KAMARAJ COLLEGE
(AUTONOMOUS)
Accredited with A+ Grade by NAAC
Among Top 150 Colleges in India - NIRF Ranking 2024
இந்து நாடார் சங்கங்களால் 1966-ல் தொடங்கப்பட்ட கல்லூரி
(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)
THOOTHUKUDI - 628 003.

B.Sc., Chemistry

Semester - III

SYLLABUS

(With effect from the academic year 2024-2025 onwards)

Department Profile

Name of the Programme	B.Sc., Chemistry
Programme Code	03003
Year of Establishment	1967

Vision

To make the students excel in the fields of education, fundamental and advanced research in Chemistry by providing quality education so that they can compete and contribute to the varying technology.

Mission

To teach the students to analyze problems ranging from the basics of Chemistry to advanced level.

To give the students adequate hands on experience to work in applied fields.

To train the students to act as a useful member or effective leader of a team in multidisciplinary setting

College Mail ID	kamarajcoll@gmail.com
College Website	www.kamarajcollege.ac.in

Undergraduate Degree Programme

1. Introduction

Programme Outcome, Programme Specific Outcomes and Course Outcomes. Students completing this programme will be able to present their core under-graduate discipline clearly and precisely, make abstract ideas precise by formulating them in the language of the specific discipline, describe related ideas from multiple perspectives and explain fundamental concepts. Completion of this programme will also enable the learners to join teaching profession, enhance their employability for government jobs, jobs in various other public and private enterprises.

Eligibility: +2 course with Mathematics, Physics and Chemistry (Or) Physics, Chemistry and Biology

Learning Outcomes-Based Curriculum Framework Guidelines Based Regulations For Under Graduate Programme	
Programme:	B.Sc. (Chemistry)
Programme Code:	03003
Duration:	3 Years (UG)
Programme Outcomes	
PO1	**Disciplinary knowledge**: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an Undergraduate Programme of study.
PO2	**Communication Skills**: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
PO3	**Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO4	**Problem solving:** Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.
PO5	**Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.
PO6	**Research-related skills:** A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and- effect relationships; ability to plan, execute and report the results of an experiment or investigation
PO7	**Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team
PO8	**Scientific reasoning:** Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.

Programme Specific Outcomes

On successful completion of Bachelor of (Chemistry) programme, the student should be able to:

PSO1	Disciplinary Knowledge:
PSO2	Critical Thinking:
PSO3	Problem Solving
PSO4	Analytical & Scientific Reasoning:
PSO5	Research related skills:

Methods of Evaluation		Marks	
Internal Evaluation	Continuous Internal Assessment Test	15	25
	Assignment (PPT) and Seminar	5	
	Group Discussion and Viva	5	
External Evaluation	End Semester Examination		75
Total			**100**
Methods of Assessment			
Recall(K1)	Simple definitions , MCQ, Recall steps, Concept definitions		
Understand/ Comprehend(K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview		
Application(K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain		
Analyze(K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate Between various ideas, Map knowledge		
Evaluate(K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons		
Create(K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations		

Extra Credits

Curricular Activities	Co-Curricular Activities	Extra-Curricular Activities
Paper Presentation	Cultural Competitions	NCC
Paper Publication	Domain Clubs	NSS
Placement Training		Sports
Quiz		YRC
Competitions		UBA
SWAYAM /NPTEL/MOOCs		

Level	Credit			
	Participation	III Prize	II Prize	I Prize
Intra college	1	2	3	4
Intercollegiate	2	3	4	5
District	3	4	5	6
University	4	5	6	7
State	5	6	7	8
National	6	7	8	9
International	7	8	9	10

****Paper Presentation for each paper: 1 credit.**

Total credits Under – Graduate Courses including Lab Hours- 2024 to 2025

Semester	Hours	Credits	Additional Credits	Extra Credits
I	30	22	2	
II	30	22	2	
III	30	22	2	
IV	30	23	2	
V	30	28	2	
VI	30	23	2	
Total		**140**	**14**	

**Extra Credit will be given on the basis of student's performances

Written Examination: Theory Paper (Bloom's Taxonomy based) Question paper Model

Assessment Pattern

Continuous Internal Assessment (CIA) & End Semester Examination (ESE)

- CIA : 25
- ESE: 75

Theory Course:

For theory courses there shall be two tests conducted by the faculty concerned and the average can be taken as the Continuous Internal Assessment (CIA).CIA is for 30 marks max and will be converted in to 15 marks. The duration of each test shall be 1.15 Hrs.

Continuous Internal Assessment (Writing)	15 marks
Assignment (PPT) & Seminar	5 marks
Group Discussion & Viva	5 marks

For theory Papers:

- Part A (10 × 1 = 10) Marks-Answer all questions(Multiple choice)
- Part B (5 × 5 = 25) Marks-Choosing either (a) or (b)
- Part C (5 × 8 = 40) Marks-Choosing either (a) or (b)
- **Total =75 marks**

Laboratory Courses Assessment

- CIA - 40 marks
- ESE -60 marks
- Mandatory Record submission, attendance and class participation.
  - Experiments (a minimum of six experiments) done in the class alone should be recorded.
  - Students having a bonafide record only should be permitted to appear for the practical examination.
  - Experimental work - 20 marks
  - Regularity -20 marks

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

The S, M, L is based on the Course outcomes. The mapping is

based on the revised Bloom's Taxonomy Verbs used to

describe your Course outcomes.

- Remember and Understanding – Lower level
- Apply and Analyse – Medium Level
- Evaluate and Create – Strong Level

Pedagogy:

- Technology Based Learning (PPT)
- Peer Teaching (Chalk & Talk)
- Virtual Lab
- Blended Learning (Online & Offline)
- Group Learning
- Self - Study
- Games Based Learning

Course Structure for Science Stream

(With effect from the academic year 2024 to 2025 onwards)

Second Year – Semester III

UG Chemistry

Semester III	Course Code	Title of the Course	Hours / Week L/P	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Part- I	24ULTL31	பொதுத்தமிழ் - தமிழக வரலாறும் பண்பாடும்	**6**	**3**	**3**	**25**	**75**	**100**
Part- II	24ULEN31	General English - III	**6**	**3**	**3**	**25**	**75**	**100**
Part -III Core -III	24UMCH31	General Chemistry-III	**5**	**5**	**3**	**25**	**75**	**100**
Core -III Lab-3	24UMCHL3	Qualitative inorganic analysis (mixture)	**3P**	**2**	**3**	**40**	**60**	**100**
EC- III	24UEPH31	Allied: Physics Paper – I	**4**	**3**	**3**	**25**	**75**	**100**
Discipline /Generic Lab - 1	24UEPHL1	Allied Physics Practical-I	**2P**	**2**	**3**	**40**	**60**	**100**
Part-IV SEC- IV	24USCHL1	Entrepreneurial skills in Chemistry	**2P**	**2**	**3**	**40**	**60**	**100**
Part - IV	24UYOG31	Yoga, Culture & Heritage	**2**	**2**	**1.5**	**25**	**75**	**100**
		Total	**30**	**22**				

**** SEC-Skill Enhancement Course**

****CIA- Continuous Internal Assessment**

****EC –Elective Course**

**** ESE- End Semester Examination**

General Chemistry

Title of the Course		**General Chemistry**				
Course Type		**Core III**				
Course Code		**24UMCH31**				
Year	**II**	**Semester**	**III**	**Credits**	**5**	
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		5			**--**	**5**
Pre-requisite		**General Chemistry–I and II**				

Learning Objectives ; This course aims at providing an overall view of

LO1	The physical properties of gases, liquids, solids and X-ray diffraction of solids.
LO2	Fundamentals of nuclear chemistry and nuclear waste management.
LO3	Applications of nuclear energy
LO4	Basic chemistry of halo-organic compounds, phenol and other aromatic alcohols.
LO5	Preparation and properties of phenols and alcohols.

Unit	Contents
I	**Gaseous state** Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; The Maxwell–Boltzmann distribution of speed of molecules-average, root mean square and most probable velocity and average kinetic energy,law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Collision frequency; collision diameter; mean free path and viscosity of gases. **Real gases**: Deviations from ideal gas behavior, compressibility factor, Z, and its variation with pressure for different gases. Equations of states for real gases–VanderWaal's equation; Boyle temperature, isotherms of realgases–critical phenomena– isotherms of CO_2 -continuity of state –Vanderwaal's equation and the critical state; law of corresponding states-liquefaction of gases
II	**Solid State** Crystals–size and shape; laws of crystallography; symmetry elements–plane, Centre and axis; Miller indices, unit cells and space lattices; classification of crystal systems; Bravais lattices; X – ray diffraction – Bragg's equation. Packing in atomic solids – simple cubic, body centered cubic, face centered and hexagonal close packing; Co-ordination number in typical structures - NaCl, CsCl, ZnS, TiO2; comparison of structure and properties of diamond and graphite; Defects in solids-stoichiometric and non- stoichiometric defects. **Liquid crystals**–Classification and applications
III	**Nuclear Chemistry** Natural radioactivity -α, β and y rays; half-life period; Fajan– Soddy group displacement law; Geiger–Nattal rule; isotopes, isobars, isotones, nuclear isomerism; radioactive decayseries; magic numbers; units – Curie, Rutherford, Roentgen; nuclear stability - neutron- proton ratio; binding energy; packing fraction; mass defect. Simple calculations involving mass defect and B.E., decay constant and $t_{1/2}$ and radioactive series. Isotopes – uses – tracers – determination of age of rocks by radiocarbon dating. Nuclear energy; nuclear fission and fusion– major nuclear reactors in India; radiation hazards, disposal of radioactive waste and safety measures.

IV	**Halogen derivatives** **Aliphatic halogen derivatives** Nomenclature and classes of alkyl halides – isomerism, physical properties, Chemical reactions. Nucleophilic substitution reactions –S_{N1} and S_{N2} mechanisms with stereochemical aspects and effect of solvent. **Aromatic halogen compounds** Nomenclature, preparation, properties and uses Mechanism of nucleophilic aromatic substitution–benzyne intermediate **Alcohols:** Nomenclature, classification, preparation, properties, use; conversions– ascent and descent of series; test for hydroxyl groups. Oxidation of diols by per iodic acid and lead tetra acetate. Test for alcohols
V	**Phenols** Nomenclature; classification, Preparation from diazonium salts, cumene, Dow's process, Raschig process; properties – acidic character and effect of substitution on acidity. Reactions–Fries, claisen rearrangement, Electrophilic substitution reactions, Reimer - Teimen, Kolbe, Schmidt, Gatermann synthesis, Libermann, nitro reaction, phthalein reaction. Resorcinol, quinol, picricacid–preparation, properties and uses. **Aromatic alcohols** Nomenclature, benzyl alcohol –methods of preparation– hydrolysis, reduction of benzaldehyde, Cannizzaro reaction, Grignard synthesis, physical properties, reactions – reaction with sodium, phosphorus pentachloride, thionyl chloride, acetic anhydride, hydrogen iodide, oxidation–substitution on the benzene nucleus, uses.

Extended professional component(is a part of internal component only, Not To be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	
1	B.R. Puri, L.R. Sharma, M.S.Pathania; *Principles of Physical Chemistry*, 46th edition, Vishal Publishing, 2020.
2	B.R. Puri, L.R. Sharma and K.C.Kalia, *Principles of Inorganic Chemistry*, Milestone Publishers and Distributors, New Delhi, thirtieth edition, 2009.
3	P.L. Soni and Mohan Katyal, *Textbook of Inorganic Chemistry*, Sultan Chand & amp; Sons, twentieth edition, 2006.
4	M.K.Jain, S.C.Sharma, *Modern Organic Chemistry*, Vishal Publishing, fourth reprint, 2003.
5	S.M.Mukherji, and S.P.Singh, *Reaction Mechanism in Organic Chemistry*, Macmillan India Ltd., third edition, 1994.
References Books:	
1	T.W. Graham Solomons, *Organic Chemistry*, John Wile y& amp; Sons, fifth edition, 1992.
2	A. Carey Francis, *Organic Chemistry*, Tata McGraw-Hill Education Pvt., Ltd., New Delhi, seventh edition, 2009.
3	I.L. Finar, *Organic Chemistry*, Wesley Longman Ltd, England, sixth edition, 1996.
4	P.L.Soni, and H.M. Chawla-*Text Book of Organic Chemistry*, New Delhi, Sultan Chand & Sons, twenty ninth edition, 2007.
5	J.D.Lee, *Concise Inorganic Chemistry*, Blackwell Science, fifth edition, 2005.
Web Resources:	
1	**MOOC components** https://nptel.ac.in/courses/104104101Solidstate chemistry https://nptel.ac.in/courses/103106071Nuclear industries and safety https://nptel.ac.in/courses/104106119s Introduction to organic chemistry

Course outcomes CO	On completion of this course, students will be able to:
CO1	Explain the kinetic properties of gases by using mathematical concepts.
CO2	Describe the physical properties of liquid and solids; identify various types of crystals with respect to its packing and apply the XRD method for crystal structure determinations
CO3	Investigate the radioactivity, nuclear energy and its production, also the nuclear waste management.
CO4	Write the nomenclature, physical & chemical properties and basic mechanisms of halo organic compounds and alcohols
CO5	Investigate the named organic reactions related to phenol; explain the preparation and properties of aromatic alcohol

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Qualitative Inorganic Analysis (Mixture)

<table>
<tr><td>Title of the Course</td><td colspan="6">Qualitative Inorganic Analysis (Mixture)</td></tr>
<tr><td>Course Type</td><td colspan="6">Core III Lab</td></tr>
<tr><td>Course Code</td><td colspan="6">24UMCHL3</td></tr>
<tr><td>Year</td><td>II</td><td>Semester</td><td>III</td><td>Credits</td><td colspan="2">2</td></tr>
<tr><td rowspan="2">Instructional Hours Per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td>-</td><td colspan="2">-</td><td>3</td><td>3</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="5">General Chemistry-II</td></tr>
<tr><td colspan="7">Learning Objectives : This course aims at providing knowledge on</td></tr>
<tr><td>LO1</td><td colspan="6">To develop the skill on systematic analysis of mixture of inorganic salts.</td></tr>
<tr><td>LO2</td><td colspan="6">Study the principles/equation of the experiment.</td></tr>
<tr><td>LO3</td><td colspan="6">Study the ionic reactions</td></tr>
</table>

Experiments	
Semi-Micro Qualitative Analysis 1. Analysis of simple acid radicals: Carbonate, sulphide, sulphate, chloride, bromide, iodide, nitrate 2. Analysis of interfering acid radicals: Fluoride, oxalate, borate, phosphate. 3. Elimination of interfering acid radicals and Identifying the group of basic radicals 4. Analysis of basic radicals (group wise): Lead, copper, bismuth, cadmium, zinc, manganese, nickel, cobalt, calcium, strontium, barium, magnesium, ammonium. 5. Analysis of a mixture containing two cations and two anions – of which one is interfering type.	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Reference Books:	Venkateswaran, V.; Veeraswamy, R.; Kulandaivelu, A.R. Basic Principles of Practical Chemistry, 2nd ed.; Sultan Chand: New Delhi, 2012.
Web resources:	https://www.vlab.co.in/broad-area-chemical-sciences

Course outcomes CO	**On completion of this course, students will be able to:**
CO1	Acquire knowledge on the systematic analysis of simple salts.
CO2	Understand the nature of ionic reactions
CO3	Identify the captions and anions in the unknown inorganic mixture.
CO4	Identify the captions and anions in water and to test the quality of water.
CO5	Identify the captions and anions in the soil and to test the quality of soil. Assess the role of common ion effect and solubility product.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Entrepreneurial Skills in Chemistry

Title of the Course	**Entrepreneurial Skills In Chemistry**				
Course Type	**Skill Enhancement Course IV**				
Course Code	**24USCHL1**				
Year	**II**	**Semester**	**III**	**Credits**	**2**
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	
		-	**-**	**2**	
Pre-requisite		**General Chemistry**			

Learning Objectives : This course aims at providing training to

LO1	Develop entrepreneurial skills in students
LO2	Provide hands on experience to prepare and develop products
LO3	Study the principle/equation of the experiment
LO4	Develop start ups
LO5	Know about food adultrants

I	**Food Chemistry** Food adulteration–contamination of food items with clay stones, water and toxic chemicals -Common adulterants. Food additives, Natural and synthetic, antioxidants, glazing agents (hazardous effect), food colourants, Preservatives, leavening agents, Baking powder and baking soda, yeast, MSG, vinegar. **Dyes** Classification–Natural, synthetic dyes and their characteristics–basic methods and principles of dyeing.
II	Hands on Experiments (Students can choose any four) Detection of adulterants in food items like coffee, tea, pepper, chillipowder, turmeric powder, butter, ghee, milk, honey etc., by simple techniques. Preparation of Jam, squash and Jelly, Gulkand, cottage cheese. Preparation of products like candles, soap, detergents, cleaning powder, shampoos, pain balm, tooth paste/powder and disinfectants in small scale. Extraction of oils from spices and flowers. Testing of water samples using testing kit. Dyeing–cotton fabrics with natural and synthetic dyes Printing–tie and dye, batik.
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Reference Books:	1. George S & Muralidharan V, (2007) Fibre to Finished Fabric–A Simple Approach, Publication Division, University of Madras, Chennai. 2. Appaswamy GP, A Hand book on Printing and Dyeing of Textiles 3. ShyamJha, Rapid detection of food adulterants and contaminants (Theory and Practice), Elsevier,eBook ISBN 9087128004289,1st Edition,2015
Web resources:	https://www.vlab.co.in/broad-area-chemical-sciences
Course outcomes CO	**On completion of this course, the students will be able to**
CO1	Identify adulterated food items by doing simple chemical tests.
CO2	Prepare cleaning products and become entrepreneurs
CO3	Educate others about adulteration and motivate them to become entrepreneurs.
CO4	Dye fabric with natural/ synthetic dye
CO5	Extract oils from spices /flowers.

Mapping With Programme Outcomes and Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

S-Strong (3) M-Medium (2) L-Low (1)

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Blue Print – End Semester Examinations – November 2024
Semester -I

Class: U.G. / P.G. Time: 3 Hours Max. Marks: 75

Section A (10 x 1 = 10)

Answer ALL questions.
Choose the correct answer. (With four options)

	Unit I	Unit II	Unit III	Unit IV	Unit V
Question Nos.	1 & 2	3 & 4	5 & 6	7 & 8	9 & 10

Section B (5 x 5 = 25)

Answer ALL questions choosing either (a) or (b).
Answer should not exceed 250 words

	Unit I	Unit II	Unit III	Unit IV	Unit V
Question Nos.	11 (a) & 11 (b)	12 (a) & 12 (b)	13 (a) & 13 (b)	14 (a) & 14 (b)	15 (a) & 15 (b)

Section C (5 x 8 = 40)

Answer ALL questions choosing either (a) or (b).
Answer should not exceed 500 words.

	Unit I	Unit II	Unit III	Unit IV	Unit V
Question No.	16 (a) & 16 (b)	17 (a) & 17 (b)	18 (a) & 18 (b)	19 (a) & 19 (b)	20 (a) & 20 (b)