanide - peroxides - reduction reactions.	18	CO 1, CO 2, CO 3 CO 4, CO 5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment:** (Not to be included for External Examination) Properties of CO_2 - Phase diagram for CO_2 - Uses of CO_2 in dry cleaning - instrumentation - types of sonochemical reaction in ultrasound assisted green synthesis.	-	CO 1, CO 2	K1, K2

Text Books

1. Kumar, V. (2007) An Introduction to Green Chemistry. Vishal Publishing Co. Jalandhar.
2. Ahluwalia. V. K. An Introduction to Green Chemistry. Narosa Publishing.
3. Anastas. P. T., and Warner, J. C. (2008). Green Chemistry. Oxford University Press.

Reference Books

1. Ahluwalia. V. K., and Kidwai, M. (2007). New Trends in Chemistry. Anamaya Publishers. 2nd Edition.
2. Ahluwalia. V. K., and Varma, R. S. (2009). Green Solvents. Narosa Publishing. 1st Edition.

Web References

1. https://www.epa.gov/greenchemistry/basics-green-chemistry.
2. https://pubs.rsc.org/en/content/articlelanding/2005/gc/b418069k.
3. https://www.scielo.br/j/jbchs/a/Fzh57FB7TrhBWRLnzkCCfDs/?lang=en#:~:text=The%20solid%2Dphase%20organic%20synthesis%20(SPOS)%20has%20emerged%20as,chemistry%20to%20discover%20new%20hits.&text=In%20SPOS%2C3%20the%20solid,to%20drive%20reactions%20to%20completion.
4. https://www.organic-chemistry.org/topics/sonochemistry.shtm.
5. https://www.sciencedirect.com/topics/chemistry/phase-transfer-catalyst.

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar.

Course Designer

- Dr. S. Devi

Semester II	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. / Week**	**CREDITS**
23PCH2DSE2B	**FORENSIC CHEMISTRY**	**DISCIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Course Objectives:

- To identify the physical and biological evidences.
- To asset the various system of finger prints, forgery and natural origin.
- To explore the processing and usage of explosives.

Prerequisites

Terminologies, fingerprint, counterfitting, explosions.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Identify the fundamental principles and functions of forensic science.	**K1**
CO2	Apply the principles of Spectroscopy in forensic science.	**K2**
CO3	Analyze the techniques involved in the field of forensics.	**K3**
CO4	Appraise the role of chemistry and other branches in forensics.	**K4**
CO5	Feasibility and evaluation of explosives.	**K5**

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	2	2
CO3	2	3	3	3	3	2	3	3	3	2
CO4	3	3	2	3	2	3	2	2	2	2
CO5	2	3	1	2	3	3	3	3	2	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" Indicates there is No Correlation.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Introduction to Forensic Science:** Functions of forensic science - historical aspects of forensic science - definitions - concepts in forensic science - scope of forensic science -need of forensic science - basic principles of forensic science - branches of forensic science -forensic science in international perspectives.	18	CO 1, CO 2, CO 3, CO 4, CO 5	K1,K2,K3, K4,K5
II	**Chemistry of Forensic Investigations:** Definition of physical evidence - classification of physical evidence - types of physical evidences - glass - soil - physical properties - comparing glass fragments - collection - preservation of glass evidence - forensic characteristics of soil - collection - preservation of soil evidence - fingerprints - fundamental principles of fingerprints - classification of fingerprints methods of detecting fingerprints - preservation of developed prints - document - voice examination - collection of handwriting exemplars - typescript comparisons - inks and papers - alterations - erasures - obliterations.	18	CO 1, CO 2, CO 3, CO 4, CO 5	K1, K2, K3, K4, K5
III	**Technological Methods in Forensic Science:** Chromatographic methods - fundamental - principles - forensic applications of thin layer chromatography - gas chromatography - liquid chromatography - spectroscopic methods - fundamental principles - forensic applications of ultraviolet - visible spectroscopy - infrared spectroscopy - atomic absorption spectroscopy - atomic emission spectroscopy - mass spectroscopy - X-ray spectrometry - colorimetric analysis - Lambert-Beer law.	18	CO 1, CO 2, CO 3 CO 4, CO 5	K1,K2,K3, K4,K5

IV	**Forgery and Counterfeiting**: Detecting forgery in bank cheques / drafts - educational records (mark lists, certificates) using UV-light - alloy analysis using AAS to detect counterfeit coins - checking silverline water mark in currency notes - jewellery - detection of gold - purity in 22 carat ornaments - detecting gold plated jewels - authenticity of diamonds - natural - synthetic - glassy.	18	CO 1, CO 2, CO 3, CO 4, CO 5	K1,K2,K3, K4,K5
V	**Explosive and Explosion:** Introduction - classification of explosives - primary - secondary or high explosive - detonator pyro technique propellant IEDs - firing mechanism of IEDs - evaluation - assessment of explosion.	18	CO 1, CO 2, CO 3, CO 4, CO 5	K1,K2,K3, K4,K5
VI	**Self-Study for Enrichment:** (Not to be included for External Examination) Role of Forensic scientist in Post blast investigation - collection of samples - explosion effects - technical report frame work.	-	CO 1, CO 2, CO 3 CO4	K1,K2,K3, K4

Text Books

1. Eckert G. William, (1996), Introduction to forensic sciences, New york, washington, CRC, Press.
2. Kemp, W. (1991) Organic Spectroscopy, 3rd Edition, Macmillan, Hampshire.
3. Henry, C. (2006) Physical Evidence in Forensic Science.
4. Nanda, B.B. and Tewari, R.K. (2001) Forensic Science in India: A vision for the twenty first century Select Publisher, New Delhi.

Reference Books

1. Tiwari, R. K., & Nanda, B. K. (2014) Forensic Science in India: A vision for the 21st Century.
2. Nordby, J. J., & James, S. H. (2019). An Introduction to Scientific and Investigative Techniques
3. James, S. H., & Nordby, J.J. (2003) Forensic Science: An introduction to scientific and investigative techniques CRC Press.

Web References

Semester II	Internal Marks: 25	External Marks: 75

1. https://digitalcommons.njit.edu/cgi/viewcontent.cgi?article=1432&context=chemsyllabi.
2. https://www.aknu.edu.in/Academics/links/AAF/PG2021 22/M.Sc.%20FSc%20Chem%20&%20Tox.pdf
3. https://www.routledge.com/Introduction-to-Forensic-Chemistry/Elkins/p/book/9781032094632.

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar.

Course Designer

- Dr. R. Subha

COURSE CODE	COURSE TITLE	CATEGORY	Hrs. / Week	CREDITS
23PCH2DSE2C	ANALYTICAL CHEMISTRY	DISCIPLINE ELECTIVE COURSE	6	3

Course Objectives

- To acquire the knowledge of basic principles and theory behind analytical techniques.
- To know the separation of chemical compounds from mixtures.
- To gain knowledge about the application of analytical techniques to analysis chemical compounds.

Prerequisites

Adsorption, elution, solubility, electromagnetic radiation.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Describe the basic concepts of data analysis, chromatography, electroanalytical methods, thermal methods and flame photometry.	K1
CO2	Understand the theory of various analytical techniques.	K2
CO3	Illustrates the instrumentation, experimental and purification details of analytical techniques.	K3
CO4	Compare various analytical techniques based on their principle and applications.	K4
CO5	Evaluate the applications of data analysis, chromatography, electroanalytical methods, thermal methods and flame photometry.	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	3	2	3
CO3	3	3	2	3	3	3	3	3	2	2
CO4	3	3	2	2	3	3	3	2	2	2
CO5	3	3	2	3	3	3	3	3	2	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" Indicates there is No Correlation.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Introduction to Analytical Chemistry:** Analytical chemistry - role of analytical chemistry - classification - advantages - limitations of analytical methods - safety in laboratory - errors - types - definitions of relative error - absolute error - significant figures - mean - median - standard deviation - sensitivity - detection limits – precision - accuracy - confidence limit - test of significance - Q - test, F - test - T - test - minimization of errors.	18	CO1, CO2, CO3, CO4, CO4	K1, K2, K3, K4, K5
II	**Chromatography I:** Chromatography - introduction - definition - types - principles - theories - experimental details - advantages - limitations - applications of paper chromatography - thin layer chromatography - liquid - liquid partition chromatography - column chromatography.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Chromatography II:** Introduction, principle, instrumentation, advantages, limitations and applications of gas chromatography, gel permeation chromatography, silver impregnated ion exchange chromatography. Principle, instrumentation and applications of high performance liquid chromatography, gas chromatography - mass spectroscopy.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Purification techniques:** Purification of solid organic compounds - recrystallization - use of miscible solvents - use of drying agents - properties - sublimation - experimental techniques of distillation - fractional distillation - distillation under reduced pressure – extraction - use of	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

	immiscible solvents - solvent extraction - chemical methods of purification.			
V	**Thermal Methods and Flame Photometry:** Thermogravimetry - Introduction - principle - instrumentation - derivative thermogravimetry analysis - factors affecting TGA - applications of TGA for quantitative analysis of calcium carbonate - copper sulphate pentahydrate - calcium oxalate hydrate - differential thermal analysis - Introduction - principle of working - factors affecting DTA - applications - flame photometry - introduction - principles - instrumentation - advantages - limitations - applications.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment** (Not to be included for External Examination) Methods of expressing accuracy and precision - fractional distillation - column chromatography - chemical methods of purification - gas chromatography - applications of TGA.	-	CO1, CO2, CO3	K1, K2, K3

Text Books

1. Skoog. D. A., West. D. M., & Holler. H. J. (1992). Fundamentals of Analytical Chemistry.
2. Chatwal, G. R., and Anand. S. (1999). Instrumental Method of Analysis. Himalya PublishingHouse, 13th reprint.
3. Srivastava. A. k., and Jain, P. C. Instrumental Approach to Chemical Analysis.
4. Allen J. Bard and Larry R. Faulkner. Electrochemical Methods: Fundamentals and Applications.

Reference Books

1. Skoog, D. A., Holler, F. J., & Crouch, R. (2006). Principles of Instrumental Analysis. 6th Edition.
2. Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education. 6th Edition.
3. Kaur, H. Instrumental Methods of Chemical Analysis. Pragati Edition.

Web References

1. https://www.simplilearn.com/data-analysis-methods-process-types-article.
2. https://www.britannica.com/science/chromatography.
3. https://microbenotes.com/high-performance-liquid-chromatography-hplc/
4. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Instrumentation_and_Analysis/Cyclic Voltammetry.
5. https://soe.unipune.ac.in/studymaterial/ashwiniWadegaonkarSelf/621%20Unit%202.pdf

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar.

Course Designer

1. Dr. G. Sivasankari
2. Dr. S. Devi

Semester III	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
23PCH3CC5	**PHYSICAL CHEMISTRY - II**	**CORE COURSE**	**6**	**5**

Course Objectives

- To understand the significance of electrochemistry and kinetics of reactions in solution.
- To predict the vibrational modes, hybridization using he concepts of group theory.
- To apply the approximation methods to hydrogen and polyelectronic systems.
- To determine thermodynamic properties of diatomic molecules using partition function.

Prerequisites

Electrolytes, electrode potential, sterling approximation, thermodynamic properties, Kronecker delta.

Course Outcomes and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Understand theories of electro-kinetics, over voltage, factors affecting reactions in solution, partition function, group theoretical selection rule molecular vibration, electronic transitions.	K1, K2
CO2	To compare and correlate variation and Perturbation method, theories of electrolytic double layers. Derive partition function for gas molecules.	K3
CO3	Explain the principle electro-capillary phenomenon, electric double layers, factors affecting reactions in solution, IR/Raman active modes of vibrations, approximation method and VB theory. Ortho para ratio of hydrogen.	K3, K4
CO4	Discriminate various concepts of electro kinetic phenomenon, theories for construction of wavefunctions quantum mechanical. VB and perturbation theorem to construct trial wavefunction for hydrogen like molecules	K5
CO5	To determine activity, activity co-efficient, Butler volmer and Tafel equations to predict over voltage. Using find hybridization and IR/Raman active modes of vibration. Deduce thermodynamic properties using partition function. Develop slater determinant for find bonder order for pi electron system.	K5, K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	2	3	3	3	1	3
CO2	3	2	2	3	2	2	3	3	3	2
CO3	3	3	3	1	2	3	2	2	2	3
CO4	3	3	3	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	3	3

"1"–Slight (Low) Correlation "2"–Moderate (Medium) Correlation

"3"–Substantial (High) Correlation "-"indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COs	CONGNITIVE LEVEL
I	**Electrochemistry:** Theory of electrolytic conductance – ionic activity and activity coefficient. – Ionic strength. Debye – Huckel theory – Limiting Law –Molar conductivity – Debye – Huckel – Onsager equation. Introduction to electrical double layer -Electrocapillary phenomenon - Lipmann's equation, interpretation and electro kinetic phenomenon. Theories of double layer. Helmholtz – Perrin, Gouy chapman model – Stern theories. Over voltage – Hydrogen overvoltage – Butler -Volmer equation, Tafel equation. Corrosion and passivation - Pourbaix diagram iron in water and Evans diagram for Zinc in HCl.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
II	**Kinetics of Reaction in solutions and chain reactions:** Reactions in solution: Comparison between gas-phase - solution in reactions-effect of ionizing power of solvent (Grunwald Weinstein equation) - primary salt effect (Bronsted-Bjerrum equation) - Significance of volume and entropy of activations. Chain reactions-characteristics – derivation for rate constant expression for decomposition of acetaldehyde (Rice-Herzfeld scheme) - photochemical reaction of H_2-Br_2.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5

III	**Partition functions:** Partition functions – definitions and separations, evaluation of translational- rotational, vibrational and electronic partition functions for monoatomic and diatomic gases molecules. Calculation of thermodynamic functions and equilibrium constant in terms of partition functions- entropy of monoatomic gas – Sacker-Tetrode equation- Quantum theory of heat capacity-Derivation of Debye's for heat capacities of solids. Statistical basis of entropy of H_2 gas- ortho and para nuclear states- calculation of residual entropy of H_2 at 0 K in terms of ortho-para ratio of hydrogen molecule.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
IV	**Applications of group theory:** Molecular symmetry - selection rule for IR/Raman and electronic spectra. Application of group theory to predict the selection rules for IR / Raman activity of normal modes of H_2O and NH_3. Prediction of orbitals and hybridization for the molecules BF_3 and CH_4. Applications of group theory to electronic spectra of formaldehyde and ethylene.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
V	**Applications of quantum theory:** Need for approximation methods – the perturbation theory (first order only) – application of the perturbation method to Hydrogen atom. Variation method – application of variation method to Hydrogen atom. slater determinants –VB treatment to hydrogen molecule – Coloumbic integral – exchange integral and overlap integral. Huckel method to Ethylene and butadiene to determine bond order and charge density on each carbon atom.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
VI	**Self-Study for Enrichment:** **(Not to be included for External Examination)** Conductivity electrolytes, electrode potential, ionic		CO1 CO2 CO3 CO4	K1 K2 K3 K4

	strength, solvation, modes of vibration, types of electronic transition in molecules. Orbital overlapping, hybridized molecular orbitals, wave function, Kronecker delta.		CO5	K5

Text Books

1. Samuel Glasstone. (2006). An Introduction to Electrochemistry, New Delhi, East-West Press (Pvt.) Ltd.
2. Laidler, K. J. (2003). Chemical Kinetics (3rd ed), India, Pearson Education.
3. Gupta, M. C. (2003). Statistical Thermodynamics (2nd Ed), New Delhi, New Age International Publishers.
4. Albert Cotton, F. (2008). Chemical Applications of Group theory (3rd Ed), New Delhi, Willy India Pvt. Ltd publisher.
5. Chandra, A. K. (1994). Introduction to Quantum Chemistry, (4th Ed.), India, Tata-McGraw-Hill.

Reference Books

1. Laidler, K. J. (1987). Chemical Kinetics (3rd ed), Harper and Row publications, p.359-360 ISBN 0-06- 043862-2.
2. Espenson, J. H. (2002). Chemical Kinetics and Reaction Mechanisms (2nd ed), McGraw-Hill, p.264-6 ISBN 0-07-288362-6.
3. Prasad, R. K. (2006). Quantum Chemistry (3rd ed), New Delhi, New Age International Publishers.
4. Prasad, R.K. (1992). Quantum Chemistry, Wiley Easter.
5. Gurdeep Raj. (2016). Advanced Physical Chemistry, (4th Ed), Meerut, Krishna prakashan media.
6. Puri, Sharma and Pathania. (2018). Principles of Physical Chemistry (47th Ed), Jalandhar, Vishal publication.
7. Raman, K. V. (1990), Group theory and its applications to chemistry (3rd Ed), McGraw-Hill Education.
8. Bhattacharya, P. K. (2014). Group Theory and its Chemical Application, New Delhi, Himalaya Publishing House.
9. McQuarrie, D. A. (2015). Quantum Chemistry, India, Viva Books.
10. Rajaram and Kuriacose, J. C. (1986). Thermodynamics for Students of Chemistry (second Ed), Jalandhar, S. L. N. Chand and Co.

Web References

1. https://nptel.ac.in/courses/115101107
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA
3. https://www.chem.tamu.edu/rgroup/hughbanks/courses/673/lecturenotes/lecturenotes.html http://www.kpgcollege.org/admin/upload/1586604901.pdf
4. https://youtu.be/ALwziZSRiqM
5. https://youtu.be/ACY-Wbudg0o
6. https://youtu.be/yO8v0nszUz8
7. https://nptel.ac.in/courses/104101124
8. https://ipc.iisc.ac.in/~kls/teaching.html
9. https://www.pdfdrive.com/modern-electrochemistry-e34333229.

Pedagogy

Chalk and talk, PPT, E-content, Discussion, Assignment, Demo, Quiz and Seminar

Course Designer

Dr. V. Sangu

Semester III	Internal Marks: 25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
23PCH3CC6	**INORGANIC CHEMISTRY**	**CORE COURSE**	**6**	**5**

Course Objectives

- To articulate the learning of coordination chemistry in Inorganic chemistry.
- This subject will also create foundation to learn inorganic photochemistry.

Course Outcomes

Course Outcomes and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Identify the chemistry of coordination compound.	K1
CO2	Apply the basic concepts co-ordination compounds.	K2
CO3	Analyze the mechanism of coordination reactions.	K3
CO4	Compare the reaction standards of organometallic compounds.	K3
CO5	Understand the chemistry of photochemical reactions	K4

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2	3	1	1	1	3
CO2	3	2	1	3	2	2	3	1	1	2
CO3	2	3	2	1	2	3	2	2	2	3
CO4	3	3	2	2	3	2	2	1	2	3
CO5	3	3	2	3	3	3	3	2	1	3

"1" – Slight (Low) Correlation, "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" Indicates there is no Correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Principles of coordination chemistry:** Studies of coordination compounds in solution – detection of complex formation in solution –stability constants – stepwise and overall formation constants. Simple methods (potentiometric, pH metric and photometric methods of determination).Factors affecting stability – statistical and chelate effects – forced configurations.	17	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
II	**Theories of Metal - Ligand bond:** VB theory and its limitations – Crystal field theory - splitting of d-orbitals under various geometries – Factors affecting splitting – CFSE and evidences for CFSE (Structural and thermodynamic effects) – Spectrochemical series – Jahn-Teller distortion – Spectral and magnetic properties of complexes – Site preferences - Limitations of CFT – Ligand field theory – MO theory – sigma – and pi-bonding in complexes – Nephelauxetic effect – The angular overlap model.	20	CO1, CO2, CO3, CO4	K1, K2, K3, K4, K5
III	**Reaction mechanism in coordination complexes:** Kinetics and mechanism of reactions in solution – labile and inert complexes – ligand displacement reactions in octahedral and square planar complexes – acid hydrolysis, base hydrolysis and anation reactions.Trans effect – theory and applications – electron transfer reactions – electron exchange reactions – complementary and non-complementary types – inner sphere and outer sphere processes – application of electron transfer reactions in inorganic complexes – isomerisation and racemisation reactions of complexes. Molecular rearrangements of four- and	21	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

	six-coordinate complexes – interconversion of stereoisomers – reactions of coordinated ligands.			
IV	**CATALYTIC REACTIONS OF ORGANOMETALLIC COMPOUNDS:** Reactions and Catalysis by Organometallics Organometallic reactions – ligand association and dissociation – oxidative addition and reductive elimination – insertion reactions. Reactions of coordinated ligands in organometallics – hydrogenation, hydroformylation, epoxidation, metathesis. Polymerization of olefins, olefin oxidation (Wacker process) and carbonylation of methanol.	16	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**Inorganic photochemistry:** Fundamental concepts - electronic transitions in metal complexes, metal - centered and charge transfer transitions - various photophysical and photochemical processes of coordination compounds. Unimolecular charge transfer photochemistry of cobalt (III) complexes mechanism of CTTM, photoreduction - ligand field photochemistry of chromium(III) complexes - Adamson's rules, photoactive excited states, V-C model photophysics and photochemistry of ruthenium – polypyridine complexes, emission and redox properties.	16	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment:** **(Not to be included for External Examination)** Importance and applications of coordination compound. Photochemistry of organometallic compounds – metal carbonyl compounds – compounds with metal-metal bonding – Reinecke's salt chemical actinometer. Template effect and its applications for the synthesis of macrocyclic ligands		CO1, CO2 CO3	K1, K2, K3, K4

	– unique properties.			

Text Books:

1. Earnshaw, A., and Greenwood. N. (1997) Chemistry of the elements, Butterworth-Heinemann.
2. Shriver, D. F., Kaesz, H. D., and Adams, R. D. (1989). The Chemistry of Metal Cluster Complexes, VCH, Weinheim.
3. Puri, B. R., Sharma, L. R., Day, M. C., and Selbin, J. (2012) Theoretical Inorganic Chemistry, Sisler, Literary Licensing (LLC),Montana.
4. Cotton, F. A., and Wilkinson, G. Murillo C. A. and Bochmann, M. (1999). Advanced Inorganic Chemistry, 6th Ed., A Wiley - Interscience Publications, John Wiley and Sons, USA.
5. Huheey, J. E. (2006). Inorganic Chemistry, 4th Ed, Harper and Row publisher, Singapore.
6. Adamson, A. W. (1975). Concept of Inorganic Photochemistry, John Wiley and Sons, New York.
7. Kettle, S. F. A. (1996). Physical Inorganic Chemistry – A Coordination Chemistry Approach, Academic Publishers,Oxford University Press, New York.
8. Adamson, W. and Fleischaue, P. D. (1984). Concepts of Inorganic photochemistry, R. E. Krieger Pubs, Florida.

Reference Books:

1. Lee, J. D. (2000). Concise Inorganic Chemistry, 20th revised edition, Sultan Chand & Sons.
2. Gurdeep Raj, J. (2000). Advanced Inorganic Chemistry, 20th revised edition, Sultan Chand &Sons.
3. Ferraudi, J. (1998). Elements of InorganicPhotochemistry, Wiley, NewYork.
4. Basolo and Pearson R. G. (1967). Mechanism of Inorganic Reactions, 2nd Edition., John Wiley, New York.
5. Sharma, R. K. (2007). Inorganic Reactions Mechanism, Discovery Publishing House, New Delhi.

Web References

1. https://www2.chemistry.msu.edu/courses/cem151/chap24lect_2019.pdf
2. http://www.vpscience.org/materials/Unit%203%20B%20Coordination %20chemistry .pdf
3. https://www.usb.ac.ir/FileStaff/2896_2019-4-18-0-9-32.pdf

4. https://www.uou.ac.in/sites/default/files/slm/BSCCH-101.pdf

5. https://www.chem.uci.edu/~lawm/11-16.pdf

6. https://www.usb.ac.ir/FileStaff/5269_2018-9-18-10-21-39.pdf

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar

Course Designer

Dr. K. Shenbagam

Semester III	Internal Marks:40	External Marks:60		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs/ Week**	**CREDITS**
23PCH3CC4P	**INORGANIC CHEMISTRY – II (P)**	**CORE PRACTICAL**	**6**	**4**

Course Objectives

- To gain the knowledge on the molecular structure and of chemical and biological properties of biomolecules such as amino acids, proteins, lipids and nucleic acids.
- To know the mechanisms of enzymatic reactions, the various role of organic molecules in living systems.
- To learn the concepts of bio energies.

Course Outcomes

Course Outcomes and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course students will be able to	Cognitive Level
CO1	Apply the principles for the separation of cations.	K3
CO2	Prepare the inorganic complexes.	K3
CO3	Estimation of metal ions by volumetric and gravimetric methods.	K3
CO4	Characterization of metal ions.	K4
CO5	Identification and recrystallisation of complexes.	K5

Mapping of CO with PO and PSO

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	3	2	3	3	3	2	2
CO2	2	3	2	2	1	3	2	3	3	3
CO3	3	2	2	3	3	3	3	3	2	2
CO4	3	2	2	2	3	3	3	3	2	2
CO5	3	2	2	3	2	3	3	3	2	2

"1" – Slight or No Correlation "2" –(Moderate(/Medium) correlation

"3" – Substantial(High) Correlation "-" – indicates No Correlation

Syllabus

I. TITRIMETRY AND GRAVIMETRY

A mixture of solution(s) should be given for estimation

1. Cu (V) and Ni (G)
2. Cu (V) and Zn (G)
3. Fe (V) and Zn (G)
4. Fe (V) and Ni (G)
5. Zn (C) and Cu (G)

II. PREPARATION OF COMPLEXES

1. Tris(thiourea)copper(I) chloride
2. Tetraamminecopper(II) sulphate
3. Potassium trioxalatoferrate
4. Potassium trioxalatoaluminate(III)
5. Potassium trioxalatochromate(III)
6. Hexammine cobalt(III) chloride.

Text Book

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

Reference Book

Gurthu, J. N., and Kapoor, R. (1987). Advanced Experimental Chemistry, S. Chand and Co.

Web References

1. https://www.youtube.com/watch?v=OGFWZclzXkk
2. https://labguider.com/synthesis-of-tetraamminecopperii-sulphate-monohydrate/
3. https://in.video.search.yahoo.com/search/video?fr=mcafee&ei=UTF-8&p=preparation+of+Potassium+trioxalatoferrate&vm=r&type=E211IN826G0#id=1&vid=cc898fe1f3d6eca2842e1498dd920917&action=click

Pedagogy

E-content, Demo, Hands on training

Course Designer

Dr. K. Shenbagam

Semester : III	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS/WEEK**	**CREDITS**
22PGCS3CCC2A	**CYBER SECURITY**	**CORE CHOICE**	**3(T) + 2(P)**	**4**

Course Objective

- To develop skills in students that can help them plan, implement, and monitor cyber security mechanisms to ensure the protection of information technology assets.
- To expose students to governance, regulatory, legal, economic, environmental, social, and ethical contexts of cyber security.
- To expose students to the responsible use of online social media networks.
- To systematically educate the necessity to understand the impact of cyber-crimes and threats with solutions in a global and societal context.
- To select suitable ethical principles, commit to professional responsibilities and human values, and contribute value and wealth for the benefit of society

Prerequisites

Basic Knowledge of Cyber Security

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement	Cognitive Level
CO1	Understand the cyber security threat landscape	K1,K2
CO2	Develop a deeper understanding and familiarity with various types, cyber crimes, vulnerabilities, and remedies there to.	K2, K3
CO3	Analyse and evaluate existing legal frameworks and laws on cyber security.	K4, K5
CO4	Analyse and evaluate the digital payment system security and remedial measures.	K4, K5
CO5	Analyse and evaluate the cyber security risks, plan suitable security controls	K4, K5

Mapping of CO with PO and PSO

COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	P0 1	PO 2	PO 3	PO 4	PO 5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	2
CO4	3	3	3	3	2	3	3	3	3	2
CO5	3	3	3	3	2	3	3	3	3	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" indicates there is no correlation

Syllabus Theory

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	Overview of Cyber Security: Cyber security increasing threat landscape, -Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection ofend user machine, Critical IT and National Critical Infrastructure, Cyber warfare, Case Studies.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	Cyber Crimes: Cyber Crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cyber-squatting, Pharming, Cyber espionage, Cryptojacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake news cyber crime against persons –cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	Cyber Law: Cyber Crime and legal landscape around the world, IT Act, 2000 and its amendments. Limitations of IT Act, 2000. Cyber Crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

IV	Data Privacy and Data Security: Defining data, meta-data, big data, non-personal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA). Social media- data privacy and security issues.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	Cyber security Management, Compliance and Governance: Cyber security Plan-cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self Study for Enrichment** **(Not included for End Semester Examinations) Case Studies**: Largest Cyber Attacks : Yahoo Data Breach, Equifax Data Breach, WannaCry Malware Attack, Simple Locker.	-	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

Reference Books

1. Vivek Sood, (2017). *Cyber Law Simplified*. McGraw Hill Education
2. Sumit Belapure and Nina Godbole, (2011). *Computer Forensics and Legal Perspectives*. Wiley India Pvt. Ltd.
3. Dorothy F. Denning, (1998). *Information Warfare and Security*. Addison Wesley.
4. Henry A. Oliver, (2015). *Security in the Digital Age: Social Media Security Threats and Vulnerabilities*.Create Space Independent Publishing Platform.
5. Natraj Venkataramanan and Ashwin Shriram, (2016). *Data Privacy Principles and Practice.* 1st Edition, CRC Press.
6. W.Krag Brothy, (2008). *Information Security Governance, Guidance for Information Security Managers*. 1st Edition, Wiley Publication.
7. Martin Weiss, Michael G.Solomon, (2015). *Auditing IT Infrastructures for Compliance*. 2nd Edition, Jones & Bartlett Learning.

Web References

1. https://www.tutorialspoint.com/principles-of-information-system-security
2. https://www.geeksforgeeks.org/principle-or-information-system-secutiry/
3. https://www.techtarget.com/searchsecurity/definition/cybersecurity
4. https://www.ukessays.com/essays/computer-science/analysis-of-the-yahoo-data-breaches.php
5. https://www.csoonline.com/article/3444488/equifax-data-breach-faq-what-happened-who-was- affected-what-was-the-impact.html
6. https://www.techtarget.com/searchsecurity/definition/WannaCry-ransomware
7. https://www.cloudflare.com/learning/ddos/syn-flood-ddos-attack/

Practicals:

List of Exercises: (Not included for End Semester Examinations)

1. Platforms for reporting cyber crimes.
2. Checklist for reporting cyber crimes online
3. Setting privacy settings on social media platforms.
4. Do's and Don'ts for posting content on Social media platforms.
5. Registering complaints on a Social media platform.
6. Prepare password policy for computer and mobile device.
7. List out security controls for computer and implement technical security controls in the personal computer.
8. List out security controls for mobile phone and implement technical security controls in the personal mobile phone.
9. Log into computer system as an administrator and check the security policies in the system.

Web References

1. https://cybercrime.gov.in/
2. https://cybercrime.gov.in/webform/crime_onlinesafetytips.aspx
3. https://www.digitalvidya.com/blog/social-media-dos-and-donts/
4. https://www.medianama.com/2023/02/223-platform-grievance-appellate-committees-social- media/
5. https://www.ibm.com/topics/security-controls
6. https://docs.oracle.com/cd/E19683-01/817-0365/concept-2/index.html

Pedagogy

Chalk and Talk, Group discussion, Seminar & Assignment.

Course Designer

From UGC SYLLABUS

Semester III	Internal Marks: 25		External Marks: 75	
COURSECODE	**COURSETITLE**	**CATEGORY**	**Hrs/ Week**	**CREDITS**
22PCH3CCC2B	**PHOTOCHEMISTRY AND ADVANCED CHEMICAL KINETICS**	**CORE CHOICE COURSE– II**	**5**	**4**

Course Objective

- To learn the basic principles of photochemistry and energy transfer mechanism.
- To learn about the theories of reaction rates and kinetics of fast reactions.
- To gain knowledge about the catalysis and solar cells.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recall the terms related to photochemistry, theories of reaction rates, kinetics of fast reactions and catalysis.	K1
CO2	Discuss the various methods to study photochemistry and chemical kinetics.	K2
CO3	Apply the concepts of photochemistry, chemical kinetics and solar cells.	K3
CO4	Analyze the importance of photochemistry, chemical kinetics, catalysis and solar cells.	K4
CO5	Evaluate the theory and applications of photochemistry, chemical kinetics, and solar cells.	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	3	3	2	3	3
CO5	3	3	3	2	3	3	3	2	3	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation
"3" – Substantial (High) Correlation "-" indicates there is no correlation.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Photo Chemistry** Principle - absorption and emission spectra - properties of excited states - excited state acidity constants - dipole moments and redox properties - importance of photochemistry - photo physical processes in electronically excited molecules - types of photophysical pathways - types of radiation less transitions - fluorescence emission-fluorescence and structure - Triplet state and phosphorescence emission – delayed fluorescence - e - type and p-type delayed fluorescence - photosynthesis.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**Electronically excited states** Electronic, vibrational and spin levels - unimolecular and bimolecular photophysical processes - kinetic collisions and optical collisions - mechanism of fluorescence quenching - collisions in solution - kinetics of collisional quenching - Stern- Volmer equation - deviations from Stern- Volmer equation - concentration dependence of quenching and excimer formation - quenching by added substances - charge transfer- mechanism - energy transfer mechanism.	15	CO1 CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

III	**Theories of reaction rates** Potential energy surfaces – reaction coordinate – theories of unimolecular gas phase reactions – Lindemann hypothesis – Hinshelwood treatment –reactions in solutions – kinetic isotope effect – Linear free energy relationships – Hammett equation – Okamato–Brown Equation – Taft Equation - chain reactions H_2–Cl_2, H_2–Br_2 and H_2–O_2 reaction – explosion limits – factors affecting explosion limits.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Kinetics of Fast Reactions** Chemical relaxation method - principles – parameters affecting relaxation time and amplitude – derivation of equations for relaxation time for one-step transformations – chemical relaxation in two step – experimental techniques - pressure jump - principle and relaxational behavior in beryllium sulphate solutions – temperature jump - principle and factors affecting relaxation time –competition methods – nuclear magnetic resonance line shape analysis – nuclear relaxation – effect of chemical exchange –flash photolysis and pulse radiolysis – principles and applications.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

V	**Catalysis and Solar Cells** Homogenous catalysis – heterogenous catalysis – enzyme catalysis: Kinetics – influence of substrate concentration – pH – temperature – turn over number – catalytic efficiency – enzyme-like catalysis– critical micellar concentration (CMC) – factors affecting CMC – thermodynamics of micellization – reverse micelles – mechanism of surface reactions – unimolecular and bimolecular surface reactions – solar cells – photovoltaic and photo galvanic cells –prospects of solar energy conversion and storage - organic solar cells.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment:** **(Not to be included for External Examination)** Photo chemical reactions - ketones, olefins conjugated olefins and aromatic compounds - Mechanism of sensing - sensing techniques based on coalitional quenching - electrical field jump - principles and applications to neutralization reaction - methods with enhance time resolution- photoelectron chemistry - – Michaelis-Menten equation – reactions assisted by micelles.	-	CO1, CO2	K1, K2

Text Books

1. Kalidas. C., (1995). Chemical Kinetic Methods Principles of relaxation techniques and Applications. (2nded.). New Age International (P) Ltd., New Delhi.
2. Keith J Laidler, (2004). Chemical Kinetics. (3rded.). Pearson education. New Delhi.
3. Santosh K. Upadhyay, (2006). Chemical Kinetics and Reaction Dynamics, New York:

Springer with Anamaya Publishers. New Delhi.

4. Margaret Robson Wright, (2005). An introduction to Chemical Kinetics. John Wiley & sons, Ltd. England.
5. Rohatgi K. K and Mukherjee, (1978). Fundamentals of Photochemistry. NewAge International Publisher. New Delhi.

Reference Books

1. Peter Atkins and Julio de Paula, (2016). Physical Chemistry. (10th ed.). Oxford University Press. New Delhi.

2. Houston, Paul L, (2001). Chemical Kinetics and Reaction Dynamics. McGraw-Hill, Inc, Singapore.

3. Ira N. Levine, (2011). Physical Chemistry.(6th ed.). McGraw-Hill Higher Education. New York.

4. Robert G. Mortimer, (2008). Physical Chemistry. (3rd ed.). Elsevier Academic Press. London.

5. Alan Cox and Terence James Kemp, (1971). Photochemistry. McGraw-Hill. European.

Web References

1. https://www.jstor.org/stable/2414473
2. https://www.sciencedirect.com/topics/chemistry/excited-electronic-state#:~:text=An%20excited%20electronic%20state%20of,any%20of%20the%20valence%20electrons.
3. https://archive.nptel.ac.in/courses/104/101/104101128/
4. https://www.youtube.com/watch?v=k3Y_tONFQTU
5. https://pdfcoffee.com/homogeneous-catalyst-pdf-free.html

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar

Course Designer

Dr. P. Thamizhini

Semester III	Internal Marks: 25	External Marks:75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
22PCH3CCC2C	**ELECTRO CHEMISTRY**	**CORE CHOICE COURSE– II**	**5**	**4**

Course Objective

- To understand the theories and concepts of electrochemistry.
- To understand the behavior of electrolytes in solution and compare the structures of electrical double layer of different models.
- To predict the kinetics of electrode reactions applying Butler-Volmer and Tafel equations
- To gain knowledge about modern areas of electrochemistry like electrocatalysis, photoelectron catalysis and bioelectrodics.

Pre requisites:

Electrode, bio electrochemistry, electro diodes, Debye-Huckel

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Categorize and account the importance ions in electrode reactions and applications of electrochemistry.	K1&K2
CO2	Demonstrate and categorize the importance of electrodics and its reactions in multi-step systems	K3
CO3	Understand the concept and applications of electrochemistry in photo and bio electrochemistry.	K4
CO4	Recognize the characterization of electrolyte in Electro-chemical reaction mechanisms with rates of reaction.	K5
CO5	Distinguish the categorization of electrolyte in Electro-chemical reaction mechanisms and bio electrochemistry.	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2	3	2	1	3	2
CO2	3	2	1	2	2	3	3	1	1	2
CO3	3	2	2	3	3	3	3	2	2	3
CO4	3	1	2	3	2	3	3	2	1	2
CO5	3	2	2	3	2	3	3	2	2	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation
"3" – Substantial (High) Correlation "-" indicates there is no correlation

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Ionics:** Arrhenius theory –limitations- van't Hoff factor and its relation to colligative properties- Deviation from ideal behavior- Ionic activity- mean ionic activity and mean ionic activity coefficient-concept of ionic strength-Debye Huckel theory of strong electrolytes- activity coefficient of strong electrolytes-Determination of activity coefficient ion solvent and ion-ion interactions- Born equation- Debye-Huckel Bjerrum model-Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications- Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte qualitative and quantitative verification and limitations- Evidence for ionic atmosphere- Ion association and triple ion formations.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,K6
II	**Electrode-electrolyte interface:** Interfacial phenomena - Evidences for electrical double laye-, polarizable and non-polarizable interfaces- Electrocapillary phenomena - Lippmann equation electro capillary curves-Electro-kinetic phenomena electro-osmosis-electrophoresis- streaming and sedimentation potentials- colloidal and poly electrolytes-Structure of double layer- Helmholtz –Perrin-Guoy Chapman and Stern models of electrical double layer- Zeta potential and potential at zero charge. Applications and limitations.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,K6

III	**Electrodics of Elementary Electrode Reactions:** Behavior of electrodes- Standard electrodes and electrodes at equilibrium- Anodic and Cathodic currents, condition for the discharge of ions- Nernst equation- polarizable and non-polarizable electrodes- Model of three electrode system- over potential- Rate of electro chemical reactions- Rates of simple elementary reactions- Butler-Volmer equation-significance of exchange current density- net current density and symmetry factor-Low and high field approximations- symmetry factor and transfer coefficient Tafel equations and Tafel plots.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,K6
IV	**Electrodics of Multistep Multi Electron System:** Rates of multi-step electrode reactions- Butler - Volmer equation for a multi-step reaction- Rate determining step- electrode polarization and depolarization- Transfer coefficients, its significance and determination- Stoichiometric number. Electro-chemical reaction mechanisms- rate expressions- order and surface coverage- Reduction of I^{3-} -Fe^{2+}-and dissolution of Fe to Fe^{2+} -Overvoltage - Chemical and electro chemical- Phase-activation and concentration over potentials- Evolution of oxygen and hydrogen at different pH.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,K6
V	**Advanced topics in electrochemistry** Photo electrochemistry- introduction, band bending at the semiconductor/solution interface- photo excitation of electrons by absorption of light- surface effects in photo electrochemistry- photo electrochemical splitting of water- photo electrochemical reduction of CO_2. Bio electrochemistry – bioelectrodics- membrane potentials- electrochemical communication in	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5,K6

	biological organisms- enzymes as electrodes- electron transfer in enzymes- electrochemical sensors- electrochemical biosensors- gas sensors- solid state devices and sensor arrays.			
VI	**Self-Study for Enrichment (Not to be included for External Examination)** Rates of electrochemical reactions- over potential- chemical- electrochemical conditions for the discharge of ions- electro catalysis- Basics of electrodics- rates of simple electrode reactions- elementary electron electrode process.	-	CO1, CO2, CO3	K1, K2, K3

Text Books:

1. D. R. Crow, Principles and applications of electrochemistry, 4th edition, Chapman & Hall/CRC, 2014.
2. J. Rajaram and J.C. Kuriakose, Kinetics and Mechanism of chemical transformations Macmillan India Ltd., New Delhi, 2011.
3. S. Glasstone, Electro chemistry, Affiliated East-West Press, Pvt., Ltd., New Delhi, 2008.
4. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan, Electrochemistry-Principles and applications, S. Viswanathan Printers, Chennai,2007.
5. Joseph Wang, Analytical Electro chemistry, 2nd edition, Wiley, 2004.

Reference Books:

1. J.O.M. Bockris and A.K.N. Reddy, Modern Electro chemistry, vol.1 and 2B, Springer, Plenum Press, New York, 2008.
2. J.O.M. Bockris, A.K.N. Reddy and M.G. Aldeco Morden Electro chemistry, vol. 2A, Springer, Plenum Press, New York, 2008.
3. Philip H. Rieger, Electrochemistry, 2nd edition, Springer, New York, 2010.
4. L.I. Antropov, Theoretical electrochemistry, Mir Publishers, 1977.
5. K.L. Kapoor, A Text book of Physical chemistry, volume-3, Macmillan, 2001.

Web References:

1. https://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-Physical-Chemistry-Volume-1/ATOPCV1-4-5-Debye-Huckel-Limiting-Law-of-Activity-Coefficients-and-Its-Limitations.pdf

2. https://www.pdfdrive.com/modern-electrochemistry-e34333229.
3. https://www.ph.tum.de/academics/org/labs/fopra/docs/userguide-28.en.pdf

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar

Course Designer

Dr. K. Uma Sivakami

Semester III			External Marks: 100	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH3DSE3A	**CHEMISTRY FOR COMPETITIVE EXAMINATIONS**	**DISCIPLINE SPECIFIC ELECTIVE**	**4**	**3**

Course Objectives

- To know the types of bonds, properties of transition elements, structures and functions of biomolecules.
- To study the reaction mechanism and spectroscopy techniques.
- To learn the catalytic behavior of organometallic compounds.

Prerequisites

Polarity, oxidation state, biomolecules, selection rule

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recall and understand the modern approaches of chemical bonding, coordination compounds, reaction mechanism and various spectral techniques.	K1,K2
CO2	Interpret the shapes, reactions, spectrum and point group of the molecules.	K3
CO3	Analyze bond properties, catalytic behaviour, enzyme mechanism, reagents and frequencies of functional group.	K4
CO4	Explain the molecular bonding, functions of biomolecules, rearrangements and applications of various spectroscopies.	K5
CO5	Predict the nature of bonds, organometallic reactions, electron transfers, reagents and structure of molecules.	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2	3	1	1	1	3
CO2	3	2	1	3	2	2	3	1	1	2
CO3	3	3	1	1	2	3	2	2	2	3
CO4	3	3	2	2	3	3	2	1	2	3
CO5	3	3	1	1	2	3	2	2	2	3

"1"–Slight (Low)Correlation "2"–Moderate (Medium)Correlation

"3"–Substantial (High) Correlation "-"indicates there is no correlation

SYLLABUS

UNIT	CONTENT	HOURS	CO	COGNITIVE LEVEL
I	**Chemical Bonding:** Ionic bond - lattice energy- Born-Haber cycle. Covalent bond- polarities of bonds in molecules and their dipole moments. Valence bond theory - VSEPR model- shapes of molecules. Molecular orbital theory (LCAO method): Bonding in H_2,He_2, Li_2, Be_2, B_2, N_2, NO, CO, HF, and CN^-. Bond order- bond strength and bond length.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**Chemistry of Coordination Complexes:** IUPAC nomenclature - No. of possible isomers - EAN rule- Valence bond theory - CFT and CFSE calculation-Jahn Teller distortion theory. Organometallic reactions: ligand association - dissociation - oxidative addition- reductive elimination and insertion reactions. Reactions of coordinated ligands in organometallics: hydrogenation-hydroformylation - epoxidation - metathesis- polymerization of olefins and olefin oxidation (Wacker process).	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**Bioinorganic Chemistry**: Metal ions in biological systems - role in ion transport across the membranes (molecular mechanism) - oxygen uptake proteins. Heme and non-heme proteins -haemoglobin and myoglobin - oxygen transport and storage - electron transfer and oxygen activation- cytochromes - Ferredoxin and Rubredoxin. Copper containing proteins: Classification and examples - electron transfer - oxygen transport –	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

	oxygenation - oxidases and reductases - cytochrome oxidase - superoxide dismutase (Cu, Zn). Nickel containing enzyme: urease.			
IV	**Reaction Mechanism of Rearrangements and Reagents:** Molecular Rearrangements: Baeyer-Villiger – Favorskii- Fries – Claisen – Cope - Stevens and Wagner-Meerwein rearrangements. Aldol condensation - Claisen condensation – Dieckmann – Perkin – Knoevenagel –Witting - Von Richter reactions. Synthetic Uses of Reagents: OsO_4 - HIO_4 - $Pb(OAc)_4$ - SeO_2 – NBS - $LiAlH_4$ - $NaBH_4$ - n-BuLi and MCPBA.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**Spectroscopy and Group Theory:** Principle and applications in structural elucidation. Rotational: Diatomic molecules - isotopic substitution and rotational constants. Vibrational: Diatomic molecules- linear triatomic molecules - specific frequencies of functional groups in polyatomic molecules. Mass Spectrometry- parent peak - base peak - metastable peak -McLafferty rearrangement. Group theory: symmetry elements - symmetry operation - point group of simple molecules like H_2O, NH_3, BF_3, C_6H_6, biphenyl and Ferrocene.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self-Study for Enrichment: (Not to be included for External Examination)** Lewis structure -hydrogen bonding - calculation of oxidation number and oxidation state - action of enzymes - types of fissions and rearrangements - electromagnetic radiations - wavelength - frequency and wave number.	**--**	CO1, CO2, CO3	K1, K2, K3

Text Books

1. Puri B. R., Sharma L. R., Day M. C., and Selbin J. (2012), Theoretical Inorganic Chemistry; Sisler, Literary Licensing (LLC), Montana.
2. Jagdambasingh (2016), Organic Synthesis, Pragati Prakashan.
3. Kasim W and Schewederski B. (2013), Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life; 2nd Edn. John Wiley and Sons, New York, USA.
4. Finar I.R, (2009) Organic Chemistry Vol.1, 7thEdn, Pearson Education Asia.
5. Banwell C.N and Mc Cash.E.M.(2000) Fundamentals of Molecular Spectroscopy, 4thEdn,Tata McGraw Hill, New Delhi.

Reference Books

1. Huheey J. E. (2006) Inorganic Chemistry, 4th Edn., Harper and Row publisher, Singapore.
2. Mukherji,S.M and Singh.S.P (2015) Reaction Mechanism in Organic Chemistry, (Revised Edition), Trinity, New Delhi.
3. Dargo.R.S. (1977) Physical Methods in Chemistry, Saunders, Philadelphia.
4. Carey.F.A and Sundberg R.J (2000) Advanced Chemistry Part A &B, 4th Edn, Kluwer Academic/Plenum Publishers.
5. Ramam.K.V. (1990) Group Theory and its Application to Chemistry, Tata McGrawHill, New Delhi.

Web References

1.https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Supplemental_Modules_(Organic_Chemistry)/Fundamentals/Ionic_and_Covalent_Bonds

2. https://byjus.com/jee/coordination-compounds/

3.https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Organometallic_Chemistry_(Evans)/04%3A_Fundamentals_of_Organometallic_Chemistry

4.https://www.ncbi.nlm.nih.gov/books/NBK544256/#:~:text=Myoglobin%20is%20a%20protein%20located,can%20reversibly%20bind%20to%20oxygen.

5.https://tmv.ac.in/ematerial/chemistry/kpb/SEM_IV_Honours_Rearrangement%20final.pdf

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar.

Course Designer

Dr. A. Sharmila

Semester III	Internal Marks: 25			External Marks:75
COURSE CODE	COURSE TITLE	CATEGORY	HRs/ WEEKS	CREDITS
22PCH3DSE3B	BIOORGANIC CHEMISTRY	DISCIPLINE SPECIFIC ELECTIVE	4	3

Course Objectives

- To Gain the knowledge on the molecular structure and of chemical and biological properties of biomolecules such as amino acids, proteins, lipids and nucleic acids.
- To know the mechanisms of enzymatic reactions, the various role of organic molecules in living systems.
- To learn the concepts of bio energies.

Prerequisites

Bio energies, nucleic acids, molecular structure.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course students will be able to	Cognitive Level
CO1	To understand the basic concepts of biomolecules and natural products.	K2, K3
CO2	To integrate and assess the different methods of preparation of structurally different biomolecules and natural products.	K2, K3
CO3	To illustrate the applications of biomolecules and their functions in the metabolism of living organisms.	K3, K4
CO4	To analyse and rationalise the structure and synthesis of heterocyclic compounds.	K4, K5
CO5	To develop the structure of biologically important heterocyclic compounds by different methods.	K4, K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2	3	1	1	1	3
CO2	3	2	1	3	2	2	3	1	1	2
CO3	3	3	1	1	2	3	2	2	2	3
CO4	3	3	2	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	1	3

"1"–Slight (Low)Correlation "2"–Moderate (Medium)Correlation
"3"–Substantial (High) Correlation "-"indicates there is no correlation

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Chemistry and metabolism of carbohydrates** Definition, classification and biological role of carbohydrates. Monosaccharides: Linear and ring structures (Haworth formula) of ribose, glucose, fructose and mannose (structure determination not required), physical and chemical properties of glucose and fructose. Disaccharides: Ring structures (Haworth formula) –occurrence, physical and chemical properties of maltose, lactose and sucrose. Polysaccharides: Starch, glycogen and cellulose – structure and properties, glycolysis of carbohydrates.	12	CO1 CO2 CO3 CO4 CO5	K2 K3 K4 K5
II	**Steroids and Hormones:** Steroids-Introduction, occurrence, nomenclature, configuration of substituents. Diels' hydrocarbon, stereochemistry, classification, Diels' hydrocarbon, biological importance, colour reactions of sterols, cholesterol-occurrence, tests, physiological activity, biosynthesis of cholesterol from squalene. Hormones-Introduction, classification, functions of sex hormones-androgens and estrogens, adrenocortical hormones-cortisone and cortisol	12	CO1 CO2 CO3 CO4 CO5	K2 K3 K4 K5
III	**Proteins:** Separation and purification of proteins – dialysis, gel filtration and electrophoresis. Catabolism of amino acids - transamination, oxidative deamination and decarboxylation. Biosynthesis of proteins: Role of nucleic acids. Amino acid	12	CO1 CO2 CO3 CO4 CO5	K2 K3 K4 K5

	metabolism and urea cycle.			
IV	**Nucleic acids:** Structure, methods for the synthesis of nucleosides - direct combination, formation of heterocyclic base and nucleoside modification, conversion of nucleoside to nucleotides. Primary and secondary structure of RNA and DNA, Watson-Crick model, solid phase synthesis of oligonucleotides.	12	CO1 CO2 CO3 CO4 CO5	K2 K3 K4 K5
V	**Fused Ring Heterocyclic Compounds:** Benzofused five membered rings: Indole, isoindole, benzofuran and benzothiophene, Preparation and properties. Benzofused six membered rings: Quinoline and isoquinoline: Preparation by ring closure reactions, Reactions: Mechanism of electrophilic and nucleophilic substitutions, oxidation and reduction reactions	12	CO1 CO2 CO3 CO4 CO5	K2 K3 K4 K5
VI	**Self-Study for Enrichment** **(Not to be included for External Examination)** Formation of heterocyclic base and nucleoside modification, conversion of nucleoside to nucleotides. Structure and functions of non-steroidal hormones-adrenaline and thyroxin.		CO1, CO2	K2, K3

Text Books

1. Lindhorst, T.K., (2007). Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH, North America,2007.
2. Finar, I. L., (1975). Organic Chemistry Vol-2, 5th edition, Pearson Education Asia.
3. Ahluwalia V. K., Goyal, M., (2000). Textbook of Heterocyclic compounds, Narosa Publishing, New Delhi, 2000.
4. Jain M. K. , Sharma, S. C., (2014). Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi.
5. Ahluwalia, V. K., (2009). Steroids and Hormones, Ane books pub., New Delhi.

Reference Books

1. Finar, I. L., (2004). Organic Chemistry Vol-1, 6thedition, Pearson Education Asia.
2. Pelletier, (2000). Chemistry of Alkaloids, Van Nostrand Reinhold Co.
3. Shoppe,(1994). Chemistry of the steroids, Butterworthes.
4. Khan, I. A. , Khanum, A.(2004). Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad.
5. Singh. M. P. , Panda, H. , (2005). Medicinal Herbs with their formulations, Daya Publishing House, Delhi.

Web References

1. https://www.organic-chemistry.org/
2. https://www.studyorgo.com/summary.php
3. https://www.clutchprep.com/organic-chemistry

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar

Course Designer

Dr. K. Shenbagam

Semester III	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH3DSE3C	**PHARMACEUTICAL CHEMISTRY**	**DISCIPLINE SPECIFIC ELECTIVE**	**4**	**3**

Course Objectives

- To understand the advanced concepts of pharmaceutical chemistry. To recall the principle and biological functions of various drugs.
- To train the students to know the importance as well the consequences of various drugs.
- To have knowledge on the various analysis and techniques.
- To familiarize on the drug dosage and its structural activities

Prerequisites

Drugs, Isotopic dilution analysis, clincical tesing, Radio pharamaceuticals

Course Outcome and Cognitive Level Mapping

CO No.	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO 1	To identify the suitable drugs for various diseases.	K1, K2
CO2	To apply the principles of various drug action and drug design.	K3
CO3	To acquire the knowledge on product development based on SAR.	K4
CO4	To apply the knowledge on applications of computers in chemistry.	K5
CO5	To synthesize new drugs after understanding the concepts SAR.	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2	3	1	1	1	3
CO2	3	2	1	3	2	2	3	1	1	2
CO3	3	3	1	1	2	3	2	2	2	3
CO4	3	3	2	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	1	3

"1"–Slight (Low)Correlation "2"–Moderate (Medium)Correlation
"3"–Substantial (High)Correlation "-"indicates there is no correlation

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Physical properties in Pharmaceuticals:** Physical properties- Refractive index- specific & molar refraction. Optical activity\rotation- angle of rotation, specific rotation- examples-measurement of optical activity-Dielectric Constant- Induced Polarization-explanation-determination. Rheology of pharmaceutical systems-concept of viscosity, Newton's law of flow, Kinematic, Relative, Specific, Reduced & Intrinsic viscosity. Newtonian system, non-Newtonian system-Plastic flow-Pseudo plastic flow- Dilatant flow-Viscosity measurements- selection of viscometer for Newtonian and non- Newtonian system.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
Ii	**Isotopic Dilution analysis:** Principle and applications Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning-radio pharmaceuticals. Properties-diagnostics, as therapeutics, for research and sterilization. Physico Chemical Properties and drugaction- Physico chemical properties of drugs- Partition coefficient-solubility-surface activity-degree of ionization.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Drug dosage and product development:** Drug dosage Forms- Drug Delivery system–Drug Regulation and control pharmacopoeias formularies-sources of drug- drug nomenclature- routes of administration of drugs products-need for a dosage form-classification of dosage forms- Drug dosage and product development. Introduction to drug dosage Forms &Drug Delivery system–Drug regulation and	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K 6

	control-pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms.			
IV	**Development of new drugs:** Drug design, the research for lead compounds-molecular modification of lead compounds. Structure-Activity Relationship(SAR) - Factors effecting bioactivity-resonance-inductive effect- isoterism, ioisosterism, spatial considerations -biological properties of simple functional groups-theories of drug activity-occupancy theory-rate theory-induced-fittheory-4.3Quantitative structure activity relationship(QSAR)-Development of QSAR- drug recept or interactions-the additivity of group contributions- physico- chemical parameters-Lipophilicity parameters- electronic parameter-ionization constants.	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**Antibiotics, Analgesics, Antipyretics and Anesthetics** Definition – introduction – classification and biological actions- structure, properties and therapeutic uses – chemical structure and pharmacological activity of antibiotics, analgesics, antipyretics and anaesthetics-Aspirin, paracetamol and phenacetin – analgen– methohexitone-,ibuprofen, cocaine and amethocaine preparation- structure-properties and uses .	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

VI	**Self-Study for Enrichment:** **(Not to be included for External Examination)** Determination of sugar (glucose) in serum – o-toluidine method – diagnostic test for sugar in urine – Benedict's test – detection of diabetes – detection of cholesterol in urine – detection of anaemia – estimation of haemoglobin (Hb concentration) – red cell count.		CO1, CO2 CO3	K1, K2, K3,K4

Text Books

1. Bartley, E. H. (1901). Text-book of Medical and Pharmaceutical Chemistry. United Kingdom: P. Blakiston's Son & Company.
2. Braun, T., Kyrš, M., Tölgyessy, J. (2013). Isotope Dilution Analysis: International Series of Monographs in Analytical Chemistry. United Kingdom: Elsevier Science.
3. Shargel, L. (2016). Generic Drug Product Development: Specialty Dosage Forms. United Kingdom: CRC Press.
4. Toxicity Bibliography. (1972). United States: National Library of Medicine.

Reference Books

1. Ghosh, J. (n.d.). A Textbook of Pharmaceutical Chemistry. India: S. Chand Limited.
2. Alonso, J., Gonzalez, P. (2019). Isotope Dilution Mass Spectrometry. United Kingdom: Royal Society of Chemistry.
3. Isadore Kanfer, Leon Shargel, Generic Drug Product Development: International Regulatory Requirements for Bioequivalence. (2010). United Kingdom: CRC Press.
4. Goulding, R. (2013). Handbook of Dental Pharmacology and therapeutics. Netherlands: Elsevier Science..

Web References

https://www.ncbi.nlm.nih.gov/books/NBK482447/https://training.seer.cancer.gov/treatment/chemotherapy/types.html

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar.

Course Designers

1. Dr. R. Subha
2. Dr. C. Rajarajeswari

Semester III	Internal Marks: 25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. / Week**	**CREDITS**
23PCH3GEC1	**RENEWABLE ENERGY AND ENERGY HARVESTING**	**GENERIC ELECTIVE COURSE**	**3**	**2**

Course Objectives

- Understand the fundamental principles of renewable energy sources, including solar, wind, hydroelectric, geothermal, and biomass, and their potential for sustainable power generation.
- Explore the engineering principles underlying energy harvesting techniques, such as photovoltaic systems, wind turbines, hydroelectric generators, and thermoelectric devices.
- Analyze the environmental, economic, and social impacts of various renewable energy technologies, including their advantages and limitations compared to conventional fossil fuel-based energy sources.
- Investigate policy frameworks, regulatory mechanisms, and financial incentives influencing the deployment and adoption of renewable energy solutions at local, national, and global scales.
- Foster effective communication skills to articulate the technical, economic, and environmental implications of renewable energy technologies.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Understanding of the fundamental principles governing renewable energy sources, including solar, wind, hydroelectric, geothermal, and biomass, and their potential applications for sustainable energy generation.	K1
CO2	Analyze and evaluate the environmental, economic, and social implications of various renewable energy technologies,	K2
CO3	Implementing, and optimizing energy harvesting systems, utilizing a range of techniques such as photovoltaics, wind turbines, hydroelectric generators, and thermoelectric devices to efficiently capture and convert renewable energy resources into usable electricity.	K3
CO4	Expertise in navigating the complex policy and regulatory landscape governing renewable energy deployment	K4
CO5	Promote ethical awareness and responsible citizenship by exploring the ethical dilemmas, social justice considerations, and cultural dimensions associated with the transition to a renewable energy-based economy.	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2	3	2	3	3	3
CO2	3	3	2	2	3	3	2	2	2	2
CO3	2	2	2	3	2	3	3	2	3	3
CO4	3	2	3	2	3	3	2	2	2	3
CO5	3	2	2	3	3	3	3	1	2	2

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" Indicates there is No Correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Fossil fuels and Alternate Sources of energy:** Fossil fuels and nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**Solar energy:** Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Wind Energy harvesting and Ocean Energy:** Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

	Energy Devices.			
IV	**Piezoelectric Energy harvesting:** Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power.	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**Electromagnetic Energy Harvesting:** Linear generators, physics mathematical models, recent applications. Carbon captured technologies, cell, batteries, power consumption. Environmental issues and Renewable sources of energy, sustainability.	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment:** **(Not to be included for External Examination)** Solar energy, biomass, biochemical conversion- applications of solar pond and solar energy- grid interconnection topologies- mathematical description of piezoelectricity – batteries.	-	CO1, CO2, CO3, CO4	K1, K2, K3, K4

Text Books

1. Rai, G. D. (2017). Non-conventional energy sources, 6th Edition, Khanna Publishers, New Delhi.
2. Agarwal, M. P. (1983). Solar energy, S Chand and Co. Ltd, New Delhi.
3. Sukhatme, S. P., and Nayak, J. K. (2017). Solar energy, 4th Edition. Tata McGraw - Hill Publishing Company Ltd, New Delhi.
4. Boyle, G. (2012). Renewable Energy, Power for a sustainable future, Oxford University Press, in association with The Open University.

5. Jayakumar, P. (2009). Solar Energy: Resource Assessment Handbook, Asian and Pacific Centre for Transfer of Technology, Thailand.
6. Balfour, J., Shaw, M., and Jarosek, S. (2012). Introduction to Photovoltaics, Jones & Bartlett Publishers, USA.

Reference Books

1. Boyle, G., Everett, B., and Ramage, J. (2012). Renewable energy: Power for a sustainable future (3rd ed.), Oxford University Press.
2. Goswami, D. Y. (2000). Principles of solar engineering. CRC Press.
3. Manwell, J. F., McGowan, J. G., and Rogers, A. L. (2009). Wind energy explained: Theory, design and application (2nd ed.). Wiley.
4. Pandey, B. (2015). Hydroelectric energy: Renewable energy and the environment. CRC Press.
5. Klass, D. L. (1998). Biomass for renewable energy, fuels, and chemicals. Academic Press.
6. Glassley, W. E. (2015). Geothermal energy: Renewable energy and the environment. CRC Press.
7. Priya, S., and Inman, D. J. (2009). Energy harvesting technologies. Springer.
8. Markvart, T., and Castaner, L. (2003). Solar cells: Materials, manufacture and operation (2nd ed.). Elsevier.
9. Burton, T., Jenkins, N., Sharpe, D., and Bossanyi, E. (2011). Wind energy handbook (2nd ed.). Wiley.
10. Donovan, C. W. (2015). Renewable energy finance: Powering the future. World Scientific.

Web References

1. https://en.wikipedia.org/wiki/Renewable_energy
2. https://www.ieee-pes.org/pes-communities/technical-committees/tc-renewable-energy-resources
3. https://www.energy.gov/science-innovation/energy-sources/renewable-energy
4. https://www.renewableenergyworld.com/

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar.

Course Designer

Dr. G. Sivasankari

Semester IV	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSETITLE**	**CATEGORY**	**Hrs/Week**	**CREDITS**
23PCH4CC7	**PHYSICAL METHODS IN CHEMISTRY**	**CORE**	**6**	**5**

Course Objectives

- To understand electronic spectroscopy of metal complexes.
- To study in detail IR, Raman and NMR of inorganic compounds.
- To learn the Mossbauer and magnetic properties of metal complexes.

Prerequisites

Metal complexes, magnetic properties, electromagnetic spectrum.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Explain the principles of electronic, IR, NMR, ESR and mass spectrometry.	K1
CO2	Describe the applications of various spectroscopy to study the inorganic molecules.	K2
CO3	Sketch the different types of spectrum for metal complexes.	K3
CO4	Analyze the spectrum qualitatively certain chemical compounds.	K4
CO5	Assess the structure of a compound by various spectral data.	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	2	3	3	3	2	3	3
CO5	3	3	2	2	3	3	3	2	3	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation
"3" – Substantial (High) Correlation "-" indicates there is no correlation.

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Electronic Spectroscopy:** Electronic configuration - terms and microstates of atoms and ions - term symbols (pn and dn) - spectroscopic terms - L-S coupling – effect of inter-electronic repulsion and spin- orbit coupling - selection rules - Orgel diagram - prediction and assignment of transitions for weak field d^1 – d^9 ions - calculation of β and 10 Dq for simple octahedral complexes of Co and Ni- charge transfer spectra – electronic spectra of $[Ru(bipy)_3]^{2+}$.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**IR and Raman Spectroscopy:** Introduction to IR spectroscopy– IR active and IR inactive vibrations - compare the intensity of M-O, M-N, and M-S stretching vibrations in urea and thiourea complexes– factors affecting metal-ligand vibrations - Raman spectroscopy– theory of Raman effect– applications of Raman spectroscopy for inorganic chemistry - combined uses of IR and Raman Spectroscopy in the structural elucidation of simple molecules like H_2O, ClF_3, $NO_3^-$and ClO_3- - applications of IR to identify terminal and bridging carbonyl group.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**NMR Spectroscopy:** Introduction to NMR spectroscopy – one dimensional NMR of ^{13}C, ^{15}N, ^{31}P, ^{19}F – structural determination of molecules by 2D NMR (Peptides-I & II) – chemical exchange – hydrogen or deuterium exchange - Diffusion ordered spectroscopy (DOSY)– use of chemical shift reagents – NMR of paramagnetic compounds	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

	(contact & pseudo-contact shift) - magnetic resonance imaging (MRI).			
IV	**EPR Spectroscopy and Magnetic properties:** Electron spin and its characteristics - treatment of EPR of hydrogen atom with spin levels, g-value and hyperfine interaction in hydrogen atom and free radicals - McConnell equation - spectra of V(II), Mn (II), Fe(II), Co(II), Ni(II) and Cu(II) complexes - applications of EPR to biological molecules containing Cu(II) and Fe(III) ions - magnetic properties.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**Photoelectron Spectroscopy Electron and Neutron Diffraction Analysis:** Basic principle of PES – Koopman's theorem – Types of PES - XPS – Chemical shifts in XPS – Applications of XPS. Electron diffraction by gases – scattering intensity vs scattering angle, Wierl equation – measurement techniques. Neutron diffraction by crystals – magnetic scattering – Comparison between electron diffraction and neutron diffraction techniques.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self Study for Enrichment:** **(Not to be included for External Examination)** Applications of electronic spectroscopy to metal complexes - symmetry notation for molecular vibrations - Examples for different spin systems - chemical shifts and coupling constants - factors affecting the magnitude of g and A tensors in metal species – high resolution mass spectrometry.	-	CO1	K1, K2

Text Books

1. Drago, R. S. (2012). Physical Methods in Inorganic Chemistry; Affiliated East-West Press Pvt. Ltd., New Delhi.
2. Drago, R. S. (1992) Physical Methods in Chemistry; Saunders College Publications, Philadelphia.
3. Cotton, F. A., and Wilkinson, G. (1999). Advanced Inorganic Chemistry, 6th Ed., Wiley Eastern Company, New Delhi.
4. Wheatley, P. J. (1981). The Determination of Molecular Structure; 2nd Ed., Dover Publications, Mineola.
5. Leigh, G. J., and Winterton, N. (2002). Modern Coordination Chemistry; Royal Society of Chemistry, UK.

Reference Books

1. Ebsworth, E. A. V. (1987). Structural Methods in Inorganic Chemistry; 3rd Ed., ELBS, Great Britain.
2. Kemp, W. (2011). Organic Spectroscopy; 3rd Ed., Palgrave, New York.
3. Puri, Sharma and Pathania, (2024). Principles of Physical Chemistry; 48th Ed., Vishal Publishing Co., Jalandhar.
4. Malik, W. U., Tuli G. D., and Madan R. D. (2009). Selected Topics in Inorganic Chemistry 7th edition, S.Chand, New Delhi.
5. Abdul Jameel, A. (2003). Application of Physical Methods to Inorganic compounds JAN publication, Trichy.

Web References

1. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/chemistry/07.inorganic_chemistry-ii/12._electronic_spectra_of_coordination_complexes-iv/et/7436_et_et.pdf
2. https://oms.bdu.ac.in/ec/admin/contents/160_P16CH41_2020052904251921.pdf
3. https://www.youtube.com/watch?v=4yUQMEwW4TU
4. https://ccsuniversity.ac.in/bridge-library/pdf/chem-ESR-Lecture-5.pdf
5. https://www.blogs.uni-mainz.de/fb09akguetlich/files/2017/11/Moessbauer_Lectures.pdf
6. http://www.ccdc.cam.ac.uk/products/csd/Protein Data Bank (PDB)

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar

Course Designer

Dr. P. Thamizhini

Semester IV	Internal Marks:25	External Marks:75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs/ Week**	**CREDITS**
22PCH4CCC3A	**CHEMISTRY OF NANOSCIENCE**	**CORE CHOICE**	**6**	**4**

Course Objectives

- To know the basic concepts of nanoscience and synthetic methods of various nanoparticles.
- To know the ideas of nano clusters, reactions as semiconductors and its social applications like agriculture and food technology.

Prerequisites

Synthesis, characterization, solar cells, nano structures.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Thorough knowledge of the general principles of physics, chemistry, electronics and biology that play a role on the nanometer scale	K1
CO2	Insight into the materials, fabrication and other experimental techniques that can be used on the nanoscale, as well as their limitations	K2
CO3	In-depth knowledge of at least one specialisation area within the field of nanoscience and nanotechnology	K3
CO4	Sufficient scientific background to undertake research.	K4
CO5	Proficiency in translating this knowledge into useful technological applications	K5

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	2	2
CO3	2	3	3	3	3	2	3	3	3	2
CO4	3	3	2	3	2	3	2	2	2	2
CO5	2	3	1	2	3	3	3	3	2	3

"1"–Slight (Low)Correlation "2"–Moderate (Medium)

"3"–Substantial (High)Correlation "-"indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Synthetic Methods:** Nano dimensional materials – synthesis – hydrothermal synthesis- solvo thermal synthesis – microwave irradiation– sol-gel - precipitation technologies – chemical vapour condensation process – sono chemical synthesis – Microbial and plant-mediated synthesis**.**	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
II	**Characterization of Nanoscale Materials:** Principles of Atomic Force Microscopy (AFM) – Transmission Electron Microscopy (TEM) Resolution and Scanning Transmission Electron Microscopy (STEM) – Scanning Tunneling Microscopy (STM) – Scanning Nearfield Optical Microscopy (SNOM) and Scanning ion conductance microscope.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
III	**Carbon Clusters and Nanostructures:** Nature of carbon bond− new carbon structures − carbon clusters – discovery of C60−alkali doped C60−superconductivity in C60−larger - smaller fullerenes - carbon nanotubes – synthesis − single walled carbon nanotubes − structure and characterization − chemically modified carbon nanotubes − applications of carbon nanotubes - nanowires −synthetic strategies − applications of nanowires	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
IV	**Chemical Sensors and Biosensors:** Biosensor and nanobiosensor - basic concepts – characterization - Enzyme– meta NP hybrids for	18	CO1 CO2	K1 K2

	biosensing - generation of nanostructures- Biomolecule – different types of nanobiosensors - nano biosensors for medical diagnostics -nanoprobes for analytical applications.		CO3 CO4 CO5	K3 K4 K5
V	**Solar and Fuel Cells:** Nanomaterials for solar cells- Dye-sensitized solar cells- Organic-inorganic hybrid solar cells- Polymer composites for solar cells- current status and future prospects. Polymer membranes for fuel cells, Acid/ alkaline fuel cells- carbon nanotubes for energy storage- use of nanoscale catalysts to save energy and increase the industrial productivity.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
VI	**Self-Study for Enrichment** **(Not to be included for External Examination)** Classification and properties of nano materials, Scanning Nearfield Optical Microscopy, applications of carbon nanotube, nano biosensors for medical diagnostics, Dye-sensitized solar cells.	-	CO1 CO2 CO3 CO4	K1 K2 K3 K4

Text Books

1. Rao, C. N. R., Muller, A. and Cheetham, A. K., (2004). The Chemistry of Nanomaterials: (Eds), Vol. 1 and 2 Wiley-VCH. Germany, Weinheim.

2. Poole, C. P., and Owens, F. J., (2003). Introduction to Nanotechnology. Wiley Interscience New Jersey.

3. Pradeep,T. (2007) Nano:The Essentials in Understanding Nanoscience and Nanotechnology. 1st Ed., Tata McGraw Hill, New York.

4. Balandin,A. A., Wang, K. L., (2006). Handbook of Semiconductor Nanostructures and Nanodevices Vol 1-5. American scientific publishers.

5. Frewer, Lynn. Willehm, Norde, J. Fischer, R. H., and Kampers, W. H., (2011). Nanotechnology in the Agri-food sector Wiley-VCH Verlag.

Reference Books

1. Klabunde, K.J., (2009). Nanoscale Materials in Chemistry; 2nd Ed., Wiley-Interscience, New York .
2. Fujita, H., (2003). Micromachines as Tools in Nanotechnology Springer-Verlag. Berlin.
3. Kain, W., & Schweder ski, B. (2013). Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life; 2nd Ed., John-Wiley R Sons, New York.
4. Chaudry,Q., Castle, L., and Watkins, R., (2010) Nanotechnologies in Food. RSC Publications.

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1. https://www.sathyabama.ac.in/sites/default/files/course-material/2020 10/note_1519281517.pdf
2. https://www.britannica.com/technology/solar-cell
3. https://www.nano.gov/about-nanotechnology/applications-nanotechnology
4. https://www.iberdrola.com/innovation/nanotechnology-applications

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar

Course Designers

1. Dr. G. Sivasankari
2. Dr. K. Shenbagam

Semester IV	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH4CCC3B	**BIOFUELS**	**CORE CHOICE**	**6**	**4**

Course Objectives

- To understand basic concepts about biomass derived energy
- To acquire the concept of 1st generation, 2nd generation and advance biofuels
- To understand terminologies related to biomass conversion and biofuel production
- To describe techno-economic analyses of biofuel conversion technologies

Prerequisites

Biomass derived energy, advance biofuels, biofuel production, environmental impact.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Know the outline about introduction of biofuels, biorefineries and environmental impacts.	K1, K2
CO2	Stabilize the knowledge on classifications and significance of biofuels in various fields.	K3
CO3	Interpret the characteristics and production methods of different biofuels and environmental impacts.	K4
CO4	Recognize the technique for synthesis and purification of classified biofuels.	K5
CO5	Predict the scope of different biofuels in various fields.	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2	3	1	1	1	3
CO2	3	2	1	3	2	2	3	1	1	2
CO3	3	3	1	1	2	3	2	2	2	3
CO4	3	3	2	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	1	3

"1"–Slight (Low)Correlation "2"–Moderate (Medium)Correlation

"3"–Substantial (High)Correlation "-"indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Biofuels**: Classification of biofuels- solid-liquid - gaseous fuels- production processes - raw materials – products – Generation – first – second - third - fourth generation of biofuels Concepts of biorefinery - alternative energies - environmental - economic and regulatory issues- value added processing of biofuel residues - co-products.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
II	**Solid biofuels**: Structure - properties of cellulose - isolation and applications of lignin - pretreatment/fractionation by dilute acid - steam explosion – organo solvent and ammonia fiber explosion (AFEX) methods - biochemical conversion of lignocellulosic to alcohols by separate hydrolysis and fermentation (SHF) - simultaneous saccharification and fermentation (SSF) process - thermal conversion of biomass to liquid fuels by gasification – pyrolysis	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
III	**Liquid Biofuels**: Characteristics - significance of liquid biofuels - production - refined oils as fuel hydrogenation of unsaturated lipids - Fischer-Tropsch process for the production of hydrocarbons from syngas - bioethanol- raw materials - pretreatment processes- enzymatic hydrolysis and fermentation – recovery - uses – regulations - production of Ethyl ter-butyl ether (ETBE) biodiesel- trans esterification - raw materials - pretreatment process- separation – purification - quality- uses - regulations.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
IV	**Gaseous Biofuels**: Characteristics and scope of gaseous biofuels- Energy conversion process- anaerobic digestion acidogenesis – acetogenesis – methanogensis - disintegration – hydrolysis - environmental and optimization conditions for production of gaseous biofuels	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5

	– temperature –pH – alkalinity nutrients - organic loading rate - solid and hydraulic retention time - granulation of anaerobic biomass.			
V	**Other Biofuels:** Biobutanol production − Principles, materials and feedstocks − Process technologies – Biopropanol – Bioglycerol − Production of bio-oils via catalytic pyrolysis − Life-Cycle environmental impacts of biofuels and Co-products.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
VI	**Self-Study for Enrichment** **(Not to be included for External Examination)** Generation of biofuels -Integration of biofuels into biorefineries -Environmental sustainability of biofuels − Economic sustainability of biofuels.	-	CO1 CO2	K1 K2 K3

Text Books

1) K. Sharma, Environmental chemistry, Krishanan pumblications,2014.
2) Rao, M.N and Datta, A. K, Wastewater treatment, Oxfod and IBH publishers,2007.
3) Robert C.Brown, Biorenewable resources: Engineering new products from Agriculture, Wiley Publishers,2003.
4) Mousdale, Biofuels: Biotechnology, chemistry & Sustainble development, CRC Press,2008.

Reference Books

1) Mark Hammer, Water and Wastewater Technology, Pearson, 1975.
2) Sharma, B.K, An Introduction to Environmental pollution, Krishna Prakashan media,2001.
3) Caye Drapcho, Terry Walker, Engineering Process Technology,Mc Graw Hill,2008.
4) Sungyu Lee & Y.T. Shah, Biofuels and Bioenergy Process Technologies, CRC Press,2013.

Web References

1. https://www.slideshare.net/flanzashebarina/biofuels-28535080.
2. https://unstats.un.org/unsd/energy/meetings/2016iwc/19renewables.ppsx.
3. https://www.slideshare.net/AjaySinghLodhi/biofuel-226702434.
4. https://www.rgpv.ac.in/PDF/05%20Biomass.ppt.
5. https://www.slideshare.net/tarun316/biobutanol-ppt.

Pedagogy

Chalk and talk, PPT, E-content, Discussion, Assignment, Demo, Quiz, Seminar

Course Designer

Dr. K. Uma Sivakami

Semester IV	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH4CCC3C	**BIOINORGANIC CHEMISTRY**	**CORE CHOICE**	**6**	**4**

Course Objectives

- ✓ To learn the basic concepts of bioinorganic chemistry
- ✓ To give ideas of biological membrane
- ✓ To learn the concepts of oxygen transport
- ✓ To study the role of biological enzymes

Prerequisites

Biological enzymes, Enzyme functions, metallo enzymes

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recall and summarize the fundamentals of bioinorganic chemistry	K1, K2
CO2	Interpret the concept to structure, function and transport of enzymes.	K3
CO3	Categorize the interaction and effect of biological enzymes	K4
CO4	Evaluate the role of metals in function of biological system	K5
CO5	Predict the favorable conditions of application of metals and enzymes in daily life.	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2	3	1	1	1	3
CO2	3	2	1	3	2	2	3	1	1	2
CO3	3	3	1	1	2	3	2	2	2	3
CO4	3	3	2	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	1	3

"1"–Slight (Low)Correlation "2"–Moderate(Medium)Correlation
"3"–Substantial (High)Correlation "-"indicates there is no correlation

Syllabus

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**General Principles of Bioinorganic Chemistry:** Occurrence and availability of Inorganic elements in biological systems- Metal ion interactions with purine and pyrimidine bases, nucleosides, nucleotides and nucleic acids - DNA and RNA, metal ions in genetic information transfer- Different possible ways of DNA interaction	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**Function and Transport of Alkali and Alkaline earth metals**: Uptake, transport and storage of metal ions by organisms - structure and functions of biological membranes - the generation of concentration gradients (the Na+ -K + pump) - mechanisms of ion-transport across cell membranes – bleomycin - siderophores (e.g. enterobactin and desferrioxamine) - transport of iron by transferring - storage of iron by ferritin - bio chemistry of calcium as hormonal messenger.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
III	**Metalloporphyrins/Metalloenzymes:** Dioxygen transport and storage - hemoglobin and myoglobin: electronic and spatial structures - hemeythrin and hemocyanine - synthetic oxygen carriers, model systems - blue copper proteins (Cu) - iron-sulfur proteins (Fe)- cytrochromes electron transport chain - carbon monoxide poisoning.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
IV	**Redox enzymes**: Catalase, peroxidase, super oxide dismutase (SOD), cytochrome P-450, nitric oxide synthases (NOS), ascorbate oxidase, aldehyde oxidase - molybdo enzymes- xanthene oxidase, nitrate reductase, sulfite oxidase including some model study.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

V	**Bioenergetics** DNA polymerization, glucose storage, metal complexes in transmission of energy- chlorophylls, photo system I and photo system II in cleavage of water - Model systems.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
VI	**Self-Study for Enrichment:** **(Not to be included for External Examination)** Medicinal bioinorganic chemistry: platinum complexes in cancer therapy – cis-platin and its mode of action – metal toxicity. Metals in medicine: anticancer agents, diabetes, arthritis, radionuclides and related applications		CO1, CO2 CO3	K1, K2, K3, K4

Text Book

1. Lippard, S. J., and Berg, J. M., Principles of Bioinorganic Chemistry, (1997) Panima Publishing Company, New Delhi
2. Kaim W., and Schewederski, B., Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life (2013 John Wiley & Sons, New York, USA,
3. Bertini, I., Gray, H. B., Lippard, S. J. and Valentine, J. S., Bioinorganic Chemistry, 1st South Asia edition, (2007) Viva books Pvt. Ltd
4. Huheey, J. E., Keiter, E. A. and Keiter, R. L., and Medhi, O. K., Inorganic Chemistry Principles of Structure and Reactivity,4th edition (2006), Pearson Education,
5. Behrens, P., Bauerlein, E., Hand Book of Biomineralization, 1st edition, Vol. 1& 2 Wiley-VCH.
6. Arnikar, H. J., Essentials of Nuclear Chemistry, 4th edition (1995), New Age International Publishers Ltd., New Delhi,
7. Loveland, W. D., Morrissey, D. J., Seaborg, G. T., Modern Nuclear Chemistry (2006), Wiley-VCH Verlag GmbH Co. KGaA
8. Glasstone,'Source Book on Atomic Energy', 3rd edition (1979), Affiliated East West Press.
9. Lee, J. D. Concise Inorganic Chemistry, 5th edition (1996) Blackwell Science.
10. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry (1994), University Science Books,

Mill Valley, California.

Reference Books

1. Purcell, K. F. and Kotz, J. C., Inorganic Chemistry, (2012) Cengage Learning.
2. Cotton, F. A., Wilkinson, G., Carlos A. Murillo, Manfred Bochmann, Advanced Inorganic Chemistry, 6th edition (2007) A Wiley - Interscience Publication, John – Wiley & Sons, USA.
3. Atkins, P., Overton, T., Rourke, J., Weller M., and Armstrong, F., Inorganic Chemistry, 5th edition (2010) Oxford University Press.
4. Lehninger, A., Nelson, D. L., Cox, M. M, Principles of Biochemistry, 5th edition (2008) W.H Freeman.
5. Alessio, E., Bioinorganic Medicinal Chemistry, 1st Edition (2012) Wiley-VCH Verlag GmbH Co. KGaA.

Web References

1. https://www.youtube.com/watch?v=jrkqvZSCsQU
2. https://www.sciencedirect.com/science/article/pii/S2772422022000283
3. https://www.slideshare.net/fatimasaleh94214/enzymes-2-30256325
4. https://www.slideshare.net/iqbal1313/bioenergetics-25078367

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar.

Course Designer

Dr. K. Shenbagam

Semester IV	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs/Week**	**CREDITS**
23PCH4CC5P	**PHYSICAL CHEMISTRY –II (P)**	**CORE**	**6**	**5**

Course Objectives

- To construct the phase diagram of two component system forming congruent melting solid and find its eutectic temperatures and compositions
- To understand the principle of conductivity experiments through conductometric titrations.
- To understand the principle of potentiometric experiments through emf measurements.

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	To remember the principle involved in various physical-chemical experiments.	K2 & K3
CO2	To Plan and carry out all experiments scientifically.	K3
CO3	Monitor and systematically record the readings of all experiments.	K4
CO4	Calculate and process experimentally measured values and compare graphically data.	K4
CO5	Scientifically interpret experimental data to improve the effectiveness of student social development.	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	3	2	2	3	3	2	3
CO2	3	3	2	3	3	3	3	2	2	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	2	3
CO5	3	3	3	3	3	3	3	3	3	3

"1"–Slight (Low) Correlation "2"–Moderate (Medium) Correlation

"3"–Substantial (High) Correlation "-"indicates there is no correlation.

Syllabus

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

I. Non-Electrical Experiments

1. Phase diagram -Construction of phase diagram for a simple binary system
   a) Naphthalene- Phenanthrene
   b) Benzophenone- diphenylamine
   c) Benzoic acid and Cinnamic acid
2. Determination of heat of solution of a substance (benzoic acid or ammonium oxalate) by the measurement of its solubility as a function of temperature.
3. Comparison of the strength of acids by the kinetic study of iodination of acetone.

II Electrical Experiments

1. Conductivity Experiments

a) Determination of equivalent conductance of a strong electrolyte & the verification of DHO equation.
b) Verification of Kohlrausch's Law for weak electrolytes.
c) Determination of solubility of a sparingly soluble salt.
d) Acid-base titration (strong acid and weak acid vs. NaOH).
e) Precipitation titrations (mixture of halides only).
f) Verification of Henderson equation.
g) Estimation of acetic acid – sodium acetate buffer.

2. Potentiometric Experiments

a) Potentiometric titration of a mixture of Chloride and Iodide vs. $AgNO_3$.
b) Determination of the pH of buffer solution by EMF method using Quinhydrone and Calomel Electrode.
c) Determination of dissociation constant of weak acids.
d) Potentiometric redox titration Ce^{4+} - Fe^{2+} system.

Text Books

1. Viswanathan, B., and Raghavan, P. S. (2009). Practical Physical Chemistry, Viva Books, New Delhi.
2. Athawale, V. D., and Mathur, P. (2008). Experimental Physical Chemistry, New Age International (P) Ltd., New Delhi.
3. Sundaram, Krishnan and Raghavan. (1996). Practical Chemistry (Part II), S. Viswanathan Co. Pvt.

4. Sinha, S. K. (2014). Physical Chemistry: A laboratory Manual, Narosa Publishing House Pvt, Ltd., New Delhi.
5. Jensen, F. (2016). Introduction to Computational Chemistry, 3rd Ed., Wiley Blackwell.

Reference books

1. Yadav, J. B. (2001). Advanced Practical Physical chemistry", 20thedn. GOEL publishing House, Krishna Pakashan Media Ltd.
2. Levitt, B. P. (1985). Findlay's Practical Physical Chemistry, 9th ed., Longman, London.
3. Gurtu, J. N., and Gurtu, A. (2008). Advanced Physical Chemistry Experiments, Pragati Prakashan, Uttar Pradesh.

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2. https://mhchem.org/222/pdfLabs222/Kinetics.pdf
3. https://staff.buffalostate.edu/nazareay/che301/lab5.pdf
4. https://www.youtube.com/watch?v=4BbFCcqF_Ww

Pedagogy

Demonstration and practical sessions

Course Designer

Dr. K. Shenbagam

Semester IV	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. / Week**	**CREDITS**
22PCH4GEC2	**CORROSION AND POLLUTION MANAGEMENT**	**GENERIC ELECTIVE COURSE**	**3**	**2**

Course Objectives

- To describe the forms, mechanism, and kinetics of corrosion.
- To determine the probable corrosion, corrosion rate, and corrosion mechanism of the metallic material in the given environment.
- To recommend a suitable corrosion protection method for sustainable materials use.

Prerequisites

Corrosion, pollution, solid waste, e-waste

Course Outcomes

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recall the basic concept of corrosion and pollutions.	K1
CO2	Understand the types of corrosion and objectives of pollution management.	K2
CO3	Illustrate the significance of corrosion inhibition and pollution control.	K3
CO4	Analyze the methods to prevent corrosion and pollution.	K4
CO5	Propose a way to avoid corrosion and pollution.	K5

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2	3	1	1	1	3
CO2	3	2	1	3	2	2	3	1	1	2
CO3	3	3	1	1	2	3	2	2	2	3
CO4	3	3	2	2	3	3	2	1	2	3
CO5	3	3	2	3	3	3	3	2	1	3

"1" – Slight (Low) Correlation "2" – Moderate (Medium) Correlation

"3" – Substantial (High) Correlation "-" Indicates there is No Correlation.

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Basic aspects of corrosion:** Importance of corrosion studies - EMF and galvanic series - categorization of corrosion - dry corrosion and electrochemical corrosion - difference between chemical and electrochemical corrosion - factors influencing corrosion.	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**Types of corrosion:** Pitting, inter-granular, waterline corrosion, stress corrosion, erosion corrosion, galvanic corrosion, dezincification - atmospheric corrosion - classification, factors influencing atmospheric corrosion - microbiological corrosion - soil corrosion.	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Effective Coatings:** Introduction - classification - metallic coating, non - metallic coating - organic coatings - pre-treatment of the surface - metallic coatings - hot dipping, spraying, cladding inorganic non-metallic coating - chromate coating, phosphate coating and oxide coating - organic coatings – paints - requirements of good paint.	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Control Measures of air and soil pollution:** Control of particulate emissions - gravitational settling chambers - cyclone separators - fabric filters - electrostatic precipitators - wet scrubbers - control of gaseous pollutants - control of nitrogen oxides pollution - control of SOx pollution - control measures to prevent soil pollution - integrated plant nutrient management	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

	- integrated pest management - bioremediation - phytoremediation.			
V	**Solid and e-waste management:** Objectives of solid waste management - municipal solid waste treatment - dumping - composting - vermi composting - sanitary land fill - incineration of municipal solid waste - industrial solid waste treatment - recycling techniques - e-waste - composition - recovery of metals and recycling.	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment:** (Not to be included for External Examination) Forms of metallic corrosion, corrosion failure analysis, corrosion testing and monitoring - control of pollutant emission from mobile sources - biodegradability of organic matter, cellulosic waste and lignin - solid waste management by biotechnology.	-	CO1, CO2	K1, K2

Text Books

1. Pletcher, D., & Walsh, F. C. (1993) Industrial Electrochemistry, Vol. II, Blakrid Academic Professional, London.
2. Jones, D. (1992) Principles and prevention of corrosion, Macmillan Publications, New York.
3. Meketta, J. J. (1993) Cathodic protection Theory and practice, Marcel Dekker Publication, New York.
4. Kaur, H. (2016). Environmental Chemistry, A Pragati Prakashan – Meerut Publication.

Reference Books

1. Schweitzer, P. A. (2009). Fundamentals of Corrosion, CRC Press, 1st Edition.
2. R. Winston Revie, R., & Uhlig, H. H. (2008). Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, Wiley, 4th Edition.
3. Washington, D. C. (2011). Research Opportunities in Corrosion Science and Engineering, National Academic Press.

4. De, A. K. (2018). Environmental Chemistry. 9th Edition, New Age International Publishers, New Delhi.

Web References

1. https://www.slideshare.net/rayhan_u01/corrosion-engineering-54230652.
2. https://www.usna.edu/NAOE/_files/documents/Courses/EN380/Course_Notes/Ch05_Corrosion_Types.pdf.
3. https://www.slideshare.net/Faisal419/coating-chemistry.
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2963874/
5. https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WEDC/es/ES07CD.pdf
6. https://cpcb.nic.in/displaypdf.php?id=em9iZW5nYWx1cnUvQVBDRHMucGRm

Pedagogy

Chalk and talk, PPT, Discussion, Assignment, Demo, Quiz, Seminar.

Course Designers

1. Dr. K. Uma Sivakami
2. Dr. S. Devi