CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)
NATIONALLY ACCREDITED WITH "A^{+}" GRADE BY NAAC
TIRUCHIRAPPALLI

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

M.Sc., Chemistry

Syllabus

2026 - 2027 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.

EDUCATIONAL OBJECTIVES (PEOs)

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

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

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

PROGRAMME SPECIFIC OUTCOMES FOR M.Sc. CHEMISTRY

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

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

PG & RESEARCH DEPARTMENT OF CHEMISTRY

M. Sc. CHEMISTRY

CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

(For the Candidates admitted from the Academic year 2026 - 2027 onwards)

Semester	Course	Course Title	Course Code	Inst Hrs/ week	Credits	Exam			Total
						Hrs.	Marks		
							Int	Ext	
I	Core Course - I (CC- I)	Organic Chemistry– I	26PCH1CC1	5	5	3	30	70	100
	Core Course - II (CC-II)	Inorganic Chemistry-I	26PCH1CC2	6	5	3	30	70	100
	Core Practical – I (CP-I)	Inorganic Chemistry - I (P)	26PCH1CP1	6	5	6	40	60	100
	Discipline Centric Elective Course - I (DCEC-I)	A. Analytical Chemistry	26PCH1DCE1A	5	3	3	30	70	100
		B. Nanochemistry	26PCH1DCE1B						
		C. Green Chemistry	26PCH1DCE1C						
	Generic Elective Course- I (GEC-I)	A. Analytical Techniques (P)	26PCH1GEP1A	5	2	5	40	60	100
		B. Nanochemistry (P)	26PCH1GEP1B						
	Non-Major Elective Course-I (NMEC- I)	Fundamentals of Energy Resources	26PCH1NME1	3	2	3	30	70	100
	Total			**30**	**22**				**600**
II	Core Course – III (CC-III)	Physical Chemistry – I	26PCH2CC3	6	5	3	30	70	100
	Core Course – IV (CC-IV)	Organic Chemistry – II	26PCH2CC4	6	5	3	30	70	100
	Core Practical -II (CP-II)	Organic Chemistry (P)	26PCH2CP2	6	5	6	40	60	100
	Discipline Centric Elective Course - II (DCEC-II)	A. Molecular Spectroscopy	26PCH2DCE2A	5	3	3	30	70	100
		B. Chemical kinetics	26PCH2DCE2B						
		C. Electrochemistry	26PCH2DCE2C						
	Generic Elective	A. Forensic Chemistry	26PCH2GE2A	4	2	3	30	70	100

	Course- II (GEC-II)	B. Bioinorganic Chemistry	26PCH2GE2B						
	Non-Major Elective Course -II (NMEC-II)	Cosmetic Chemistry	26PCH2NME2	3	2	3	30	70	100
	Extra Credit Course	SWAYAM	As per UGC Recommendation						
	Total			**30**	**22**				**600**
30 Days INTERNSHIP during Semester Holidays									
III	Core Course – V (CC-V)	Physical Methods in Chemistry	26PCH3CC5	6	5	3	30	70	100
	Core Course – VI (CC-VI)	Inorganic Chemistry-II	26PCH3CC6	6	5	3	30	70	100
	Core Practical - III (CP-III)	Inorganic Chemistry -II (P)	26PCH3CP3	6	5	6	40	60	100
	Discipline Centric Elective Course - III (DCEC-III)	A. Bioorganic Chemistry	26PCH3DCE3A	5	3	3	30	70	100
		B. Photochemistry	26PCH3DCE3B						
		C. Natural products	26PCH3DCE3C						
	Generic Elective Course- III (GEC-III)	A. Industrial Chemistry	26PCH3GE3A	3	2	3	30	70	100
		B. Environmental Chemistry	26PCH3GE3B						
	Skill Enhancement Course -I (SEC-I)	Chemistry for Competitive Examinations	26PCH3SE1	4	2	2	-	100	100
	Internship	Internship	26PCH3INT	-	2	-	20	80	100
	Extra Credit Course	SWAYAM	As per UGC Recommendation						
	Total			**30**	**24**				**700**
IV	Core Course-VII (CC-VII)	Physical Chemistry – II	26PCH4CC7	5	5	3	30	70	100
	Core Practical-IV (CP-IV)	Physical Chemistry (P)	26PCH4CP4	5	5	6	40	60	100
	Discipline Centric Elective Course - IV (DCEC-IV)	A. Food Chemistry	26PCH4DCE4A	5	3	3	30	70	100
		B. Polymer Chemistry	26PCH4DCE4B						
		C. Pharmaceutical Chemistry	26PCH4DCE4C						
	Generic Elective Course- IV	A. Basics of Research Methodology	26PCH4GE4A	3	2	3	30	70	100

	(GEC-IV)	B. Designing Impactful Posters and Presentation in Chemistry	26PCH4GE4B						
	Skilled Enhancement Course - II (SEC-II)	Electrical Methods in Chemistry (P)	26PCH4SEP2	4	2	4	40	60	100
	Entrepreneurship / Industry Based Course	Industrial Organic Synthesis and Quantitative Estimation (P)	26PCH4IBP	4	2	4	40	60	100
	Project	Project Work	26PCH4PW	4	4	-	-	100	100
			Total	**30**	**23**				**700**
			Grand Total	**120**	**91**				**2600**

5/5/26

Dr.K.SRINIVASAN
PROFESSOR
School of Chemistry
Bharathidasan University
Tiruchirappalli - 620 024

Courses & Credits for PG Arts & Science Programmes

S. No.	Courses	No. of Courses	Hours/Course	No. of Credits	Marks
1.	Core Course – (CC)	7	6/5	7*5=35	700
2.	Core Practical – (CP)	4	6/5	4*5=20	400
3.	Discipline Centric Elective Course – (DCEC)	4	5	4*3=12	400
4.	Generic Elective Course-(GEC)	4	5/4/3	4*2=8	400
5.	Non-Major Elective Course	2	3	2*2=4	200
6.	Skill Enhancement Course- (SEC)	2	4	2*2=4	200
7.	Project	1	4	4	100
8.	Internship	1	-	2	100
9.	Entrepreneurship/Industry Based Course	1	4	2	100
	Total	26		91	2600

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY

CHOICE BASED CREDIT SYSTEM- LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (CBCS - LOCF)

(For the candidates admitted from the academic year 2026 - 2027 and onwards)

Semester	Course	Course Title	Course Code	Inst. Hrs./ week	Credits	Exam			Total
						Hrs	Marks		
							Int	Ext	
I	Core Course - I (CC- I)	Organic Chemistry– I	26PCH1CC1	5	5	3	30	70	100
	Core Course - II (CC-II)	Inorganic Chemistry-I	26PCH1CC2	6	5	3	30	70	100
	Core Practical – I (CP-I)	Inorganic Chemistry - I (P)	26PCH1CP1	6	5	6	40	60	100
	Discipline Centric Elective Course - I (DCEC-I)	A. Analytical Chemistry	26PCH1DCE1A	5	3	3	30	70	100
		B. Nanochemistry	26PCH1DCE1B						
		C. Green Chemistry	26PCH1DCE1C						
	Generic Elective Course- I (GEC-I)	A. Analytical Techniques (P)	26PCH1GEP1A	5	2	5	40	60	100
		B. Nanochemistry (P)	26PCH1GEP1B						
	Non-Major Elective Course-I (NMEC- I)	Fundamentals of Energy Resources	26PCH1NME1	3	2	3	30	70	100
	Total			**30**	**22**				**600**

Dr.K.SRINIVASAN
PROFESSOR
School of Chemistry
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Tiruchirappalli - 620 024

Semester I	Internal Marks: 30			External Marks: 70
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. /Week**	**CREDITS**
26PCH1CC1	**ORGANIC CHEMISTRY-I**	**CORE**	**5**	**5**

Course Objective

- To learn the basic concepts of substitution, addition, elimination, aromaticity and stereochemistry organic molecules.
- To understand the feasibility and the mechanism of various organic reactions.
- To comprehend the techniques in the determination of reaction mechanisms.

Prerequisites

Intermediates, Transition state, Aromaticity and symmetry

S. No.	Course Features	Relevance Status
1.	Course emphasis on Employability/Entrepreneurship/Skill Development	Employability and Skill Development
2.	Course integrates cross cutting issues relevant to Professional Ethics/Gender sensitization/ Environment and Sustainability/ Human Values/Indian Knowledge System	Professional Ethics
3.	Course relevant to Local/Regional/National/ Global needs	Global needs
4.	Course focus on Sustainable Developmental Goals	SDGs 2, 3 and 6

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	Remember the basic concepts of reaction mechanisms, aromaticity and stereochemistry.	K1, K2
CO2	Interpret Hickel's theory, thermodynamic and kinetic requirements of various reactions and conformational analysis.	K3
CO3	Use mechanistic principles, aromaticity rules, and stereochemical concepts to predict reaction products and pathways.	K4
CO4	Analyze reaction rates, substituent effects, conformations, and mechanistic evidence to understand reaction behaviour.	K5
CO5	Predict the intermediates conditions, and product of organic reaction.	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.	15	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, aromaticity in azulene and annulenes – other systems with aromatic sextet- concept of homo aromaticity and anti-aromaticity- Craig's rule – applications - consequences of aromaticity non-alteration in bond length -Huckel's MO calculation - Electron occupancy - NMR concept of aromaticity and anti-aromaticity.	15	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	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6

	centres (N, S and P) – molecules with more than one chiral centre. Biphenyls, allenes, spiranes and analogues-atropisomerism- helicity and chirality-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 - arylation reactions-Aliphatic electrophilic substitution Mechanisms: S_E1, S_E2 and S_Ei-Mechanism and evidences.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5, K6
V	**Addition and Elimination** Addition to carbon - carbon multiple bonds – electrophile - nucleophile - free radical addition. Addition to carbonyl - conjugated carbonyl system with mechanisms - Knoevenagel - Stobbe - Darzen's glycidic ester condensation - Reformatsky reaction- Elimination reaction - mechanism of E1, E2, E1CB - stereochemistry - Hoffmann's - Zaitsev's rules - pyrolytic cis elimination - Chugaev reaction - Hoffmann exhaustive methylation - Cope elimination - Bredt's rule.	15	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-Definition and examples for electrophile and nucleophile.	-	CO1, CO2 CO3	K1, K2, K3

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. Carruthers, W., & Coldham, I. (2004). Modern Methods of Organic Synthesis. 4th Edition. Cambridge University Press. UK.
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

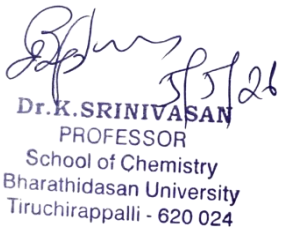
1. https://openstax.org/books/chemistry-2e/pages/12-6-reaction-mechanisms
2. http://courses.washington.edu/medch562/pdf/MEDCH400_Stereochem.pdf
3. https://universe.bitspilani.ac.in/uploads/Dubai/rusalraj/Substitution%20Reactions.pdf

Pedagogy

Lecture Method, Interactive Learning, ICT-Enabled Teaching, Problem-Solving Sessions, Case Study Approach, Peer Teaching

Course Designer

Dr. C. Rajarajeswari



Semester I	Internal Marks: 30			External Marks: 70
COURSE CODE	COURSE TITLE	CATEGORY	Hrs./ WEEKS	CREDITS
26PCH1CC2	INORGANIC CHEMISTRY - I	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

S. No.	Course Features	Relevance Status
1.	Course emphasis on Employability/Entrepreneurship/Skill Development	Employability and Skill Development
2.	Course integrates cross cutting issues relevant to Professional Ethics/Gender sensitization/ Environment and Sustainability/ Human Values/ Indian Knowledge System	Professional Ethics
3.	Course relevant to Local/Regional/National/ Global needs	Global needs
4.	Course focus on Sustainable Developmental Goals	SDGs 1,3,4

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 and summarize the Boron compounds, Borazines, EAN rule and crystal systems.	K1, K2
CO2	Apply the wades rule in clusters, EAN and eighteen electron rules in organometallic compounds.	K3
CO3	Explain the structure of clusters, metal carbonyls, functions of alkali earth metals and crystal systems, acid bases, non -aqueous solvents.	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, radius ratio and defects of crystals.	K6

Mapping with Programme Out comes

COs	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	**Acids and Bases** Differentiating and levelling solvents – Usanovich and Lux Flood concepts – Solvent ion theory of acids and bases –Hard and Soft Acids and Bases (HSAB)– classification - acid-base strength - hardness and softness – Symbiosis – Theories of hardness and softness – Electronegativity - hardness and softness – Applications of HSAB - Non-aqueous solvents: Classification- protic and aprotic solvents, – Liquid NH_3, BrF_3, CH_3COOH, liquid SO_2, liquid HF - Proton sponges- molten salts as solvents and ionic liquids.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
II	**Structure of Main Group Compounds and Clusters** Structure of B_2H_6, B_4H_{10}, B_6H_{10}, B_8H_{12}, $B_{10}H_{14}$. Synthesis of neutral boron hydrides - polyhedral boron anions and dianions - structure of polyhedral boranes- Nido –arachno- and closo frameworks- PSEPT (Wade's rule and Styx code) - carboranes- synthesis, polyhedral geometries of Metallo boranes - metallocarboranes- Boron –Nitrogen compounds - structure and bonding of $B_3N_3H_6$, Borazines, B-N clusters and azaboranes - Metal clusters: Structure and bonding of dinuclear cluster $Re_2Cl_8^{2-}$. Silicates- Structure and classification.	18	CO1 CO2 CO3 CO4 CO5	K1 K2 K3 K4 K5 K6
III	**Ionic Crystals Structure** Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing - voids in crystal lattice - Radius ratio - Crystal systems and Bravais Lattices- structural features of the crystal systems- Rock salt, zinc blende, wurtzite, fluorite, anti-fluorite, rutile, 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
IV	**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) - 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

V	**Crystal Field Theory and Stability of Complexes** Crystal field splitting patterns in octahedral, tetrahedral, tetragonal, square planar, geometries – CFSE, Factors affecting CFSE– Interpretation of electronic spectra and magnetic properties – Spectrochemical series – Jahn-Teller effect; Effect of chelation and stability of complexes – Thermodynamic aspects of complex formation –Determination of stability constants by spectrophotometric, polarographic and potentiometric methods.	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 CO3	K1 K2 K3

Text Books

1. Sharma, L. R., Puri, B. R., Sharma, L. R., Puri, B. R. (1976). Principles of Inorganic Chemistry.
2. Shriver, D. F., Kaesz, H. D., & Adams, R. D. (1990). The chemistry of metal cluster complexes.
3. Cotton, F. A., Wilkinson, G., Cotton, F. A., Wilkinson. (2007). Advanced Inorganic Chemistry,6th Edition, India: Wiley India Pvt. Limited.
4. Smart, L., Moore E. (2012). Solid State Chemistry – An Introduction, 4th Edition, CRC Press.
5. Huheey, J. E., Keiter, E. A., Keiter R. L. (1983). Inorganic Chemistry; 4th ed.; Harper and Row: New York.

Reference Books

1. Lee, J.D., (2008). ConciseInorganicChemistry,5th Edition. (2008).India: Wiley India Pvt. Limited.
2. Gurdeep Raj, (2020). Advanced Inorganic ChemistryVol-1, Krishna Prakashan.
3. Sharma, R.K., Sharma, R. K. (2007). Inorganic Reaction mechanisms. India: Discovery Publishing House.
4. Rao, C. N. R., Gopalakrishnan, J., (1997). New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press.
5. Purcell, K. F., Kotz, J. C. (1977). Inorganic Chemistry; W.B. Saunders company: Philadelphia.
6. Basolo, F., Johnson, R. C (1986) Coordination chemistry. 2 nd Edition. W. A. Benjamin, Inc. New York.

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

Lecture Method, Interactive Learning, ICT-Enabled Teaching, Problem Solving Sessions, Case Study Approach, Peer Teaching.

Course Designers

Dr. N. Anusuya

5/5/21
Dr.K.SRINIVASAN
PROFESSOR
School of Chemistry
Bharathidasan University
Tiruchirappalli - 620 024

Semester I	Internal Marks: 40		External Marks: 60	
COURSE CODE	COURSE TITLE	CATEGORY	Hrs. /Week	CREDITS
26PCH1CP1	INORGANIC CHEMISTRY -I (P)	CORE PRACTICAL	6	5

Course Objectives

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

Prerequisites

Separation of cations and anions, qualitative analysis

S. No.	Course Features	Relevance Status
1.	Course emphasis on Employability/Entrepreneurship/Skill Development	Employability and Skill Development
2.	Course integrates cross cutting issues relevant to Professional Ethics/Gender sensitization/ Environment and Sustainability/ Human Values/ Indian Knowledge System	Professional Ethics
3.	Course relevant to Local/Regional/National/ Global needs	Global needs
4.	Course focus on Sustainable Developmental Goals	SDGs 1,3,4

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	Explain the preparation of original solution and separation of mixture into cations.	K2
CO2	Demonstrate the estimation of metal ions using spectrophotometer.	K2
CO3	Identify the cations using appropriate test and reagents	K3
CO4	Differentiate various concentration terms and to draw calibration curve	K4
CO5	Apply the laws of absorption for calculating the concentration of unknown solution.	K4

Mapping of CO with PO and PSO

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

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

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

SYLLABUS

1. Semi-micro qualitative analysis of a mixture containing two common cations (Pb, Bi, Ca, Cd, Fe, Cr, Al, Co, Ni, Mn, Zn, Ba, Sr, Ca, Mg,) and two less common cations (W, Tl, Se, Te, Mo, Ce, Th, Zr, Ti, V, U, Li).
2. Quantitative Estimation of copper, iron, nickel, chromium and manganese ions using photoelectric colorimeter.

Text Books

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

Reference Book

1. Vogel, Arthur I. (1979). *Vogel's qualitative inorganic analysis* (7th ed., revised by G. Svehla). Longman.

Web References

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

Pedagogy

E-content, Demo, Hands on training

Course Designers

Dr. A. Sharmila

5/5/21
Dr.K.SRINIVASAN
PROFESSOR
School of Chemistry
Bharathidasan University
Tiruchirappalli - 620 024

Semester I	Internal Marks: 30		External Marks: 70	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. / Week**	**CREDITS**
26PCH1DCE1A	**ANALYTICAL CHEMISTRY**	**DISCIPLINE CENTRIC ELECTIVE COURSE - I**	**5**	**3**

Course Objective

- To develop a strong foundation in the principles and practices of analytical chemistry for real-world applications.
- To understand and apply various separation and purification techniques for analysing chemical mixtures effectively.
- To explore modern analytical methods and instrumentation used in chemical analysis.
- To build skills in data interpretation, accuracy, and error analysis in experimental results.
- To encourage independent learning through selected self-study topics in analytical techniques.

S. No.	Course Features	Relevance Status
1.	Course emphasis on Employability/Entrepreneurship/Skill Development	Skill Development, Employability
2.	Course integrates cross cutting issues relevant to Professional Ethics/Gender sensitization/ Environment and Sustainability/ Human Values/ Indian Knowledge System	Environment and Sustainability
3.	Course relevant to Local/Regional/National/ Global needs	Local & Global Need
4.	Course focus on Sustainable Developmental Goals	SDG 3, 6, 9, 12

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 fundamental concepts and principles underlying analytical chemistry and chemical analysis.	K1
CO2	Demonstrate the ability to interpret analytical data and draw meaningful conclusions in chemical analysis.	K2
CO3	Apply appropriate analytical and purification techniques for the separation and analysis of chemical substances.	K3
CO4	Analyze the working principles and performance of various analytical methods and instruments.	K4
CO5	Evaluate different analytical techniques based on their accuracy, sensitivity, and practical applications.	K5

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	2	1	2	2
CO2	3	3	2	2	2	3	3	2	2	2
CO3	3	3	2	3	2	3	3	2	2	2
CO4	3	3	2	3	3	3	3	3	2	2
CO5	3	3	3	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	**Introduction to Analytical Chemistry** Analytical chemistry - role of analytical chemistry - classification - advantages - limitations of analytical methods - safety in laboratory - errors - types - relative error - absolute error - significant figures - mean- median - standard deviation - sensitivity - detection limits – precision - accuracy - minimization of errors.	15	CO1, CO2, CO3, CO4, CO4	K1, K2, K3, K4, K5
II	**Chromatography I** Chromatography - introduction - definition of important terms - types - principles - advantages - limitations - applications of column chromatography - paper chromatography- thin layer chromatography.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Chromatography II** Introduction - principle- instrumentation- Development methods - advantages- limitations - applications of gas chromatography, high-performance liquid chromatography, gas chromatography – mass spectrometry- comparison of GC and HPLC.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Purification techniques** Purification of solid organic compounds – principle -filtration techniques- crystallization- recrystallization -use of miscible solvents –sublimation – drying techniques- experimental techniques of distillation – fractional distillation - extraction - use	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

	of immiscible solvents - solvent extraction.			
V	**Thermal Analysis and Flame photometry:** Thermogravimetry – introduction – principle – instrumentation – factors affecting TGA – applications of TGA for quantitative analysis of calcium carbonate – copper sulphate pentahydrate – differential thermal analysis – introduction – principle of working – factors affecting DTA – applications – flame photometry – introduction – principles – instrumentation – advantages – limitations – applications.	15	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 - column chromatography - gas chromatography - fractional distillation- applications of TGA.	-	CO1, CO2, CO3	K1, K2, K3

Text Books

1. Skoog. D. A., West. D. M., & Holler. H. J. (1992). Fundamentals of Analytical Chemistry.
2. Chatwal, G. R., and Anand. S. (1999). Instrumental Method of Analysis. Himalya 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., & 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_
5. Modules_(Analytical_Chemistry)/Instrumentation_and_Analysis/Cyclic_Voltammetry.

Pedagogy

Chalk and talk, Discussion, Assignment, Demo, Quiz, Open Book, ICT Tools, Test and Seminar.

Course Designer

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

Dr.P.Pungayee Alias Amirtham
Professor & Head
Department of Chemistry
Cauvery College for Women (Autonomous)
Tiruchirappalli- 620 018.

Dr.K.SRINIVASAN
PROFESSOR
School of Chemistry
Bharathidasan University
Tiruchirappalli - 620 024

DEAN OF SCIENCE
CAUVERY COLLEGE FOR WOMEN
(AUTONOMOUS)
ANNAMALAI NAGAR
TIRUCHIRAPPALLI - 620 018
TAMILNADU

Semester I	Internal marks :30			External marks: 70
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRs/ WEEK**	**CREDITS**
26PCH1DCE1B	**NANOCHEMISTRY**	**DISCIPLINE CENTRIC ELECTIVE COURSE - I**	**5**	**3**

Course Objectives

- To provide fundamental knowledge of nanochemistry, including synthesis, characterization, and applications of nanomaterials.
- To develop the ability to understand and evaluate their role in scientific and technological advancements.

Prerequisites

Quantum dot, Capping agents, AFM, TEM and sensors.

S. No.	Course Features	Relevance Status
1.	Course emphasis on Employability/Entrepreneurship/Skill Development	Skill Development, Employability
2.	Course integrates cross cutting issues relevant to Professional Ethics/Gender sensitization/ Environment and Sustainability/ Human Values/ Indian Knowledge System	Environment and Sustainability
3.	Course relevant to Local/Regional/National/ Global needs	Local & Global Need
4.	Course focus on Sustainable Developmental Goals	SDG 3, 6, 9, 12

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 fundamentals, types, preparation, and applications of nanomaterials.	**K1**
CO2	Illustrate connections among preparation, structure, analytical techniques, behavior, and uses.	**K2**
CO3	Demonstrate experimental and analytical approaches for studying nanomaterials.	**K3**
CO4	Analyze how structure and size influence properties and uses	**K4**
CO5	Evaluate effectiveness of materials in various applications.	**K5, K6**

Mapping of CO with PSO and PO

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	COGNITIVE LEVEL
I	**Fundamentals of Nanochemistry** Concept – scope - -classification of nanomaterials based on dimensionality- composition- size dependent properties - surface effects – graphene - nanowire – nanotubes - nano cones – nano clusters - quantum dots- quantum confinement.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
II	**Synthetic Methods** Top-down approaches: Ball milling - sputtering - chemical etching – thermal / laser ablation – lithography- Bottom-up approaches: sol- gel method - chemical vapor deposition- hydrothermal synthesis - green synthesis - stabilization of nanoparticles (capping agents) - self-assembly and supramolecular approaches.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
III	**Characterization of Nanomaterials** Scanning probe microscopy- Atomic Force Microscopy (AFM) – Scanning Tunnelling Microscopy (STM) - Scanning Near-field Optical Microscopy (SNOM) - Scanning Ion Conductance Microscopy (SICM) - Scanning Thermal Microscopy (SThM)- Electron Microscopy - Scanning Electron Microscopy (SEM) - Transmission Electron Microscopy (TEM) - Scanning Transmission Electron Microscopy (STEM).	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
IV	**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 – properties - structure and characterization − chemically modified carbon nanotubes −Functionalization of CNT- applications of carbon nanotubes.	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6
V	**Applications of Nano chemistry** Use of nanomaterials in medicine - Drug delivery systems (targeted delivery) - cancer therapy - imaging and diagnostics (quantum dots) – Biosensors - energy sectors such as solar cells – hydrogen storage materials - batteries and	15	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5, K6

	supercapacitors - Environmental applications - water purification and air purification- Nano catalyst in industrial applications.			
VI	**Self-Study for Enrichment: (Not to be included for External Examination)** Size effects, significance of nanoscale - synthesis using microorganisms- properties and thermal methods.	-	CO1 CO2 CO3	K1, K2, K3

Text Books

1. Goyal, R.K., (2018). Nanomaterials and Characterization, New York: Taylor & Francis Group. CRC Press.
2. Nanocomposites: Synthesis, Properties, Hornyak L.G., Tibbals H.F., Dutta J., and Moore J.J., (2009). Introduction to Nanoscience & Nanotechnology, New York: CRC press. Print.
3. Sharon M., Pandey S., & Oza G., (2012). Bionanomaterials: Concepts and Applications, New Delhi: Ane Books Pvt. Limited. Print.
4. Kumar N., & Kumbhat S., (2016). Essentials in nanoscience and nanotechnology, New Jersey: John Wiley & Sons., Inc.

Reference Books

1. Balaji, S., (2010). Nanobiotechnology, Chennai: MJP Publishers. Print.
2. Cao, G. & Wang, Y., (2011). Nanostructures and Nanomaterials:(Synthesis, Properties and Applications), New Delhi: World Scientific Publishing Co. Pvt. Ltd. Print.
3. Poole, C.P., & Owens F.J., (2010). Introduction to Nanotechnology, New Delhi: John Wiley and Sons (Asia) Pvt. Ltd. Print

Web References

1. https://drive.google.com/file/d/1KXRsFv11_ydF02BG43kLyQ2cds1nKQ4Y/view
2. https://lecture-notes.tiu.edu.iq/wp-content/uploads/2023/10/Lec4.-Nanomaterial-synthesis-methods-.pdf
3. https://www.sathyabama.ac.in/sites/default/files/course-material/2020-10/note_1519281485.pdf
4. https://educationsource.in/wp-content/uploads/2024/04/UNIT-%E2%80%93-IV-CARBON-CLUSTERS- AND-NANOSTRUCTURES-msc-chem-sem-4.pdf
5. https://www.deshbandhucollege.ac.in/pdf/resources/1590038900_P(H)-VI-Nanomaterials-Unit-5.pdf

Pedagogy

Lecture based teaching and learning, PPT, Discussion, Assignment, Demo, Quiz, Seminar

Course Designer

Dr. A. Sharmila

Dr.K.SRINIVASAN
PROFESSOR
School of Chemistry
Bharathidasan University
Tiruchirappalli - 620 024

Semester I	Internal Marks: 30			External Marks: 70
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs./Week**	**CREDITS**
26PCH1DCE1C	**GREEN CHEMISTRY**	**DISCIPLINE CENTRIC ELECTIVE COURSE-I**	**5**	**3**

Course Objective

- To understand the fundamental principles of green chemistry and their role in sustainable development and environmental protection.
- To develop knowledge of green synthetic methods, eco-friendly solvents, and modern techniques in organic synthesis.
- To apply concepts of green catalysis and sustainable chemical processes in industrial and research applications.

Prerequisites

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

S. No.	Course Features	Relevance Status
1.	Course emphasis on Employability/Entrepreneurship/Skill Development	Employability, Entrepreneurship, Skill Development
2.	Course integrates cross cutting issues relevant to Professional Ethics/Gender sensitization/ Environment and Sustainability/ Human Values/ Indian Knowledge System	Environment and Sustainability
3.	Course relevant to Local/Regional/National/ Global needs	Global needs
4.	Course focus on Sustainable Developmental Goals	SDGs 6, 7,12,13

Course Outcomes

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	Describe the principles of green chemistry, green solvents, ionic liquids, modern green techniques, and green catalysis.	K1
CO2	Explain eco-friendly synthetic methods, reaction mechanisms, solvent systems, and catalytic processes used in green chemistry.	K2
CO3	Apply green chemistry principles, ionic liquids, alternative reaction media, and modern techniques in organic synthesis and industrial processes.	K3
CO4	Analyze the efficiency, sustainability, and environmental impact of various green synthesis methods and catalytic processes.	K4
CO5	Evaluate and compare conventional and green chemical processes in terms of safety, efficiency, cost, and environmental sustainability.	K5

Mapping of CO with PO and PSO

Cos	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	2	1	2	1	2	1	1
CO2	3	2	1	2	2	3	2	2	1	2
CO3	3	3	2	2	2	3	3	2	1	2
CO4	2	3	3	2	2	3	3	3	2	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	COGNITIVE LEVEL
I	**Introduction to Green Chemistry** Introduction - need of green chemistry - twelve principles of green chemistry - planning a green synthesis - atom economy - evaluating the type of the reaction involved - - selection of starting materials - appropriate solvents- use of catalyst - international organizations promoting green chemistry.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**Organic Synthesis in Green Solvents** Introduction, reactions in water - pericyclic reactions - Claisen rearrangement - Wittig-Horner reaction - Knoevenagel reactions - pinacol coupling - aldol condensation - benzoin condensation - Heck reaction - Wurtz reaction - Mannich reactions - supercritical carbon dioxide in organic synthesis- Diels-Alder reaction - Kolbe- Schmitt synthesis - reaction in ionic liquids - types - preparations - synthetic applications.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
III	**Organic synthesis using ionic liquids** Introduction - types of ionic liquids - preparation of ionic liquids - applications - conversion of epoxides to halohydrins - thiocyanation of alkyl halides - Biginelli reaction - synthesis of homoallylic amines - cyclic carbonates - biotransformation in ionic liquids - transesterification reactions - ammonolysis of carboxylic acids - synthesis of Z-aspartame.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

IV	**Modern Green Techniques in Organic Synthesis** Green synthetic methods – need for modern green techniques – solvent-free reactions – advantages - applications – microwave assisted organic synthesis – principle – selected organic reactions – ultrasound assisted synthesis – cavitation – electrochemical synthesis – environmentally friendly processes – flow chemistry – green reaction conditions – energy efficiency – waste minimization – comparison with conventional methods – industrial applications.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**Green Catalysis and Sustainable Chemical Processes:** Definition – importance – homogeneous and heterogeneous catalysis – types of green catalysts – biocatalysts – heterogeneous catalysts – nano catalysts – in organic synthesis – enzyme catalyzed reactions – green industrial processes – cleaner production techniques – environmentally benign oxidation and reduction reactions – recent advances – photocatalysis – electrocatalysis – future trends.	15	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self Study for Enrichment** (Not to be included for External Examination) Life Cycle Assessment basics - green solvent selection guides - Industrial scale applications of ionic liquids - Industrial case studies of microwave synthesis - CO_2 utilization in catalysis - Circular economy in chemical industries.	-	CO1	K1, K2

Text Books

1. Anastas, P. T., & Warner, J. C. (1998). *Green chemistry: Theory and practice*. Oxford University Press.
2. Ahluwalia, V. K. (2006). *Green chemistry: Environmentally benign reactions*. CRC Press.
3. Lancaster, M. (2010). *Green chemistry: An introductory text* (2nd ed.). Royal Society of Chemistry.

Reference Books

1. Anastas, P. T., & Williamson, T. C. (Eds.). (1998). *Green chemistry: Frontiers in benign chemical synthesis and processes*. Oxford University Press.
2. Clark, J. H., & Macquarrie, D. J. (2002). *Handbook of green chemistry and technology*. Blackwell Science.
3. Tundo, P. (Ed.). (2005). *Green chemical reactions*. Springer.

Web References

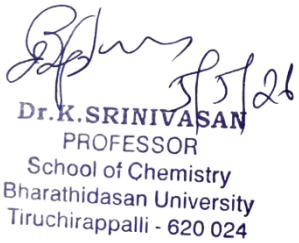
1. https://www.epa.gov/greenchemistry
2. https://chem.libretexts.org/green_synthesis
3. https://www.scirp.org/ionic-liquid-research
4. https://www.sciencedirect.com/electrochemical-synthesis
5. https://www.nature.com/green-catalysis

Pedagogy

Lecture Method, Interactive Learning, ICT-Enabled Teaching, Problem-Solving Sessions, Case Study Approach, Peer Teaching.

Course Designer

Dr. P. Thamizhini



Semester I	Internal Marks: 40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. / Week**	**CREDITS**
26PCH1GEP1A	**ANALYTICAL TECHNIQUES (P)**	**GENERIC ELECTIVE COURSE- I**	**5**	**2**

Objectives

- Understanding the principles and working mechanisms of modern analytical instruments.
- Developing practical skills in calibration, validation, and operation of analytical equipment.
- Performing accurate qualitative and quantitative analysis of real samples.
- Interpreting experimental data using graphical and mathematical approaches.
- Relating analytical findings to applications in environmental, pharmaceutical, food, and industrial sectors.

S. No.	Course Features	Relevance Status
1.	Course emphasis on Employability/Entrepreneurship/Skill Development	Skill Development, Employability
2.	Course integrates cross cutting issues relevant to Professional Ethics/Gender sensitization/ Environment and Sustainability/ Human Values/ Indian Knowledge System	Environment and Sustainability
3.	Course relevant to Local/Regional/National/ Global needs	Local & Global Need
4.	Course focus on Sustainable Developmental Goals	SDG 2, 3, 6, 12, 14

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 principles and components of analytical instruments.	K1
CO2	Explain the working and calibration of instrumental techniques.	K2
CO3	Apply suitable analytical methods for real sample analysis.	K3
CO4	Analyze and interpret experimental data using graphs and calculations.	K4
CO5	Evaluate analytical results for accuracy and practical relevance.	K5

Mapping of CO with PO and PSO

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

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

SYLLABUS

1. Calibration and Validation of pH Meter and Conductivity Meter.
2. Analysis of soil
    i) Determination of pH of soil.
    ii) Determination of total soluble salts by conductometry
3. 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.
4. Identification of a mixture of metal salts by TLC.
5. Potentiometric Determination of HCl in Toilet Cleaner
6. Verification of Beer-Lambert's law by colorimetry.
7. Determination of ascorbic acid in lime juice by titration.
8. Determination of Caffeine in Tea/Coffee Sample by UV–Visible Spectrophotometry (Demo).
9. Separation of Food Colors present in Soft Drinks or Candies by Paper Chromatography.

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:
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

Demonstration and practical session

Course Designer

- Dr. G. Sivasankari

5/5/21
Dr.K.SRINIVASAN
PROFESSOR
School of Chemistry
Bharathidasan University
Tiruchirappalli - 620 024

Semester I	Internal Marks: 40		External Marks: 60	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. / Week**	**CREDITS**
26PCH1GEP1B	**NANOCHEMISTRY (P)**	**GENERIC ELECTIVE COURSE – I**	**5**	**2**

Objectives

- To provide basic knowledge on the synthesis and preparation of nanomaterials.
- To train students in safe handling of nanomaterials and proper laboratory practices.
- To enable students to analyze experimental data and interpret results effectively.

S. No.	Course Features	Relevance Status
1.	Course emphasis on Employability/Entrepreneurship/Skill Development	Employability and Skill Development
2.	Course integrates cross cutting issues relevant to Professional Ethics/Gender sensitization/ Environment and Sustainability/ Human Values/ Indian Knowledge system	Environment and Sustainability
3.	Course relevant to Local/Regional/National/ Global needs	Local/Regional/National/ Global need
4.	Course focus on Sustainable Developmental Goals	SDG 6, 7, 9, 12

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 fundamental concepts and synthesis methods of nanomaterials.	K1
CO2	Understand preparation of metal and metal oxide nanoparticles using chemical and green methods.	K2
CO3	Perform the synthesis of nanomaterials and analyze them using UV-Visible spectroscopy.	K3
CO4	Demonstrate safe handling of nanomaterials and report experimental results effectively.	K3
CO5	Analyze the properties and experimental data of nanomaterials.	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	3	2	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2
CO3	2	3	2	2	2	2	3	2	2	2
CO4	2	2	2	2	2	2	2	2	3	2
CO5	2	3	2	2	2	2	3	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 nanoparticles by hydrothermal method.
2. Synthesis of carbon nanoparticles by microwave irradiation method.
3. Characterization of nanoparticles by UV- Visible spectrophotometer.
4. Synthesis of silver nanoparticles by chemical reduction method and their UV-Vis absorption studies.
5. Synthesis of ZnO nanoparticles by co-precipitation method.
6. Preparation of TiO_2 nanoparticles by sol-gel method.
7. Green synthesis of nanoparticles using plant extract.

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., & Ciliberto, E. (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 Nano structuring Techniques. Germany: Wiley.
2. Muller, A., Cheetham, A. K., & Rao C. N. R. (2006). The Chemistry of Nanomaterials: Synthesis, Properties and Applications. Germany: Wiley.

Web References

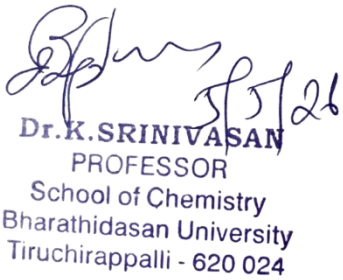
1. https://pmc.ncbi.nlm.nih.gov/articles/PMC10573823/pdf/materials-16-06549.pdf
2. https://www.chemijournal.com/archives/2024/vol12issue6/PartA/12-6-23-446.pdf
3. https://www.degruyterbrill.com/document/doi/10.1515/ntrev-2023-0150/html

Pedagogy

Demonstration and practical session

Course Designer

Dr. S. Devi



Semester I	Internal Marks: 30		External Marks: 70	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**Hrs. / Week**	**CREDITS**
26PCH1NME1	**FUNDAMENTALS OF ENERGY RESOURCES**	**NON-MAJOR ELECTIVE COURSE – I**	**3**	**2**

Course Objectives

- To provide fundamental knowledge on energy classification, resources and conversion process.
- To provide insight into the environmental impacts of energy production and consumption
- To foster sustainable development practices by emphasizing energy efficiency, conservation strategies, and the adoption of green technologies.

Prerequisites

Basic idea of resources and sustainability concepts

S. No.	Course Features	Relevance Status
1.	Course emphasis on Employability/Entrepreneurship/Skill Development	Employability
2.	Course integrates cross cutting issues relevant to Professional Ethics/Gender sensitization/ Environment and Sustainability/ Human Values/Indian Knowledge system	Environment and Sustainability
3.	Course relevant to Local/Regional/National/ Global needs	Global needs
4.	Course focus on Sustainable Developmental Goals	SDGs 7,9,11 and 13

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 the principles, advantages and limitations of renewable energy systems.	K1
CO2	Explain various energy conversion process, biomass production and energy storage.	K2
CO3	Apply knowledge of energy resources and evaluate their energy production and practical applications.	K3
CO4	Analyze energy efficiency, solar cell, biofuels and environmental impacts.	K4
CO5	Evaluate energy security, turbines, power plants and green technologies for sustainable development.	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2	3	2	1	1	1
CO2	3	3	2	2	3	3	2	2	1	1
CO3	3	3	2	2	2	3	3	3	1	1
CO4	3	3	3	3	3	3	3	3	3	1
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	**Fundamentals of Energy** Energy - definition – classification - primary and secondary energy sources - energy conversion processes – classification -renewable and non-renewable energy sources- conventional and non-conventional energy- commercial and non-commercial - global energy scenario – worldwide renewable energy availability – Indian energy scenario - Energy demand - supply trends (World and India) – energy efficiency -methods to improve efficiency- energy security – energy and its environmental impacts.	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
II	**Non-renewable Energy** Introduction – classification - fossil fuels - nuclear fuels – characteristics - limitations – Coal energy – coal based thermal power plants – refining of crude oil - fractional distillation - petroleum products - applications – compressed natural gas – liquefied natural gas – applications – advantages and limitations – nuclear power plants- nuclear fuels – safety concern - waste management.	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5

III	**Renewable Energy** Need for renewable energy – classification of renewable energy sources - advantages - limitations – solar energy – solar radiation and its measurement – solar pond -solar water heater, solar cooker-solar photovoltaic technology – types - working principle of solar cell- applications. Wind Energy - origin - wind energy potential- horizontal and vertical axis wind turbines - components of wind energy system -advantages - limitations.	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
IV	**Hydro, geothermal and Bioenergy** Hydropower energy - hydrological cycle -types of hydroelectric power plants - micro and mini hydropower - environmental impacts. Geothermal Energy - sources - types of geothermal power plants - applications and limitations. Biomass energy - introduction - types of biomass resources -biogas production (aerobic and anaerobic digestion) -factors affecting biodigestion - Biomass gasification - Biofuels (Biodiesel, Bioethanol).	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
V	**Environmental and Sustainability Issues** Greenhouse gas emissions - climate change mitigation and adaptation - carbon footprint - carbon sequestration - global warming - acid rain -resource depletion – Oil spills and marine pollution - nuclear hazards and radioactive waste disposal - energy conservation measures - Energy storage and grid integration issues - Socio-economic impacts and displacement - green technologies.	09	CO1, CO2, CO3, CO4, CO5	K1, K2, K3, K4, K5
VI	**Self-Study for Enrichment:** (Not to be included for External Examination) Components of a solar photovoltaic system and thermal power plant - Tidal and wave energy types - nuclear waste management - comparison between renewable and non-renewable energy - Energy crisis and resource depletion.	-	CO1, CO2	K1, K2

Text Books

1. Rai, G. D. (2017). *Non-conventional energy sources* (6th ed.). Khanna Publishers.
2. Khan, B. H. (2013). *Non-conventional energy resources* (3rd ed.). McGraw Hill Education (India).
3. Ramana, D. V., et al. (2012). *Renewable energy sources and emerging technologies*. Pearson India.
4. Rao, S., & Parulekar, B. B. (2013). *Energy technology* (4th ed.). Khanna Publishers.
5. Kaushik, A., & Kaushik, C. P. (2010). *Environmental studies* (2nd ed.). New Age International Publishers.

Reference Books

1. Rapp, R. A. (2008). *Energy and the environment* (2nd ed.). Oxford University Press.
2. Boyle, G. (Ed.). (2012). *Renewable energy: Power for a sustainable future* (3rd ed.). Oxford University Press.
3. Khan, B. H. (2013). *Non-conventional energy resources* (3rd ed.). McGraw Hill Education.
4. Twidell, J., & Weir, T. (2015). *Renewable energy resources* (3rd ed.). Routledge.

Web References

1. https://www.coursera.org/learn/energy-and-environment.
2. https://library.unity.edu/sustainable-energy/websites
3. https://www.merrimack.edu/academics/arts-and-sciences/environmental-sciences-and-sustainability-old/resources/
4. https://serc.carleton.edu/serc/site_guides/sustainability.html
5. https://sustainableworld.us/environmental-education/

Pedagogy

Chalk and talk, Group Discussion, Problem solving Assignment, Quiz and Seminar.

Course Designer

Dr. P. Pungayee Alias Amirtham