CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

NATIONALLY ACCREDITED WITH "A" GRADE BY NAAC

ISO 9001:2015 Certified

TIRUCHIRAPPALLI

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

M.Sc., Chemistry

Syllabus

2022-2023 and Onwards

CAUVERYCOLLEGEFORWOMEN (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 holisticprogress 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 chemicalsciences.	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), Trichy-18
PG and Research Department of Chemistry

M.Sc., Chemistry

(For the Candidates admitted from the Academic year 2022-2023 onwards)

Semester	Course	Course Title	Course Code	Inst. Hrs. / week	Credits	Exam			Total
						Hrs.	Marks		
							Int.	Ext.	
I	Core Course– I (CC)	Organic Chemistry – I	22PCH1CC1	6	5	3	25	75	100
	Core Course – II (CC)	Inorganic Chemistry – I	22PCH1CC2	6	5	3	25	75	100
	Core Course –III (CC)	Physical Chemistry – I	22PCH1CC3	6	5	3	25	75	100
	Core Practical - I (CP)	Organic Chemistry – I (P)	22PCH1CC1P	6	5	6	40	60	100
	Discipline Specific Elective Course-I (DSE)	A. Instrumentation Techniques (P)	22PCH1DSE1AP	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 Methods in Chemistry – I	22PCH2CC4	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 Chemistry – II	22PCH2CCC1A	6	4	3	25	75	100
		B. Chemistry of Natural Products	22PCH2CCC1B						
		C. Molecular Rearrangement	22PCH2CCC1C						
	Core Practical – III (CP)	Inorganic Chemistry – I (P)	22PCH2CC3P	6	5	6	40	60	100
	Discipline Specific Elective Course-II (DSE)	A. Green Chemistry	22PCH2DSE2A	6	3	3	25	75	100
		B. Forensic Chemistry	22PCH2DSE2B						
		C. Analytical Chemistry	22PCH2DSE2C						
	Internship	Internship	22PCH2INT	-	2	-	-	100	100
	Extra Credit Course	SWAYAM	As per UGC Recommendation						
	Total			**30**	**24**				**600**

III	Core Course– V (CC)	Physical Chemistry- II	22PCH3CC5	6	5	3	25	75	100
	Core Practical – IV (CP)	Inorganic Chemistry –II (P)	22PCH3CC4P	6	5	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						
	Core Practical - V (CP)	Physical Chemistry – I (P)	22PCH3CC5P	6	5	6	40	60	100
	Discipline Specific Elective Course-III (DSE)	A. Chemistry for Competitive Examinations	22PCH3DSE3A	4	3	2	-	100	100
		B. Bioorganic Chemistry	22PCH3DSE3B	4	3	3	25	75	
		C. Pharmaceutical Chemistry	22PCH3DSE3C						
	Generic Elective Course -I (GEC)	Nanoscience and Nanotechnology	22PCH3GEC1	3	2	3	25	75	100
	Extra Credit Course	SWAYAM	As per UGC Recommendation						
	Total			**30**	**24**				**600**
IV	Core Course–VI (CC)	Physical Methods in Chemistry – II	22PCH4CC6	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 - VI (CP)	Physical Chemistry - II (P)	22PCH4CC6P	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	22PCH4PW	9	5	-	-	100	100
			Total	**30**	**21**				**500**
			Grand Total	**120**	**92**				**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	30	600
4.	Discipline Specific Elective- (DSE)	3	09	300
5.	Generic Elective Course - (GEC)	2	04	200
6.	Project	1	05	100
7.	Internship	1	02	100
	Total	**22**	**92**	**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 40 marks (i.e. 16 marks)

b) The passing minimum for End Semester Examinations shall be 40% out of 60 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	05
Assignment & Seminar	10
CIA -I	05
CIA-II	05
Total	**25**

Internal Component (Practical)

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

Question Paper Pattern

PART A (10X2=20)
Answer all the questions

PART B (5X5=25)
Answer all the questions

PART C (3X10=30)
Answer any three questions

Semester I	InternalMarks:25		ExternalMarks:75	
COURSECODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH1CC1	**ORGANIC CHEMISTRY-I**	**CORE**	**6**	**5**

Course Objectives

- To learn the basic concepts of aromaticity and stereochemistry of various organic molecules
- To give ideas of nucleophilic and electrophilic substitution reactions and makes to learn about the oxidizing and reducing reagents for organic synthesis.

Prerequisites

Aromaticity, substitution, 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 aromaticity, stereochemistry, selection rules and reagents inorganic synthesis.	K1, K2
CO2	Interpret the concept to Huckels theory, conformation analysis, substitution, FMO method, oxidation and reduction reactions.	K3
CO3	Categorize the aromaticity, configuration, reactivity and reagents.	K4
CO4	Evaluate aromatic character, stereoanalysis, pathway of reactions and catalysis.	K5
CO5	Predict the conditions and product of substitution mechanism, Pericyclic reactions and suitable reagents in redox reactions.	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO 5
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	COGNITIVELEVEL
I	**Electronic Effects and Aromaticity:** ElectronicEffects-inductive, resonance and hyper conjugativeeffects and their influence. 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's rule and its applications. Consequences of aromaticity. non-alteration in bond length-Huckel's MO calculation. Electron occupancy in MO's and aromaticity NMR concept of Aromaticity and anti-aromaticity.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
II	**Stereochemistry and Conformational Analysis:** Stereoisomerism – optical activity and chirality –types of molecules exhibiting optical activity – R, S andE, Z configuration, absolute configuration chirality in molecules with non-carbon stereocenters (N, S and P) Molecules with more than one chiral center. Stereochemistry of molecules with axial chirality.Biphenyls, allenes, spiranes and analogues-Atropisomerism - Helicity and chirality - Resolution –methods of Resolution. Conformations of monoand disubstituted six membered ring systemsconformations of decalin. Quantitative correlation between conformation and reactivity.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Aliphatic Substitution Reactions:** Aliphatic Electrophilic substitution: selected reactions-migration of double bonds-halogenation of aldehydes and ketones - Stork-Enamine reaction-decarboxylation	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

	of aliphatic acids-Haloform reaction. Aliphatic nucleophilic substitution-mechanisms-SN1, SN2, SNi-ion-pair mechanisms - neighboring group participation non-classical Carbocations–substitutions at allylic and vinylic carbons. Reactivity effect of substituents, nucleophilic, leaving group and stereo chemical factors -correlation of structure with reactivity-solvent effects-Von Braun Reaction. Claisen and Deickmann condensation.			
IV	**Pericyclic Reactions:** Concerted reactions –orbital symmetry and concerted symmetry –Woodward and Hoffmann rules–selection rules for electrolytic reactions–frontier molecular orbital approachcorrelation diagram–examples–Chelotropic and ene reactions. Sigmatropic rearrangements – 1,3, 1,5and1,7- hydrogen shifts–examples–Cope and Claisen rearrangements–1,3-dipolar cycloadditions reactions.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4,K5,K6
V	**Reagents in Organic Synthesis:** Oxidation: Jacobsen epoxidation, Shi epoxidation,Jones reagent, PCC, PDC, DMP, Selenium oxide, Swern oxidation, Sommelet reaction, Elbs reaction, Prevost reaction and Woodward modification. Reduction: palladium / platinum rhodium/nickel based heterogeneous catalysts for hydrogenation, Noyori asymmetric hydrogenation. Red-Al, $NaBH_4$ and $NaCNBH_3$, trialkylsilanes and trialkylstannane.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4,K5,K6

VI	**Self-Study for Enrichment:** **(Not to be included for External Examination)** Rules of resonance–tautomerism-steric effects-Enantiomers and diastereomers-SE1 and SE2 and SEi mechanisms-selection rules for cycloaddition reactions Thermal and photochemical reaction of pericyclic reaction- MCPBA reagent and Wilkinson's catalyst.		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, MechanismsandStructure,7th Edition. (2013),Wiley, New York.
2. Finar. I.R, Organic ChemistryVol.II7th edition. (2009), Pearson, New Delhi.
3. Nasipuri. D, Stereochemistry of Organic Compounds Principles, 2nd Edition.(2002), New Age International and applications.
4. Lowry.T.H.E and Richardson. K. S, Mechanism and Theory in Organic chemistry,3rd edition. (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://hithaldia.in/faculty/sas_faculty/Dr_Gora_Das/Class%20Notes%20(CH-101%20&CH-201)%20Module-4%20(Structure%20&%20reactivity%20of%20Organic%20Molecules).pdf
2. http://courses.washington.edu/medch562/pdf/MEDCH400_Stereochem.pdf

3. https://byjus.com/chemistry/substitution-reaction/
4. http://www.ancpatna.ac.in/departments/Chemistry/lectures/PG/Sem-II/Pericyclic%20Reactions%20By%20Dr%20Tripti%20Gangwar.pdf
5. https://www.tcichemicals.com/assets/brochure-pdfs/Reagent_Guide_8th_Synthetic_Organic_Chemistry_Materials_Chemistry_E.pdf

Pedagogy

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

Course Designers

1. Dr. P. Pungayee Alias Amirtham
2. Dr. C. Rajarajeswari

Semester I	Internal Marks:25			External Marks: 75
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs/Week**	**CREDITS**
22PCH1CC2	**INORGANIC CHEMISTRY-I**	**CORE**	**6**	**5**

Course Objectives

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

Prerequisites

Metals, ligands, complexes and stereoisomers

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	Recognize and execute the basic concepts of clusters and complexes in inorganic chemistry.	K1, K2
CO2	Sketch the synthesis of polynuclear compounds reaction mechanism of coordination compounds and their photochemical reactivity.	K2, K3
CO3	Examine the properties of clusters and coordination complexes.	K3, K4
CO4	Generalize the stabilization of clusters, kinetics of reactions, structure of metal carbonyls and ligand field photochemistry.	K5
CO5	Critical thinking on complex structure and properties of reactions.	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	2	2	2	3	1	1	3
CO2	3	2	2	3	3	3	3	2	2	3
CO3	3	2	2	3	2	3	2	2	2	2
CO4	3	3	3	2	3	3	3	2	2	3
CO5	2	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	**Clusters and Polynuclear Compounds**: Introduction-clusters of the p-block elements, clusters of p-block Elements in a ligand shell: Boron hydrides, Clusters in a ligand shell of the heavier elements of Group 13 and14, Bare clusters of p-block Elements. Clusters of d-block elements, Low-valent metal clusters, Metal carbonyl clusters, Low-valent metal clusters stabilized by other πligands, Clusters of late transition metals stabilized by phosphines.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	**Principles of Coordination Chemistry**: Studies of coordination compounds in solution –detection of complex formation in solution –stability constants–step wise and overall formation constants –methods of determination (potentiometric, pH metric and photometric)–factors affecting stability– statistical and chelate effects– forced configurations.	16	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
III	**Mechanism in Coordination Complexes**: Kinetics and mechanism of reactions in solution–labile and inert complexes–ligand displacement 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 – isomerization and racemization reactions of complexes. Molecular rearrangements of four- and six-coordinate complexes – interconversion of stereoisomers –reactions of coordinated ligands.	20	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

IV	**Organometallic Compounds** -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 $Fe2(CO)_9$ – 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
V	**Inorganic Photochemistry**: Fundamental concepts- Electronic transitions in metal complexes, metal-cantered and charge-transfer transitions – various photo physical and photochemical processes of coordination compounds. Unimolecular charge transfer photochemistry of cobalt (III) complexes–mechanism of CTTM, photo reduction –ligand field photo chemistry of chromium (III) complexes – Adamson's rules, photo active excited states, V-C model – photo physics and photochemistry of ruthenium– polypyridine complexes, emission and redox properties.	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- Importance and applications of coordination compounds. Template effect and its applications for the synthesis of macrocyclic ligands-Fullerene Ligands and Metal complexes- Reinecke's salt chemical actinometer.		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.(1990).The Chemistry of MetalCluster 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. Day, M. C., Selbin, J., Day, M. C.,Selbin,J.(1976).Theoretical Inorganic Chemistry.
5. Cotton, F .A.,Wilkinson,G.,Cotton,F.A.,Wilkinson,AdvancedInorganicChemistry,6th Edition.(2007). India: Wiley India Pvt. Limited.
6. Keiter, E. A., Keiter, R. Medhi, O.K.,Huheey,J.E.,Keiter,E.A.,Keiter,R.L.,Medhi,O.K.,Huheey,J.E.(2006) Inorganic Chemistry: Principles of Structure and Reactivity. India: Pearson Education.
7. Arthur W. Adamson, Paul. D.(1975).Fleischauer, Concepts of Inorganic Photochemistry. United Kingdom: Wiley.
8. Kettle, S. F. A., Kettle, S. F. A. (2019). Physical Inorganic Chemistry: ACoordination Chemistry Approach. Germany: Springer Berlin Heidelberg.

Reference Books

1. J.D.Lee, Concise Inorganic Chemistry,5thEdition.(2008).India:Wiley India Pvt. Limited.
2. GurdeepRaj, Advanced Inorganic ChemistryVol-1(2020). Krishna Prakashan.
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.

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 I	InternalMarks:25		ExternalMarks:75	
COURSECODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH1CC3	**PHYSICAL CHEMISTRY-I**	**CORE**	**6**	**5**

Course Objectives

- To understand the principles of quantum chemistry and group theory
- To learn about theories of reaction rates, kinetics of reactions in solution phase and catalysis
- To study in detail the basic concepts of statistical thermodynamics.

Prerequisites

Diatomic, rigid rotator and symmetry operations

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	Re-phrase and discuss the basic concepts of quantum mechanics, group theory, Kinetics of reactions, catalysis and statistical thermodynamics.	K1 &K2
CO2	Illustrate an insight on quantum mechanical operators, character table, and theories of reaction rate, adsorption isotherm and Maxwell's distribution law.	K3
CO3	Analyze and interpret particles in box, Applications of HMO theory, orthogonality theorem, kinetics of complex reaction, enzyme catalysis, types of statistical thermodynamics.	K4
CO4	Evaluate the energy of particles in a box, Symmetry operations, factors influencing reaction rate, kinetics of enzyme catalysis, partition functions for diatomic molecules.	K5
CO5	Develop and write wavefunction for hydrogen like particles, charactertable, Michaelis Menten equation, and quantum statistics.	K6

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3	3	3	1	1	3
CO2	2	2	1	2	2	3	3	1	2	2
CO3	3	3	2	3	3	3	3	2	1	3
CO4	3	2	2	2	2	2	2	2	2	2
CO5	3	3	2	3	3	3	3	2	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	**Quantum Theory:** Concept of operators-sums and products of operators-commutator-linear and non-linear operators-Hermitian and Hamiltonian Operators- -postulates of quantum mechanics-Applications Schrodinger wave equation to free particle-particle in a one-dimensional box, simple linear harmonic oscillator and its limitations, Rigid rotator- model for a rotating diatomic molecule-solutions. Solving of Schrodinger equation for the H-atom (or H-like species)-energy levels. Introduction to the methodsof self – consistent field. Virial theorem - Huckel theory ofconjugated systems, bond order and charge density calculations, Application to ethylene, 1, 3-butadiene, and benzene.	18	**CO1** **CO2** **CO3** **CO4** **CO5**	**K1** **K2** **K3** **K4** **K5** **K6**
II	**Group Theory:** Definition of a mathematical group and its properties – multiplication table -cyclic groups-subgroups - classes – symmetry elements - symmetry operation – classes of symmetry operations-classification of molecular point groups. Matrix representations of symmetry operations-representation of groups-reducible and irreducible representations. Great Orthogonality theorem and its consequences- character tables – construction of character tables for C_{2v} and C_{3v}point groups.	18	**CO1** **CO2** **CO3** **CO4** **CO5**	**K1** **K2** **K3** **K4** **K5** **K6**
III	**Kinetics of Complex and Fast Reactions:** Theories of reaction rates- absolute reaction rate theory-thermodynamic formulation of ARR theory-Lindeman's theory of unimolecular reactions. Chain reactions-characteristics, kinetics of decomposition of acetaldehyde (Rice-Herzfeld scheme), photochemical reaction of H_2-Br_2·Thermal reaction-non-stationary chain reaction, H2-O2reaction and explosion limits. Effect of temperature, relative permittivity, ionic strength and solvent (Grunwald Weinstein equation) on reaction rates. Reactions in solutions-effect of pressure,	18	**CO1** **CO2** **CO3** **CO4** **CO5**	**K1** **K2** **K3** **K4** **K5** **K6**

	dielectric constant, and ionic strength on reactions in solutions.			
IV	**Surface chemistry and catalysis:** Adsorption: physisorption and chemisorption, Gibb's adsorption isotherm - Langmuir theory, kinetic and statistical derivation, multi-layer adsorption BET theory, Use of Langmuir and BET isotherms for surface area determination. Application of Langmuir adsorption isotherm in surface catalyzed reactions. Catalysis by enzymes - Kinetics of enzyme-catalyzed reaction - Michaelis - Menten equation and its interpretation. Effect of substrate concentration, pH and temperature on enzyme-catalyzed reactions - inhibition of enzyme-catalyzed reactions - Competitive, Non-competitive and uncompetitive inhibition.	18	**CO1 CO2 CO3 CO4 CO5**	**K1 K2 K3 K4 K5 K6**
V	Statistical Thermodynamics: Calculation of thermodynamic probability of a system- micro and macro states-different methods of counting macro states - distinguishable and indistinguishable particles, classical statistics- derivation of Maxwell-Boltzmann distribution law. Physical significances of translational, rotational, vibrational, electronic partition functions -application to mono atomic and diatomic molecules. Quantum statistics-Bose-Einstein and Fermi-Dirac distribution equations comparison of B.E and F.D statistics.	18	**CO1 CO2 CO3 CO4 CO5**	**K1 K2 K3 K4 K5 K6**
VI	**Self-Study for Enrichment** **(Not to be included for External Examination)** Eigen values and Eigen functions- physical interpretation of wave function- orthogonality and normalization theorems-space group and Schoen flies symbol for point group-kinetics of fast reactions-flow method and relaxation methods-comparison of physisorption and chemisorption and types of adsorption isotherms-difference between thermodynamic and statistical probability.	-	**CO1, CO2**	**K2 K3**

Text Books

1. Akins, P. W. (2008). Physical Chemistry. Oxford, UK. Oxford University Press,8th Edition.
2. Puri, Sharma, Pathania, (2019). Principle of Physical Chemistry. Jalandhar, India. Vishal publication & CO. 47th Edition.
3. Grutu, J.N & Grutu, A (2015).Advanced Physical Chemistry.Pune,India.Pragathipublisher,18th Edition.

Reference Books

1. Prasad, R. K. (2006). Quantum Chemistry. New Delhi, India. NewAge International(P)Ltd., Revised 3rd Edition.
2. Albert Cotton, F. (2008). Chemical Applications of Group theory. New Delhi, India. WillyIndia PvtLtd publisher, 3rdEdition.
3. Laidler, K. J. (2003). Chemical Kinetics.NewDelhi,India.TataMecraHill,Revised3rdEdition.
4. Gupta, M. C. (2011). Statistical Thermodynamics. New Delhi, India. New Age International(P)Lt d., 3rdEdition.

Web References

1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA
2. https://www.chem.tamu.edu/rgroup/hughbanks/courses/673/lecturenotes/lecturenotes.html
3. http://www.kpgcollege.org/admin/upload/1586604901.pdf
4. https://youtu.be/ALwziZSRiqM
5. https://youtu.be/ACY-Wbudg0o
6. https://youtu.be/yO8v0nszUz8

Pedagogy

Chalk and talk, PPT, 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**
22PCH1CC1P	**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	PSO1	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 methylbenzoate (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.KBhagat.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.IT atchell. A. R Furniss B.S Hannaford. A. Jand SmithP. W. G, (1989), Vogel's Textbook of PracticalOrganic 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**
22PCH1DSE1AP	**INSTRUMENTATION TECHNIQUES (P)**	**DISCIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Course 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	To be trained in lab safety, preparation of solutions numerically.	K4
CO4	Develop the core skills to parse existing chromatographic protocols and identify the key factors influencing a chromatography experiment	K5
CO5	To develop students' ability and skill to acquire expertise in calibration techniques.	K5

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
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

1. Dr. G. Sivasankari.

Semester I	Internal Marks: 40		External Marks: 60	
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.
- Introduces the theory and practice on Nanomaterials and various techniquesused 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	To foundational 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	Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment	K2 & 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	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 Sonochemical 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:40	External Marks:60		
COURSECODE	**COURSE TITLE**	**CATEGORY**	**Hrs/Week**	**CREDITS**
22PCH1DSE1CP	**BIOCHEMISTRY (P)**	**DISCIPLIN ESPECIFIC 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 chromatographicand colorimetric techniques	K3
CO3	Qualitatively and quantitatively analyze the biomolecules	K4

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

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

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

Syllabus

I EXTRACTION OF BIOMOLECULES

* Starch from potato.
* Casein from milk.
* Oil from oil seeds.
* Cellulose from plant material.

II BIOCHEMICAL TECHNIQUES

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

III QUALITATIVE ANALYSIS OF BIOMOLECULES

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

IV COLORIMETRIC ESTIMATION

* Glucose by DNS method.
* Protein by Biuret/Bradford and Lowry's method.
* Uric acid.
* Urea by DAM method.
* Creatinine by Jaffe's method.
* 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 PracticalBiochemistry. 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

1. Dr. P. Pungayee Alias Amirtham
2. Dr. S. Saranya

Semester II	InternalMarks:25	ExternalMarks:75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH2CC4	**PHYSICAL METHODS IN CHEMISTRY-I**	**CORE COURSE**	**6**	**5**

Course Objectives

- To understand, Microwave Spectroscopy and Vibrational Spectroscopy
- To learn IR and UV-Vis spectroscopy
- To study NMR & EPR spectroscopy
- To learn, mass and ORD techniques

Prerequisites

Electromagnetic radiation, molecular energy level, 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 of electromagnetic radiations.	K1, K2
CO2	Apply NMR, IR, MS, UV-Vis spectroscopic techniques in solving structure of organic molecules and in determination of their Stereochemistry	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 compounds, radical and radical ion from adsorption pattern of molecules.	K5
CO5	Evaluate and identify configuration and conformation of isomers.	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	1	1	3	3
CO2	3	2	1	3	2	2	3	3	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	**Theoretical principles of Molecular Spectroscopy:** Microwave spectroscopy – rotational spectra of diatomic molecules, rigid and nonrigid rotors, - Intensity of spectral lines, - Effects of isotopic substitution - Stark effect. Applications of microwave spectroscopy - determination of bond length and atomic mass from microwave spectra. Infrared Spectroscopy: Linear harmonic oscillator-vibrational energies of diatomic molecules - zero point energy- force constant and bond strengths – anharmonicity- Morse potential energy diagram- vibration-rotation spectroscopy. Basic instrumentation, selection rules -normal modes of vibration - group frequencies - overtones - Fermi resonance - hot bands - factors affecting the band positions and intensities – problems - Hydrogen bonding (intermolecular and intramolecular). and NIR	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
II	**Electronic spectroscopy**: Franck-Condon principle – Selection Rules for Electronic Transitions Vibrational and rotational fine structure- Predissociation- spectroscopic determination of dissociation energy Electronic spectra of diatomic molecules – solvent effect - decay of an electronicallyexcited state-photophysical processes, Jablonsky diagram, fluorescence and phosphorescence, excited state lifetime and quantum yield -fluorescence quenching- quenching by excimer and exciplex emission- fluorescence resonance energy transfer between photoexcited donor and acceptor system.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5

III	**Raman and UV-Visible Spectroscopy**: Raman spectra – Rotational Raman spectra of linear and symmetric top molecules – Vibrational Raman spectra, Rotational fine structure. Rayleigh and Raman scattering, Stokes and anti-Stokes lines For trait diagram - applications of Raman spectroscopy. **UV-Visible Spectroscopy:** Introduction- Instrumentation, Sampling techniques - Woodward–Fieser and Scott rules for conjugated dienes and polymers, ketones, aldehydes, α, β-unsaturated acids, esters- identification of geometrical isomers and positional isomers.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
IV	**NMR Spectroscopy:** ^{1}H NMR spectroscopy – origin of NMR spectra – chemical shift – number of signals – peak areas – multiplicity – geminal, vicinal and long-range couplings – factors affecting chemical shifts and coupling constants, Karplus equation, AX, AX_3, AB_2, AMX andABX pattern of first order spectra (problems in spin - spin splitting pattern), Simplification of complex spectra– Double resonance techniques, shifts reagents – an elementary treatment of NOE phenomenon. Carbon NMR spectroscopy: ^{13}C NMR Spectroscopy — Broad band decoupling – Off resonance decoupling ^{2}D Techniques: $^{1}H^{1}H$ COSY – $^{1}H^{13}C$ COSY and NOESY.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5

V	**NQR, X-Ray, Electron and Neutron Diffraction:** Characteristics of quadrupolar nucleus – Effects of field gradient and magnetic field upon quadrupolar energy levels – NQR transitions – Applications of NQR spectroscopy. X-Ray diffraction by single crystal method – space groups – systematic absences in X-ray data and identification of lattice types, glide planes and screwaxes –Electron diffraction by gases – scattering intensity vs. scattering angle, Wierl equation – measurement techniques. Neutron diffraction by crystals – magnetic scattering – measurement techniques –elucidation of structure of magnetically ordered unit cell.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
VI	**Self-Study for Enrichment** **(Not to be included for External Examination)** Problems based on joint application of UV, IR, PMR, CMR, and Mass. (Including reaction sequences), DEPT, INTEPT, Chemical spin decoupling of rapidly exchangeable protons (OH, SH, COOH, NH, NH_2).	-	CO2, CO3, CO4	K3 K4 K5

Text Books

1. Banwell. C.N., (2017). Fundamentals of molecular Spectroscopy, 4th edition, McGraw Hill, New Delhi.
2. Silverstein.P.M., & 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.

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. Jan Fleming.,& Dudley Williams., (2020). Spectroscopic Methods in Organic Chemistry, 7th edition, Tata McGraw-Hill Education, India.

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%20Unit-5.pdf
5. http://www.rcsb.org/pdb/home/home.do

Pedagogy

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

Course Designers

1. **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 qualitative estimation and double stage preparation of organic compounds.	K2
CO2	Apply the methods in organic and ethical scientific conduct.	K3
CO3	Interpret results observed in lab experiments	K3
CO4	Analyze qualitatively organic components in the environment	K4
CO5	Exercise hands-on experience with latest technical instrumentation.	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	2	1	1	2	1
CO4	2	3	3	2	3	1	1	2	2	1
CO5	3	3	3	2	3	2	2	2	2	1

"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 OrganicChemistry, 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 Textbookof 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**
22PCH2CCC1A	**ORGANIC CHEMISTRY-II**	**CORE CHOICE COURSE**	**6**	**4**

Course Objectives

- To learn about the effect of structure on reactivity.
- Enable the students to acquire surplus knowledge about the addition, elimination mechanism, and the chemistry behind the photolytic reactions.
- Guide the students to know the role of heterocyclic compounds in drug development.

Prerequisites

Quantitative treatment, Substitution, Addition, Elimination, photoreaction and Heterocycles.

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, various methods for determining the mechanism and fundamentals of photochemistry.	K1&K2
CO2	Interpret the reaction mechanism of various organic reactions including photochemical and heterocycles.	K3
CO3	Classify the different types of substitution, addition, elimination, photolytic reactions and heterocyclic compounds.	K4
CO4	Categorize the techniques of investigating 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	**Effect of Structure on reactivity:** Quantitative treatment: Hammett equation- linear free energy relationship, substituent constant and reaction constant and limitations of Hammett equation, Taft equation, thermodynamically and kinetically controlled reactions, Hammond's postulate, Non- kinetic methods of determining mechanism- isolation, trapping and detection of intermediates, isotopic labelling, crossover experiments, product analysis, stereo chemical evidence, kinetic method -kinetic isotope effect.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	**Aromatic Nucleophilic and Electrophilic Substitution:** SN1, SNAr, Benzyne mechanism, reactivity and orientation, Ullmann, Sandmeyer and Chichibabin reaction, Steven's – Sommelet Hauser and Von Richter Rearrangements.Aromatic electrophilic substitution – orientation, reactivity and mechanism based on transition state theory with suitable reactions. Ortho- para ratio, ipso attack, Vilsmeier- Haack, Jacobson and Scholl's reactions.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
III	**Addition and Elimination:** Addition to carbon-carbon multiple bonds - Electrophile, nucleophile and free radical addition, addition to carbonyl and conjugated carbonylsystem-mechanisms. Knoevengal, Stobbe, Darzen'sglycidic ester condensation and Reformatsky reaction. Elimination reaction-Mechanism of E1, E2, E1CB, stereochemistry, Hoffmann's and Zaitsev's rules. Pyrolytic cis elimination, Chugaev reaction, Hoffmann exhaustive methylation, Cope elimination and Bredt's rule.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6

IV	**Organic Photochemistry:** Fundamental concepts, energy transfer, characteristic of photoreaction - photo-reduction, photo-oxidation and photosensitization. Classification of photoreactions of Ketones and enones- Norrish type I and II, Paterno-Buchi reaction, Photo-Fries rearrangement. Photochemistry of alkenes and 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
V	**Heterocycles:** Nomenclature, synthesis and reactivity of aromatic heterocycles – pyrazole, isothiazole, triazole, pyrimidine, purines, triazines, pyridazines and pyrazines. Synthesis and reactivity of non-aromatic heterocycles – tetrahydro furan, pyrrolidine, piperidine, oxirane, oxetane, oxazole and 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)** Reactivity of intermediates, nature of substituents, Markovnikov's and Anti-Markovnikov's rule, syn-anti addition and elimination, Jablonski diagram and chemistry of simple heterocycles.	-	CO1 CO2 CO3	K1 K2 K3 K4

Text Books

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

Reference Books

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

Web References

1. https://chemicalnote.com/reaction-mechanism-methods-of-determining-reaction-mechanism/
2. https://www.chemistrylearner.com/addition-reaction.html
3. http://www-oc.chemie.uni-regensburg.de/OCP/ch/chb/oc5/Photochemie-08.pdf

Pedagogy

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

Course Designers

Dr. P. Pungayee Alias Amirtham

Dr. A. Sharmila

Semester II	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH2CCC1B	**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 natural products chemically and biosynthetically.

Prerequisites

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

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**: Classification of alkaloids, general methods of structural determination of alkaloids, synthesis and biogenesis of Papaverine, Adrenaline, Ephedrine, Piperine, Hygrine and Reserpine	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 and camphor. Diterpenoids: Carotenoid- Introduction- Structure and Synthesis of β-Carotene and Lycopene.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
III	**Steroids:** Introduction and nomenclature of steroids, Blanc's rule, Barbier-Wieland degradation, Oppenauer oxidation, Diel's hydrocarbon, chemistry of Cholestrol, Ergosterol and 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 and synthesis of Kaempferol, Quercetin, Cyanidin, Genestein.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
V	**Vitamins:** Classification and structure of water soluble and 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, and 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 Designers

1. Dr. C. Rajarajeswari

Semester II	Internal Marks:25	External Marks:75		
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH2CCC1C	**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 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.	K3
CO3	Classify the different types of intermediates involving in organic rearrangement reactions.	K4
CO4	Recognize the technique of identifying reaction mechanism in various naming reactions.	K5
CO5	Predict the mechanism and product of molecular rearrangement reactions.	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	**Molecular Rearrangements –** Introduction, intermolecular and intra molecular rearrangement, intermediates, classification based on migration origin and migration terminus. Rearrangement to electron-deficient carbon - Wagner- Meerwein rearrangement, pinacol rearrangement, Wolff rearrangement, benzil-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 and [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	**Aromatic and Photochemical rearrangement** Stevens rearrangement-Wittig rearrangement–Photochemical rearrangement – di -pi methane rearrangement	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.	-	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://www.masterorganicchemistry.com/2012/08/15/rearrangement-reactions-1-hydride-shifts
2. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/rearrang.htm
3. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3A_Virtual_Textbook_of_OChem
4. https://www.organic-chemistry.org/namedreactions/claisen-rearrangement.shtm

Pedagogy

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

Course Designers

1. 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

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

Prerequisites

Separation of cations and anions, quantitative 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 quantitative estimation and estimation of inorganic compounds.	K2
CO2	Apply the methods and identify the components.	K3
CO3	Interpret results,while observing responsible and scientific conduct	K3
CO4	Analyze quantitatively organic components in the environment	K4
CO5	Hands-on experience with latest technical instrumentation	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	2	2	2	1	1	1	2	2
CO3	2	3	2	2	2	2	1	2	2	1
CO3	2	3	2	2	2	1	1	1	2	2

"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.

Reference Books

1. Vogel.A.IT atchell. A.R, Furniss B.S, Hannaford.A. J &SmithP.W. G, (1989), Vogel's Textbookof 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

1. Dr. K. Shenbagam

Semester II	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH2DSE2A	**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 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 introduction of organic synthesis.	K1
CO2	Understand the importance and role 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 from the knowledge gained throughout the course.	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:** Need of Green Chemistry- twelve principles of green chemistry. Planning a green synthesis- percentage atom utilization - Evaluating the type of the reaction - selection of solvents-selection of starting materials- use of catalyst. International organizations promoting green chemistry.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
II	**Organic Synthesis in Green Solvents:** Reactions in water - pericyclic reactions, Wittig-Horner reaction, Knoevenagel reactions, Pinacol coupling, Aldol condensation, Benzoin condensation, Heck reaction, Wurtz reaction and Mannich reactions. Organic synthesis in supercritical carbon dioxide -Diels-Alder reaction and Kolbe-schmitt synthesis. Reaction in ionic liquids – types, preparations and synthetic applications.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
III	**Organic Synthesis in Solid State:** Introduction, room temperature solid state reactions - Grignard reaction, Reformatsky reaction. Solid state reactions on heating – oxidations of hydroxylated aldehydes, ketones, nitriles, sulfides and nitrogen heterocycles. Solid state reactions using solid support – oxidation, reduction, rearrangement, isomerization and condensation reactions.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
IV	**Alternate Energy Processes in Chemical Synthesis:** Microwave assisted organic synthesis - hydrolysis of benzyl chloride and benzamide and coupling reactions - Baylis - Hillman reaction, Esterification, synthesis of chalcones. Ultrasound assisted organic synthesis -homogenous sono chemical reactions - Curtius rearrangement, organometallic reactions- Heterogenous	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5

	liquid-liquid reactions and solid-liquid reactions.			
V	**Phase Transfer Catalysts:** Mechanism of phase transfer reaction, types and advantages of phase transfer catalyst. Applications of phase transfer catalyst in organic synthesis - Darzen reaction, Michael addition, oxidation reactions using permanganate, chromate, hypochloride, osmium tetraoxide, potassium ferricyanide and peroxides and reduction reactions	18	CO1 CO2 CO3 CO4 CO5	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. Synthesis of quinoxaline derivatives and β-keto sulfones from ketones using green synthesis. Instrumentation and types of sonochemical reaction in ultrasound assisted green synthesis.	-	CO1 CO2	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 Designers

Dr. S. Devi,

Semester II	Internal Marks:25		External Marks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH2DSE2B	**FORENSIC CHEMISTRY**	**DISCIPLINE SPECIFIC ELECTIVE**	**6**	**3**

Course Objectives

- To know about the history and principles involved in Forensic science
- To demonstrate proficiency in accurately conveying scientific data's for crime cases.
- To develop testable hypothesis, designing and analysis of collected sample to solve criminal justice system.

Prerequisites

Finger print analysis, Crime detection in Gold, Food and soil

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 know the fundamental principles, technological methods and functions of forensic science	K1 &K2
CO2	Apply the principles of Spectroscopy in physical evidences and beverages	K3
CO3	Illustrate the mechanism persisting in identification of evidences,finger prints and explosives	K4
CO4	Appraise the role of chemistry in detection of corrupted jewels, explosives and consumed liquors	K5
CO5	Design the role of handwriting exemplars, alcoholic beverages, marked currency notes and hidden explosives	K6

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3	2	3	3	3	2
CO2	2	3	3	3	2	3	3	2	3	3
CO3	2	3	3	3	2	3	2	3	3	3
CO4	2	2	2	3	3	2	3	2	3	2
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	CONGNITIVE LEVEL
I	**INTRODUCTION OF FORENSICSCIENCE:** Functions of forensic science-Historical aspects - definitions and 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	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	**CHEMISTRYOFFORENSIC INVESTIGATIONS:** Definition, Classification -physical evidence- Glass and soil - physical properties - comparing glass fragments - collection and preservation of glass evidence - forensic characteristics of soil - collection and preservation of soil evidence. Fingerprints- fundamental principles -classification of methods of detecting fingerprints - preservation of developed prints. Document and voice examination - collection of handwriting exemplars – typescript comparisons - inks and papers - alterations, erasures and obliterations.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
III	**TECHNOLOGICALMETHODSINFORENSICSCIENCE:** Chromatographic methods-Fundamental principles and forensic applications of thin layer chromatography- gas chromatography and liquid chromatography. Spectroscopic methods-Fundamental principles and forensic applications of Ultraviolet- visible spectroscopy, infrared spectroscopy, atomic absorptions spectroscopy, atomic Emission spectroscopy and masss spectroscopy. X-rays spectrometry. Colorimetric analysis and Lambert-Beer law.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
IV	**FORGERYANDCOUNTERFEITING:** Detecting forgery in bank cheques / drafts and educational	18	CO1 CO2	K1 K2

	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 goldplated jewels, authenticity of diamonds, (natural, synthetic, glassy).		CO3 CO4 CO5	K3 K4 K5 K6
V	**STUDY OFBEVERAGES ANDEXPLOSIVES:** Definition-classification of liquors based on origin (Indian made foreign products, Country made)- Methods-Fermentation and Distillation process- Characterization of Beer, wines, Congeners in alcoholic beverages. Explosives-Definition and chemistry of explosives- characteristics of high and low explosion, dust explosion- Gas/vapour explosion- Detection of hidden explosives- Examination of explosives and explosion residues using chemical and instrumental techniques.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
VI	**Self-Study for Enrichment** **(Not to be included for External Examination)** Case studies on crime cases related to documentation, money and mobile data hacking	-	CO1 CO2	K1 K2 K3

Text Books

1.Jay.A.Seigel (2015), Forensic Chemistry: Fundamentals and Applications, Wiley Pulications.

2. Suzanne Bell, (2022), Forensic Chemistry, CRC Press

3. Syed Aftab Iqbal (2021), Textbook of Forensic chemistry, Discovery Publishers Ltd

Reference Books

1. Kenyon Evans Nguyen (2021), Forensic Chemistry, American chemical society.

2. Anthony J.Bertino (2019), Forensic Science: Fundamentals and Investigations, Cenage Publishers

Web References

1. https://www.pdfdrive.com/introduction-to-forensic-chemistry-e189712545.html
2. https://www.degruyter.com/document/doi/10.1515/9783110718812/html?lang=en

Pedagogy

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

Course Designers

1. Dr. R. Subha

Semester II	InternalMarks:25		ExternalMarks:75	
COURSE CODE	COURSE TITLE	CATEGORY	Hrs /Week	CREDITS
22PCH2DSE2C	ANALYTICAL CHEMISTRY	DISCIPLINE SPECIFIC ELECTIVE	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 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 and experimental details of analytical techniques.	K3
CO4	Compare various analytical techniques based on their principles 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 and 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 and accuracy. Confidence limit, test of significance - Q - test, F - test and T - test. Linear least squares methods. Minimization of errors. Sampling, standardization and calibration in analytical methods.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
II	**Chromatography I:** Chromatography -Introduction, definition, types, principles and theories. Principle, experimental details, theory, advantages, limitations and 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, ion exchange chromatography. Principle, instrumentation and applications of high-performance liquid chromatography, gas chromatography - massspectroscopy and liquid chromatography - mass spectroscopy techniques.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
IV	**Electroanalytical Methods:** Definitions and terminology involved in electrochemistry. Types of	18	CO1 CO2	K1 K2

	electrodes - ion selective electrode, glass membrane electrode, solid and liquid membrane electrodes. Principle, instrumentation, titrations, advantages and application of potentiometry, conductometry and coulometry. Principle, instrumentation, advantages and applications of polarography, cyclic voltammetry and amperometric titrations.		CO3 CO4 CO5	K3 K4 K5
V	**Thermal Methods and Flame Photometry:** Thermogravimetry - Introduction, principle, instrumentation, derivative thermogravimetry analysis, factors affecting TGA and applications of TGA for quantitative analysis of calcium carbonate, copper sulphate pentahydrate and calcium oxalate hydrate. Differential thermal analysis - Introduction, principle of working, factors affecting DTA and applications. Flame photometry - Introduction, principles, instrumentation, advantages, limitations and 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- Electrogravimetry - Calibration - Thermometric titrations - Interference and effect of solvent in flame photometry - Flame infrared emission.	-	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 Publishing House, 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., and 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. S. Devi

Semester III	Internal Marks:25		External Marks:75	
COURSECODE	**COURSETITLE**	**CATEGORY**	**Hrs/ Week**	**CREDITS**
22PCH3CC5	**PHYSICAL CHEMISTRY-II**	**CORE COURSE**	**6**	**5**

Course Objective

- To recall the fundamentals of thermodynamics and the composition of partial molar quantities.
- To apply the quantum mechanics to hydrogen and polyelectronic systems.
- To familiarize the symmetry in molecules and predict the point groups.
- To predict the vibrational modes, hybridization using he concepts of group theory

Prerequisites

Thermodynamics, chemical equilibrium, electrolytes, wave function, Schrodinger wave equation, Eigen values, Eigen functions, Hermitian properties of operators.

Course Out come 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 classical and irreversible thermodynamics, interfaces of electrolytes, variation and approximation methods for wavefunctions.	K1,K2
CO2	Compare and correlate the thermodynamic concepts to study the kinetics of chemical reactions, variation and Perturbation method, theories of electrolytic double layer.	K3
CO3	Analyses thermodynamic concepts, variation theorem, perturbation method and electro-capillary phenomenon.	K4
CO4	Discriminate various concepts of reversible and irreversible thermodynamics and theories of quantum mechanics	K5
CO5	Apply the concept of TDs to study the kinetics of chemical reactions, VB and perturbation theorem to construct trial wavefunction for hydrogen like molecules and slater determinant for conjugated system to determine energy and bond order.	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	CONG NITIVE LEVEL
I	**Classical Thermodynamics:** Partial molar properties- Chemical potential- Gibb's- Duhem equation-binary and ternary systems- Determination of partial molar quantities. Thermodynamics of real gases - Fugacity- determination of fugacity by graphical and equation of state methods-dependence of temperature- pressure and composition- Thermodynamics of ideal and non-ideal binary mixtures-Duhem - Margulus equation - applications of ideal and non-ideal mixtures- Activity and activity coefficients-standard states - determination- vapour pressure- EMF and freezing point methods.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
II	**Irreversible Thermodynamics:** Theories of conservation of mass and energy entropy production in open systems by heat- matter and current flow- force and flux concepts- Onsager theory-validity and verification- Onsager reciprocal relationships- Electro kinetic and thermo mechanical effects-Application of irreversible thermodynamics to biological systems.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
III	**Electrode-electrolyte interface:** Interfacial phenomena - Evidences for electrical double layer- 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.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5
IV	**Applications to Hydrogen and Polyelectron atoms:** Hydrogen atom and hydrogen like ions-Hamiltonian-	18	CO1 CO2 CO3 CO4	K1 K2 K3 K4

	wave equation and solutions- radial and angular functions- representation of radial distribution functions- Approximation methods –variation methods- trial wave function-variation integral and application to particle in 1D box- Perturbation method - first order applications- Hatrefock self-consistent field method-Hohenberg-Kohn theorem and Kohn-Sham equation- Helium atom-electron spin-Paulis exclusion principle and Slater determination.		CO5	K5
V	**Applications of quantum and group theory:** Hydrogen Molecule-Molecular orbital theory and Heitler London (VB) treatment- Energy level diagram-Hydrogen molecule ion- Use of linear variation function and LCAO methods- Electronic conjugated system- Huckel method to Ethylene butadiene- cyclopropenyl, cyclo butadiene and Benzene- Applications of group theory to molecular vibrations- electronic spectra of ethylene.	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. Rajaram and KuriacoseJ.C (1986), Thermodynamics for Students of Chemistry, S.L.N.Chand and Co., Jalandhar, 2nd edition,
2. GrutuN, Grutu,A.(2015) AdvancedPhysicalChemistry.Pune,India.Pragathipublisher,18th Edition
3. Atkins, P.W. (2008).Physical Chemistry.Oxford,UK.Oxford UniversityPress,8th Edition.
4. Prasad, R.K.(2006).QuantumChemistry. New Delhi, India.New Age International(P)Ltd.,Revised3rd Edition.
5. Albert Cotton,F.(2008).Chemical Applications of Grouptheory. New Delhi, India.Willy India PvtLtd., publisher, 3rdEdition.
6. L.I Antropov (1977), Theoretical electrochemistry, Mir Publishers.

Reference Books

1. Rastogi R.P and Misra R.R (1990), Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi.
2. Maron S.H and Lando J.B (1974), Fundamentals of Physical Chemistry, Macmillan Publishers, New York.
3. Levine N (1983), Quantum Chemistry, Allyn& Bacon Inc, 4th edition.
4. Kaur.K, (2014), Spectroscopy, 16th edition, Pragati Prakashan Educational Publisher.
5. Sharma Y. R (2016), Elementary organic spectroscopy, revised 4th edition, S. Chand &Co Ltd, New Delhi.
6. Atkins P.W and de Paula J (2000), Physical Chemistry, 7th Ed., Oxford University Press, Oxford,
7. Rahman A (1986), Nuclear Magnetic Resonance-Basic Principles, Springer-Verlag, New York.
8. Levine N.I (1974), Molecular Spectroscopy, John Wiley & Sons, New York.

Web References

1.https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA

2.https://www.chem.tamu.edu/rgroup/hughbanks/courses/673/lecturenotes/lecturenotes.

3. 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, Seminar

Course Designers

Dr. V. Sangu

Semester III	Internal Marks:40		External Marks:60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs/Week**	**CREDITS**
22PCH3CC4P	**INORGANIC CHEMISTRY –II (P)**	**CORE PRACTICAL – IV**	**6**	**5**

Course Objective

- 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

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 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 with Programme Outcomes

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 Books

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

Reference Books

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

Web References:

1. https://www.youtube.com/watch?v=OGFWZclzXkk

Pedagogy

E-content, Demo, Hands on training

Course Designer

Dr. K. Shenbagam

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. (10thed.). 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.(6thed.). McGraw-Hill Higher Education. New York.
4. Robert G. Mortimer, (2008). Physical Chemistry. (3rded.). 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, 4thedition, 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 Reference

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	Internal Marks:40			External Marks:60
COURSECODE	**COURSE TITLE**	**CATEGORY**	**Hrs/ Week**	**CREDITS**
22PCH3CC5P	**PHYSICAL CHEMISTRY – I (P)**	**CORE**	**6**	**5**

Course Objective

- To understand the principle of conductivity experiments through conductometric titrations.
- To evaluate the order of the reaction, temperature coefficient, and activation energy of the reaction by following pseudo first order kinetics.
- To construct the phase diagram of two component system forming congruent melting solid and find its eutectic temperatures and compositions. To determine the kinetics of adsorption of oxalic acid on charcoal.

Prerequisites

Basic Knowledge in electrochemistry, kinetics, phase rule and adsorption theories.

Course Outcome and Cognitive Level Mapping

CO No.	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recall the principles associated with various physical chemistry experiments.	K1,K2
CO2	Scientifically plan and perform kinetics, rast and adsorption experiments.	K3, K4
CO3	Calculate and process the experimentally measured values and compare with graphical data.	K4, K5
CO4	Interpret the experimental data scientifically to improve students' efficiency for societal developments.	K6
CO5	Comprehend the kinetics and mechanism of substitution reactions in octahedral and square planar complexes.	K5

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO 5
CO1	3	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	2	3	3	3	2
CO3	3	3	3	3	3	3	2	3	3	3
CO4	3	3	3	3	3	3	3	2	3	3
CO5	3	3	3	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. Kinetics

1. Study the kinetics of acid hydrolysis of an ester, relative strength of acids, determine the temperature coefficient and also the activation energy of the reaction.

2. Study the kinetics of the reaction between acetone and iodine in acidic medium by half-life method and determine the order with respect to iodine and acetone.

3. Study of effect of salt (ionic strength) on the kinetics of reaction between potassium persulphate and potassium iodide (second order reaction).

II. Phase diagram -Construction of phase diagram for a simple binary system

1. Naphthalene- Phenanthrene
2. Naphthalene – Biphenyl
3. Benzophenone- diphenylamine
4. Benzoic acid and Cinnamic acid

III. Adsorption and CST

1. Adsorption of oxalic acid on charcoal and determination of surface area (Freundlich adsorption isotherm only).

2. Determination of critical solution temperature of phenol-water system.

3. Effect of added electrolyte on the CST of phenol-water system.

Text Books

1. Viswanathan B and Raghavan P.S, Practical Physical Chemistry (2009), Viva Books, New Delhi,
2. Sundaram, Krishnan (1996), Raghavan, Practical Chemistry (Part II), Viswanathan Co. Pvt.,
3. Athawale and Parul Mathur (2008), Experimental Physical Chemistry, New Age International (P)Ltd., New Delhi.
4. Lewers E.G (2011), Computational Chemistry: Introduction to the Theory and Applications of Molecular and Quantum Mechanics, 2nd Ed., Springer, New York,

Reference Books

1. Yadav J.B, (2001), Advanced Practical Physical Chemistry, Goel Publishing House,
2. Gurthu J.N and Kapoor R (1987), Advanced Experimental Chemistry, S. Chand & Co.,

Web References

https://web.iitd.ac.in/~nkurur/2015-16/Isem/cmp511/lab_handout_new.pdf

Pedagogy

E-content, Demo, Hands on training, Quiz, Assignments.

Course Designers

Dr. V. Sangu,

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 – oxygenation - oxidases and reductases -	12	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

	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, 7th Edn, Pearson Education Asia.
5. Banwell C.N and Mc Cash.E.M.(2000) Fundamentals of Molecular Spectroscopy, 4th Edn, 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 Objective

- 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 metabolism and urea cycle.	12	CO1 CO2 CO3 CO4 CO5	K2 K3 K4 K5

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 Designers

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.
- Totrainthestudentstoknowtheimportanceaswelltheconsequencesofvariousdrugs.
- 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–DrugRegulationandcontrol-pharmacopoeiasformularies-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)-Factorseffectingbioactivity-resonance-inductiveeffect-isoterism,-ioisosterism,spatial considerations -biological properties of simple functional groups-theories of drug activity-occupancytheory-ratetheory-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**
22PCH3GEC1	**NANO SCIENCE AND NANOTECHNOLOGY**	**GENERIC ELECTIVE COURSE-I (GEC)**	**3**	**2**

Course Objectives

- To understand the concept of nanomaterials and nanotechnology.
- To understand the various types of nanomaterials and their properties.
- To understand the applications of synthetically important nanomaterials.
- To correlate the characteristics of various nano materials synthesized by new technologies.
- To design synthetic routes for synthetically used new nanomaterials.

Prerequisites

Basic knowledge of crystallography and material science

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 methods of fabricating nanostructures	K1&K2
CO2	To relate the unique properties of nanomaterials to reduce dimensionality of the material.	K1,K2 &K3
CO3	To describe tools for properties of nanostructures.	K3
CO4	To discuss applications of nanomaterials.	K4
CO5	To Perceive the health and safety related to nanomaterial.	K5

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	3	3	3	3	1	1	3
CO2	2	2	1	2	2	3	3	2	2	2
CO3	3	3	2	3	3	2	3	2	2	2
CO4	2	3	2	2	2	3	2	2	2	2
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	**Basics of Nanomaterials:** Introduction of nanomaterials and nanotechnologies – role of size – classification – 0D, 1D, 2D and 3D – Nano powder - Nano powders - Features of nanostructure - Background of nanostructures- Techniques of synthesis of nanomaterials - Tools of the nanoscience - Applications of nanomaterials and technologies.	9	CO1, CO2, CO3, CO4, CO5	K1, K2,K3, K4
II	**Bonding, structure and properties of nanomaterial:** Predicting the type of Bonding in a substance crystal structure - Metallic nanoparticles - Surfaces of materials, Nanoparticle size and Properties - mechanical properties of materials- thermal properties – electrical properties – conductivity and resistivity - magnetic properties- semiconductor material – Synthesis of Nanoparticles: gold and silver, metal oxides: silica, iron oxide and alumina.	9	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4
III	**Synthesis:** Top down and Bottom-up approach Limitations -Physical and chemical methods - inert gas condensation, arc discharge, laser ablation, sol-gel, solvothermal and hydrothermal-CVD-types, metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis	9	CO2, CO3, CO4	K1, K2, K3, K4
IV	**Characterization Techniques:**	9	CO1	K1, K2, K3

	SEM, TEM and AFM– Surface plasmon resonance spectroscopy - principle, instrumentation and applications – Spectroscopic analysis- Dynamic light scattering - Zeta potential – Inductively coupled plasma mass Spectrometry – Matrix assisted Laser Desorption.		CO2 CO3, CO4, CO5	K4, K5
V	**Nano photonics**- Foundation for nanophotonics– free-space propagation - confinement of photons and electrons - propagation through a classically Forbidden zone - localization under a periodic potential - nanoscale optical interactions - near field-optics - theoretical modeling of near-field nanoscopic interactions - photonic crystals - basic concepts - theoretical modeling of photonic crystals.	9	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
	Self-Study for Enrichment **(Not to be included for External Examination)** Nanofabrication - functional nanoparticles and nanomaterials,- Microwave assisted and electrochemical synthesis.- FESEM principle, instrumentation and applications- thermal and semi conducting properties of nanomaterials- Electrochemical sensors for food analysis and contaminant detection.	-	**CO1, CO2**	**K2, K3**

Text Books

1. Mohan,S.and Arjunan, V.(2016). Principles of Materials Science. MJP Publishers
2. Arumugam,(2007).Materials Science, Anuradha Publications.
3. Giacavazzo et. al.,(2010).Fundamentals of Crystallography. International Union of Crystallography. Oxford Science Publications.
4. Woolfson, (2012) . An Introduction to Crystallography, Cambridge University Press.
5. James, F. Shackelford, and Madanapalli, Muralidhara, K. (2007). Introduction to Materials Science for Engineers. 6thed., PEARSON Press.

Reference Books

1. Klabunde,K.J.(2009).Nanoscale Materials in Chemistry; 2nd Ed.,Wiley-Interscience.New York.
2. Fujita,H.(2003)MicromachinesasToolsinNanotechnologySpringer-Verlag.Berlin.

Web References

1. http://xrayweb.chem.ou.edu/notes/symmetry.html.
2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.

Pedagogy

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

Course Designer:

Dr. G. Sivasankari

Semester IV	Internal Marks: 25		External Marks: 75	
COURSECODE	**COURSETITLE**	**CATEGORY**	**Hrs/Week**	**CREDITS**
22PCH4CC6	**PHYSICAL METHODS IN CHEMISTRY -II**	**CORE**	**6**	**5**

Course Objective

- 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 and jj 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, M-X, and M-S stretching vibrations– 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 H2O, ClF3, NO3-and ClO3- - 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 (contact & pseudo-contact shift) - magnetic resonance imaging (MRI).	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

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 - types of magnetism -magnetic properties of free ions - magnetic moments and their applications to the elucidation of structures of inorganic compounds - magnetic properties of lanthanides and actinides.	18	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	NRF and Mass spectrometry Basic principle of NRF spectroscopy - Mossbauer experiment - isomer shift - quadrupole splitting magnetic interactions - applications to iron and tin compounds - mass spectrometry - introduction - ion production -EI and CI - factors affecting fragmentation - ion analysis - ion abundance - mass spectral fragmentation of organic compounds - common functional groups - molecular ion peak - metastable peak - McLafferty rearrangement.	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. & Wilkinson, G. (1999). Advanced Inorganic Chemistry. 6th Ed., WileyEastern Company, New Delhi.

4. Wheatley, P. J. (1981). The Determination of Molecular Structure. 2nd Ed., Dover Publications, Mineola.
5. Leigh, G. J. & 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 & Pathania, (2024). Principles of Physical Chemistry; 48th Ed., Vishal Publishing Co., Jalandhar.
4. Wahid.U.Malik, Tuli, G.D. & 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_20200529042519 21.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

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.

Web References

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 Designer

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 – temperature –pH – alkalinity nutrients - organic loading rate - solid and hydraulic retention time - granulation of	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5

	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 Designers

Dr. K. Uma Sivakami

Semester IV	Internal Marks:25		External Marks:75	
COURSECODE	**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, 1 st 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 Designers

Dr. K. Shenbagam, Assistant Professor of Chemistry

Semester IV	Internal Marks 40		External Marks:60	
COURSECODE	**COURSE TITLE**	**CATEGORY**	**Hrs /Week**	**CREDITS**
22PCH4CC6P	**PHYSICAL CHEMISTRY- II (P)**	**CORE**	**6**	**5**

Course Objectives

- To interpret the electrical devices standardization
- This course helps to perform various electrical experiments.
- To know the difference between conductometric and potentiometric titration.
- To analyze the pH meter and to identify common items as acid, base or neutral.

Course Outcome

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 various types of reactions using instruments	K2
CO2	Apply the methods and identify the suitability of methods	K3
CO3	Analyze the electrical data and correlating results graphically	K3
CO4	Estimate the concentration of ions using Potentiometer	K4
CO5	Estimate the concentration of ions using Conductometer	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	2	2	2	1	1	1	2	2
CO3	2	3	2	2	2	2	1	2	2	1
CO3	2	3	2	2	2	1	1	1	2	2

"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.

A) Conductometry

1)Acid-alkali titrations.

2) Precipitation titration

3) Displacement titrations.

4) Determination of dissociation constant of weak acids

5) Solubility product of sparingly soluble salts like Barium chromate and Lead sulphate.

6) Verification of Onsager equation for a strong electrolyte like NaCl and KCl.

7) Determination of relative strength of two acids.

8) Determination of degree of hydrolysis and hydrolysis constant of a substance.

B) Potentiometry

1) Acid- alkali titrations.

2) Precipitation titrations.

3) Redox titrations.

4) Determination of dissociation constant of weak acids

5) Determination of solubility product of silver salts.

6) Determination of activity and activity coefficient of ions.

C) pH-Metry

1) Titration of ortho-phosphoric acid.

2) To determine the pH of a buffer solution using a quinhydrone electrode-Henderson’s equation.

Text Books

1. Yadav J. B, Advanced Practical Physical Chemistry, 20th Edition (2001), GOEL Publishing House
2. Levitt B. P., Findlay's Practical Physical Chemistry; 9th Edition, 1985, Longman.
3. Gurtur J. N and Kapoor R, Advanced Experimental Physical Chemistry, S. Chand and Co. Vol. 1- 1997

Reference Books

1. Das R.C and Behera Experimental Physical Chemistry Tata McGraw – Hill, 1983
2. Shoemaker and Gerland, Advanced Physical Chemistry Experiments, McGraw –Hill Higher Education 2009

Web References

1. https://www.youtube.com/watch?v=-GS6uoFf3qQ
2. https://www.youtube.com/watch?v=j_Fk3X3YNww
3. https://www.youtube.com/watch?v=gd1YQr-74sw
4. https://www.youtube.com/watch?v=JhKUEM29k94
5. https://www.youtube.com/watch?v=YWBZuOgvPWE

Pedagogy

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

Course Designers

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.

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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.
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Publishers, New Delhi.

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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 Designer

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