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

2025-2026 and Onwards

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

VISION

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

MISSION

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

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

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

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

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

PROGRAMME SPECIFIC OUTCOMES FOR M.Sc. CHEMISTRY

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

Cauvery College for Women (Autonomous), Trichy-18

PG & Research Department of Chemistry

M.Sc., Chemistry

(For the Candidates admitted from the Academic year 2025-2026 onwards)

Semester	Course	Course Title	Course Code	Inst. Hrs. / week	Credits	Exam			Total
						Hrs.	Marks		
							Int.	Ext.	
I	Core Course– I (CC)	Organic Reaction Mechanism – I	23PCH1CC1	6	5	3	25	75	100
	Core Course – II (CC)	Structure and Bonding in Inorganic compounds	25PCH1CC2	6	5	3	25	75	100
	Core Course –III (CC)	Molecular Spectroscopy	23PCH1CC3	6	5	3	25	75	100
	Core Practical - I (CP)	Organic Chemistry – I (P)	24PCH1CC1P	6	5	6	40	60	100
	Discipline Specific Elective Course-I (DSE)	A. Analytical Instrumentation Techniques (P)	24PCH1DSE1AP	6	3	6	40	60	100
		B. Nanoscience and Nanotechnology (P)	22PCH1DSE1BP						
		C. Biochemistry (P)	22PCH1DSE1CP						
	Total			**30**	**23**				**500**
15 Days INTERNSHIP during Semester Holidays									

Semester I	**Internal Marks:25**	**External Marks:75**

COURSE CODE	COURSE TITLE	CATEGORY	Hrs /Week	CREDITS
23PCH1CC1	ORGANIC REACTION MECHANISM-I	CORE	6	5

Course Objective

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

Prerequisites

Aromaticity, oxidation, reduction and symmetry

Course Outcome and Cognitive Level Mapping

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

Mapping of CO with PO and PSO

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

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

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

SYLLABUS

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

	allenes, spiranes and analogues- Atropisomerism- Helicity and chirality- Resolution–methods of resolution - Conformations of mono and di substituted cyclohexane system and decalin. Quantitative correlation between conformation and reactivity.			
IV	**Aromatic and Aliphatic Electrophilic Substitution:** Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation - Halogen electrophiles: chlorination and bromination- Carbon electrophiles: Friedel- Crafts alkylation, acylation and arylation reactions- Aliphatic electrophilic substitution Mechanisms: S_E1, S_E2 and S_Ei-Mechanism and evidences.	**18**	**CO1, CO2, CO3, CO4, CO5**	**K1, K2, K3, K4, K5, K6**
V	**Aromatic and Aliphatic Nucleophilic Substitution**: Aromatic nucleophilic substitution: Mechanisms - S_NAr, S_N1 and Benzyne mechanisms - Evidences - reactivity Effect of structure - leaving group and attacking nucleophile. Reactions: Oxygen and Sulphur-nucleophiles -Bucherer and Rosenmund reactions, von Richter, Sommelet- Hauser and Smiles rearrangements - S_N1, ion pair, S_N2 mechanisms and evidences. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon. Swain- Scott, Grunwald- Winstein relationship - Ambident nucleophiles	**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- Bredt's rule- neighbouring group participation.	-	**CO1, CO2 CO3**	**K1, K2, K3, K4**

Text Books

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

Reference Books

1. March and Smith. M. B March's Advance Organic Chemistry Reactions, Mechanisms and Structure,7thEdition. (2013), Wiley, New York.
2. Finar. I. R,Organic Chemistry Vol.II 7th edition. (2009), Pearson, New Delhi.
3. Nasipuri. D, Stereo chemistry of organic compounds Principles, 2ndEdition. (2002), New Age International and applications.
4. Lowry. T. H. E and Richardson. K. S, Mechanism and Theory in Organic chemistry, 3rdedition. (1997), Benjamin Cummings Publishing, USA.
5. Carey. F. A and Sundberg. R. J, Advanced Organic chemistry Part A and B,5thedition. (2007), Springer, Germany.

Web References

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

Pedagogy

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

Course Designers

Dr. C. Rajarajeswari

Semester I	**Internal Marks: 25**	**External Marks:75**

COURSE CODE	COURSE TITLE	CATEGORY	HRs/ WEEKS	CREDITS
25PCH1CC2	STRUCTURE AND BONDING IN INORGANIC COMPOUNDS	CORE	6	5

Course Objective

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

Prerequisites

Clusters, Solid state, organometallic compounds, Band theory

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course students will be able to	Cognitive Level
CO1	Recall and summarize the Boron compounds,Borazines,EAN rule and crystal systems	K1, K2
CO2	Apply the wades rule in clusters,EAN rule and eighteen electron rule in organometallic compounds,primary process in photosynthesis	K3
CO3	Explain the structure of clusters, metal carbonyls,functions of alkali earth metals and crystal systems	K4
CO4	Compare the structural features of P-N,S-N Compounds, various inorganic compounds and normal and inverse spines.	K5
CO5	Predict the chemistry of silanes,structure of ferrocene,metals at the center of photosynthesis, radius ratio and defects of crystals	K6

Mapping with Programme Out comes

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

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

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

SYLLABUS

UNIT	CONTENT	HOURS	COs	COGNITIVE LEVEL
I	**Structure of main group compounds and clusters:** Chemistry of boron – borane, higher boranes, carboranes, borazines and boron nitrides – chemistry of silicon – silanes, higher silanes, multiple bonded systems, disilanes, silicon nitrides. P-N compounds, cyclophosphazanes and cyclophosphazenes – S-N compounds – S_2N_2, S_4N_4, (SN)x, polythiazyl SxN_4 compounds – S-N cations and anions, S-P compounds – molecular sulphides such as P_4S_3, P_4S_7, P_4S_9 and P_4S_{10} – homocyclic inorganic systems – oxocarbon anion. Clusters - Introduction- bi-tri-tetra and hexa nuclear clusters(Metal halides and oxides only),Wades rule,Polyatomic- Zintl anions and cations.	**18**	**CO1** **CO2** **CO3** **CO4** **CO5**	**K1** **K2** **K3** **K4** **K5** **K6**
II	**Organometallic Compounds:** Hapticity of ligands- 18 Electron rule and its limitation- Classification of organometallic compounds – structure of methyl lithium, Zeise's salt and Ferrocene- Metal carbonyls – EAN rule – Mono and poly nuclear carbonyls – preparation, reactions and structure ($Ni(CO)_4$, $Fe(CO)_5$, $Cr(CO)_6$, $Mn_2(CO)_{10}$, $Co_2(CO)_8$and $Fe_2(CO)_9$ – Bonding in metal Carbonyls – Metal-ethylenic complexes – methods of formation- bonding-chemical properties.	**18**	**CO1** **CO2** **CO3** **CO4** **CO5**	**K1** **K2** **K3** **K4** **K5** **K6**

III	**Bioinorganic chemistry** Function and transport of alkali and alkaline earth metal ions: characterization of K^+, Na^+, Ca^{2+} and Mg^{2+} – complexes of alkali and alkaline earth metal ions with macrocycles – ion channels – ion pumps, catalysis and regulation of bio energetic processes by the alkaline earth metal ions – Mg^{2+} and Ca^{2+}. Metals at the center of photosynthesis – Primary processes in photosynthesis – photosystems I and II-light absorption (energy acquisition) – exciton transport (direct energy transfer) – charge separation and electron transport – manganese catalyzed oxidation of water to O_2.	**18**	**CO1** **CO2** **CO3** **CO4** **CO5**	**K1** **K2** **K3** **K4** **K5** **K6**
IV	**Solid state Chemistry** Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Crystal systems and Bravis lattices Structural features of the crystal systems: Rock salt, zinc blende &wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels -normal and inverse types and perovskite structures.	**18**	**CO1** **CO2** **CO3** **CO4** **CO5**	**K1** **K2** **K3** **K4** **K5** **K6**

V	**Band theory and defects in solids** Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors; Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser and phosphors; Linear defects and its effects due to dislocations.	**18**	**CO1** **CO2** **CO3** **CO4** **CO5**	**K1** **K2** **K3** **K4** **K5** **K6**
VI	**Self-Study for Enrichment** **(Not to be included for External Examination)** High-valent metal Clusters and halide Clusters-Bragg's law, powder diffraction pattern. X-ray diffraction and Electron diffraction comparison		**CO1** **CO2**	**K2,** **K3**

Text Books

1. Greenwood. (1996). Chemistry of the Elements, United Kingdom, Elsevier Science & Technology Books.
2. Kaesz, H., Adams, R., Shriver, D., Kaesz, H., Adams, R.,Shriver,D.(1990).The Chemistry of Metal Cluster Complexes.
3. Sharma, L. R., Puri, B. R., Sharma, L. R., Puri, B. R. (1976). Principles of Inorganic Chemistry: For B.Sc. and B.Sc. (Hons.) Classes of Indian Universities. India:S.Nagin.
4. Cotton, F. A., Wilkinson, G., Cotton, F. A., Wilkinson. (2007). Advanced Inorganic Chemistry,6th Edition, India: Wiley India Pvt. Limited.
5. Keiter, E.A. (2006). Inorganic Chemistry: Principles of Structure and Reactivity. India: Pearson Education.
6. Kasim W., and Schewederski, B., Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life; 2nd Edn. John Wiley and Sons, New York, USA.
7. Arthur, W. Adamson Paul, D. (1975).Fleischauer, Concepts of Inorganic Photochemistry. United Kingdom: Wiley.
8. West, A. R., (2014). Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd.,.

9. Bhagi, A.K., Chatwal, G. R. (2001). A textbook of inorganic polymers, Himalaya Publishing House.
10. Smart, L., Moore E. (2012). Solid State Chemistry – An Introduction, 4th Edition, CRC Press.
11. Purcell, K. F., Kotz, J. C. (1977). Inorganic Chemistry; W.B. Saunders company: Philadelphia.
12. Huheey, J. E., Keiter, E. A., Keiter R. L. (1983). Inorganic Chemistry; 4th ed.; Harper and Row: NewYork.

Reference Books

1. Lee, J.D., (2008). ConciseInorganicChemistry,5th Edition. (2008).India:Wiley India Pvt. Limited.
2. Gurdeep Raj, (2020). Advanced Inorganic ChemistryVol-1, KrishnaPrakashan.
3. Ferraudi, G. J., Ferraudi, G. J. (1988). Elements of Inorganic Photochemistry. United Kingdom: Wiley.
4. Pearson, R. G., Basolo, F., Pearson, R. G., Basolo, F. (1967). Mechanisms of Inorganic Reactions:A Study of Metal Complexes in Solution. United Kingdom: Wiley.
5. Sharma, R.K., Sharma, R. K. (2007). Inorganic Reaction mechanisms. India: Discovery Publishing House.
6. Douglas, D. E. McDaniel, D.H., Alexander, J. J. (1994). Concepts and Models in Inorganic Chemistry, 3rd Ed, John Wiley & Sons, Inc., New York.
7. Tilley, R. J. D., (2013). Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication.
8. Rao, C. N. R., Gopalakrishnan, J., (1997). New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press.

Web References

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

Pedagogy

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

Course Designers

Dr. N.Anusuya

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

Course Objective

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

Prerequisites

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

Course Outcome and Cognitive Level Mapping

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

Mapping of CO with PO and PSO

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

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

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

SYLLABUS

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

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

Text Books

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

Reference Books

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

Web References

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

Pedagogy

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

Course Designers

Dr. V. Sangu.

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

Course Objectives

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

Pre-requisites

Separation of components, Qualitative analysis

Course Outcome and Cognitive Level Mapping

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

Mapping of CO with PO and PSO

CCOs	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) andpurified (bulk separation).

II PREPARATION OF ORGANIC COMPOUNDS (SINGLE STAGE)

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

Text Books

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

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

Reference Books

1. Gnanaprakasam, N.S and Ramamurthy. G (1987), Organic Chemistry Lab Manual, S. V. Printers

2. Vogel. A. I Tatchell. A. R Furniss B.S Hannaford. A. Jand Smith P. W. G, (1989), Vogel's Textbook ofPractical Organic Chemistry, 5th Ed., Prentice Hall

Web References

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

Pedagogy

Demonstration and practical sessions

Course Designers

Dr. P. Pungayee Alias Amirtham

Dr. R. Subha

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

Objectives

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

Prerequisites

Chromatography, qualitative analysis and spectroscopy

Course Outcome and Cognitive Level Mapping

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

Mapping of CO with PO and PSO

Cos	PSO1	PSO 2	PSO3	PSO 4	PSO5	PO1	PO 2	PO3	PO 4	PO 5
CO1	2	3	3	3	3	2	3	2	3	3

CO2	2	2	2	1	2	2	2	3	2	2
CO3	3	2	2	2	2	1	2	2	2	2
CO4	3	2	3	2	2	3	2	2	2	3
CO5	2	3	2	3	3	2	2	2	2	2

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

Syllabus

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

Text Books

1. Fifield, F.W. (2011). Principles and Practice of Analytical Chemistry. United States: Springer US.

2. Lundanes, E., Reubsaet, L., Greibrokk, T., Lundanes, E., Reubsaet, L., Greibrokk, T. (2013). Chromatography: Basic Principles, Sample Preparations and Related Methods. Germany: Wiley.

3. Franson, S., Mary, H. (2007). Standard Methods for the Examination of Water and Wastewater. United States: American Public Health Association.

Reference Books

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

4. Mikeš, O., Mike S, O., Chalmers, R. A. (2007). Laboratory Handbook of Chromatographic Methods. United Kingdom: Van Nostrand.

Web References

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

Pedagogy

Table Work

Course Designer

Dr. G. Sivasankari

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

Course Objectives

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

Prerequisites

Precipitation, reduction and absorption methods.

Course Outcome and Cognitive Level Mapping

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

Mapping of CO with PO and PSO

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

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

SYLLABUS

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

Text Books

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

Reference Books

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

Web References

1. https://www.researchgate.net/publication/229419482_Sonochemical_synthesis_size_controlling_and_gas_sensing_properties_of_NiO_nanoparticles

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

Pedagogy

Table Work

Course Designers

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

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

Course Objectives

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

Prerequisites

Chromatographic techniques, biomolecules and plant pigments.

Course Outcome and Cognitive Level Mapping

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

Mapping of CO with PO and PSO

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

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

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

Syllabus

I. EXTRACTION OF BIOMOLECULES

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

II. BIOCHEMICAL TECHNIQUES

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

III. QUALITATIVE ANALYSIS OF BIOMOLECULES

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

IV. COLORIMETRIC ESTIMATION

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

Text Books

1. Rajan, S. &Selvi Christy. R.(2018). Experimental Procedures in Life Sciences. CBS

Publishers & Distributors.
2. Wilson, K.&Walker, J. (2000). Principles and Techniques of Practical Biochemistry. Fifth edition. Cambridge University Press.
3. Upadhyay & Upadhyay Nath (2016). Biophysical Chemistry: Principles and Techniques. Himalaya Publishing House.

Reference Books

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

Web References

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

Pedagogy

Demonstration and practical sessions

Course Designers

Dr. P. Pungayee Alias Amirtham