KONGUNADU ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)
COIMBATORE – 641 029

DEPARTMENT OF CHEMISTRY (UG)

CURRICULUM AND SCHEME OF EXAMINATIONS (CBCS)
(2026 – 2027 and onwards)

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
Coimbatore – 641 029

DEPARTMENT OF CHEMISTRY

Vision

To provide personal, intellectual and professional growth of the students and to impart an ideal science education with the emphasis on man-making and character building.

Mission

To produce quality and knowledgeable chemistry graduates capable of creating new developments for the society and preparing chemists of highest caliber for global standards, simultaneously imbibing Indian cultural values in the minds of the students.

PROGRAMME OUTCOME (PO)

On the successful completion of the programme, the following are the expected outcomes

PO 1 Understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day today life.

PO 2 Acquired the skills in handling scientific instruments, planning and performing in laboratory experiments.

PO 3 The skills of observations and drawing logical inferences from the scientific experiments

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PO 4 Been able to think creatively (divergently and convergent) to propose novel ideas in explaining facts and figures or providing new solution to the problems

PO 5 An understanding of professional, ethical, and social responsibilities

PO 6 Determine the scope and perceive unique areas for further study and employability

PO 7 Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

PO 8 To be exposed to the different process used in industries and their applications

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO 1 Graduates will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Physical Chemistry.

PSO 2 Graduates are able to employ critical thinking and scientific inquiry in the performance, design, interpretation and documentation of laboratory experiments.

PSO 3 Graduates are able to grab enormous existing job opportunities at all levels of chemical, medical, food processing, material industries and educational institutions.

PSO 4 The graduates become entrepreneurs to own enterprises based on the national and international market potentials.

PSO 5 Graduates can perform good social responsibility with greater in ethics and conducive use of natural resources.

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

COIMBATORE – 641 029

Programme Name: **B. Sc., Chemistry**

Curriculum and Scheme of Examination under CBCS

(Applicable to the students admitted during the Academic Year 2026-2027)

Semester	Part	Subject Code	Title of the Paper	Instruction hours/cycle	Exam. Marks			Duration of Exam (hours)	Credits
					CIA	ESE	TOTAL		
I	I	26TML101	Language I@	6	25	75	100	3	3
	II	26ENG101	English -I	6	25	75	100	3	3
	III	26UCH101	Core Paper 1 – Inorganic, organic and Physical chemistry – I	6	25	75	100	3	5
			Core practical – I Inorganic qualitative analysis & Preparation	3	-	-	-	-	-
	III	26UMA1AA/ 26UZO1A1	Allied A Paper I – Mathematics/ Zoology – I	7/5	25/ 20	75/ 55	100/ 75	3	5/4
			Allied Zoology practical	2	-	-	-	-	-
	IV	26EVS101	Environmental Studies **	2	-	50	50	3	2
			Total	**30**	-	-	450/425	-	**18/ 17**
II	I	26TML202	Language II@	6	25	75	100	3	3
	II	26ENG202	English –II	6	25	75	100	3	3
	III	26UCH202	Core Paper 2 – Inorganic, Organic and Physical chemistry – II	6	25	75	100	3	5
	III	26UCH2CL	Core practical – I Inorganic qualitative analysis & Preparations	3	40	60	100	3	2
	III	26UMA2AB/ 26UZO2A2	Allied A Paper II – Mathematics/ Zoology – II	7/5	25/ 20	75/ 55	100/ 75	3	5/4
	III	26UZO2AL	Allied Zoology practical	2	20	30	50	3	2
	IV	26VED201	Value Education- Moral and Ethics**	2	-	50	50	3	2
			Total	**30**	-	-	550/575	-	**21/ 22**

III	I	26TML303	Language III@	6	25	75	100	3	3
	II	26ENG303	English –III	6	25	75	100	3	3
	III	26UCH303	Core Paper 3 - Inorganic, Organic and Physical chemistry – III	4	25	75	100	3	4
			Core practical – II Inorganic Volumetric and Organic qualitative analysis	3	-	-	-	-	-
	III	26UPH3A1	Allied B Paper 1 – Physics I	4	20	55	75	3	4
			Allied Physics practical - I	3	-	-	-	-	-
	IV	26UGC3S1	Skill Based Subject 1 – Basics of Cyber Security *	2	100	-	100	3	3
	IV	26TBT301/ 26TAT301/ 26UHR3N1	Basic Tamil* / Advanced Tamil**/ Non-major elective- I**	2	-	75	75	3	2
			Total	**30**	-	-	550	-	**19**
IV	I	26TML404	Language IV@	6	25	75	100	3	3
	II	26ENG404	English –IV	6	25	75	100	3	3
	III	26UCH404	Core Paper 4 - Inorganic, Organic and Physical chemistry – IV	4	25	75	100	3	4
	III	26UCH4CM	Core practical – II Inorganic Volumetric and Organic qualitative analysis	3	40	60	100	6	3
	III	26UPH4A2	Allied B Paper II – Physics I	4	20	55	75	3	4
	III	26UPH4AL	Allied Physics practical - I	3	20	30	50	3	2
	IV	26UCH4S2	Skill Based Subject 2- Water pollution and management	2	25	75	100	3	3
	IV	26TBT402/ 26TAT402/ 26UWR4N2	Basic Tamil* / Advanced Tamil**/ Non-major elective- II**	2	-	75	75	3	2
			Total	**30**	-	-	700	-	**24**
V	III	26UCH505	Core Paper 5 – Spectroscopy and chromatographic techniques	3	25	75	100	3	3
	III	26UCH506	Core Paper 6 – Inorganic Chemistry	4	25	75	100	3	3

	III	26UCH507	Core Paper 7 – Organic Chemistry	4	25	75	100	3	4
	III	26UCH508	Core Paper 8 – Electro Chemistry	4	25	75	100	3	4
	III	26UCH5E1	Major Elective 1	3	25	75	100	3	5
	III		Core practical – III Gravimetric Analysis	3	-	-	-	-	-
	III		Core practical – IV Physical Chemistry experiments	4	-	-	-	-	-
	III		Core practical – V Application Oriented Practical	3	-	-	-	-	-
	IV	-	EDC *	2	100	-	100	3	3
	-	26UCH5IT	Internship Training ****	Grade					
			Total	**30**	-	-	600	-	**22**
VI	III	26UCH609	Core Paper 9 – Solid state and Coordination Chemistry	5	25	75	100	3	4
	III	26UCH610	Core Paper 10 Chemistry of natural products	5	25	75	100	3	4
	III	26UCH611	Core Paper 11 Physical Chemistry	5	25	75	100	3	3
	III	26UCH6E2	Major Elective 2	3	25	75	100	3	5
	III	26UCH6CN	Core practical – III Gravimetric Analysis	3	40	60	100	3	3
	III	26UCH6CO	Core practical – IV Physical Chemistry experiments	4	40	60	100	3	4
		26UCH6CP	Core practical – V Application Oriented Practical	3	40	60	100	3	4
	III	26UCH6Z1	Project viva-voce***	-	20	80	100	-	5
	IV	26UBI6S3	Skill Based subject 3- Basics of Intellectual Property Right's	2	100	-	100	3	3
			Total	**30**	-	-	900	-	**35**
	V	**26NCC$ / NSS/YRC /PYE/ECC/RRC/ WEC101#**	Co curricular Activities*	-	50	-	50	-	1
Grand Total				**-**	**-**	**-**	**3800**	**-**	**140**

Note :

CBCS – Choice Based Credit system, CIA– Continuous Internal Assessment, ESE– End of Semester Examinations

$ For those students who opt NCC under Cocurricular activities will be studying the prescribed syllabi of the UGC which will include Theory, Practical & Camp components. Such students who qualify the prescribed requirements will earn an additional 24 credits.

@ Hindi/Malayalam/ French/ Sanskrit – 26HIN/MLM/FRN/SAN101 - 404

***** - No End-of-Semester Examinations. Only Continuous Internal Assessment (CIA)

******- No Continuous Internal Assessment (CIA). Only End-of-Semester Examinations (ESE)

*** Project Report – 60 marks; Viva voce – 20 marks; Internal-20 marks

**** The students shall undergo Internship training / field work for a minimum period of 14 working days at the end of the fourth semester during summer vacation and submit the report in the fifth semester which will be evaluated for 100 marks by the concerned guide and followed by an Internal Viva voce by the respective faculty or HOD as decided by the department. According to their marks, the grades will be awarded as given below.

Marks %	Grade
85 – 100	O
70 – 84	D
60 – 69	A
50 – 59	B
40 – 49	C
< 40	U (Reappear)

Major Elective Papers (2 papers are to be chosen from the following 6 papers)

1. Polymer Science
2. Nano Science
3. Pharmaceutical Chemistry
4. Agricultural Chemistry
5. Food Chemistry
6. Leather Chemistry

Non-Major Elective Papers

1. Human Rights
2. Women's Rights
3. Consumer Affairs

Sub. Code & Title of the Extra Departmental Course (EDC):

26UCH5X1 - Chemistry in day- to-day life

 # List of Cocurricular Activities:

1. National Cadet Corps (NCC)
2. National Service Scheme (NSS)
3. Youth Red Cross (YRC)
4. Physical Education (PYE)
5. Eco Club (ECC)
6. Red Ribbon Club (RRC)
7. Women Empowerment Cell (WEC)

Note: In core/ allied subjects, no. of papers both theory and practical are included wherever applicable. However, the total credits and marks for core/allied subjects remain the same as stated below.

Tally Table:

S.No.	Part	Subject	Marks	Credits
1.	I	Language – Tamil/Hindi/Malayalam/ French/ Sanskrit	400	12
2.	II	English	400	12
3.	III	Core – Theory/Practical	1600	60
	III	Allied	400	20
		Electives/Project	300	15
4.	IV	Basic Tamil / Advanced Tamil (OR) Non-major electives	150	4
		Skill Based subject	300	9
		EDC	100	3
		Environmental Studies	50	2
		Value Education	50	2
5.	V	Cocurricular Activities	50	1
		Total	**3800**	**140**

- 100 % CIA for Basics of Cyber Security, EDC and Basics of IPR.
- The students should complete **Health and Wellness Programme (26UHW401)**### in the **4th semester** and the completion marks should be submitted through the HoD to the Controller of Examinations. Extra credits will be given to the candidates who have successfully completed.

- The students may be encouraged to complete any **MOOC course available for Online learning platforms like SWAYAM, NPTEL, Coursera$$, IIT Bombay Spoken Tutorial, e-Pathshala etc.,** before the completion of the **5th semeste**r and the course completion certificate should be submitted through the HoD to the Controller of Examinations. Appropriate credits will be given to the candidates who have successfully completed.

  $$Note: One course to be taken from coursera for all the under graduate students of self finance stream during the even semester of the I year. **Appropriate extra credits@@@** and certification as applicable shall be awarded to the students who have completed the course.

  @@@Note : Course Duration :

Duration	Extra Credits
< 10 hours	0
> =10 hours and < = 20 hours	1
> 20 hours	2

- An **Onsite Training** preferably relevant to the course may be undertaken as per the discretion of the HoD.
- Extra credits shall be awarded for innovative products/ individual paper presentations and publications in reputed national/ international proceedings and in indexed journals by the UG students for their original research contributions.

- Product development through Technology Readiness Levels:
  - Phase 1 Level (TRL 1-3) : Basic research: 1 credits
  - Phase 2 Level (TRL 4 -6) : Development and validation : 2 credits
  - Phase 3 Level (TRL 7-9) : Deployment : 3 credits
- National / International level paper presentation in conferences and publications of full papers in reputed Scopus/ web of Science indexed journals
  - National Level : 1 credit/ paper
  - International Level : 2 credits/ paper
  - Open access Journals are not included

- Extra credits shall be awarded to students who prefer to opt any course out of their programme on self learning mode. No internal components. 100% ESE.

Teaching Pedagogy

Smart ClassRoom /Powerpoint presentation/Seminar/Quiz/Discussion/Flipped Classroom/ Peer Learning/Experimental Learning/Blended learning

Flipped Classroom

Preamble:

- Under flipped classroom model, students review foundational content before class, with class time dedicated to practice, discussion, and problem – solving where the role of the teachers will be facilitating discussions and enabling students to embark on a holistic learning perspectives

Work instructions:

- One flipped session / unit is made mandatory and the course In-charge shall identify and specify the topic to be covered in the flipped session in the lesson plan.
- Detailed session plans must be intimated to all students at least one week in advance.
- Curated content such as LORs, video lectures, animations, and other relevant digital content shall be provided to students in advance to facilitate effective preparation for the flipped classroom session.

Peer Learning

Preamble:

- Peer Assisted learning enables students to learn from each other sharing knowledge in a collaborative learning environment.
- Development of leadership skills and student engagement through student to student academic support.
- Reduce drop out/failure rates of the students and create a supportive academic culture where a high performing or trained student assists peers academically.

Work Instructions:

- Course In-charge shall supervise the programme by periodically reviewing its implementation, conducting review meetings, and monitoring the progress reports.
- Course In-charge shall identify 5 to 6 fast learners based on their academic performance in internal and external examinations.
- Course In-charge shall also identify students who require additional academic support and assign 4 to 5 such students to each fast learner to facilitate peer learning.
- This team will operate remedial classes on a peer learning mode as per the following:
  a) One session / week / course and each session shall be for 30 minutes in duration, with follow-up learning activities.
  b) The faculty In-charge shall review attendance records and monitor the academic progress of the students.

Blended learning

Preamble:

- Blended learning integrates traditional in class instruction with digital tools exposing students to a myriad options for learning from subject experts across the globe
- It is provided with online learning sessions on recorded videos, lecture captured sessions (included under guided library hours), digital resources, and guided sessions facilitated by internal faculty members and external experts through Zoom meets etc.,

Work Instructions:

- For every course, students will be motivated to attend additional webinar/online courses through any interactive learning tools such as, telepresence systems, podcasts, interactive videos etc. with minimum of 2 sessions/course and maximum of 3 sessions/course.

Extra credit Courses

Semester	Subject code	Title of the paper	Instruction hour/cycle	Exam marks			Duration	Credits
				CIA	ESE	Total		
	26UCH0J1	JOC – Textile technology	3		100	100	3	2

Components of Continuous Internal Assessment

Components		Marks	Total
Theory			
CIA I	75	(75+75 = 150/10) 15	25
CIA II	75		
Objective Capacity Testing */Seminar		5	
Attendance		5	
Practical			
CIA Practical		25	40
Observation Notebook		10	
Attendance		5	
Project			
Review		15	20
Regularity		5	
Theory (Allied) (External : 55 marks)			
CIA I	55	(55+55) Converted to 10	20
CIA II	55		
Objective Capacity Testing */Seminar		5	
Attendance		5	
Practical (Allied) (External : 30 marks)			
CIA Practical		10	20
Observation Notebook		5	
Attendance		5	

*** Objective Capacity Testing:**

For the first assessment, questions shall be set from 2 ½ units (25 questions) and evaluation for 5 marks. The assessment shall be conducted through any authentic online platform, one week prior to the commencement of I CIA theory examinations.

For the second assessment, questions shall be set from 2 ½ units (25 questions) and evaluation for 5 marks. The assessment shall be conducted through any authentic online platform, one week prior to the commencement of II CIA theory examinations. The average of the first and second assessment scores shall be considered for the final **5 marks** allocation.

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

K1-Remembering; **K2**-Understanding; **K3**-Applying; **K4**-Analyzing; **K5**-Evaluating

1. ESE Theory Examination:

(i) CIA I & II and ESE: 75 Marks

Knowledge Level	Section	Marks	Description	Total
K1 Q1 to 10	A (Answer all)	10 x 1 = 10	MCQ	75
K1 – K5 Q11 to 15	B (Either or pattern)	5 x 5 = 25	Short Answers	
K2 – K5 Q16 to 20	C (Either or pattern)	5 x 8 = 40	Descriptive / Detailed	

(ii) CIA I & II and ESE: 55 Marks (Allied)

Knowledge Level	Section	Marks	Description	Total
K1 Q1 to 10	A (Answer all)	10 x 1 = 10	MCQ	55
K2 – K4 Q11 to 15	B (Either or pattern)	5 x 3 = 15	Short Answers	
K2 – K5 Q16 to 20	C (Either or pattern)	5 x 6 = 30	Descriptive / Detailed	

2. ESE Practical Examination:

Knowledge Level	Section	Marks	Total
K3	Experiments	50	60
K4	Record Work	10	
K5			

(For Allied papers)			
Knowledge Level	Section	Marks	Total
K3	Experiments	25	30
K4	Record Work	05	
K5			

3. ESE Project Viva Voce:

Knowledge Level	Section	Marks	Total
K3	Project Report	60	80
K4	Viva voce	20	
K5			

Scheme of Evaluation - Health and Wellness Programme (26UHW401)###

Part	Description	Mark
A	Report	40
B	Attendance	20
C	Activities (Observation during Practice)	40
Total		**100**

Subject code: 26UCH101

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PAPER – 1 INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY – I**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development**
2026 - 2027	I	6	90	5	

Objectives	
1.	To know the concept of qualitative inorganic analysis.
2.	To acquaint knowledge about electron displacement effects, hybridization and conformations.
3.	To know about the structure of an atom.

Course Outcomes (CO)

K1 – K5	CO1	Explain the basic analytical knowledge and group separation of elements.
	CO2	To know the types of bonding and geometry in molecules and VSEPR theory
	CO3	Explain the introduction of organic chemistry.
	CO4	Acquire the knowledge about the structure of atoms.
	CO5	Understand characteristics of gases.

UNIT – I	**Qualitative Analysis and Laboratory safety**	**18 Hours**

Introduction, Macro, micro, and semi-micro methods. Important Principles Involved in Qualitative Analysis - Chemical Equilibrium, Common Ion Effect, Solubility Product, Precipitation of Sulphides of Group II and IV, Complex Ion Formation. Semi micro qualitative analysis for inorganic anions and cations (pertaining to B.Sc. practical syllabus only). Dry test – heating and flame tests; Wet test. Scheme of classification of anions. Sodium carbonate extract test, identification of interfering radicals and their elimination, classification of cations into analytical groups (group separation only).

Laboratory Safety Rules and Regulations:

General rules and regulations for lab safety: Minimizing Risks of Hazards, Personal Protective Equipment (PPE) - Hair, Dressing for the Laboratory, Eye Protection, Eyewash fountain, Gloves, Laboratory Protocols, Labelling Chemicals, Careful reading of labels Prevention of Inhaling Harmful Chemicals, Guide to Chemical Hazards, Chemical Spills. Some Common Accidents and their Treatment - Accident Related to Eye. Minor Injury Due to Glass Apparatus or Any Sharp Metal. An Injury Due to Fire Burn, Acid Burn or Alkali Burn and Bromine Water Burn.

UNIT-II	**Chemical Bonding**	**18 Hours**

Chemical bond – definition - Types of chemical bonds.Ionic or electrovalent bond: Definition - Illustration of the formation of ionic bond, (Examples: NaCl, MgO only) - Condition for the formation of ionic compounds - Characteristics of ionic compounds - Born Haber cycle.

Covalent bond: Definition - Types of covalent bond (single, double and triple) - Illustration of the formation of covalent bond (Example: HF, H_2O, NH_3 only) - Characteristics of covalent compounds.

Coordinate bond: Definition - Illustration of the formation of coordinate bond (Example: SO_2, NH^{4+} only) - Comparison between Ionic, Covalent and Coordinate Bond. Hydrogen bond: Definition - Illustration of the formation of Hydrogen bond (Example H_2O only) - Conditions for hydrogen bonding properties - Types of Hydrogen Bonding and Characteristic of Hydrogen Bonded Compound effect of hydrogen bonding.
Hybridization and Geometries of molecules – VSEPR theory - Geometry of $BeCl_2$, PCl_3, H_2O only.

UNIT-III	**Introduction to organic chemistry**	**18 Hours**

Electronic effects: Inductive effect-reactivity of alkyl halides, relative acidic and basic strength. Electromeric effect, Resonance effect – Conditions for resonance, Resonance structure, acidic character of acids and basic character of amines. Hyperconjugative effect– Relative Stability of alkenes. Steric effect – Steric hinderance.
Bond fission: Homolytic and heterolytic fission.
Reaction Intermediates–Carbocations, Carbanions, Free radicals, and Carbenes.
Classification of reagents: Electrophiles and nucleophiles.
Types of organic reactions: Substitution, addition, elimination, and rearrangement reactions with one example each (Basic ideas only).
Alkanes: IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atoms in alkanes. Isomerism in alkanes, Sources, methods of preparation (with reference to Sabatier-Senderen's reaction, Wurtz reaction, Kolbe reaction, and, decarboxylation of carboxylic acids reaction only), physical and chemical properties of alkanes. Conformation study of ethane and n-butane.
Cycloalkanes (upto six membered rings): Nomenclature, Methods of preparation (with reference to Dehalogenation of dihalides, Diels-Alder addition. Dieckmann reaction and [2 + 2] Photochemical Cycloaddition reaction only**)**, physical and chemical properties of Cycloalkanes, Baeyer's strain theory and its limitations.

UNIT-IV	**Structure of atom**	**18 Hours**

Atom Models – Bohrs atom model – orbit and orbital – dual nature of matter – de Broglie equation (Verification not required) – Heisenberg Uncertainty Principle - Schrodinger wave equation and its applications. Eigen value and Eigen functions – Significance of ψ and ψ^2. Quantum Numbers- Principal, Azimuthal, Magnetic, Spin Quantum Numbers and their significance. Probability distribution of electron around the nucleus – Radial Probability distribution – Pauli exclusion principle, Hund Rule, Aufbau Principle, $n + l$ rule. Stability of half - filed and fully filled orbitals.

UNIT-V	**Gaseous state**	**18 Hours**

Characteristics of gases- parameters of a gas. Gas laws-Boyele's law, Charle's Law, Gay lussac's law and Avogadro's law. The ideal gas equation- kinetics of molecular theory of gases. Derivation of kinetic gas equation. Distribution of molecular velocities- calculation of molecular velocities. Collision properties. Van der Waals equation – Liquefaction of gases – Law of corresponding states- Methods of liquefaction of gases.

Self study portion

TEXT BOOKS:	
1.	G. Svehla, (2012) **Vogel's Text book of Macro and Semimicro Qualitative Analysis**, Longman Inc., Newyork.
2.	R. D. Madan, (2004) Modern **Inorganic Chemistry**, S. Chand & Co., New Delhi.
3.	M.K. Jain. S.C. Sharma, (2004) **Modern Organic Chemistry**, Vishal publishing Co., New Delhi.
4.	B. R. Puri, L. R. Sharma, K. K. Kalia, (2014) **Principles of Inorganic Chemistry**, Milestone Publishers and Distributors, New Delhi.
5.	Arun Bahl, B.S.Bahl, (2012) **Advanced Organic Chemistry,** S. Chand & Co., New Delhi, Revised multicolor edition.
6.	Arun Bahl and B.S.Bahl, G.D.Tuli, (2012) **Essentials of Physical Chemistry**, S. Chand & Co., New Delhi, Revised multicolor edition.
7.	Chemical safety matters IUPAC – IPCS, Cambridge University Press (1992).
8.	Robert h. Hill, jr., David c. Finster, Laboratory safety for chemistry students,Wiley Publication,(2010).
REFERENCE BOOKS:	
1.	Sathya Praksash, G.D. Tuli, S. K. Basu, R.D. Madan, **(**2012) **Advanced Inorganic Chemistry,** Vol. 1, S. Chand & Co., New Delhi.
2.	J. D. Lee, (2006) **Concise Inorganic Chemistry**, Black Well Science, UK.
3.	M. K. Jain, S. C. Sharma, (2011) **Modern Organic Chemistry**, Vishal Publishing Co., New Delhi,.
4.	S. Glasstone, D. Lewis, (2004) **Elements of Physical Chemistry**, Macmillan Ltd, London.

E-Resource:

1. https://www.youtube.com/watch?v=37dCMzOVaoo
2. https://www.youtube.com/watch?v=1DWZFkipYtE
3. https://www.youtube.com/watch?v=bpgF4xBGF_Y
4. https://www.youtube.com/watch?v=RDVsgjVItw4&list=PLOzRYVm0a65f298xo_WnFOmXm5t-piWHk
5. https://www.youtube.com/watch?v=4CsNKvoYDMw
6. https://www.youtube.com/playlist?list=PLoFQYaxzWNnalEZaBPzuqCeiEPLHNO9re

Subject code: 26UCH101

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	H	M	H
CO2	S	S	M	M	M
CO3	S	S	M	M	M
CO4	S	S	H	M	M
CO5	S	S	H	M	M
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge

Signature of the HOD

Subject code: 26UCH202

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PAPER – 2** **INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY -II**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development**
2026 - 2027	II	6	90	5	

Course Objectives

1	Know about metallurgy, importance of periodic table and atomic properties.
2	To learn about Benzene and Aromaticity.
3	To study the fundamentals of thermodynamics and thermochemistry.

Course Outcomes (CO)

K1 – K5	CO1	Obtain problem solving skills in order to modify industrial processes in Extraction metallurgy.
	CO2	Gain knowledge about periodic properties
	CO3	Study of Aromatic Compounds and mechanism of certain reactions
	CO4	Learn about concepts of thermodynamics.
	CO5	Acquire the knowledge in thermochemistry.

UNIT – I	**Metallurgy**	**18 Hours**

***Introduction-Minerals, ores - occurrence of metals-classification of ores**-various steps involved in the metallurgical processes- concentration of ores, working of concentrated ore-Calcination – roasting - smelting - Thermodynamic Principles-reduction by carbon-Alumino Thermic process-reduction by heating air-electrolytic reduction - purification of metals- electro refining - zone refining - van Arkel process - Amalgamation process - Mond's process. Vedic Metallurgy: Introduction - Metallurgy in India, Copper (Tamra), Iron (Loha), Zinc, Gold (Survarṇa) and Silver (Rajata).

UNIT-II	**Periodic table and atomic properties**	**18 Hours**

Mendeleev Periodic Table, Modern Periodic table-long form periodic table, Description of groups-Alkali metals-Alkali earth metals-Boron Family-Carbon Family-Nitrogen family/ Pnicogens-Oxygen family/ Chalcogens-Halogen Family-Inert gases/Noble gases –IUPAC nomenclature for the super heavy elements, Merits and Demerits of long form of periodic table.

Periodicity, causes of periodicity, Calculation of effective nuclear charge, Periodic Properties, Atomic Size-Covalent radius--Ionic Radius-Metallic radius-Vander Waal's radius, Factors affecting atomic size, Ionization energy – factors affecting ionization energy-applications of ionization energy, Electron Affinity-Factors affecting electron affinity, Electro Negativity-Factors Affecting electro negativity-applications of electro negativity.

UNIT-III	**Aromatic Compounds**	**18 Hours**

Nomenclature of Aromatic Compounds – Mono substituted Benzene – Di substituted Benzene – Polysubstituted Benzene – Resonance energy of benzene, Conditions of Aromaticity, Huckel's rule

– Aromaticity in cyclopropenyl cation, cyclopentadienyl anion and tropylium cation. Antiaromaticity - Cyclobutadiene. Aromatic Electrophilic substitution Reactions: Arenium ion mechanism and typical reactions of benzene: Nitration, Sulphonation, Halogenation, Friedel Craft's alkylation, acylation and their mechanism. Orientation and reactivity in mono substituted benzene.		
UNIT-IV	**Thermodynamics – I**	**18 Hours**
Basic Concepts – system and surrounding. Types of system - Extensive and Intensive properties - State functions and path functions- Types of thermodynamic process- Zeroth law of Thermodynamics, Exact and Inexact differentials, Statement of first laws thermodynamics – definition of internal energy (E) and enthalpy (H), Concept of Work, Energy and Heat - Calculations work done in isothermal and adiabatic reversible and irreversible processes for ideal gases. Heat capacities at constant volume (C_v) and Constant pressure (C_p)- relationship between C_p & C_v. Joule – Thomson effect – Joule Thomson Coefficient for ideal and real gases – Inversion Temperature.		
UNIT-V	**Thermo Chemistry**	**18 Hours**
Introduction - exothermic and endothermic reactions - Thermo chemical equations - Kirchoff's equation - types of heat of reaction - heat of formation - standard heat of formation - standard heat of reaction - heat of combustion-heat of solution - heat of neutralization-heat of fusion - heat of vaporization - heat of sublimation and heat of transition – definition - simple problems. Hess's law of constant heat summation – applications - bond energy and strength of bond - experimental determination of heat of combustion - bomb calorimeter.		
Self study portion		

TEXT BOOKS:

1.	Puri B.R, Sharma L.R, Kalia K.C., (2014) **Principles of Inorganic Chemistry**, Milestone publishers and Distributors, New Delhi.
2.	Sathya Praksash, G.D. Tuli, S. K. Basu, R.D. Madhan, (2012) **Advanced Inorganic Chemistry,** Volume 1, S. Chand & Company, New Delhi.
3.	M.K. Jain, S.C. Sharma, (2011) **Modern Organic Chemistry**, Vishal Publishing Co., Delhi.
4.	B.S. Bahl, and Arun Bahl, (2012) **Advanced Organic Chemistry**, S. Chand and Co, New Delhi, Revised multicolor edition.
5.	B.S. Bahl and G. D. Tuli, and Arun Bahl, (2012) **Essentials of Physical Chemistry,** S. Chand publishing, Revised multicolor edition.
6.	Knowledge Traditions and Practices of India, Book code 11151, Chemistry and Metallurgy in India, NCERT Publication.

REFERENCE BOOKS:

1.	R. D. Madan, (2011) **Modern Inorganic Chemistry**, S. Chand and Co., Third Revised Edition.
2.	R. Gopalan, (2009) **Inorganic Chemistry for Undergraduate**, Universities Press (India) Private Limited, Hyderabad.
3.	Puri B. R. Sharma L. R., M. S. Pathania, **(**2013) **Principles of Physical Chemistry,** Vishal

	Publishing Co., New Delhi.

E-Resource:

1.https://www.youtube.com/watch?v=qNYr7Fd5k4w&list=PLk8HOmRjk93PbMTZKqy1WRqb4JH1Z7Cjm

2. https://www.youtube.com/watch?v=w_RAe7oSg_M&list=PLCaU4WJJKPiN366IP5-w2s7Zx1XAN2kEa

3. https://www.youtube.com/playlist?list=PLxQan_UVCYxBKBsPxJ_r6IaGZn6_llYZo

4. https://www.youtube.com/watch?v=vcfO0uQcTN0

5. https://www.youtube.com/watch?v=XF2eyGkw28Y

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	H	H	H
CO2	S	S	M	M	M
CO3	S	S	H	H	M
CO4	S	S	H	H	M
CO5	S	S	H	H	M

S – Strong **H** – High **M** – Medium **L** – Low

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PRACTICAL – I INORGANIC QUALITATIVE ANALYSIS & PREPARATIONS**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	II	3	90	2	

Course Objectives

1.	To demonstrate the basic laboratory technique of semi micro qualitative analysis.
2.	To understand the interfering anions, its elimination and group separation.
3.	To prepare inorganic complexes.

Course Outcomes (CO)

K3 – K5	CO1	Build knowledge in principles of semi micro qualitative analysis.
	CO2	Know about the interfering and non-interfering anions.
	CO3	Experience to remove interfering anion and group separation of various cations.
	CO4	Group separation of various cations
	CO5	Learn the preparation of inorganic complexes.

I	**Semi - Micro Qualitative Analysis**
Analysis of a mixture containing two cations and two anions of which one will be an interfering ion. Semi-micro methods using the conventional scheme with Sodium Sulphide (Na2S) may be adopted.	
II	**Preparation of Inorganic Complexes.**
1	Tetraamminecopper(II) sulphate
2	Potassiumtrioxalatochromate(III)
3	Iron(III) hexacyanoferrate(II)
4	Hexamminecobalt(II) chloride
5	Hexathiourealead(II) nitrate
6	Tristhioureacopper(I) Sulphate
III	**Melting point** and **FT-IR spectrum** of Inorganic complexes. (demonstration only)

TEXT BOOKS:

1. Venkateswaran. V, Veeraswamy. R, Kulandaivelu. A.R, (1997), **Basic Principles of Practical Chemistry**, New Delhi, Sultan Chand and Sons,

REFERENCE BOOKS:

1. G. Svehla, (1987), **Vogel's Qualitative Inorganic Analysis**, Orient Longman Ltd, Hyderabad.

Subject code: 26UCH2CL

Time: 3 Hours			**Max. Marks: 60**
Distribution of Total Marks: 50			
	Record	10 marks	
	Analysis	40 marks	
	Preparation	10marks	
Inorganic Analysis Marks: 40			
	Four ions with correct Procedure	40 marks	
	Three ions with correct Procedure	30 marks	
	Two ions with correct Procedure	25 marks	
	One ions with correct Procedure	12 marks	
❖ Spotting of an ion -5 marks			
❖ Precipitation- 5 marks			
❖ Correct detection of cations without eliminating the interfering ion should be treated as spotting			
❖ At least one confirmatory test for each ion is expected. If no confirmatory test is reported deduct 3 marks			
❖ The candidate may be asked to leave a small portion of the given mixture so that the examiners may confirm the presence of an ion if any discrepancies arise.			
❖ Anions to be given: Sulphate, Chloride, Bromide, Fluoride, Borate, Nitrate, Carbonate, Oxalate, and Phosphate.			
❖ Cations to be given: Lead, Bismuth, Copper, Manganese, Aluminium, Ferrous, Ferric, Cadmium, Cobalt, Nickel, Zinc, Barium, Calcium, Strontium, Magnesium and Ammonium.			

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	H	M	M
CO2	S	S	H	M	M
CO3	S	S	H	M	M
CO4	S	S	S	M	M
CO5	S	S	S	H	H
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code: 26UCH303

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PAPER – 3** **INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY - III**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development**
2026 - 2027	III	4	60	4	

Course Objectives

1.	To know the basic concepts in quantitative analysis.
2.	To observe the chemistry of dicarboxylic acids and reactions involving carbonyl compounds.
3.	To enumerate second law of thermodynamics, state functions S, A, G and chemical equilibrium.

Course Outcomes (CO)

K1 – K5	CO1	Gain knowledge in preparation, standardization of solution and principles of volumetric analysis.
	CO2	Study the preparation, properties and reactions of di carboxylic acids
	CO3	To study on the preparation and properties of aldehydes and ketones.
	CO4	Analyze and apply laws of thermodynamics.
	CO5	To understand the importance of absolute zero

UNIT – I	**Quantitative Analysis**	**12 Hours**

1. Equivalent mass – Equivalent mass of an acid, equivalent mass of a base, equivalent mass of oxidizing and reducing agents.
2. Concentration terms – Normality, molarity, mole fraction, molality.
3. Principles of volumetric analysis – standard solution (primary and secondary standards) titration – types (acid, base, oxidation, reduction), difference between equivalent point and end point, Acid base indicators – action of phenolphthalein and methyl orange, caution in volumetric titrimetry – precautions to avoid errors in titrimetric analysis

UNIT-II	**Dicarboxylic acids**	**12 Hours**

Preparation, physical, chemical properties and uses of Oxalic, Malonic, Succinic, Glutaric, Adipic acid. synthesis of Malonic ester and Acetoacetic ester, Tautomerism of Acetoacetic ester.

UNIT-III	**Aldehydes and ketones**	**12 Hours**

General methods of preparations and properties of aldehydes and ketones. Mechanism of Nucleophilic addition of Grignard reagents, aldol condensation reaction, Perkin condensation reaction, Knoevenagel condensation reaction, Reformatsky reaction. Reactions with LiAlH4 and NaBH4, Wolf Kishner reduction, Meerwein - Ponndorf-Verley reductions and Cannizzaro reactions

UNIT-IV	**Thermodynamics-II**	**12 Hours**
Limitations of First law – Need for second law. Various statements of second law. Spontaneous or irreversible processes. Criteria of spontaneity - Cyclic process- Entropy – definition - numerical definition. The Carnot's cycle- thermodynamic efficiency. Derivation of entropy from Carnot's cycle. Physical significance of entropy- Entropy change in isothermal expansion of an ideal gas, entropy change in reversible and irreversible processes, entropy change accompanying change of phase. Entropy as the function of P, V and T. Work and Free energy functions - Gibb's free energy (G) and Helmholtz free energy (A)- variation of free energy with temperature and pressure. - Gibbs-Helmholtz equations.		
UNIT-V	**Thermodynamics-III**	**12 Hours**
Partial molal properties: Concept of chemical potential- Physical significance-The Gibbs –Duhem equation-variation of chemical potential with T and P- Time's Arrow . Need for third law of thermodynamics – Nernst heat theorem- Third law of thermodynamics. Determination of absolute entropy of solids, liquids and gases. Standard absolute entropies (S^o). Entropy change in chemical reactions. Unattainability of absolute zero. Derivation of Boltzmann entropy equation. Residual entropy. Problems involving residual entropy. Stirlings approximation.		
Self study portion		

TEXT BOOKS:

1.	R. D. Madan, (2013) **Modern Inorganic Chemistry**, S. Chand & Co., New Delhi.
2.	B. R. Puri, L. R. Sharma, K. K. Kalia, (2017) **Principles of Inorganic Chemistry**, Milestone Publishers and Distributors, New Delhi.
3.	Arun Bahl, B. S. Bahl, (2010) A**dvanced Organic Chemistry**, S. Chand & Co., New Delhi.
4.	Arun Bahl and B. S. Bahl, G. D. Tuli, (2009) **Essentials of Physical Chemistry**, S. Chand & Co., New Delhi.

REFERENCE BOOKS:

1.	Sathya Praksash, G.D. Tuli, S. K. Basu, R.D. Madan, (2012) **Advanced Inorganic Chemistry**, Vol. 1, S. Chand & Co., New Delhi.
2.	J. D. Lee, (2006) **Concise Inorganic Chemistry**, Black Well Science, UK.
3.	M. K. Jain, S. C. Sharma, (2011) **Modern Organic Chemistry**, Vishal Publishing Co., New Delhi.
4.	B. Mehta, Manju Mehta, (2005) **Organic Chemistry**, Prentice Hall of India Pvt Ltd., New Delhi,
5.	S. Glasstone, D. Lewis, (2012) **Elements of Physical Chemistry**, Macmillan Ltd, London.
6.	B. R. Puri, L. R. Sharma, M. S. Pathania, (2009) **Principles of Physical Chemistry**, S. Chand & Co., New Delhi.

E resources
1. https://www.youtube.com/watch?v=wRAo-M8xBHM
2.https://www.tutorsglobe.com/homework-help/chemistry/dicarboxylic-acids-and-their-derivatives-78780.aspx#:~:text=General%20Physical%20Characteristics:,carboxyl%20group%20(%2DCOO%2D)
3. https://unacademy.com/content/wp-content/uploads/sites/2/2022/10/30.-Aldehydes-Ketones-and-Carboxylic-Acid.pdf
4. https://www.mlsu.ac.in/econtents/2251_SLOTcarnot-converted.pdf
5. https://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-Physical-Chemistry-Volume-1/ATOPCV1-6-0-Thermodynamics-II.pdf

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	S	M	H
CO2	S	S	S	H	H
CO3	S	S	S	H	H
CO4	S	S	H	H	M
CO5	S	S	H	H	M
S – Strong	**H** – High	**M** – Medium	**L** – Low		

Content prepared by (Based on Inputs)

Signature of the Course in-charge

Signature of the HOD

Subject code : 26UCH404

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PAPER – 4** **INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY - IV**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development**
2026 - 2027	IV	4	60	4	

Course Objectives

1.	To learn group IA elements.
2.	To know about various types of alcohols, phenols and their reactions
3.	To know about phase rule and phase equilibria and properties of solutions

Course Outcomes (CO)

K1 – K5	CO1	Gain the knowledge about the properties of alkali metals.
	CO2	Analyze the basics of mono, di and trihydric alcohols
	CO3	Understand the basic aspects of phenols and its reactions.
	CO4	Analyze and apply phase rule to various systems
	CO5	Understanding about solutions and their chemical properties

UNIT – I	**Group IA elements - Alkali metals**	**12 Hours**

***General properties-electronic configuration, density, molar volume, atomic volume, atomic and ionic radii, heat of atomization**,
melting and boiling point- ionization energy-Comparison of ionization energy of alkali metals- electropositive character. Similarities in chemical properties – formation of halides, nitrates, oxides, hydroxides, hydrides. Comparison of Lithium with other members of the family. Anomalous behavior of lithium- diagonal relationship of Li and Mg - Lithium- Extraction, properties and uses. Sodium extraction, properties, commercial and analytical uses

UNIT-II	**Alcohols**	**12 Hours**

Classification and Nomenclature, Monohydric **Alcohols:** Methods of Formation by Reduction of Aldehydes, Ketones, Carboxylic Acids and Esters, Hydrogen Bonding, Acidic Nature, Reactions of Alcohols. **Dihydric Alcohols:** Methods of Formation, Chemical Reactions of Vicinal Glycols, Oxidative Cleavage [$Pb(OAc)_4$ and HIO_4] **Trihydric Alcohols :** Methods of Formation, Chemicals Reactions of Glycerol. Commercial importance of methanol in energy field

UNIT-III	**Phenols**	**12 Hours**

Monohydric Phenol - preparation and properties, acidity of phenol, reaction of monohydric phenol – Esterification reaction, Nitration reaction, Sulphonation reaction, Halogenation reaction, coupling reaction of phenol with diazonium salts, Kolbe-Schmitt reaction, Reimer-Tiemann reaction and Gattermann reaction with mechanism, Lederer Manasse reaction, Phenol formaldehyde resin, Phenolphthalein preparation.

UNIT-IV	**Phase rule and Phase equilibria**	**12 Hours**
Phase rule-statement- Definition of terms phase, component, and degrees of freedom. Derivation of Gibb's Phase rule. Phase diagrams of water system, carbon dioxide system and Sulphur system. Polymorphism- transition temperature-Two components system: Simple Eutectic systems – silver - lead system and Formation of compounds with congruent and incongruent melting point (Ferric chloride – water system and Sodium sulfate - water system).		
UNIT-V	**Solutions**	**12 Hours**
Introduction- Solution of Gases in Gases-Henry's law-limitations of Henry's law. Solutions of liquids in liquids-solubility of partially miscible liquids. Phenol-water system. Solutions of solids in liquids-solubility- its equilibrium concept. Dilute Solutions- Colligative properties- lowering of vapour pressure – Raoult's Law –derivation. Ideal solutions and deviations from Raoult's law. Determination of molecular mass from vapour pressure lowering. Elevation of Boiling point relation and determination of molecular mass. Depression of freezing point and determination of molecular mass from depression of freezing point by Rast's Camphor method.		
***Self study portion**		

TEXT BOOKS :

1.	R. D. Madhan, (2012)**Modern Inorganic Chemistry**, S. Chand and Co.
2.	Arun Bahl and B.S.Bahl, (2010) **Advanced Organic Chemistry**, S. Chand and Co., New Delhi.
3.	B. R. Puri, L.R. Sharma, and S. Pathania, (2019) Principles of Physical Chemistry, Shoban Lal Nagin Chand & Co, New Delhi.
4.	Sathya Praksash, G.D. Tuli, S. K. Basu, R.D. Madhan, (2012) Advanced Inorganic Chemistry, Volume 1, S. Chand & Company, New Delhi.

REFERENCE BOOKS:

1.	Lee J.D., (2007) **Concise Inorganic Chemistry**, Black Well Science-Wiley – India, New Delhi.
2.	B.Mehta, Manju Mehta, (2005) **Organic Chemistry**, Prentice Hall of India Private Limited, New Delhi.
3.	Arun Bahl, B.S. Bahl, G.D.Tuli., (2009) **Essentials of Physical Chemistry** S. Chand and company, New Delhi.

E-Resources

1. https://byjus.com/jee/alkali-metals/
2. https://mlsu.ac.in/econtents/2472_UNIT-II%20and%20IV.pdf
3. https://utkaluniversity.ac.in/wp-content/uploads/2023/03/Phenol-Preparation-and-Chemical-reactions.pdf
4. https://colloidmueg.weebly.com/uploads/2/5/7/3/25736627/chapter_19._the_phase_rule.pdf
5. https://silapatharcollege.edu.in/online/attendence/classnotes/files/1661953885.pdf

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	M	M	M
CO2	S	S	M	M	M
CO3	S	S	M	M	M
CO4	S	S	H	H	M
CO5	S	S	H	H	M
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code: 26UCH4CM

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PRACTICAL – II INORGANIC VOLUMETRIC AND ORGANIC QUALITATIVE ANALYSIS**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Skill Development/ Entrepreneurship**
2026 - 2027	**IV**	3	90	3	

Course Objectives

1.	To demonstrate the concept of quantitative volumetric analysis.
2.	To understand the various types of titrimetric analysis.
3.	To identify the functional groups of unknown organic compounds.

Course Outcomes (CO)

K3 – K5	CO1	Gain the knowledge in principles of volumetric analysis.
	CO2	Estimating the amount of substances present in solutions.
	CO3	Learn to approach a problem systematically
	CO4	Interpret the results logically.
	CO5	Detect various functional groups present in an organic compound.

I	**Titrimetric Quantitative Analysis**

a. Acidimetry and Alkalimetry:

1.Estimation of HCl by NaOH using a standard Oxalic acid solution

2. Estimation of Na_2CO_3 by HCl using a standard Na_2CO_3 Solution.

b. Permanganametry:

1.Estimation of Oxalic acid by $KMnO_4$ using a standard Oxalic acid solution

2.Estimation Iron(II) Sulphate by $KMnO_4$ using a standard Mohr's Salt solution

3.Estimation of Calcium(II) by $KMnO_4$ using standard oxalic acid solution

c. Dichrometry:

1.Estimation of Iron (II) by potassium dichromate using standard Mohr's salt solution

d. Iodometry:

1. Estimation of $KMnO_4$ by Thio using a standard Potassium dichromate Solution

2. Estimation of Copper (II) Sulphate by $K_2Cr_2O_7$ solution.

II	**Organic analysis**
	Analysis of organic compounds
1	Preliminary tests
2	Detection of elements present
3	Aromatic or Aliphatic
4	Saturated or Unsaturated

5	Nature of the functional group
6	Confirmatory tests and Preparation of derivatives for the functional groups.

The following functional group compounds may be given:
Aldehydes, Ketones, Amines, Amides, Diamide, Carbohydrates, Phenols, Acids, Esters and Nitro compounds.

TEXT BOOKS :

1.	Venkateswaran. V, Veeraswamy. R, Kulandaivelu. A.R, (1997), **Basic Principles of Practical Chemistry**, New Delhi, Sultan Chand and Sons,
2.	Mendham. J, Denney. R.C, Bames. J.D, and Thomas, M. (2006) Vogel's Text book of Quantitative Chemical Analysis, Pearson Education.

REFERENCE BOOKS:

1.	Gopalan. R, Subramaniam. P.S, and Rengarajan. K, (2010) Elements of Analytical Chemistry, Sultan Chand and Sons..

Time: 6 Hours			**Max. Marks : 60**
Distribution of Total Marks: 50			
	Record	10 marks	
	Analysis	50 marks	
Distribution of Practical Marks-50			
	Volumetric	25 mark	
	Organic Analysis	25 mark	
Volumetric Analysis Marks-25			
	Procedure (To be written within five minutes)	5 mark	
	Experiment	20 mark	
	Error up to <2 %	20 mark	
	2 – 3 %	15 mark	
	3 - 4 %	10 mark	
	>4 %	5 mark	
Organic Analysis Marks- 25			
	Preliminary Tests	6 mark	
	Aliphatic or Aromatic	4 mark	
	Saturated or Unsaturated	3 mark	
	Special elements	4 mark	
	Functional group	5 mark	
	Derivative	3 mark	

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	S	S	H
CO2	S	S	H	H	M
CO3	S	S	H	H	H
CO4	S	S	H	S	H
CO5	S	S	H	S	H
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code : 26UCH505

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PAPER – 5 SPECTROSCOPY AND CHROMATOGRAPHIC TECHNIQUES**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development**
2026 - 2027	V	3	45	3	

Course Objectives

1.	To know about the region of electromagnetic spectrum, fundamentals of ultra – violet visible spectroscopy and Infrared spectroscopy.
2.	To study Nuclear Magnetic Resonance (NMR) spectroscopy and Mass
3.	Spectrometry and to interpret and solve problems using various spectra.

Course Outcomes (CO)

K1 – K5	CO1	Understand the basic principles of UV-Visible spectroscopy and to utilize their basic aspects to identify various organic compounds.
	CO2	Gain the knowledge in principles, and functions of IR spectroscopy.
	CO3	Study the basic principles of NMR spectroscopy and apply to identify the organic compounds.
	CO4	Know about basic principles of mass spectroscopy technique and the application of various spectral techniques to elucidate the structure of organic molecules.
	CO5	Exploring the various chromatography techniques and their applications in separation of organic mixtures.

UNIT – I	**Ultra – violet and visible spectroscopy**	**9 Hours**

Electromagnetic spectrum and absorption of radiations, Principle of ultraviolet spectroscopy, the absorption laws- Lambert's law and Beer's law. Selection rules, instrumentation – Block Diagram, theory of electronic spectroscopy, types of electronic transitions, the chromophoric concept, auxochromes, absorption and intensity shifts – bathochromic, hypso chromic hyperchromic and hypochromic shifts. Types of absorption bands, solvent effects, Frank – Condon principle. Woodward Fischer rule for calculating absorption maximum in dienes.

UNIT-II	**Infrared spectroscopy**	**9 Hours**

Principle of Infrared spectroscopy, molecular vibrations, vibrational frequency, number of fundamental vibrations, overtones and combination bands, selection rules, factors influencing vibrational frequency – coupled vibrations and Fermi resonance, electronic effects, hydrogen bonding and bond angles. Scanning of infrared spectrum (instrumentation), finger print region. only. *IR technique in the identification of simple organic molecules. (Ethanol, Propanic acid and Butanol

UNIT-III	**Nuclear Magnetic Resonance (NMR) spectroscopy**	**9 Hours**
Principle and theory of NMR spectra, conditions of resonance, relaxation process – spin –spin relaxation, spin – lattice relaxation and quadrupole relaxation. Instrumentation, solvent used in NMR, Chemical shift (shielding and deshielding effects). Number of signals, position of signals, factors influencing chemical shift – inductive effect, vander-Waal's deshielding, Anisotropy (diamagnetic shielding in benzene), Peak area and proton coupling, spin – spin splitting, splitting of the signals in pure ethanol and chloroethane.		
UNIT-IV	**Mass spectrometry and application of spectroscopic methods**	**9 Hours**
Basic principles, theory of mass spectrometry, meta stable ions or peaks, nitrogen rule, general fragmentation modes of hydrocarbons, Retro – Diels Alder reaction, hydrogen transfer rearrangements and Mclafferty rearrangement.		
UNIT-V	**Chromatography**	**9 Hours**
Introduction, definition, types, thin layer chromatography – experimental techniques - coating materials - preparation of thin layer in plates – activation of adsorbents – purification of silica gel – sample application – development tank – solvent systems – plate development – detection of components, evaluation of chromatography. Column chromatography – principle experimental techniques – apparatus – adsorbents – preparation of adsorption columns – solvents used in successive elution – gradient elution.		
Self study portion		

TEXT BOOKS :

1.	Y.R, Sharma, (2007) **Elementary Organic Spectroscopy Principles and Chemical Applications**, S.Chand & Company Ltd, New Delhi.
2.	Gurdeep R. Chatwal, (2018) **Instrumental Methods of Chemical Analysis**, Himalaya publishing house, Delhi.
3.	V.K. Srivastava, K.K. Srivastava, K.K. Kishore, **Introduction to Chromatography – Theory** & Practice, S. Chand & Co. (P) Ltd., New Delhi, 3rd Edn., (2010).

REFERENCE BOOKS:

1.	P.S. Sindhu, **Elements of (2010) Molecular Spectroscopy**, New Age International Publishers, New Delhi.
2.	H.S. Randhana, (2007) **Modern Molecular Spectroscopy**, Macmillan India Ltd, New Delhi.
3.	H. Kaur, **Instrumental Methods of Chemical Analysis**, Pragati Prakashan, Meerut, 2010.
4.	Jag Mohan, (2018) **Organic Spectroscopy – Principles and Applications**, Narosa publishing house
5.	A.K. Srivastava, P.C. Jain, **Chemical Analysis: An Instrumental Approach** for B.Sc. Hons.

	and M.Sc. Classes, S. Chand and Company Ltd., Ram Nagar, New Delhi, 2010.

e- resources

1. https://www.chemguide.co.uk/analysis/uvvisiblemenu.htmlpectroscopy
2. https://www.khanacademy.org/science/chemistry
3. https://faculty.washington.edu/seattle/physics541/%202010-reading/nmr-spectroscopy.pdf
4. https://chem.libretexts.org/Courses/Purdue/Purdue%3A_Chem_26200%3A_Organic_Chemistry_II_(Wenthold)/Chapter_11%3A__IR_and_Mass_Spectrometry/11.06%3A_Introduction_to_Mass_Spectrometry
5. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_Lab_Techniques_(Nichols)/02%3A_Chromatography/2.03%3A_Thin_Layer_Chromatography_(TLC)
6. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Instrumentation_and_Analysis/Chromatography/V._Chromatography/B._Column_Chromatography

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	S	H	M
CO2	S	S	M	M	M
CO3	S	S	H	M	H
CO4	S	S	S	H	H
CO5	S	S	S	H	H
S – Strong	**H** – High	**M** – Medium	**L** – Low		

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code : 26UCH506

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PAPER – 6 INORGANIC CHEMISTRY**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development**
2026 - 2027	V	4	60	3	

Course Objectives

1.	To understand the key features of coordination compounds, including: the variety of structures, ligands, various theories of coordination complexes, stability of complexes.
2.	To identify what radioisotopes and acquaint knowledge about nuclear reactions.
3.	To describe about Inorganic acids, bases, Inorganic Solvents and Inorganic Polymers.

Course Outcomes (CO)

K1 – K5	CO1	Understand the theories of co-ordination compounds.
	CO2	Knowledge about basics nuclear Chemistry
	CO3	Analyze the importance of radioactive isotopes and nuclear reactions.
	CO4	Describe about the different concepts of Inorganic acids, bases,
	CO5	Understanding the importance of Inorganic Solvents

UNIT – I	**Co-ordination Compounds**	**12 Hours**

Co-ordination Compounds – Types of ligands, Industrial applications of Chelation, Nomenclature, Werner's coordination theory- Electronic interpretation of coordinate bond by Sidgwick. EAN rule, Magnetic properties of square planar and octahedral coordination compounds and their interpretation by Pauling's Valence Bond Theory

UNIT-II	**Nuclear Chemistry - I**	**12 Hours**

Introduction – Nuclear stability and n/p ratio. Magic numbers. Packing fraction. Mass defect and binding energies. Definition for isotopes, isobars and isotones. Detection of isotopes - mass spectrographs-Thomson's, Dempster's and Aston's mass spectrographs - Importance of discovery of isotopes. Radioactivity – emission of alpha, beta and gamma rays. Radioactive disintegration - first order kinetics - half-life period. Radioactive disintegration series. Basic difference between nuclear reaction and conventional chemical reaction.

UNIT-III	**Nuclear Chemistry - II**	**12Hours**

Nuclear reactions – fission, fusion, spallation, capture and particle-particle reactions - nuclear fission-nuclear reactors- basic components of nuclear reactor, Atom bomb- nuclear fusion - Stellar energy- Hydrogen bomb. Artificial transmutation of elements. Artificial radioactivity. Uses of radioactive isotopes – medicine – agriculture – C^{14} dating – dating of Universe. ***Atomic power projects in India- Disposal of nuclear wastes, Cyclotron**.

UNIT-IV	**Acids and Bases**	**12 Hours**
Different concepts of acids and bases- Arrhenius, Lowry- Bronsted, Lewis, Cady- Esley (solvent system), Lux-Flood and Usanovichs concepts. Conjugate acids and bases- comparison of strengths of Lowry-Bronsted acids - Comparison of strengths of Lewis acids and bases. Levelling effect and levelling solvents. Hard and soft acids and bases (HSABs)- Acid and bases strengths of HSABs- Applications of HSABs concept- Limitations of HSAB concept.		
UNIT-V	**Solvents**	**12 Hours**
Solubilities of compounds - effect of temperature on solubility- chemical structure and solubility. Classification of solvents - Types of reactions in solvents. Specific non-aqueous solvents - protic solvents (ammonia) Auto-ionisation, Acid base reaction, precipitation, solvation- aprotic solvents (SO_2)-Acid base reaction, reaction with organic compounds, complex formation, oxidation reduction reactions.		
Self study portion		

TEXT BOOKS :

1. R. D. Madhan, G. D. Tuli, and S. M. Malik,(2009) Selected Topics in Inorganic Chemistry, S. Chand & Co., New Delhi.
2. B. R. Puri, L. R. Sharma, K. K. Kalia, (2019) **Principles of Inorganic Chemistry**, Milestone Publishers and Distributors, New Delhi
3. U. N. Dash, (2010) **Nuclear Chemistry**, S. Chand & Co., New Delhi U. N. Dash, (2010) Nuclear Chemistry, S. Chand & Co., New Delhi

REFERENCE BOOKS:

1. Karen C.Timberlake,(2008) **Basic Chemistry**, Los Angeles Valley College, Pearson-Benjamin Cummings, San Francisco, First Edition.
2. G. S. Manku,(2006), **Theoretical Principles of Inorganic Chemistry**, Mc - Graw Hill Edition.
3. M. G. Arora, M. Singh, (2014) **Nuclear Chemistry**, Anmol publications Pvt. Ltd., New Delhi.
4. Sathya Praksash, G.D. Tuli, S. K. Basu, R.D. Madhan,(2012) **Advanced Inorganic Chemistry**, Vol. 1, S. Chand & Co., New Delhi.
5. H. J. Arnikar,(2018) **Essentials of Nuclear Chemistry**, New Age International.
6. R. D. Madan, (2019) **Modern Inorganic Chemistry**, S. Chand & Co., New Delhi.

e-Resources:

1. https://www.slideshare.net/slideshow/chemistry-43345078/43345078
2. https://study.com/academy/lesson/video/applications-of-coordination-compounds.html
3. https://www.youtube.com/watch?v=hFG8-ukxIQE
4. http://www.digimat.in/nptel/courses/video/104101137/L02.html
5. https://www.youtube.com/watch?v=F3NSfTXTl7E
6. https://www.youtube.com/watch?v=nvMf75TKwd4
7. https://www.youtube.com/watch?v=55pjXVeaB7I
8. https://www.youtube.com/watch?v=vzJvaFX_pkQ

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	H	M	H
CO2	S	M	S	M	S
CO3	S	M	S	M	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code : 26UCH507

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PAPER – 7 ORGANIC CHEMISTRY**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development**
2026 - 2027	V	4	60	**4**	

Course Objectives

1.	To study stereochemistry of organic molecules and basics in carbohydrate.
2.	To understand the mechanisms of important organic rearrangements reactions and Preparations and reactions of Amines and Diazo compounds.
3.	To study preparation and properties of heterocyclic compounds.

Course Outcomes (CO)

K1 – K5	CO1	Understanding the fundamental aspects of stereochemistry.
	CO2	Learn about preparation, properties and structural elucidation of carbohydrates.
	CO3	Study on the various naming reactions and their detailed mechanistic pathway.
	CO4	Acquire the knowledge about the preparations and reactions of Amines and Diazo compounds.
	CO5	To inculcate knowledge about five and six membered heterocyclic compounds

UNIT – I	**Stereochemistry**	**12 Hours**

Optical Isomerism, cause of optical activity, plane polarized light, specific rotation, Plane of symmetry, chiral (asymmetric) carbon atom, chirality, Optical isomerism of lactic acid, Fischer projections and optical isomerism of tartaric acid. Properties of Enantiomers and diastereo isomers. Resolution of Racemic mixture – mechanical separation – kinetic separation – selective adsorption – chemical method – biochemical method. Racemization, chiral (Asymmetric) synthesis, Walden inversion. Specifying absolute configuration – D, L and R, S system for asymmetric molecule. Optical activity of Biphenyl, Allenes, Spiranes and overcrowded molecules. Geometrical isomerism.

UNIT-II	**12 Hours**

Carbohydrates - ***Introduction**, classification

Monosaccharides - occurrence, preparation, structural elucidation, properties and uses of Glucose and Fructose. Cyclic form of glucose and fructose. Mutarotation, interconversion of glucose to fructose and vice versa.

Disaccharides – Structure, preparation, properties and uses of sucrose and maltose.

Polysaccharides – Starch and cellulose - Manufacture, structure and properties. Derivatives of cellulose.

UNIT-III	**Molecular Rearrangements with mechanism**	**12 Hours**

Reaction, mechanism, and applications of molecular rearrangement reactions - Pinacol-Pinacolone, Beckmann, Hoffmann, Curtius, Benzilic acid, Claisen Rearrangements, Cope rearrangement and Fries rearrangement.

UNIT-IV	**Amines and Diazo compounds**	**12 Hours**

Preparation and reactions of amines, separation of a mixture of primary, secondary and tertiary amines – comparison of their basicity. Hinsberg test for distinguishing primary secondary and tertiary amines, Ring substitution, Diazotization and coupling reaction of aromatic amines.
Preparation, structure and synthetic applications of Diazomethane.

UNIT-V	**Green Chemistry**	**12 Hours**

Green Chemistry: Introduction-definition-*Need for green chemistry- Goals - Limitations – Progress of Green Chemistry - principles of green chemistry- Concept of Atom economy- Concept of Selectivity.
Green Reactions: Green reactions-Solvent free synthesis of Aldol condensation (Acid catalyst, Crossed aldol), Claisen rearrangement, Clemmensen reduction, Diels-Alder reaction.
.

Self study portion

TEXT BOOKS :

1.	Arun Bahl and B.S.Bahl, (2012) **Advanced Organic Chemistry**, S. Chand and Co., New Delhi.
2.	Gurdeep. R. Chatwal, (2017) **Reaction Mechanism and Reagents in Organic Chemistry**, Himalaya Publishing House Delhi.
3.	M.K. Jain, S.C. Sharma, (2013) **Modern Organic Chemistry**, Vishal Publishing Co., New Delhi.

REFERENCE BOOKS:

1.	M.G Arora, (2008) **Stereochemistry in Organic Compounds**, Anmol Publications Private Ltd New Delhi.
2.	Jagdamba Singh and Yadav, (2009) **Organic Synthesis**, Vol. I and II. Pragathi and Prakasam Publishers.

3.	I.L.Finar,(2009) **Organic Chemistry,Vol.I and II**, Addison-Wesley Longman.

e- resources

1. https://www.youtube.com/watch?v=yzfcrwJ37kI
2. https://www.youtube.com/watch?v=yZ8JDDnyxC4
3. https://www.youtube.com/watch?v=_L7RO4T3tog
4. https://chemicals.gov.in/green-chemistry

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	M	S	M	M
CO2	S	S	S	S	S
CO3	S	S	S	M	M
CO4	S	M	S	M	M
CO5	S	H	S	H	H
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge

Signature of the HOD

Subject code : 26UCH508

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PAPER - 8 ELECTRO CHEMISTRY**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Entrepreneurship**
2026 - 2027	V	4	60	4	

Course Objectives

1.	To understand the fundamentals of electrochemistry.
2.	To know the types and importance of electrodes and electro chemical cells.
3.	To study about corrosion, batteries and Electroanalysis.

Course Outcomes (CO)

K1 – K5	CO1	Understanding the concept of conductance and its applications.
	CO2	Acquire basic knowledge about electrode potential, electrochemical cell and potentiometric titrations.
	CO3	Understanding the fundamental principles of corrosion, protective coatings
	CO4	electroplating and its significance.
	CO5	Know about basic principles and instrumentation of Electrochemical Power Systems, Polarography and its applications.

UNIT – I	**Fundamentals of Electrochemistry**	**12 Hours**

Introduction-Classification of conductors – Electrolytic conductance-conductivity cell measurement of conductance of solutions – Variation of equivalent conductance with dilutions. Migrations of ions - Transport number – determination by moving boundary method and Hittorf's method – Kohlrausch's law – statement - application. Arrhenius theory of electrolytic dissociation - Ostwald's dilution law and limitations - theory of strong electrolytes: Debye-Huckel – Onsagar theory (elementary treatment only) - Debye – Falkenhagen effect and Wien effect. Applications of conductance measurements: (i) Determination of dissociation constant of a weak organic acid (i) Conductometric titrations – acid-base titration, precipitation titration. (iii) Determination of solubility product of sparingly soluble salt (iv).Determination of ionic product of water.

UNIT-II	**Electro Chemical Cells**	**12 Hours**

Galvanic cell- classification of cell – representation of cell – cell terminology. Reversible and irreversible cells - Electrode potentials – types of electrodes and their potentials. Nernst equations - Computation and measurement of cell emf and Weston - Cadmium cell - Single electrode potentials. Determination and significance of electrode potentials - Electrochemical series and its applications- Thermodynamic quantities of cell reactions (ΔG, ΔH and ΔS).

UNIT-III	**Electrodes and their types**	**12 Hours**

pH scale – Buffer solution, Buffer action – Henderson's equation – determination of pH of Buffer

solution. Concentration cells with and without transport - Liquid junction potential. Application of EMF measurements – determination of pH using hydrogen, glass and quinhydrone electrode. Potentiometric titrations – acid - base, redox and precipitation. Redox Potentials - redox indicators - diphenyl amine.

UNIT-IV	**Corrosion and Adsorption**	**12 Hours**

***Introduction, Dry or Chemical corrosion, Wet or Electrochemical Corrosion, Mechanism of Wet of Electrochemical Corrosion**, Galvanic (or Bimetallic) Corrosion, Concentration Cell Corrosion, Passivity, Types of Corrosion, Galvanic Series, Factors Influencing Corrosion, Corrosion Control Methods. Cathodic Protection Protective Coatings, Metallic Coating, Electroplating, Influencing factors, Pretreatment, Electroplating Methods – Cu, Ni, Electroless Plating – Cu, Ni. Iron metal war tools / weapons preservation in ancient India.

Sorption – Absorption, Adsorption-Types of adsorption, adsorption of gases by solids. Adsorption isotherms –Freundlich, Langmuir. Adsorption of solutes from solutions. Application of adsorption.

UNIT-V	**Electrochemical Power Systems and Analysis**	**12 Hours**

***Introduction – Batteries – Types**- Lead storage cells and Lithium ion cell. Fuel cells - Definition and importance, Hydrogen-Oxygen fuel cell, Hydrocarbon - Oxygen cell. Zinc air battery - Over voltage – Application of over voltage. Polarography – Instrumentation - Advantages of DME-Limiting current, factors affecting limiting current - Ilkovic equation (derivation not necessary) - Half wave potential –Application of polarography. Amperometric Titrations. Bio electrochemistry – Bio electrochemical cell - Electrochemical mechanism of Nervous System.

****Self study portion***

TEXT BOOKS :

1.	P. L. Soni. O. P. Dharmarha and U. N. Dash, (2013) **Textbook of physical chemistry**, S. Chand & Co., New Delhi.
2.	B.S. Bahl and G. D. Tuli, and Arun Bahl, (2012) **Essentials of Physical Chemistry**, S. Chand publishing, Revised multicolor edition.
3.	P. C. Jain and Monika Jain, (2013) **Engineering Chemistry**, Dhanpat Rai Publishing Co., New Delhi.

REFERENCE BOOKS:

1.	B. R. Puri, L. R. Sharma, M. S. Pathania, (2013) Principles **of Physical Chemistry**, S. Chand & Co., New Delhi
2.	Karen C. Timberlake, (2005) **Basic Chemistry**, Los Angeles Valley College, Pearson Benjamin Cummings New York.

3.	Samuel Glasstone,(2002) **Introduction to Electrochemistry**, EWP Pvt. Ltd.
4.	Syed Aftab Iqbal, (2011), **Text Book of Electrochemistry**, Discovery Publishing house Pvt. Ltd., New Delhi.
E-RESOURCES	
1	https://nptel.ac.in/courses/104103856 - Physical Chemistry for Undergraduates
2	https://www.youtube.com/watch?v=1t9Dq4wyhBw
3	https://www.youtube.com/watch?v=ip6sNvps2Ew
4	https://www.youtube.com/watch?v=94Gq-VdBoAY
5	https://www.youtube.com/watch?v=rirPlafmLl4
6	https://www.vlab.co.in/broad-area-chemical-sciences
7	https://chemcollective.org/vlabs

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	S	S	S
CO2	S	S	H	M	H
CO3	S	S	H	M	H
CO4	S	S	M	M	H
CO5	S	H	M	S	S
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge

Signature of the HOD

Subject code : 26UCH609

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PAPER – 9** **SOLID STATE AND COORDINATION CHEMISTRY**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Skill Development/ Entrepreneurship**
2026 - 2027	VI	5	75	4	

Course Objectives

1.	To know about fundamentals of crystallography and solid-state Chemistry
2.	To study about reactions of complexes.
3.	To in sight knowledge about Bio – Inorganic Chemistry

Course Outcomes (CO)

K1 – K5	CO1	Knowing the difference between amorphous and crystalline solids and their arrangement in crystal lattice.
	CO2	Learn about defects in crystals, various theories of metallic bonding and alloys.
	CO3	Decide the various crystal structures using X-ray diffraction techniques
	CO4	Study about various ligand substitution reactions.
	CO5	To acquire knowledge about bioinorganic chemistry.

UNIT – I	**Solid state – I**	**15 Hours**

Classification of solids (true solids, pseudo solids, crystalline and amorphous solids), elements of crystal symmetry, Definition of lattice point, crystal lattice and unit cell. Seven crystal system and 14 Bravais lattices, close packing of identical solid spheres (CCP, FCC, HCP and BCC), Designation of planes in crystals – Miller indices, radius ratio rule and shape of ionic crystal. Number of particles per unit cell and density of crystals.

UNIT-II	**Crystallography**	**15 Hours**

Study of the following with respect to cubic system: (100), (110) and (111) planes. Inter planar distances –d100, d110, d111- Ratio of inter planar distances ($d_{100} : d_{110} : d_{111}$) X-ray diffraction studies of crystals –Bragg's equation –Bragg method and powder method – crystal structure of NaCl and ZnS. Growth of a crystals from the Melt and the solution.

UNIT-III	**Solid state – II**	**15 Hours**

1. ***Defects in crystal** – Stoichiometric and non-Stoichiometric defects.
2. Metallic bonding- theories- electron gas theory, Valence bond theory, Molecular orbital theory (Band theory) –True metal or conductor, insulators, semiconductors-types of semiconductors-intrinsic and extrinsic, n and p- type.
3. Alloys-Substitutional and interstitial solid solutions, intermetallic compounds- Tamman's rule, Hume-Rothery rule. Alloys in automobile industry and construction sectors.

UNIT-IV	**Reactions mechanism of coordination compounds**	**15 Hours**
Ligand substitution reactions in octahedral complexes, labile and inert complexes – types and mechanism of substitution reactions – SN_1 and SN_2 type mechanisms – acid hydrolysis reaction – simple acid hydrolysis type and atalyzed aquation type, base hydrolysis reaction – SN_2 and SN_1CB mechanism – anation reactions. Ligand substitution reactions in square planar complexes – trans effect – trans directing series – theories of trans effect – applications of trans effect.		
UNIT-V	**Bioinorganic chemistry**	**15 Hours**
Porphyrin systems- Structure of myoglobin and hemoglobin. Role of Hemoglobin in biological systems – cooperativity effect – explanation of cooperativity effect in hemoglobin-metallo enzymes –Carbonic anhydrase, inhibition and poisoning of enzymes – role of alkali and alkaline earth metals in biological systems –sodium pump –calcium pump – biological functions and toxicity of some elements – biological fixation of nitrogen.		
self study portion		

TEXT BOOKS :

1.	Sathya Prakash, G.D. Tuli, S. K. Basu, R.D. Madhan, (2015) Advanced Inorganic Chemistry, Volume 1, S. Chand & Company, New Delhi.
2.	Wahid Malik, G.D Tuli, R. D. Madhan, (2015) Selected Topics in Inorganic Chemistry, S. Chand & Company, New Delhi.
3.	B.R.Puri,L.R.Sharma and K.C.Kalia, (2009) Principles of Inorganic Chemistry Milestone Publishers, New Delhi.

REFERENCE BOOKS:

1.	M.G. Arora, (1997) **Solid State Chemistry**, Anmol Publishing House, New Delhi.
2.	R.D.Madhan, (2011) **Modern Inorganic Chemistry**, S.Chand & Company, New Delhi
3.	Gurdeep raj, (2011) Advanced **Inorganic Chemistry**, Vol.1 , Goel Publishing House, Meerut.
4.	Gurdeep raj, (2010) **Advanced Physical Chemistry**, Vol.1 , Goel Publishing House, Meerut.
5.	Asim K.Dass, (2007) **Bioinorangic Chemistry**, Books and Allied (p) Ltd, Kolkata.

E-RESOURCES

1.https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/resources/lecture-1/

2. https://en.wikipedia.org/wiki/Crystallography

3. https://en.wikipedia.org/wiki/Crystallographic_defect

4.https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Inorganic_Chemistry_(LibreTexts)/12%3A_Coordination_Chemistry_IV_-_Reactions_and_Mechanisms

5,Chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://shivaji.du.ac.in/Study/Bioinorganic%20Chemistry%20(1).pdf

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	S	M	H
CO2	S	S	H	H	H
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CO4	S	M	S	S	S
CO5	S	H	S	M	H
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code : 26UCH610

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PAPER – 10 CHEMISTRY OF NATURAL PRODUCTS**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development**
2026 - 2027	VI	5	75	4	

Course Objectives

1.	To study about Terpenoids and Alkaloids.
2.	To understand about Vitamins and Hormones.
3.	To study Amino acids, peptides, Proteins and Chemotheraphy.

Course Outcomes (CO)

K1 – K5	CO1	Study on the classification, structural elucidation and synthesis of few important terpenoids.
	CO2	Learn about structural determination and synthesis of alkaloids.
	CO3	Acquire basic knowledge about vitamins and hormones.
	CO4	To study about Amino acids, peptides and Proteins.
	CO5	To gain knowledge about chemotherapy.

UNIT – I	**Terpenoids**	**15 Hours**

Terpenoids: Introduction, classification, isolation and commercial value of essential oils.
Isoprene rule, structural elucidation and synthesis of Geraniol, terpineol, dipentene and alpha-pinene.

UNIT-II	**Alkaloids**	**15 Hours**

Introduction, classification, phytochemical isolation of naturally occurring products, general characteristics and general methods of determining structures and Hoffmann's exhaustive methylation. Structural elucidation and synthesis of Nicotine, Coniine, Piperine and Papaverine.

UNIT-III	Vitamins and Hormones	**15 Hours**

***Introduction, classification, sources of Vitamins and their deficiency diseases**. Structural elucidation and synthesis of Thiamine and Riboflavin.
Hormones -Introduction, structural elucidation and synthesis of adrenaline and thyroxin.

UNIT-IV	**Amino acids, peptides and Proteins.**	**15 Hours**

1. **Amino acids** – Nomenclature, dipolar nature of amino acids, isoelectric point, methods of preparation – amination of halo acids – Strecker synthesis – Gabriel phthalimide synthesis – Koop synthesis. Physical and chemical properties of amino acids.
2. **Nomenclature of peptides** – peptide linkages, determination of structure of peptides – synthesis

of peptides.

3. **Proteins** - classification based on composition and function. Structure of proteins – primary – secondary and tertiary structure. General properties of proteins. Denaturation of proteins. Colour test for proteins.

UNIT-V	**Chemotherapy**	**15 Hours**

Designation of drugs based on physiological action – functional and pharmaco dynamic drugs – chemotherapeutic drugs. Definition and two examples each of antibacterial drugs- sulpha drugs and mode of action of sulpha drugs, Antimalarial drugs, Amebicidal drugs, Antiseptics, Anaesthetics, Analgesics – Narcotic and synthetic- Antipyretics and anti-inflammatory agents - Antibiotics - Penicillin, streptomycin, and tetracycline.

self study portion

TEXT BOOKS :

1.	Arun Bahl and B.S.Bahl, (2015) Advanced Organic Chemistry, S. Chand and Co., New Delhi.
2.	M. K. Jain and S. C. Sharma, (2011) Modern Organic Chemistry, New Delhi

REFERENCE BOOKS:

1.	Jagdamba Singh and Yadav, (2015) Organic Chemistry, Vol. I and II, Pragathi Prakasam Publishers.
2.	I. L. Finar, (2010) Organic Chemistry, Vol. I and Vol.II, Addison-Wesley Longman.
3.	Gurdeep Chatwal, (2013) Organic Chemistry of Natural Products, Himalaya Publishing House, New Delhi.
4.	Morrison R.T. and Boyd R.N, (2008) Organic Chemistry New York, Allyn & Bacon Ltd.

E-RESOURCES

1. https://www.youtube.com/watch?v=l2LymcI096Q
2. https://en.wikipedia.org/wiki/Alkaloid
3. Chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.nios.ac.in/media/documents/dmlt/Biochemistry/Lesson-10.pdf
4. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://nowgonggirlscollege.co.in/attendence/classnotes/files/1622538714.pdf
5. https://pmc.ncbi.nlm.nih.gov/articles/PMC8046889/

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	H	S	M	H
CO2	S	H	H	M	H
CO3	S	H	M	H	S
CO4	S	S	S	S	S
CO5	S	S	H	S	H
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code : 26UCH611

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PAPER – 11 PHYSICAL CHEMISTRY**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development**
2026 - 2027	VI	5	75	3	

Course Objectives

1.	To understand the basics and theoretical aspects of Chemical kinetics.
2.	To learn about kinetics of thermal and photochemical reactions.
3.	To gain knowledge about importance of catalysis, colloids and Liquid state.

Course Outcomes (CO)

K1 – K5	CO1	Understand the basic principles, various experimental techniques and Theories of chemical kinetics.
	CO2	To understand the importance of various theories explaining chemical kinetic.
	CO3	Gain the knowledge about principles of photochemical and photosensitized Process.
	CO4	Study the basic principles and types of catalysis and colloids.
	CO5	Explore the fundamentals of Liquid State.

UNIT – I	**Chemical Kinetics-I**	**15 Hours**

Empirical laws and experimental aspects. Rate law, stoichiometry, order and molecularity of reactions. Setting up and solving simple differential equations for first order, second order, third order and zero order reaction. Expressions for half – life periods of first order, second order, zero order and third order reactions. Determination of order of reactions. Experimental techniques involved in the following kinetics of reaction. Volumetry, Manometry, Dilatometry, Polarimetry and Colorimetry. Typical examples for each of the techniques.

UNIT-II	**Chemical Kinetics-II**	**15 Hours**

Theoretical aspects: Effect of temperature on the rate constant. The activation energy. Significance of free energy of activation. The collision theory of reaction rates and its limitations. The theory of absolute reaction rates (ARRT). Comparison of the collision theory with the absolute reaction rate theory. Lindemann theory of uni-molecular reactions.

UNIT-III	**Kinetics of Photochemical Reactions**	**15 Hours**

Dark reactions - Complex thermal reactions – Thermal chain reaction - the H2 - Br2 reaction. Absorption of light and photochemical processes – Laws of photochemistry - The Stark–Einstein law of photochemical equivalence. Kinetics of photochemical chain reaction - the H_2 / Br_2 reaction. Quantum yield of photochemical reactions. Comparison of the thermal and photochemical kinetics of the H_2 / Br_2 reaction. Photosensitized reactions – photophysical process, Fluorescence, Phosphorescence and Chemiluminescence.

UNIT-IV	**Catalysis and Colloids**	**15 Hours**
***Catalysis – Types of catalysis** – Characteristics of catalytic reactions Theories of catalysis – Intermediate Compound Formation Theory, Adsorption Theory – Acid-base catalysis – Enzyme catalysis – Mechanism of enzyme catalysis – Electrocalatysis. ***Colloids - Definitions** – Classification of colloids – sols – preparation, and properties Stability of colloids, gold number, associated colloids – Cleansing action of soaps and detergents. Emulsion – types of emulsions, preparation and properties. Gels – types of gels, preparation and properties. Applications of colloids. . Colloids in ancient Tamilian's Food.		
UNIT-V	**Liquid State and Liquid Crystals**	**15 Hours**
Intermolecular Forces in Liquids, Dipole-dipole Attractions, London Forces, Hydrogen Bonding Vapour Pressure, Effect of Temperature on Vapour Pressure, Determination of Vapour Pressure The Static Method, The Dynamic Method, Effect of Vapour Pressure on Boiling Points-Surface Tension, Units of Surface Tension, Determination of Surface Tension, Capillary Rise Method, Drop Formation Method, Ring- detachment Method, Bubble Pressure Method – Viscosity, Units of Viscosity, Measurement of Viscosity, Ostwald Method- Effect of Temperature on Viscosity of a Liquid, Refractive Index, Molar Refraction, Determination of Refractive Index Optical Activity, Specific Rotation, Measurement of Optical Activity. Introduction - Liquid crystals, Vapour pressure-temperature diagrams, Thermography, LCDs and the seven segment cell.		
****self study portion***		

TEXT BOOKS :

1.	Arun Bahl and B. S. Bahl, G. D. Tuli, (2015) Essentials of Physical Chemistry, S. Chand & Co., Revised multicolor edition.
2.	B. R. Puri, L. R. Sharma, and M. S. Pathania, (2015) Principles of Physical Chemistry, S. Chand & Co., New Delhi.
3.	P. L. Soni, O. P. Dharmarha and U. N. Dash, (2013) Textbook of Physical Chemistry, S. Chand & Co., New Delhi.

REFERENCE BOOKS:

1.	Keith J. Laidler and John H. Meiser,(2014) Physical Chemistry, CBS Publishers & Distributors, New Delhi.
2.	Gurudeep Raj, (2009) Advanced Physical Chemistry, Goel Publishing House, Meerut.
3.	K. K. Rohatgi Mukherjee, (2014) Fundamentals of Photochemistry, New age International Publishers.

E-RESOURCES :	
1.	https://nptel.ac.in/courses/104103856 - Physical Chemistry for Undergraduates
2.	https://www.youtube.com/watch?v=1t9Dq4wyhBw
3.	https://www.youtube.com/watch?v=ip6sNvps2Ew
4.	https://www.youtube.com/watch?v=94Gq-VdBoAY
5.	https://www.youtube.com/watch?v=rirPlafmLl4
6.	https://www.vlab.co.in/broad-area-chemical-sciences
7.	https://chemcollective.org/vlabs

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	H	M	M
CO2	S	S	S	S	S
CO3	S	S	M	H	M
CO4	S	S	H	M	S
CO5	S	S	H	S	H

S – Strong **H** – High **M** – Medium **L** – Low

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code: 26UCH6CN

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PRACTICAL – III GRAVIMETRIC ANALYSIS**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	VI	3	90	3	

Course Objectives

1.	To understand the concept of gravimetric analysis.
2.	To get acquainted with the experimental procedure of gravimetric analysis.
3.	To determine the quantity of analyte in solution.

Course Outcomes (CO)

K3 – K5	CO1	Understand the basic principles of Gravimetric analysis.
	CO2	Understand about the various precipitating agents.
	CO3	Determination of analyte masses through the gravimetric analysis.
	CO4	Improve the accuracy of analysis.
	CO5	To gain knowledge about Metal analysis in cosmetic products using AAS

I	**Gravimetric Analysis**
1	Estimation of Sulphate as Bariumsulphate.
2	Estimation of Barium as Barium Chromate.
3	Estimation of Lead as Lead Chromate.
4	Estimation of Calcium as Calcium Oxalate.
5	Estimation of Nickel as Nickel Dimethylglyoxime.
II.	**Metal analysis in cosmetic products using AAS. (demonstration only)**

TEXT BOOKS :

1. Venkateswaran. V, Veeraswamy. R, Kulandaivelu . A.R, (1997), **Basic Principles of Practical Chemistry**, New Delhi, Sultan Chand and Sons,

REFERENCE BOOKS:

1. Mendham. J, Denney, R.C. Bames. J.D and Thomas. (2006) M, **Vogel's Text book of Quantitative Analysis**, Pearson Education.
2. Gopalan.R, Subramaniam P.S and Rengarajan. (2004) K, **Elements of Analytical Chemistry,** Sultan Chand and Sons.

Time: 3 Hours		**Max. Marks : 60**	
Distribution of Total Marks: 50			
	Record	10 marks	
	Gravimetric	50 marks	

Gravimetric Marks-50			
	Procedure (To be written within five minutes)	10 mark	
	Experiment	40 mark	
	Error up to 2%	40 mark	
	3%	35 mark	
	4%	30 mark	
	5%	10 mark	
	>5%	5 mark	
❖ Proportionate deduction of marks must be made for errors between the limits given above.			
❖ Examiners should calculate the result of each candidate with the data obtained by the candidate.			
❖ For each independent arithmetic error deduct 2 marks.			
❖ For incomplete or wrong calculation deduct 20% of marks eligible for the result as calculated by the examiners.			
❖ For incomplete or wrong calculation deduct 30% of marks eligible for the result as calculated by the examiners.			
❖ If there is a difference between the two results, the examiners should consider the one favorable to the candidate. If a candidate is not able to complete the experiment due to accident, award 5 marks			

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	H	M	H
CO2	S	S	M	H	H
CO3	S	S	H	M	H
CO4	S	S	M	H	H
CO5	S	S	H	H	H
S – Strong	**H** – High		**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PRACTICAL – IV PHYSICAL CHEMISTRY EXPERIMENTS**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	VI	4	120	4	

Course Objectives

1.	Transformation of theoretical knowledge gain to practical aspects.
2.	To have experience in handling electrical and non-electrical equipments.
3.	To determine the strength of various solutions through spectrometric and electrochemical techniques.

Course Outcomes (CO)

K3 – K5	CO1	Correlate theoretical principles with experimental observations in physical chemistry, such as partition coefficient, phase equilibria, molecular weight determination, and transition temperatures.
	CO2	Develop hands-on expertise in physico-chemical measurements including rate kinetics, critical solution temperature, and electrolyte concentration.
	CO3	Interpret and analyze experimental data through accurate graph construction, error estimation, and result validation across diverse experiments.
	CO4	Measure and evaluate cell constant, specific conductivity, and equivalent conductivity of electrolytes; determine dissociation constants using conductivity methods.
	CO5	Perform conductometric and potentiometric and colorimetric techniques for acid-base and redox systems, and assess performance characteristics of primary and secondary batteries.

Physical Chemistry Experiments

1.	Determination of Partition coefficient of Iodine between Carbon tetra chloride and water.
2.	Determination of rate constant of acid
3.	Determination of K_f / Molecular weight by Rast Macro method (Naphthalene, Diphenyl and m-dinitrobenzene as solvents).
4.	Determination of Critical solution temperature of Phenol- Water system.
5.	Determination of concentration of an electrolyte (NaCl/ KCl/ Succinic acid) in CST
6.	Determination of Transition temperature of the hydrated salt (Sodium acetate, Sodium thio Sulphate and $SrCl_2.{}_6H_2O$)
7.	Phase diagram-Simple Eutectic system
8.	Determination of Cell Constant, Specific conductivity and Equivalent conductivity of strong electrolyte
9.	Determination of dissociation constant of a weak acid (Acetic acid)

10.	Conductometric Titration (Strong acid Vs Strong base)
11.	Potentiometric Titration (Acid-Base Titration HCl Vs NaOH CH_3COOH Vs Na_2CO_3)
12.	Potentiometric Titration (Redox Titration FAS Vs $KMnO_4$)
13.	Estimation of Manganese by colorimetric method.
14.	Secondary Battery Charging and Discharging Studies.
15.	Primary Battery Discharging Studies.

TEXT BOOKS :	
1.	Venkateswaran. V, Veeraswamy. R, Kulandaivelu . A.R, (1997), **Basic Principles of Practical Chemistry**, Sultan Chand and Sons, New Delhi.
2.	Laboratory manual –Physical Chemistry – Dr.K.Saminathan, Department of Chemistry , Kongunadu Arts and Science College, Coimbatore.
REFERENCE BOOKS:	
1.	Gopalan. R, Subramaniam. P.S., and Rengarajan, K.,(2004) Elements of Analytica Chemistry, Sultan Chand and Sons**.** New Delhi.

Time: 3 Hours			**Max. Marks : 60**
Distribution of Total Marks: 60			
	Record	*10* mark	
	Experiment	50 marks	
Mark Breakup for Experiments: 50			
1. Equilibrium Constant			
For carrying out the experiment	15 mark	Constant error up to 10%	12 marks
Remaining Marks given below	30 mark	10-12%	8 mark
Calculation of [KI]	6 mark	12-14%	4 mark
Calculation of [I_2]	6 mark	>14%	No mark
Calculation of [KI_3] Value of equilibrium	6 mark		
2. Strength of KI Solution may be given in the range from 0.02N to 0.06N			
Calculation of [KI]	12 mark	Calculation	
Calculation of [I_2]	11 mark	Strength of given [KI] Solution	11 mark
Calculation of [KI_3]	11 mark		
	For wrong calculation of above value, 50% of marks to be deducted for those steps only.		
3. HCl or H 2SO4, 0.5N to be given. If the order of difference between theoretical and			

candidates value is			
Below a factor of 10 Between 10-20 Above - reduce 3 marks for each factor -5 marks		30-45 mark	
4. Critical Solution Temperature of Phenol-Water system is 67.0^{0}C			
Phenol-Water system Plot of % Phenol Vs Temp	45 mark	Error up to ±3°C to 15°C	Reduce 3 marks for each percent
Error up to ±3°C	35 mark	Above ±15°C	5 mark
5. Candidate may be instructed to use solutions of strength 1% and below. Unknown solution must be below 0.8%			
Plot of %NaCl Vs Temp	45 mark	Error up to 1-2%	5 mark
Determination of % NaCl Solution	30 mark	Error up to 2-3%	5 mark
Error up to 1%	10 mark	Error above 3%	4 mark
6. 0.1N Acetic acid and 0.1N KCl 100ml each to be given			
Calculation of cell constant	15 mark	Error up to 10%	20 mark
Correct Eq. Conductance of Acetic acid	10 mark	Error up to 10% to 20%	Reduce 1 mark for each %.
7. 0.1N Acetic acid 100ml and 0.1N KCl 100ml to be given			
Calculation of cell constant	20 mark	Calculation of dissociation constant	15 mark
Correct Eq. Conductance of Acetic acid	15 mark	Reduce marks for errors as in **experiment-6 above**	
8. 0.02N HCl may be given			
Error up to 5%	45 mark	Error up to 10-15%	Reduce 3 marks for each %
Error up to 5-10%	Reduce 3 marks for each %	Error above 5%	5 mark
9. Rast method			
Solvent Kf	**Solute**		
1.Naphthalene (6.9°C)	1. Biphenyl	Melting point of solvent	15 mark
2. Diphenyl (8-8.4°C)	2. Naphthalene	Error upto ±10%	30 mark
3. Diphenyl amine (8.4 – 8.8°C)	3. Dicholorobenzene	Error upto ±20%	15 mark
For each step error has to be worked out		Above 20%	5 mark
10. Phase diagram			
Melting point of A	10 mark	Error up to 1%	8 mark

Melting point of B	10 mark	Error up to 2%	6 mark
Construction of phase diagram	9 mark	Error up to 3%	4 mark
Eutectic temperature	8 mark	Error > 3 %	No mark
Eutectic composition	8 mark		
11. Colorimetric Experiments			
Error upto 1%	45 mark	Error upto 3%	20 mark
Error upto 2%	30 mark	Error > 3%	5 mark

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	S	M	S
CO2	S	S	H	H	S
CO3	S	S	H	H	S
CO4	S	S	S	M	S
CO5	S	S	H	S	S
S – Strong	**H** – High		**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**CORE PRACTICAL – V APPLICATION ORIENTED PRACTICAL**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	VI	3	90	4	

Course Objectives

1.	To demonstrate the basic laboratory techniques and application oriented physical constants.
2.	To prepare organic dyes, organic compounds and home care products.
3.	To estimate the hardness of water, DO, available chlorine in bleaching powder and saponification value of an oil.

Course Outcomes (CO)

K3 – K5	CO1	Gain the knowledge of physical constants and preparation of dyes.
	CO2	Know about the preparation of organic compounds.
	CO3	Learn about the preparation method of home care products.
	CO4	Learn about estimation of hardness of water, dissolved oxygen, Saponification of oil and isolation of citric acid.
	CO5	Learn about estimation of hardness of water, dissolved oxygen

I.	**Determination of Physical Constants.**
1	Determination of Melting point
2	Determination of Boiling point
3	Estimation of Lead as Lead Chromate.
4	Estimation of Calcium as Calcium Oxalate.
5	Estimation of Nickel as Nickel Dimethylglyoxime.
II.	**Preparation of Organic dyes**
	Preparation of dyes like Methyl Orange, Methyl Red, Azo Amino benzene.
III	**Preparation of Organic Compounds**
	Preparation involving Acetylation, Hydrolysis, Oxidation, Halogenation, Nitration and Benzoylation.
IV	**Preparation of Home care products**
1	Preparation of white phenyl
2	Preparation of soap oil
3	Preparation of detergent powder
4	Preparation of transparent soap
5	Preparation of moisturizing cream
V	**Estimations**
1	Estimation of Hardness of water using EDTA
2	Estimation of dissolved oxygen in water
3	Estimation of alkalinity in water

4	Estimation of calcium in limestone by EDTA method
5	Estimation of Total Fatty Matter (TFM) of a soap
6	Estimation of acid value of an oil
7	Estimation of available chlorine in bleaching powder
VI	**Day to day activity related experiments.**
1	Natural Product extraction using Rotary vapor evaporator.
2	Water quality analysis using hydrometer.
3	Milk analysis using lactometer.
4	Green synthesis reactions in microwave oven.
5	Determination of pH for common consumables and cosmetics

TEXT BOOKS :

1. Venkateswaran. V, Veeraswamy. R, Kulandaivelu . A.R, (1997), **Basic Principles of Practical Chemistry**, New Delhi, Sultan Chand and Sons,
2. Sharma, K.K. and Sharma, D.S. (2005) **Introduction to Practical Chemistry**, Vikas Publishing House, New Delhi.

REFERENCE BOOKS:

1. G. Svehla, (1987), **Vogel's Qualitative Inorganic Analysis**, Orient Longman Ltd, Hyderabad.
2. Praveen Kukreja, (2006). **Chemistry Advanced Practical Manual**, Vrinda Publishing (p) Ltd, New Delhi.

Time: 3 Hours		**Max. Marks : 60**	
Distribution of Total Marks: 60			
	Record	10 mark	
	Physical Constant	10 mark	
	Estimation	20 mark	
	Preparation	20 mark	
Physical Constant Marks - (10)			
	±2°	10 mark	
	±3°	8 mark	
	±4°	6 mark	
	±>4°	5 mark	
	Estimation Marks - (20)		
	Error up to 2%	20 mark	
	3%	15 mark	
	4%	10 mark	
	5%	5 mark	
	>5%	3 mark	

	Preparation Marks- (20		
	Quantity	15 mark	
	Recrystallization/ Quality	05 mark	

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	S	S	S
CO2	S	S	S	S	H
CO3	S	S	S	S	S
CO4	S	S	S	S	H
CO5	S	S	S	H	S
S – Strong	**H** – High	**M** – Medium	**L** – Low		

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Subject code : 26UCH6Z1

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**PROJECT VIVA-VOCE**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	VI	-	-	5	

COURSE OBJECTIVES

- To apply fundamental principles of chemistry through research, experimentation, and analysis,
- To understand of chemical concepts, developing scientific inquiry skills,
- To promoting critical thinking and problem-solving abilities in real-world contexts.

COURSE OUTCOMES

On successful completion of the project work, the students will be able to

K3 ↕ K5	CO1	Demonstrate a clear understanding of core chemical concepts relevant to the project topic.
	CO2	Apply scientific methods to design and conduct experiments or investigations
	CO3	Analyze and interpret data to draw meaningful conclusions based on chemical principles.
	CO4	Communicate scientific findings effectively through written reports and/or presentations
	CO5	Develop skills in teamwork, time management, and independent learning in a research setting.

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Guidelines for the Distribution of Marks:

CIA	Project Review	15	**20**
	Regularity	5	
ESE	Project Report Present	60	**80**
	Viva – Voce	20	
	Grand Total		**100**

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	S	M	S
CO2	S	S	H	S	H
CO3	S	H	S	H	S
CO4	S	H	M	S	M
CO5	H	M	S	M	L

S - Strong **H** - High **M** - Medium **L** - Low

MAJOR ELECTIVE PAPERS

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**MAJOR ELECTIVE - I POLYMER SCIENCE**			
Batch		**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Entrepreneurship**
2026 - 2027		3	45	5	
Course Objectives					
1.	To know about basics of polymers, polymerization and plastic materials				
2.	To learn about polymer processing and synthesis of some commercially important polymers and to know about various polymer processes techniques.				
3.	To know different type of plastics, advancements, disposal, applications				
Course Outcomes (CO)					
K1 – K5	CO1	Know about the types of polymers, chemical and physical properties, its industrial applications and uses.			
	CO2	Understand the various polymerization techniques, processing and different types of individual polymer products.			
	CO3	Know about different Polymerization Processing Techniques			
	CO4	Acquiring knowledge of commercially important polymer products and its applications.			
	CO5	Know about the recent advances in polymer products and their applications.			

UNIT – I	**Introduction to polymers**	**9 Hours**

Introduction to polymers: Genesis of polymers: *Basic concept – monomers and polymers – definition. Classification of polymers – natural and synthetic polymers – organic and inorganic Polymers – Thermoplastic and thermosetting plastics – plastic materials, elastomers, few applications.

Chemistry of Polymerization: Types – Chain polymerization – Free radical polymerization, Ionic polymerization, coordination polymerization. Step Polymerization – polycondensation, poly addition, ring opening. Miscellaneous polymerization reactions – electrochemical. Group transfer polymerization.

UNIT-II	**Polymer properties and Reactions**	**9 Hours**

Molecular weight and Size: Average molecular weight - number average - weight average molecular weights – concepts. Sedimentation and viscosity Average molecular weights - Molecular weight and degree of polymerization.

Glass Transition Temperature (Tg): Definition, application of Tg in processing, Transition and Associated properties, Factors influencing the glass transition temperature. Photo oxidative degradation of polymers.

UNIT-III	**Polymerization Processing Techniques**	**9 Hours**

Polymer Processing Technology: Introduction to polymer processing-basic concept and applications-Injection Moulding - compression moulding, extrusion process, Blow moulding,

Polymer degradation

Types of degradation-Thermal degradation-Factors affecting thermal stability- Mechanical degradation-Degradation by ultrasonic waves-Photodegradation-Degradation by high energy radiation

UNIT-IV	**Chemistry of Commercial Polymers**	**9 Hours**

Chemistry of polymers: Types-engineering and commodity plastics, General methods and preparation Properties of PE, PP, PS, PMMA, polyacetal, PC, polyamides, PVC, PF, UF, epoxy, Teflon.

UNIT-V	**Recent Advances in Polymers**	**9 Hours**

Polymer and environmental effect-introduction-disposal of polymer waste-recycling system-importance of biopolymers –basis of conducting polymers, introduction to blends and alloys. Application of plastics in various fields-plastic industries in India.

self study portion

TEXT BOOKS :

1.	V. R. Gowariker, N.V. Viswanathan and Jayadev Sreedhar, (2012) **Polymer Science,** Revised Edition, New Age International Publishers, New Delhi.

REFERENCE BOOKS:

1.	F.W. Billmeyer – (1990) **Text Book of Polymer Science**, John Wiley & Sons.
2.	J.R. Fried, (2014) **Polymer Science & Technology**, Prentice Hall of India Private Ltd.
3.	G.S. Misra, (1997) **Introductory Polymer Chemistry**, New Age International Private Ltd, New Delhi.
4.	Sharma. B.K., **Polymer Chemistry**, Goel Publishing House, Meerut, (2004).
5.	Arora. M.G., Singh. M, and Yadav. M.S., (2003) Polymer Chemistry, Anmol Publications Private Ltd., New Delhi.

e-Resources:

1.https://byjus.com/chemistry/polymers/
2.https://www.vedantu.com/chemistry/polymers
3.https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Polymers
4.https://www.youtube.com/watch?v=8k9v2Vn8Kp0
5.https://www.toppr.com/guides/chemistry/polymers/

MAPPING					
PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	S	S	S
CO2	S	H	S	S	S
CO3	S	S	H	S	S
CO4	S	H	S	H	S
CO5	S	H	S	H	S
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Programme Code: 04	B.Sc. Chemistry			
Title of the paper	**MAJOR ELECTIVE - II NANO SCIENCE**			
Batch	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	3	45	5	

Course Objectives

1.	To gain knowledge about in - depth look at the basics of Nano Chemistry and to know the methods to prepare Nano materials.
2.	To get the knowledge about Green Chemistry and its limitations.
3.	To have a holistic idea about Green solvents in laboratory as well as in Industry and also to study the Reactions and applications of Green Chemistry.

Course Outcomes (CO)

K1 – K5	CO1	To understand the basics of Nano Chemistry.
	CO2	To know the methods to prepare Nano materials.
	CO3	To have an idea about Nano chemistry in medicine.
	CO4	To gain knowledge about Characterization of Nanomaterials.
	CO5	To gain knowledge about Applications of Nanomaterials.

UNIT – I	**Fundamentals of Nanomaterials**	**9 Hours**

Introduction to nanostructures and nanomaterials – Classification of nanomaterials (0D, 1D, 2D, 3D) – Size-dependent properties – Surface-to-volume ratio – Surface energy and stability – Chemical potential as a function of curvature – Fundamentals of nucleation and growth – Homogeneous and heterogeneous nucleation – Growth mechanisms (Diffusion controlled vs. Surface reaction controlled) – Top-down and Bottom-up approaches – Scope and limitations of nano chemistry.

UNIT-II	**Synthesis of Nanostructures I (Chemical & Solution Methods)**	**9 Hours**

Synthesis of Zero-Dimensional (0D) nanostructures – Nanoparticles through homogeneous nucleation – Sol–gel method: Hydrolysis, condensation, and gelation – Synthesis of metallic and semiconductor nanocrystals – Precipitation and co-precipitation – Microemulsion technique – Synthesis of One-Dimensional (1D) nanostructures – Spontaneous growth – Vapor-Liquid-Solid (VLS) mechanism – Template-based synthesis: Electrochemical and electrophoretic deposition – Role of surfactants and stabilizers.

UNIT-III	**Synthesis of Nanostructures II (Vapor Phase & Special Structures)**	**9 Hours**

Synthesis of Two-Dimensional (2D) nanostructures – Fundamentals of thin film growth – Physical Vapor Deposition (PVD): Evaporation, Sputtering, and Pulsed Laser Deposition (PLD) – Chemical Vapor Deposition (CVD): Thermal, Plasma-enhanced, and Laser-assisted – Atomic Layer Deposition (ALD) – Epitaxial growth – Carbon nanostructures: Synthesis of CNTs (SWNTs and

MWNTs), Fullerenes, and Graphene – Self-Assembly and Self-Assembled Monolayers (SAMs).

UNIT-IV	Characterization of Nanomaterials	9 Hours

Structural characterization – X-ray Diffraction (XRD) and determination of particle size using Scherrer's formula – Electron Microscopy: Principles, instrumentation, and applications of Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) – Scanning Probe Microscopy: Atomic Force Microscopy (AFM) and Scanning Tunneling Microscopy (STM) – Gas adsorption (BET method) for surface area measurement – Brief overview of optical spectroscopy (UV-Visible and Photoluminescence) in nanomaterials.

UNIT-V	Applications of Nanomaterials	9 Hours

Applications: Nano catalysis and its advantages – Environmental Applications: Water purification and chemical sensors – Energy Storage and Conversion: Dye-sensitized solar cells, Lithium-ion batteries, and Hydrogen storage – Biomedical Applications: Targeted drug delivery, Biosensors, and Bio-imaging – Electronic and Optoelectronic devices – Environmental impact and Nanotoxicity – Safety and ethical handling of nanomaterials.

self study portion

TEXT BOOKS :

1	Guozhong Cao., "Nanostructures and Nanomaterials Synthesis, Properties, Applications", World scientific publishing private, Ltd., Singapore , 2004.
2	Charles P. Poole Jr. and Franks. J. Qwens, "Introduction to Nanotechnology", Wiley India edition, 2012.
3	Brechijnac.C., et.al, "Nanomaterial & Nanochemistry", springer, 2007.
4	Bhanu P.S.Chauhan., "Nanomaterials, Synthesis, Characterisation and applications, John wiley & sons, 2011

REFERENCE BOOKS:

1	Pradeep.T., "Nano the essential Nano sciences and Technology", Tata McGraw Hill, New Delhi, 2007.
2	Huck.W.T.S., "Nanoscale Assembly: Chemical Techniques (Nanostructure Scienceand Technology)", Springer, 2006
3	Bandyopadhyay.A.K., "Nano Materials" New Age International Publishers; 2 Edition edition, 2010.

E-RESOURCES :

1.	https://nptel.ac.in/courses/118102003 - Introduction to N`anotechnology
2.	**https://onlinecourses.nptel.ac.in/noc19_mm21/preview** - Nanotechnology, Science and Applications

3.	https://royalsociety.org/-/media/policy/publications/2004/9693.pdf
4.	https://books.google.co.in/books?id=Ez1dYxO_ma8C&printsec=copyright#v=onepage&q&f=false
5.	https://pubs.acs.org/doi/10.1021/acsomega.4c10929
6.	https://www.vlab.co.in/broad-area-chemical-sciences
7.	https://www.quora.com/What-is-the-difference-between-nanostructures-and-Nanomaterials

MAPPING					
PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	S	S	S
CO2	S	H	S	S	S
CO3	S	S	H	S	S
CO4	S	H	S	H	S
CO5	S	S	S	H	S
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge

Signature of the HOD

Programme Code: 04	B.Sc. Chemistry			
Title of the paper	**MAJOR ELECTIVE - III PHARMACEUTICAL CHEMISTRY**			
Batch	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Entrepreneurship**
2026 - 2027	3	45	5	

Course Objectives

1.	To know about the common diseases and cure-terms of pharmacology and drug action.
2.	To get introduced to chemotherapy – antibiotics.
3.	To know the drugs meant for diabetes.

Course Outcomes (CO)

K1 – K5	CO1	Gain the knowledge about the common diseases and cure-terms of pharmacology.
	CO2	Understanding Mechanism of actions of drugs
	CO3	Understand about drug classification.
	CO4	Learn about Common body ailments.
	CO5	To understand the rich, diverse, and interdisciplinary heritage of the Indian Knowledge System of Ancient and Traditional.

UNIT – I	**Drugs**	**9 Hours**

Terminology- drug, pharmacology, pharmacognesy, pharmacodynamics, anti metabolites, LD50 and ED50 therapeutic index - Common diseases -infective disease – insect – borne, air borne and water borne - *Various sources of drugs, pharmacologically active constituents in plants, Classification of drugs- biological and chemical classification.

UNIT-II	**Action of Drugs**	**9 Hours**

Mechanism of drug action- Action at cellular and extra cellular sites. Drug receptors and biological responses- Drug receptor interaction through various bonding- Mechanism of different types of drug action- Absorption of drugs- routes of administration of drugs- factors affecting absorption of drug-Assay of drugs-chemical and biological assays.

UNIT-III	**Designation of drugs**	**9 Hours**

Designation of drugs based on physiological action; Definition and two examples each of Anaesthetics-General, IV and local- Definition and two examples each of Analgesics – Narcotic and synthetic- Definition and two examples each of antipyretics and anti-inflammatory agents – Antibiotics –Classification based on biological action, based on chemical structure-Structure and uses of Penicillin, streptomycin, chloramphenicol, tetrecyclines.

UNIT-IV	**Vital aliments and Treatments**	**9 Hours**

Blood pressure – Causes, control, and treatment- anti-hypertensive drugs -anti-anginalagents- Cardiovascular drugs – Cardio glycosides, Vasodiulators.
Anemia: Causes and control – Antianemic drugs.
Diabetes: Causes, Types, and control – hypo glycemic drugs – Insulin.
Cancer: Causes and treatment – Antineoplastic drugs – Antimetabolite.

UNIT-V	**Indian Knowledge System Ancient and Traditional**	**9 Hours**

Indian Medicinal plants: Major Chemical Constituents and Medicinal uses - Vallarai, Keezhanelli, Thumbai, Hibiscus, Adadodai, Thoothuvalai, Nochi, Tulasi,Aloe vera.
Medicinally Important compounds: Preparation and Medicinal uses - Milk of magnesia, Sodium bicarbonate, Aluminium hydroxide gel, Phosphoric acid, Arsenous anhydride, Ferrous fumarate, Ferric ammonium citrate,Yellow mercury oxide.

self study portion

TEXT BOOKS :

1. Jayashree Ghosh, (2010) **A Text Book of Pharmaceutical Chemistry**, S.Chand and Company Ltd., New Delhi.

REFERENCE BOOKS:

1. Lakshmi S., (1995) **Pharmaceutical Chemistry**, S. Chand & Sons, New Delhi.
2. Ashutosh Kar, (2005) **Medicinal Chemistry**, Wiley Eastern Ltd., New Delhi.
3. David William & Thomas Lemke, (2018) **Principles of Medicinal Chemistry**, Foyers, BI publishers.
4. Romas Nogrady, (2008) **Medicinal Chemistry**, Oxford University press 3rd edition.

E-Resource:

1. https://www.youtube.com/watch?v=NrkjY_5O_BY
2. https://www.youtube.com/watch?v=eMrTmSpKrJ4
3. https://www.youtube.com/watch?v=GGtwJ-SGXTA
4. https://www.youtube.com/watch?v=dJYZ_k6b3zY
5. https://www.youtube.com/watch?v=i7YcvUdE3-I

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	H	S	H	S

S – Strong **H** – High **M** – Medium **L** – Low

Content prepared by (Based on Inputs)

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Signature of the HOD

Programme Code: 04	B.Sc. Chemistry			
Title of the paper	**MAJOR ELECTIVE - IV AGRICULTURAL CHEMISTRY**			
Batch	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	3	45	5	

Course Objectives

1.	To know about origin, physical and chemical aspects of soil
2.	To know about the basic idea of plant nutrients
3.	To acquire the knowledge pesticides, fungicides and Herbicides

Course Outcomes (CO)

K1 – K5	CO1	To gain the knowledge about the origin soil.
	CO2	To understand about physical and chemical properties of soil.
	CO3	To understand about chemical aspects of soil
	CO4	To learn about plant nutrients.
	CO5	To learn Basic ideas about pesticides, fungicides and herbicides.

UNIT – I	**Origin of soil**	**9 Hours**

Definition of soil-origin-igneous-metamorphic and sedimentary rocks-rock systems-weathering of rocks and minerals - main components of soil-organic, inorganic, liquid and gaseous phase-Minerals of importance with respect to soil, industries and agriculture –Soil formation physical, chemical and biological factors responsible for soil formation-soil forming processes- Core soil groups of Tamilnadu-Soil survey standard soil survey-methods of soil surveys –remote sensing and soil mapping-soil resource management-use of satellite data for source inventory.

UNIT-II	**Physical Properties of Soil**	**9 Hours**

Physical properties of soil-soil texture and textural classification-pore space-bulk density, particle density –soil structure and soil colour-surface area-soil colloids-plasticity, shrinkage-flocculation and deflocculation-soil air, soil temperature, their importance in plant growth-soil reaction –ion exchange reaction-cation exchange-anion exchange –buffering capacity – hydrogen ion concentration-determination of pH Values-factors affecting soil pH-soil pH and nutrient availability- Soil degradation –causes.

UNIT-III	**Chemical Aspects of Soil**	**9 Hours**

Origin of problem soils, their properties acid, alkali and saline soils-diagnosis-remediation of acid and salt effected soils –Methods of reaction and after care-Quality of irrigation water – causes for poor quality waters for irrigation, their effects in soil and crops. Soil testing-Concept, objective and basis-soil sampling, tools, collection processing, dispatch of soil and water samples. Soil organic matter-its decomposition and effect on soil fertility-source of organic matter in soil –maintenance

and distribution –soil organism –their role-nitrification-denitrification, nitrogen fixation in soils-biological nitrogen fixation in soils –microbial interrelationship in soil-microbes in pert and disease management-***Bio-conversion of agricultural wastes**.

UNIT-IV	**Plant Nutrients**	**9 Hours**

Plant nutrients-macro and micro nutrients-their role in plant growth –sources-forms of nutrient absorbed by plants –factors affecting nutrient absorption-deficiency symptoms in plants-corrective measures-chemicals used for correcting nutritional deficiencies-nutrient requirements of crops, their availability, fixation and release of nutrients. Fertilizers –classification of NPK fertilizers –sources-natural and synthetic –straight –complex –liquid fertilizers, their properties, use and relative efficiency-secondary and micro nutrient fertilizers-mixed fertilizers –principles of fertilizers use – the efficient use of various fertilizers-integrated nutrient management biofertilizers –rhizobium, azospirillum, azotobacter-Blue green algae and azolla production and quality control of bio-fertilizers.

UNIT-V	**Pesticides, Fungicides And Herbicides**	**9 Hours**

Pesticides: Definition –classification –organic and inorganic pesticides-mechanism of action – Characteristics-Safe handling of pesticides –impact of pesticides on soil, plants and environment – Acts and Laws concerning the pesticides-. Fungicides Definition –classification – mechanism of action-Sulphur, copper-mercury compounds, dithanes, dithiocarbamates.

Herbicides: Definition –Classification-mechanism of action-Arsenic and boron compounds-nitro compounds, chloro compounds, Triazines, propionic acid derivatives, urea compounds. Acaricides-Rodenticides-Attractants-Reppellants-Fumiganus foliants.

self study portion

TEXT BOOKS:

1.	Biswas, T.D and Mukeherjee, S.K. (2001) Textbook **of Soil Science**, Tata McGraw – Hill publishing co.
2.	Daji, T.A. (1990) **Textbook of Soil Sciences**, Asia Publishing House, Madras.
3.	Tisdale. S. L., Nelson. W. L. and Beaton. J. D. (2017) **Soil Fertility and Fertilizers**, 8th edition Macmillan Publishing Company, New York.

REFERENCE BOOKS:

1.	Hesse, (1983) **A Textbook of Soil Chemical Analysis** P.R. John Murray.
2.	Buchel, K.H. John Wiley & Sons , (1983) **Chemistry of Pesticides**, New York.
3.	Sree Ramula, (1979) **Chemistry of Insecticides and Fungicides**, U.S. Oxford and IBH Publishing Co., New Delhi.

E – resources

1. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://agritechfuture.com/wp-content/uploads/2024/01/Agricultural-Chemistry.pdf
2. https://www.sciencedirect.com/topics/social-sciences/agricultural-chemistry
3. https://www.youtube.com/watch?v=J0j2VqHKxMg

MAPPING					
PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	H	S	S
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge

Signature of the HOD

Programme Code: 04	B.Sc. Chemistry			
Title of the paper	**MAJOR ELECTIVE - V FOOD CHEMISTRY**			
Batch	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	3	45	5	

Course Objectives

1.	To have an idea about food adulteration and food preservation techniques.
2.	To understand the chemistry of vinegar, fruit juices, vegetable acids and beverages.
3.	To analyse and characterize chemical aspects of milk.

Course Outcomes (CO)

K1 – K5	CO1	Know about the nutrition values in food, food adulteration, standards of food, contamination and food poisoning.
	CO2	Understand about the minerals in food
	CO3	Know about food additives
	CO4	Understand the detailed information about commercially important beverages
	CO5	Know about dairy products

UNIT – I	**Nutrition values of food materials and food adultration**	**9 Hours**

Nutritional values of carbohydrates, vitamins, proteins and fats. ***Definition – Food standards** – **Food Standards in India** – Standards for ensuring quality of Products – Common adulterants in different foods

Emerging trends in food technology

Biotechnology in food- Genetically modified food- Biofortification-Application of nanotechnology in foods- Processed and convenience foods-Space foods- Food fortification- Fortified common salt- Fortified cereals- Edible oil as a vehicle- Sugar as a vehicle- Fortification of tea

UNIT-II	**Minerals in food**	**9 Hours**

Introduction – Minerals in Food - Calcium – Phosphorus - Magnesium – Zinc - Copper – Fluoride – Iodine - Iron – Sodium – Chloride - Potassium Functions - Deficiency problems - Food sources.

UNIT-III	**Food additives**	**9 Hours**

Food Additive- Direct additives / intentional additives - Indirect Additives / Unintentional- Functions of Intentional Food Additives. Major Food Additive Categories- Color Additives- Lakes - Flavor Additives- The Sensation Of Taste - Tripartite Model. Artificial Sweeteners – Aspartame – Cyclamate – Saccharin. Acesulfame Potassium (Acesulfame K). Flavor Intensifier/Flavor Enhancer (Potentiator) - Monosodium Glutamate (Msg). Color And Flavor Preservatives – Antioxidants - Chelating agents. Fat Substitutes – Olestra – Polydextrose – Simplesse. Nutritional Additives - Texture-Improving Additives - Anticaking Agents - Dough Conditioners by pH Value, Alcohol in Vinegar. Fruit Juices and Vegetable Acids: Examination of Lime Juice, Lemon Squash,

etc.,		
UNIT-IV	**Commercially important beverages**	**9 Hours**
Introduction – Types of beverages - Tea - Nature and Properties of Tea - Adulteration of Tea - Tea Infusions. Coffee - Nature and Properties of Coffee - Adulteration of Coffee with Chicory. Cocoa and Chocolate - Nature and properties of Cocoa and Chocolate - Adulteration of Cocoa. Alcoholic Beverages - Introduction - Determination of Alcohol - Proof Spirit - Denaturing of Alcohol.		
UNIT-V	**Dairy products**	**9 Hours**
General characteristics of Cows' milk –The determination of the specific gravity – use of lactometer – Determination of total solids – Determination of ash – Determination of fat [Gerber, gottlieb – rose, Werner – Schmid and Adams methods] – Calculation of extent of adultration - Determination of total protein – Determination of lactose – Determination of acitidy – Added colouring matter in milk – Preservatives in milk [Boric acid, formaldehyde, etc.] – Boiled and pasturised milk – Homogenised milk – Cream – Reconstituted cream – Synthetic cream – Condensed milk – Dried milk.		
self study portion		

TEXT BOOKS:	
1.	C. Kenneth Tinkler and Helen Masters,(2005) **Applied Chemistry**, Vol. II, London.
2.	M. Swaminathan, (2003) **Advanced Text Book on Food and Nutrition**, Vol. II, .
3.	B. Sri Lakshmi, (2002) **Nutrition science**, New Age International Pvt. Ltd., New Delhi.

REFERENCE BOOKS:	
1.	M. Swaminathan, (2004) **Handbook of Food and Nutrition**, The Bangalore Printing and Publishing Co. Ltd.,
2.	B. Sri Lakshmi, (2004) **Food Science**, New Age International Pvt. Ltd., New Delhi.
3.	S. D. Venkataiah,(2004) **Nutrition Education**, Anmol Publication Pvt. Ltd.,.

e-Resources:

1.https://www.overdrive.com/media/4269516/basic-food-chemistry?utm_source=chatgpt.com
2.https://pdf-drive.to/dl/principles-of-food-chemistry-4?utm_source=chatgpt.com
3.https://pdf-drive.to/dl/principles-of-food-chemistry-4?utm_source=chatgpt.com
4.https://www.overdrive.com/media/4058978/encyclopedia-of-food-chemistry?utm_source=chatgpt.com
5.https://www.overdrive.com/media/4269516/basic-food-chemistry?utm_source=chatgpt.com

MAPPING					
PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	H	S
S – Strong		**H** – High	**M** – Medium		**L** – Low

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Programme Code: 04	B.Sc. Chemistry			
Title of the paper	**MAJOR ELECTIVE - VI LEATHER CHEMISTRY**			
Batch	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	3	45	5	

Course Objectives

1.	To obtain the knowledge on the structure and composition of the hides, skin and leather.
2.	To know the basic principles involved in the pre-training methods of leather manufacture.
3.	To understand about vegetable tanning, chrome tanning and leather machinery.

Course Outcomes (CO)

K1 – K5	CO1	Learning the basic principles involved in the theory of curing hides and skins
	CO2	Understanding the basics of soaking and bating process
	CO3	Widening a skill on the bating and liming
	CO4	Gaining the broad idea on the Chrome tanning and vegetable tanning process.
	CO5	To know about leather machinery.

UNIT – I	**Theory of curing hides and skins**	**9 Hours**

Putrefaction - Mechanism of Putrefaction – Theory of curing hides and skins- curing by controlling temperature- curing by temperature control- curing by using toxic materiaFls – curing by moisture – Drying – Application of salt – simple salting – brine curing – combined salting and raceway- Indian method of curing.

UNIT-II	**Socking and liming**	**9 Hours**

Socking: Introduction – disinfection of socking water and application of antiseptics- Effect of temperature and pH of sock liquor – Control of socking – surface active agents for leather industry
Liming: Introduction -Effect of liming on collagen, Effect of temperature in liming – neutralization of alkali by collagen –Alkali binding capacity – Shift of isoelectric point due to liming – swelling of collagen.

UNIT-III	**Deliming and bating**	**9 Hours**

Deliming: Introduction – selection of deliming agents- methods of deliming – Extend of deliming – drenching – distinction between deliming and drenching – Chemistry and bacteriology of drenching . Common deliming agents – Boric acid – Ammonium chloride – Ammonium sulphate
Bating : Introduction- objects of bating – important factors in the bating operation : temperature - Duration of bating – strength of bating liquor.

UNIT-IV	Chrome tanning and Vegetable tanning	9 Hours
Chrome tanning: Historical outline – double bath process – Chemical control in double bath process – Firz bath – Dipping – second bath – single bath process – Chemistry of chromium salts – Basic chrome compounds – Olation , polymerization and Oxolation. **Vegetable tanning** : The Chemistry of vegetable tanning materials.		
UNIT-V	**Leather machinery**	**9 Hours**
Introduction – Roller type machine - Unhairing machine – fleshing machine – Scudding machine – Samming and setting machine – Buffing machine – Fluffing wheel – boarding machine – New roller type of machine – Glazing machine – Rolling machine. **Disposal of tannery effluents** Introduction: Types of pollutants-Chemical oxygen demand-Biological oxygen demand-Primary treatments for tannery effluents-Secondary treatments for tannery effluents-Collection of micro organisms for biodegradation-mixing of tannery effluents with domestic sewage-world water distribution		
self study portion		
TEXT BOOKS :		
1.	B.K.Sharma, (2019), **Industrial chemistry**, Goel publishing House, Meerut.	
2.	Jayashree Ghosh, Reprint 2008, **Fundamental Concepts of Applied Chemistry**, S.Chand & Company Ltd	
REFERENCE BOOKS:		
1.	P.C.Jain, M.Jain, (2008), **Engineering Chemistry**, Dhanpat Raj Publishing Company Pvt Ltd, 15th Edn.	

e-Resources:

1.https://share.google/Fym7qddHOgibjENID
2.https://www.scribd.com/document/71793999/Leather-Chemistry
3.tps://www.researchgate.net/publication/383554525_Tannins_and_Leather_Chemistry_Tanning_Processes_and_Environmental_Impacts
4.https://www.jstor.org/stable/41365795
5.https://share.google/hNCHNs1UFAqQBkepH

MAPPING					
PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	H	H	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	H	S
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

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SKILL BASED SUBJECTS

Subject code: 26UGC3S1

Programme Code : 04		B.Sc. Chemistry			
Title of the paper		**Title of the Paper :** Skill Based Subject 1 – Basics of Cyber Security			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	Skill development
2026 - 2027	III	2	30	3	

Course Objectives

1.	To provide fundamental knowledge of cyber security concepts and the digital environment.
2.	To create awareness about cyber threats, cybercrimes, and common online frauds.
3.	To develop the ability to identify risks associated with internet, mobile, and online transactions
4	To familiarize students with safe practices in email, social media, and digital communication.
5	To introduce basic cyber laws, ethics, and responsible digital behavior

Course Outcomes (CO)

K1 – K5	CO1	Apply the fundamental concepts of cyber security and digital safety at appropriate place
	CO2	Identify various cyber threats, cybercrimes, and online frauds
	CO3	Enable safe practices while using internet, mobile, and e-commerce platforms
	CO4	Interpret security issues related to email and social media usage
	CO5	Comprehend cyber laws, ethics, and legal responses to cybercrime

UNIT – I	**6 Hours**
Foundations of Cyber Security: Cyberspace and Digital Environment -Evolution of Cyber Security- Basic Concepts and terminology in Cybersecurity –Cybersecurity Threat – Defense in Depth concept in Cyber Security- Information Literacy – Types of False Information — Digital footprint – – Cyber Frauds- Basic Safety Practices and Password Awareness - Multi-Factor Authentication (MFA)- Zero Trust Security Model.	
UNIT-II	**6 Hours**
Cyber Crimes & Threat Landscape: Introduction to AI in Cyber Security- Cyber Crimes- Important of Cybercrime- Types of Cyber Crime - CIA Triad – Tools for Confidentiality, Integrity, Availability -Cyber Crime & Digital Evidence Indian Perspective- Recent Cyber Crime Incidents- Social Engineering Frauds- Financial Frauds using Social Media Platforms- Ransomware Attacks - Deep fake based frauds -Cryptocurrency scams -Dark Web basics - Preventive Measures for individuals and Organizations – Awareness and Safe Online Behavior- Incident Response Process..	
UNIT-III	**5 Hours**
Internet, Mobile & Digital Transaction Security: Browser Security Tools – Mobile phone security and privacy settings – E-commerce concepts and risks – UPI Fraud Awareness -QR Code Scams - App permissions & Data Tracking – Malware Types and Cyber Attacks- Secure browsing and Data Theft & Public Wi-Fi Precautions – Symmetric vs Asymmetric Encryption	
UNIT-IV	**6 Hours**
Communication & Social Media Security: Basics of email usage and Communication – Email	

threats: Spam, Phishing, Malicious links- Fake News – Fake profiles, Cyber Bullying and Data Misuse –Computer Viruses – Antivirus and Firewall concepts – Safe sharing practices and Digital responsibility. Ethical Hacking.

UNIT-V	**7 Hours**

Cyber Laws, Ethics & Digital Responsibility: Introduction to Cyber Law – IT Act 2000 and Amendments– Data Protection Laws (India DPDP Act 2023). Intellectual Property in Digital Space-Cybercrime and legal provisions – User rights and responsibilities in cyberspace – Digital footprint and online identity – Personal data protection and privacy – Cyber ethics and responsible usage – Cyber safety awareness programs and best practices.

Case Study: Case studies of cyber law enforcement in India

Work Book	
1.	**1.** *Basics of Cyber Security*, prepared by Kongunadu Arts and Science College, Coimbatore

REFERENCE BOOKS:

1.	Data Security Council of India (DSCI), in collaboration with Seqrite, presents the second edition of the India Cyber, Threat Report 2025.
2.	Green, J., Smith, A., & Brown, T. (2024). Information security management principles. Routledge.
3.	Armstrong-Smith, S. (2024). Understand the cyber attacker mindset: Build a strategic security program. Kogan Page.
4.	Ismail, Y., Lacy, F., & Belu, R. (Eds.). (2024). Cybersecurity: Threats, technologies, and emerging solutions. IntechOpen.
5	Rais, R., Morillo, C., Gilman, E., & Barth, D. (2023). Zero trust networks: Building secure systems in untrusted networks (2nd ed.). O'Reilly Media.
6	Shapiro, S. J. (2023). Fancy bear goes phishing: The dark history of the information age. Farrar, Straus and Giroux.
7	Tamil Nadu Fact Check Unit, Training Handbook
8	James Graham (2011), Cyber Security Essentials, CRC Press, Auerbach Publications, Taylor & Francis Group.
9	Kathryn Knerler (2022), 11 Strategies of a World-Class Cybersecurity Operations Center, MITRE Corporation.
10	Dr. Jeetendra Pande (2017), Introduction to Cyber Security, Uttarakhand Open University.
11	Rohas Nagpal (2008), Real world cyber crime cases, Cyber Crime & Digital Evidence – Indian Perspective, Asian School of Cyber Laws
12	Prof. (Dr.) Nilesh K. Modi (2021), Cyber Security Techniques, Dr. Babasaheb Ambedkar Open University.
13	Cyber Security Awareness Handbook (2020), Ciso Jil information Technology Limited.

14	Jeff Kosseff (2020), Cybersecurity Law, John Wiley & Sons, Inc.
15	Cyber Crime Law and Practice, The Institute of Company Secretaries of India, 2016
16	Yuri Diogenes (2018), Cybersecurity Attack and Defense Strategies, Packt Publishing.
17	Cybersecurity Handbook, Ministry of Digital Governance, National Cybersecurity Authority, June 2021.
18	Justin Hutchens (2024), The Language of Deception: Weapon zing Next Generation AI– Explores AI in social manipulation, deep fakes, and malware.
19	D.R. Halston (2025), Cyber Security Mastery Covers AI-driven attacks, cloud security, and career preparation

Web References:

1.	https://safety.google/
2.	https://safety.google/security/security-tips/
3.	https://www.simplilearn.com/tutorials/cyber-security-tutorial
4.	https://www.getcybersmart.org/for-students
5.	https://www.techbuddies.io/cyber-security-basics
6.	https://www.geeksforgeeks.org/ethical-hacking/what-is-cyber-security/
7.	https://www.drishtiias.com/daily-updates/daily-news-editorials/india-s-cybersecurity-challenge-threats-and-strategies
8.	https://www.dsci.in/resource/content/india-cyber-threat-report-2025
9.	https://www.eimt.edu.eu/25-major-cyber-attacks-in-india-threats-and-strategies
10.	https://www.coursera.org/in/articles/types-of-cyber-attacks
11.	https://eventussecurity.com/cybersecurity/india/cyber-attacks/
12	www.heimdalsecurity.com

Subject code: 26UGC3S1

Question Paper Pattern

Duration: 3 hrs **Max: 75 marks**

Section - A (10x1=10)
Choose the correct answer
Section - B (5x5=25)
Short answer questions, either or type, one question from each unit.
Section - C (5x8=40)
Essay answer questions, either or type, one question from each unit.

CIA EXAMINATION MARK BREAKUP

S. NO	DISTRIBUTION COMPONENT	MARKS
1.	CIA I – 75 Marks Converted to 30	**30**
2.	CIA II – 75 Marks Converted to 30	**30**
3.	Seminar/Objective capacity testing	**10**
4.	Seminar/Objective capacity testing	**10**
5.	Attendance	**05**
6.	Any Case Study related to Cyber Security	**15**
	Total	**100**

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code: 26UCH4S2

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**SKILL BASED SUBJECT-2 WATER POLLUTION AND MANAGEMENT**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	IV	2	30	3	

Course Objectives

1.	To know about the sources and characteristics of water.
2.	To learn about the analysis of the pollutants in water.
3.	To learn the methods of purification and management of water.

Course Outcomes (CO)

K1 – K5	CO1	Understand the importance of water.
	CO2	Study the types of water pollution.
	CO3	Analyze and measure the toxic chemical substances.
	CO4	Gain knowledge in purification techniques of water.
	CO5	Know the irrigation systems used in agriculture.

UNIT – I	**Sources of water and its importance**	**6 Hours**

***Introduction- Sources of water –** Chemistry of water – Water quality parameter- Domestic purpose - Types of water- hard and soft water- uses of water – disadvantages of using hard water for domestic purpose- disadvantages of using hard water for various industries - water for industry. Quality of natural waters - Chemistry of water - Water in human body - Water as a solvent - main quality characteristics of water - organic matter in water - humic material in water - colloidal material in water.

UNIT-II	**Types and sources of water pollution**	**6 Hours**

***Definition - water pollutants** - Sewage and domestic wastes- Industrial effluents- Agricultural discharges- Fertilizers- Detergents- Toxic metals- Siltation- Thermal pollutants- Radioactive materials in water- types of water pollution - ground water pollution, surface water pollution, lake water pollution, river water pollution and sea water pollution - physical pollution of water - chemical pollution of water - biological pollution of water – physiological pollution of water.

UNIT-III	**Analysis of a water pollutants**	**6 Hours**

Physical and chemical examination of water- Sample - preservation and pre concentration method- carbon adsorption method, freeze concentration method, solvent extraction method. Chemical substances affecting portability - suspended solids - dissolved solids - measurement of toxic chemical substances – Radioactivity of water-methods of removing radioactivity from water. Dissolved oxygen - Biochemical Oxygen Demand - Chemical Oxygen Demand.

UNIT-IV	**Purification of water**	**6 Hours**

Removal of coarse, dispersed and colloidal impurities from water - Coagulation of water - Contact and electrochemical coagulation - Flocculants - Purification or treatment of water for municipal supply (Screening - Aeration - Sedimentation with coagulation- Filtration- Sterilisation and disinfection – Storage and distribution) - Chemical methods of sterilization- Aeration-Natural, artificial, Chlorination, - Physical methods of sterilization-boiling, Exposure to sunlight and UV light- Desalination of brackish water - Reverse osmosis. Zeolite process - Ion exchange method - Demineralization of water.

UNIT-V	**Water management**	**6 Hours**

Introduction - Water management - Use and conservation of water resources - Water quality management - Rain water harvesting - Water from rocks - Water management in agriculture - Rain fed system - Irrigated systems and its types- surface, subsurface, drip, sprinkler, manual irrigation Sea water for agriculture - Water management in industries.

Self study portion

TEXT BOOKS :

1. B.K Sharma, (2017) **Environmental Chemistry,** Goel publishing House, Meerut.
2. A. K. Dee ,(2017) **Environmental chemistry**, New age international.

REFERENCE BOOKS:

1. Jain and Jain, (2001) Engineering **Chemistry**, Dhanpat Rai Publishing Co.,
2. N. Manivasakam (Water Analyst),(2001) **Chemical and Microbiological Analysis of Mineral Water and Packaged Drinking Water,** Principal Public Health Laboratory, Coimbatore.

e- Resources:

1. https://byjus.com/biology/water-pollution-control/
2. https://www.slideshare.net/slideshow/water-pollution-and-its-management-ppt/55169269
3. https://www.youtube.com/watch?v=c40yPpQG8e0
4. https://microbenotes.com/water-purification/
5. https://www.slideshare.net/slideshow/irrigation-and-its-types/41655703
6. https://www.slideshare.net/slideshow/types-of-irrigation/45757543

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	H	M	H	M	S
CO2	M	S	S	S	S
CO3	H	S	M	S	S
CO4	M	S	S	M	S
CO5	H	S	S	H	H
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge

Signature of the HOD

Subject code: 26UBI6S3

Programme Code: 04		B.Sc. Chemistry		
Title of the paper		**SKILL BASED SUBJECT – 3 BASICS OF INTELLECTUAL PROPERTY RIGHT'S**		
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2026 - 2027	VI	2	30	3

Course Objectives

- To create awareness about recent trends in IPR and Innovation
- To explore the basic concepts IPR
- To focus upon trademarks, copyrights, patents, industrial designs and traditional knowledge.
- To learn more about managing IP rights and legal aspects.

Course Outcomes (CO)

K1 – K5	CO1	Know about basic concepts of IPR and patent
	CO2	Understand copyrights, industrial designs and geographical indication of goods.
	CO3	Differentiate between trademarks and trade secrets
	CO4	Acquire knowledge on protection of traditional knowledge and plant varieties.
	CO5	Manage and protect IP Rights

UNIT – I		**6 Hours**

Introduction -origin and development of Intellectual Property Rights (IPR), need for protecting IP, **Patents:** Foundation of patent law, patent searching process, basic criteria of patentability. Patentable and non - patentable subject matters in India. Patent prior art search, drafting the patent specification and filing procedure.

UNIT-II		**6 Hours**

Copyrights: Fundamentals of copyright law, originality of material, right of reproduction, right to perform the work publicly, copyright ownership issues, notice of copyright. Industrial Designs: Kind of protection provided in **Industrial design**. **Geographical Indication of Goods**: Basic aspects and need for the registration.

UNIT-III		**6 Hours**

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, transfer of rights, selecting and evaluating trademark, registration of trademarks, claims. **Trade Secrets**: Trade secret law, determination of trade secret status, liability form is appropriation of trade secrets, trade secret litigation.

UNIT-IV		**6 Hours**
Protection of traditional knowledge - Objectives, concept of traditional knowledge, issues concerning, bioprospecting and biopiracy. **Protection of Plant Varieties** - Objectives, international position, plant varieties protection in India. Rights of farmers, breeders and researchers.		
UNIT-V		**6 Hours**
Managing IP Rights: Acquiring IP Rights: letters of instruction, joint collaboration agreement, protecting IP Rights: non-disclosure agreement, cease and desist letter, settlement memorandum. **Transferring IP Rights**: Assignment contract, license agreement, deed of assignment. Infringement and enforcement.		
self study portion		

TEXT BOOKS :

1.	Ramakrishna Chintakunta and M. Geethavani (2022). A Textbook of Intellectual Property Rights. Blue Hills publications.
2.	N.K Acharya (2021).Intellectual property rights(8thEdn). Asia Law House.
3.	Craig Allen Nard, Michael J. Madison, and Mark P. McKenna. (2017). Law of Intellectual Property (5thEdn). New York Aspen publishers.
4	Barrett and Margreth (2009). Intellectual Property. New York Aspen publishers.
5	Deborah E.Bouchoux(2013). Intellectual property:The Law of Trademarks, Copyrights, Patents, and Trade Secrets. Publisher: Cengage India

REFERENCE BOOKS:

1.	B.Ramakrishna and H.S.Anil Kumar (2017). Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers.Notion Press.
2.	V. K. Ahuja(2013). Law relating to Intellectual Property rights (2nd Edn). LexisNexis.
3.	R. Radhakrishnan and S. Balasubramanian(2008).Intellectual property rights: Text and Cases. Excel Books India.
4.	D. Goeland S. Parashar (2013). IPR Biosafety and Bioethics. Pearson Education India.

Subject code: 26UBI6S3

CIA EXAMINATION MARK BREAKUP

The CIA Examination mark breakup for the course **Basics of IPR** is given below:

S.No.	Distribution Component	Marks
1	CIA I – 75 Marks Converted to 30	30
2	CIA II – 75 Marks Converted to 30	30
3	Seminar/Objective capacity Testing	10
4	Seminar/Objective capacity Testing	10
5	Attendance	05
6	Any Case Study related to IPR (as a Group)	15
	Total	**100**

QUESTION PAPER PATTERN

The following question paper pattern will be followed for the above said courses:

Section A - Multiple Choice (10 × 1 = 10 Marks)

Section B - Either or Type (5 × 5 = 25 Marks)

Section C - Either or Type (5 × 8 = 40 Marks)

Maximum Marks : 75 Duration : 3 Hours

EXTRA DEPARTMENTAL COURSE (EDC)

Subject code: 26UCH5X1

Programme Code: 04		B.Sc. Chemistry			
Title of the paper		**EXTRA DEPARTMENTAL COURSE (EDC) - CHEMISTRY IN DAY- TO-DAY LIFE**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	V	2	30	3	

Course Objectives

1.	To gain knowledge about water treatment in industrial plant and its usage.
2.	To get the knowledge about industrial fermentation process, oil, wax and soap preparation.
3.	To have a holistic idea about food adulteration, food hygiene and paints manufacture.

Course Outcomes (CO)

K1 – K5	CO1	Basic understanding of water technology and acquire knowledge in the treatment of water for multi-purpose.
	CO2	To study about Vitamins in Food
	CO3	To understand the chemistry involved in the manufacturing process of oil, fats, wax and soap.
	CO4	To design a demonstration, that provides an opportunity to identify adulteration in food standards.
	CO5	Broadening the knowledge about paints and pigments.

UNIT – I	**Water Treatment**	**6 Hours**

Introduction – Sources and Uses of Water – Water for Industrial Purposes – Quality of Normal water – water in human body – Hardness of water – Types - Softening of Water – Soda Lime Process, Zeolite, and Ion-exchange Processes (principles only). Demineralization of water – Treatment of Water for Municipal purposes – Desalination of Brackish Water – Electro dialysis – Reverse Osmosis Method (principles only).

UNIT-II	**Vitamins**	**6 Hours**

Introduction – Vitamins, Classification of vitamins, water soluble vitamins-fat soluble vitamins-Vitamin A, D, E, K, B1, B2, B3, B5, B6, B9, B12 (B-Complex vitamins) and C – Sources of vitamins- deficiencies of vitamins and diseases

UNIT-III	**Oils, Fats, Waxes and Soap**	**6 Hours**

Waxes – Classification – Solubility – Saponification value –Manufacture of Candles – Hydrocarbon of Candles – Hydrogenation – of Oils – Soaps –Manufacture – detergents – Cleansing Action of Soaps.

UNIT-IV	**Food Adulteration and Hygiene**	**6 Hours**

Definition of Adulteration Food – Common Adulterants in Different Foods – Toxic Effects of Some Metals and Chemicals – Contamination of Foods with Harmful Microorganisms – **Detection**

of Adulteration in Some Common Food items – *Food Additives and Preservatives – Food standards.		
UNIT-V	**Paints**	**6 Hours**
Classification – Requirements of a Good Paint and Importance of pigment volume concentration (PVC) – Paints Failure. Emulsion Paints, Enamels, Lacquers and Varnishes – constituents and Manufacture.		
self study portion		
TEXT BOOKS:		
1.	B.K. Sharma, **Environmental Chemistry**, Krishna Prakasam Medai (P) Ltd., Meerut, 6th Revised Edn., (2011).	
2.	P.C. Jain and Monika Jain, **Engineering Chemistry**, Dhanpat Rai & Sons, Delhi, 16th edition (2019)	
3.	M. Swaminathan, **Food & Nutrition, Bappco**, 2nd ed. (2011).	
REFERENCE BOOKS:		
1.	B. Sri Lakshmi, Food Science, New Age, 5th ed. (2013).	
2.	Jayashree, Applied Chemistry, S. Chand, 3rd ed. (2013).	

e-Resources:

1.https://www.researchgate.net/publication/362988223_Paint_as_a_Material_The_Transformation_of_Paint_Chemistry_and_Technology_in_America_ca_1880-1920
2.https://pdfroom.com/books/introduction-to-paint-chemistry-and-principles-of-paint-technology/jndOKR4wdRq?utm_source=chatgpt.com
3.https://www.scribd.com/document/71793999/Leather-Chemistry
4.https://noor-book.com/en/8gxdov
5.https://share.google/0HpbXI6MNJgrjz6jw
6.https://share.google/x6MRKSDmMuavTyXQS

Subject code: 26UCH5X1

Question Paper Pattern

Duration: 3 hrs **Max: 75 marks**

Section - A (10x1=10)
Choose the correct answer

Section - B (5x5=25)
Short answer questions, either or type, one question from each unit.

Section - C (5x8=40)
Essay answer questions, either or type, one question from each unit.

CIA EXAMINATION MARK BREAKUP

(For Theory Only)

S. NO	DISTRIBUTION COMPONENT	MARKS
1.	CIA I – 75 Marks Converted to 40	**40**
2.	CIA II – 75 Marks Converted to 40	**40**
3.	Assignment I	**05**
4.	Assignment II	**05**
5.	Attendance	**05**
6.	Others (Seminar, Group Discussion, Flipped Class room, etc.,)	**05**
	Total	**100**

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

GENERAL PAPERS

Programme code: 04				
Title of the paper	**PART IV – ENVIRONMENTAL STUDIES**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2026 - 2027	I	2	30	2

Course Objectives

1.	To provide a fundamental understanding of natural resources, environmental ethics, and the impact of modern practical conservation and sustainability
2.	To inculcate knowledge and create awareness about concepts, components and function of ecosystems.
3.	To appraise on the importance of biodiversity, its values, threats, indigenous and Traditional knowledge systems, conservation strategies, and modern identification tools, and cultivate conscious responsibility and awareness for biodiversity conservation and sustainability.
4.	To understand the environment threats and pollution, its impacts and mitigation strategies
5.	To develop an understanding of disasters (natural and man-made) and its preparedness

Course Outcomes (CO)

K1 – K5	CO1	Formulate genetic resource conservation strategies and assess India's SDG performance through AI/ML tools.
	CO2	Evaluate and predict the impact of humans on web of life, global economy and quality
	CO3	Think critically an develop strategies for biodiversity conservation, sustenance and environmental equity through eco conscious approach
	CO4	Demonstrate values and have compassion towards complex environmental issues and take part in mitigating current environment challenges through sustainable solutions
	CO5	Apply basic safety and preparedness measures in disaster situations in society, household and workplace

UNIT – I	**MULTIDISCIPLINARY NATURE OF ENVIRONMENT AND ITS SOCIAL ETHICS AND VALUES**	**6 Hours**

Introduction to environment; Historical Development of Human – environment interaction; Industrial revolution, Economic development and its impact on the environment;

Overview of resources: Definition, Classification of natural resources – biotic and abiotic, renewable and non-renewable. **Renewable Resources:** Water Resources- Rainwater Harvesting, Reservoirs managements, AI & ML tools for water resource management. Sustainable Development goals - Agriculture and Environment. Revisiting traditional agricultural practices- Biodynamic Farming, Physical and Biological soil factors. **Non-renewable Resources**- fossil fuel, nuclear fuel, Energy Resources: Conventional and non-conventional Resources- solar, wind, clean energy- hydrogen, Biomass energy-coir pith, charcoal; Use of exotic/invasive weed biomass for alternative energy/economy. Eg: *Lantana camara, Eichhornia Sp,* Genetic Resources and conservation, strategies.

***Activity:** (i) Analyze your department and its practices towards compliance to SDG's. List out the compliances towards SDG's with justification.

(ii) Examine your campus' current resource conservation strategies and provide recommendations to improve its sustainability and resource efficiency.

* Students can take up any one of the above.

UNIT-II	**ECOSYSTEMS**	**6 Hours**

Ecosystem- Definition, Components (producers, consumers and decomposers) and functions- Energy flow, Food chains and its types, food web, Disturbances to food chain and food web due to anthropogenic intrusions Eg: Diclofenac Case, Ecological pyramids: types and importance of ecological pyramids, **Types of Ecosystems**: Natural ecosystem- Aquatic Ecosystem (Pond, River, Marine and Estuarine), Terrestrial Ecosystem (Forest, Grassland and Desert). Artificial Ecosystem (Crop land).

Activity: Develop a working model for an ecosystem through building a Terrarium or Suseum.

UNIT-III	**BIODIVERSITY**	**6 Hours**

Concept of Biodiversity: Definition, Types-Genetic, Species and Ecosystem diversity. Indigenous Knowledge Systems on Biodiversity – Traditional knowledge and legal framework for bioprospecting and Biomimicry. Biodiversity- Values, uses and threats, sustainable use of bioresources for value additions, Conservation strategies of Biodiversity- *In-situ* - National Parks, Wildlife Sanctuaries, Community Reserve and Conservation Reserves, *Ex-situ* – Zoological Park, Aquarium, Botanical garden. ***Case Study**- Nilgiri Tahr Conservation Project.

Activity: (i) Applications for plant and animal identification by software -*iNaturalist* and

Merlin Bird ID (ii) Field observation and documentation of the campus biodiversity.		
UNIT-IV	**ENVIRONMENTAL THREATS AND POLLUTION**	**6 Hours**
Introduction and Classification of Pollution- physical, chemical and biological; major types of pollution- air, water, soil/land, noise, thermal, radioactive, solid waste, electronic waste (e-waste), plastic, biomedical waste. **Assessment and Monitoring:** Pollution impact assessment/health risk assessment & monitoring techniques, Biological indicators of pollution – Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). Impact of pollution and incidence of Life style disorders like Diabetes, Cardio Vascular Disease, Cancer, PCOS etc. **Waste Management** – concept of 3R (Reduce, Recycle and Reuse) and sustainability. ***Case studies:** Dye Industrial pollution from tanneries, paper and pulp industrial effluents in Noyyal and Cauvery rivers **Activity**: Prepare an Audit report for: (i) Water usage in your department/house (ii) Magnitude of solid waste generation and its management at your department/house		
UNIT-V	**DISASTER MANAGEMENT AND PREPAREDNESS**	**6 Hours**
Definition and Classification of Disaster (Natural and Man-made disasters). **Natural Disaster:** Earthquakes, Landslides, Tsunami, Floods, Volcanic eruptions, Cyclones. Wayand-landslides, Joshimath- The sinking Village, Forest fires: causes, spread, control measures. **Man-made Disasters**: Industrial and chemical accidents (Bhopal disaster, oil spills), Nuclear hazards (Chernobyl and Fukushima). Kasargod- Impact of Endosulfan spraying on cashew farms. **Preparedness and safety measures:** Early warning system, response, recovery, mitigation, vulnerability, risk, resilience and capacity building. **Forecasting methods:** Conventional – cloud formation & wind, wave patterns, behaviours of animals & plants, Modern methods – remote sensing, drone and AI tools for impact assessment. ***Case studies**: Chennai flood 2015, causes and control measures. **Activity:** Prepare (i) Personal/Class emergency plan (ii) Risk identification checklist like loose heavy furniture, poor wiring, blocked exits (iii) A document using Mobile technology to map local resources or identify safer locations. **Field Study:** Visit to eco parks'/conservation sites and report. * Case studies are not for examination purposes.		

TEXT BOOKS:	
1.	Workbook on Environmental Science (2026), published by Kongunadu Arts and Science College, Coimbatore-641029
REFERENCE BOOKS:	
1.	Fundamentals of Ecology, Odum E.P, Odum H.T & Andrews- Saunders publications
2.	Ecology, Environmental science and Conservation. Singh J.S & Gupta SR, S Chand Publishing (2017).
3.	This Fissured Land: An Ecological History of India; Gadgil M & Guha R (1993), University of California Press, 1st Edition.
4	Environment (8th Ed.) by Raven PH, Gift, Bary LR, Hassenzahl DM, 2015, Wiley publishing house.
5	R. S. Ambasht, A Text Book of Plant Ecology, Students Friends & Company, 1990 - Plant ecology - 373 pages
6	A. Ravikrishnan (2019), Environmental Science and Engineering (Forth Edition) by Sri Krishna Hitech Publishing Company Pvt.Ltd, Velappanchavadi, Chennai.
7	Yadav, P. (2021). Applied and Economic Zoology. Kedar Nath Ram Nath
8	Krishnamurthy, K. V. (2023). An advanced textbook on biodiversity: Principles and practice. Oxford and IBH Publishing.
9	Anonymous (2003) Professional's The Wildlife (Protection) Act, 1972. Professional Book Publications.
10	National Disaster Management Guidelines - National Disaster Management Information and Communication System (NDMICS) (2011). A publication of the National Disaster Management Authority, Government of India. ISBN: 978-93-80440-12-5, February 2012, New Delhi.
11	Disaster Risk Management Systems Analysis: A Guide Book, Food and Agriculture Organization of the United Nations, Rome (2008). ISBN 978-92-5106056-8.

Web Reference Sources

1. **https://egyankosh.ac.in/bitstream/123456789/77368/1/Unit-4.pdf**
2. **https://agritech.tnau.ac.in/pdf/sustainableagriculture.pdf**
3. **https://www.dev-practitioners.eu/media/key_documents/SDGs_Booklet_Web_En.pdf**
4. **https://www.pmfias.com/environment-ecosystem-components-ecosystem/**
5. **https://www.ugc.gov.in/oldpdf/modelcurriculum/Chapter3.pdf**
6. **https://mjcollege.kces.in/pdf/download_documents/study_material_env_studies/ch3.pdf**

7. **https://www.deshbandhucollege.ac.in/pdf/resources/1587401626_BA(H)-Psc-Eco-Eng-BA(P)-II-Ecosystem.pdf**
8. **http://www.tezu.ernet.in/denvsc/IDC/biodiversity.pdf**
9. **https://egyankosh.ac.in/bitstream/123456789/86424/1/Unit-11.pdf**
10. **https://utkaluniversity.ac.in/wp-content/uploads/2022/05/Environmental-Pollution.pdf**
11. **https://cdn.visionias.in/value_added_material/d6c24-disaster_management.pdf**
12. **https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCIA4001.pdf**
13. **https://mrcet.com/downloads/MBA/Disaster%20and%20Crisis%20Management_Digital%20Notes.pdf**

Question Paper Pattern	
Duration: 3 Hours	**Total Marks: 50**
Answer all Questions (5 x 10 = 50 Marks)	
Essay type, either or type questions from each unit.	

Subject code: 26VED201

Programme Code: 04		B.Sc. Chemistry		
Title of the paper		**VALUE EDUCATION – Moral and Ethics**		
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2026 - 2027	II	2	30	2

Course Objectives

1.	To impart Value Education in every walk of life.
2.	To help the students to reach excellence and reap success.
3.	To impart the right attitude by practicing self-introspection.
4.	To portray the life and messages of Great Leaders.
5.	To insist the need for universal brotherhood, patience and tolerance.
6.	To help the students to keep them fit.
7.	To educate the importance of Yoga and Meditation.

Course Outcomes (CO)

K1 – K5	CO1	Will be able to recognize Moral values, Ethics, contribution of leaders, Yoga and its practice
	CO2	Will be able to differentiate and relate the day to day applications of Yoga and Ethics in real life situations
	CO3	Can emulate the principled life of great warriors and take it forward as a message to self and the society
	CO4	Will be able to Analyse the Practical outcome of practicing Moral values in real life situation
	CO5	Could Evaluate and Rank the outcome of the pragmatic approach to further develop the skills

UNIT – I	**Moral and Ethics**	**4 Hours**

Moral and Ethics: Introduction – Meaning of Moral and Ethics – Social Ethics – Ethics and Culture – Aim of Education..

UNIT-II	**Life and Teachings of Swami Vivekananda**	**6 Hours**

Birth and Childhood days of Swami Vivekananda – At the Parliament of Religions – Teachings of Swami Vivekananda.

UNIT-III	**Warriors of our Nation**	**4 Hours**

Warriors of our Nation: Subhas Chandra Bose – Sardhar Vallabhbhai Patel – Udham Singh – V. O. Chidambaram Pillai – Bhagat Singh – Tiruppur Kumaran – Dheeran Chinnamalai – Thillaiaadi Valliammai – Velu Nachiyar – Vanchinathan.

UNIT-IV	**Fundamentals of Yoga**	**8 Hours**
Introduction to Yoga – Benefits of Yoga - Principles of Yoga Practice– Yoga for Health and Well Being – Yoga for Peace – Yoga for Success – Brain Yoga Benefits – The Science of Yoga - Importance of Yoga in Modern Life		
UNIT-V	Yoga Practices	**8 Hours**
Warm-Up Exercises in Yoga : Neck, Shoulder, Wrist, Hip, Knee and Ankle Rotations - Basic Yoga Asanas: Tadasana, Vrikshasana, Bhujangasana, Vajrasana , Shavasana and Ardhasiddhasana – Surya Namaskar - Pranayama - Meditation and Relaxation		

TEXT BOOKS:

1.	Value Based Education – **Moral and Ethics** – Published by Kongunadu Arts and Science College (Autonomous), Second Edition (2024).

REFERENCE BOOKS:

1.	Swami Vivekananda - A Biography, Swami Nikhilananda, Advaita Ashrama, India, 24th Reprint Edition (2010).
2.	Gandhi, Nehru, Tagore and other eminent personalities of Modern India, Kalpana Rajaram, Spectrum Books Pvt. Ltd., revised and enlarged edition(2004).
3.	Freedom Fighters of India, Lion M.G. Agrawal, Isha Books Publisher, First Edition (2008).
4.	Easy steps to Yoga by Swami Vivekananda, A Divine Life Society Publication(2000).

Web References:

1. https://youtu.be/4UXFb7Cs3PU?si=6c50D1IfFvxTXdX_
2. https://youtu.be/zCaq6hbDlQw?si=kNWsrIxQXvOKfacp
3. https://youtu.be/_2GgRQJ9IbU?si=Xp_YEcCSR8mvMEG-
4. https://youtu.be/ZkyN4Dy4kO0?si=BkctTS1W3jDS886v
5. https://youtu.be/TWbiDzi-rQc?si=92crHrzoNq_0jrU-

MAPPING

PSO / CO	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	H	S	S
CO2	S	S	S	H	H
CO3	S	H	S	H	H
CO4	S	H	S	H	H
CO5	S	H	H	S	S

S – Strong **H** – High **M** – Medium **L** – Low

Question Paper Pattern

Duration: 3 hours **Total Marks: 50**

Answer all Questions (5 x 10 = 50 Marks)

Essay type, either or type questions from each unit.

NON-MAJOR ELECTIVE PAPERS

Subject code: 26UHR3N1

Programme Code: 04		B.Sc. Chemistry		
Title of the paper		**PART IV -NON-MAJOR ELECTIVE –I HUMAN RIGHTS**		
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2026 - 2027	III	2	30	2

Course Objectives

1.	To prepare for responsible citizenship with awareness of the relationship between Human Rights, democracy and development.
2.	To impart education on national and international regime on Human Rights.
3.	To sensitive students to human suffering and promotion of human life with dignity.
4.	To develop skills on human rights advocacy.
5.	To appreciate the relationship between rights and duties.
6.	To foster respect for tolerance and compassion for all living creature.

Course Outcomes (CO)

K1 – K5	CO1	To understand the hidden truth of Human Rights by studying various provisions in the Constitution of India.
	CO2	To acquire overall knowledge regarding the Feminist perspectives in the Liberative Empowerment of Women.
	CO3	To gain knowledge about various gender roles and stereotypes involved in the comprehension of gender equality and women's rights.
	CO4	To comprehend the legal provisions and policies that foreground the safety of children in the society and to promote awareness.
	CO5	To gain enhanced knowledge about sexual and gender minorities to recognize, celebrate and acknowledge the diversified forms of gender expressions and rights.

UNIT – I	**6 Hours**
HUMAN RIGHTS HUMANS RIGHTS CONSTITUTION OF INDIA: Humans Rights - Constitution Of India.	
UNIT-II	**6 Hours**
WOMEN EMPOWERMENT IN INDIA: Feminism And Sexual Violence - Women And Liberation	
UNIT-III	**6 Hours**
GENDER EQUALITY AND WOMEN'S RIGHTS: Stereotype Gender Roles - Women's Education, Power and Science	
UNIT-IV	**6 Hours**
RIGHTS OF THE CHILD IN INDIA: Status of child in contemporary Indian society - Special Laws and Policies for protection of children	

UNIT-V	**6 Hours**
SOGIESC RIGHTS: Understanding SOGIESC- basic Definitions- inclusivity of SOGIESC- importance of studying SOGIESC- presence of SOGIESC in Indian Traditions- temples and cultural practices that exemplify SOGIESC in India- Genetics of Sex determination- Genetics of Intersex community- Successful SOGIESC Personalities and achievers – Alan Turing- Sally Ride- Leonardo da vinci- Alan Hart- Virginia -Woolf- Bayard Rustin- Padmini Prakash- Akkai Padmashali- K Prithika Yashini- Laxmi Narayan Tripati- Madhu Bai Kinnar-Manabi Bandhopadhyay- SOGIESC Rights and laws	
TEXT BOOKS:	
1.	Human Rights (2024) Compiled by Kongunadu Arts and Science College, Coimbatore –29.
REFERENCE BOOKS:	
	1. Human Rights, (2018) by Jaganathan, MA.,MBA.,MMM.,ML.,ML., (Humanitarian Law) and J.P. Arjun Proprietor: Usha Jaganathan, Refugee Law Law series, 1st floor, Narmatha Nanthi Street, Magathma Gandhi Nagar, Madurai – 625014. 2. Country Report on SOGIESC Rights In India: An Unfinished Agenda. Weblink: https://www.ilgaasia.org/publications/india-country-report-an-unfinished-agenda 3. Intersex. Weblink: https://my.clevelandclinic.org/health/articles/16324-intersex 4. SOGIESC Personalities: https://www.bbc.com/news/world-asia-india-29357630 https://en.wikipedia.org/wiki/Laxmi_Narayan_Tripathi https://en.wikipedia.org/wiki/Akkai_Padmashali https://www.indiatoday.in/india/story/prithika-yashini-india-first-transgender-police-officer-tamil-nadu-969389-2017-04-04 https://yourstory.com/2018/03/first-transgendre-college-principal-west-bengal 5. SOGIESC Rights and laws https://www.openglobalrights.org/lgbtqia-to-sogiesc-reframing-sexuality-gender-human-rights/ https://static1.squarespace.com/static/5a84777f64b05fa9644483fe/t/625ead0484f9005d75b92 dd0/1650371887436/ILGA+Asia+India+Report+2021.pdf

Subject code: 26UHR3N1

Question Paper Pattern **Duration: 3 hrs** **Max: 75 marks**
Section A (5x5=25)
Short notes Either – Or/ Type - Question from each unit
Section - C (5x10=50) Essay answer questions, either or type, one question from each unit.

Subject code : 26UWR4N2

Programme Code: 04		B.Sc. Chemistry		
Title of the paper		**Part IV -NON- MAJOR ELECTIVE – II WOMEN'S RIGHTS**		
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**
2026 - 2027	IV	2	30	2

Course Objectives

1.	To know about the laws enacted to protect Women against violence.
2.	To impart awareness about the hurdles faced by Women.
3.	To develop a knowledge about the status of all forms of Women to access to justice.
4.	To create awareness about Women's rights.
5.	To know about laws and norms pertaining to protection of Women.
6.	To understand the articles this enables the Women's rights.
7.	To understand the Special Women Welfare laws.
8.	To realize how the violence against Women puts an undue burden on healthcare services.

Course Outcomes (CO)

K1 – K5	CO1	Appraise the importance of Women's Studies and incorporate Women's Studies with other fields
	CO2	Analyze the realities of Women Empowerment, Portrayal of Women in Media, Development and Communication
	CO3	Interpret the laws pertaining to violence against Women and legal consequences
	CO4	Contribute to the study of the important elements in the Indian Constitution, Indian Laws for Protection of Women
	CO5	Spell out and implement Government Developmental schemes for women and create awareness on modernization and impact of technology on Women

UNIT – I	**Women's Studies:**	**6 Hours**

Women's Studies: Basic concepts of Women's studies in Higher education, Women's studies perspectives- Socialization- Patriarchy- Women's studies as an academic discipline- Growth and development of Women's studies as a discipline internationally and in India.

UNIT-II	**Socio-Economic Development of Women**	**6 Hours**

Socio-Economic Development of Women: Family welfare measures, role of Women in economic development, representation of Women in media, status of Women land rights, Women Entrepreneurs, National policy for the empowerment of women.

UNIT-III	**Women's Rights – Access to Justice**	**6 Hours**

Women's Rights – Access to Justice: Crime against Women, domestic violence – physical abuse- verbal abuse – emotional abuse - economic abuse – minorities, dowry- harassment and death, code of conduct for work place, abetment of suicide.

UNIT-IV	**Women Protective acts**	**6 Hours**
Women Protective acts: Protective legislation for Women in the Indian constitution- Anti dowry, SITA, PNDT, and Prevention Sexual Harassment at Workplace (Visaka case), Domestic violence (Prevention) Act.		
UNIT-V	**Women and Child welfare**	**6 Hours**
Women and Child welfare: Safety provisions - various forms of mass media, radio, visual, internet, cyber space, texting, SMS and smart phone usage. Healing measures for the affected Women and child society by private and public sector, NGO and society.		
***self study portion**		
TEXT BOOKS :		
1.	**1. Women's Rights (2021), compiled by Kongunadu Arts & Science College, Coimbatore – 641 029.**	
REFERENCE BOOKS:		
1.	**"Rights of Indian Women"** by Vipul Srivatsava. Publisher: Corporate Law Advisor	
2.	**"Women's security and Indian law"** by Harsharam Singh. Publisher: Aabha Publishers and Distributors	
3.	**"Women's Property Rights in India"** by Kalpaz publications	

Question Paper Pattern	
Duration: 3 hrs	**Max:** 75 marks
Section A (5x5=25)	
Short notes Either – Or/ Type - Question from each unit	
Section B (5X10=50)	
Essay type Either – Or/ Type - Question from each unit	

Programme Code: 04	B.Sc. Chemistry		
Title of the paper	**NON- MAJOR ELECTIVE – III CONSUMER AFFAIRS**		
Batch	**Hours / Week**	**Total Hours**	**Credits**
2026 - 2027	2	30	2

Course Objectives

1.	To familiarize the students with their rights and responsibilities as a consumer.
2.	To understand the procedure of redress of consumer complaints.
3.	To know more about decisions on Leading Cases by Consumer Protection Act.
4.	To get more knowledge about Organizational set-up under the Consumer Protection Act
5.	To impart awareness about the Role of Industry Regulators in Consumer Protection
6.	To understand Contemporary Issues in Consumer Affairs

Course Outcomes (CO)

K1 – K5	CO1	Able to know the rights and responsibility of consumers.
	CO2	Understand the importance and benefits of Consumer Protection Act.
	CO3	Applying the role of different agencies in establishing product and service standards.
	CO4	Analyse to handle the business firms' interface with consumers.
	CO5	Assess Quality and Standardization of consumer affairs

UNIT – I	**6 Hours**

Conceptual Framework - Consumer and Markets: Concept of Consumer, Nature of markets: Liberalization and Globalization of markets with special reference to Indian Consumer Markets, E-Commerce with reference to Indian Market, Concept of Price in Retail and Wholesale, Maximum Retail Price (MRP), Fair Price, GST, labeling and packaging along with relevant laws, Legal Metrology. Experiencing and Voicing Dissatisfaction: Consumer buying process, Consumer Satisfaction/dissatisfaction-Grievances-complaint, Consumer Complaining Behaviour: Alternatives available to Dissatisfied Consumers; Complaint Handling Process: ISO 10000suite.

UNIT-II	**6 Hours**

The Consumer Protection Law in India - Objectives and Basic Concepts: Consumer rights and UN Guidelines on consumer protection, Consumer goods, defect in goods, spurious goods and services, service, deficiency in service, unfair trade practice, restrictive trade practice.

Organizational set-up under the Consumer Protection Act: Advisory Bodies: Consumer Protection Councils at the Central, State and District Levels; Adjudicatory Bodies: District Forums, State Commissions, National Commission: Their Composition, Powers, and Jurisdiction (Pecuniary and Territorial), Role of Supreme Court under the CPA with important case law.

UNIT-III	**6 Hours**
Grievance Redressal Mechanism under the Indian Consumer Protection Law - Who can file a complaint? Grounds of filing a complaint; Limitation period; Procedure for filing and hearing of a complaint; Disposal of cases, Relief/Remedy available; Temporary Injunction, Enforcement of order, Appeal, frivolous and vexatious complaints; Offences and penalties. Leading Cases decided under Consumer Protection law by Supreme Court/National Commission: Medical Negligence; Banking; Insurance; Housing & Real Estate; Electricity and Telecom Services; Education; Defective Products; Unfair Trade Practices.	
UNIT-IV	**6 Hours**
Role of Industry Regulators in Consumer Protection i. Banking: RBI and Banking Ombudsman ii. Insurance: IRDA and Insurance Ombudsman iii. Telecommunication: TRAI iv. Food Products: FSSAI v. Electricity Supply: Electricity Regulatory Commission vi. Real Estate Regulatory Authority	
UNIT-V	**6 Hours**
Contemporary Issues in Consumer Affairs - Consumer Movement in India: Evolution of Consumer Movement in India, Formation of consumer organizations and their role in consumer protection, Misleading Advertisements and sustainable consumption, National Consumer Helpline, Comparative Product testing, Sustainable consumption and energy ratings. Quality and Standardization: Voluntary and Mandatory standards; Role of BIS, Indian Standards Mark (ISI), Ag-mark, Hallmarking, Licensing and Surveillance; Role of International Standards: ISO an Overview. Note: Unit 2 and 3 refers to the Consumer Protection Act, 1986. Any change in law would be added appropriately after the new law is notified.	
self study portion	
SUGGESTED READINGS:	

1.	Khanna, Sri Ram, Savita Hanspal, Sheetal Kapoor, and H.K. Awasthi. (2007) Consumer Affairs, Universities Press.
2.	Choudhary, Ram Naresh Prasad (2005). Consumer Protection Law Provisions and Procedure, Deep and Deep Publications Pvt. Ltd.
3.	G. Ganesan and M. Sumathy. (2012). Globalization and Consumerism: Issues and Challenges, Regal Publications.
4.	Suresh Misra and Sapna Chadah (2012). Consumer Protection in India: Issues and Concerns, IIPA, New Delhi.
5.	Rajyalaxmi Rao (2012), Consumer is King, Universal Law Publishing Company.
6.	Girimaji, Pushpa (2002). Consumer Right for Everyone Penguin Books.

7.	E-books: -www.consumereducation.in
8.	Empowering Consumers e-book, www.consumeraffairs.nic.in
9.	ebook, www.bis.org
10.	The Consumer Protection Act, 2086 and its later versions.

Question Paper Pattern (External only)	
Duration: 3 hrs	**Max**: 75 marks
Section A (5x5=25)	
Short notes Either – Or/ Type - Question from each unit	
Section B(5X10=50)	
Essay type Either – Or/ Type - Question from each unit	

EXTRA CREDIT COURSES

Subject code : 26UCH0J1

Programme Code: 04	B.Sc. Chemistry			
Title of the paper	**JOB ORIENTED COURSE (JOC) – TEXTILE CHEMISTRY**			
Batch	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	3	45	2	

Course Objectives

1.	To know about manufacture and properties of natural fibres (vegetable fibres, animal fibres) and synthetic fibres.
2.	To learn preparatory process before dying.
3.	To know the principles of bleaching and dyeing.

Course Outcomes (CO)

K1 – K5	CO1	Gain the knowledge about both synthetic and natural fibres.
	CO2	To know about Regenerated and Synthetic Fibres.
	CO3	Understand about scouring and desizing.
	CO4	Learn about bleaching.
	CO5	Basic ideas about dyeing

UNIT – I	**Vegetable Fibres And Animal Fibres**	**9 Hours**

Definition –classification of textile fibres- essential and desirable properties of textile fibres-Cotton fibre –Physical and Chemical properties, Jute –Purification; physical and chemical properties of jute, silk and wool.

UNIT-II	**Regenerated And Synthetic Fibres**	**9 Hours**

Rayon –different types of rayon and their sources-manufacture of viscose rayon- physical and chemical properties- acetate rayon –manufacture –properties, enprammonium rayon –manufacture and properties. Manufacture – properties and uses of polyamides- polyester-polypropylene and polyacrylonitrile.

UNIT-III	**Preparatory Process Prior To Dyeing**	**9 Hours**

Scouring: Objective of scouring–Process of caustic scouring on open kier machine with sine diagram, scouring with NaOH and Na_2CO_3 ¬-Precautions to be taken before scouring. Desizing using malt extract-merits and demerits of acid and enzyme desizing Singeing –Impurities present in grey cotton and cotton fabric –objects of singeing –process of singeing on gas singeing machine – precautions to be taken during gas singeing.

UNIT-IV	**Principles of Bleaching**	**9 Hours**

Principles of wetting and mechanism of detergency –synthetic detergents –surface active agents-bleaching processes –bleaching agents-H_2O_2, NaOCl, bleaching powder and bio-bleaching and their properties-bleaching of cotton, rayon, wool and synthetic fibres.

UNIT-V	**Principles of Bleaching**	**9 Hours**
Colour and chemical constitution –Chromophore and auxochromes-natural and synthetic dyes-dyes –classification, synthesis of dye shift- congored, bismark brown and erifstal violet, theories of dyeing –effect of temperature and salt on dyeing –dyeing of wool, silk and poly-esters-dyeing of cotton with reactive dyes- fastness properties –washing, light, rubbing and perspiration.		
self study portion		

TEXT BOOKS :

1.	Shenai. V.A., (1991) **Chemistry of Dyes and Principles of Dyeing** Vol. II, Mahajan Publishers, Ahmedabad.
2.	Gopalakrishnan. R. (2012) **sustainable fibursed textiles**, Textile Fibres SSM, Institute of Textile Technology, Mahajan Publishers, Ahmedabad.

REFERENCE BOOKS:

1.	1. Shenai. V.A. (1991) **Textile Fibres** (Vol. I), Mahajan Publishers, Ahmedabad.
2.	2. Shenai. V.A., (1998) **Technology of Beaching**, Mahajan Publishers, Ahmedabad.

E – resources

4. https://www.youtube.com/shorts/W9CfygFPkro
5. https://www.sciencedirect.com/topics/engineering/animal-fibre
6. https://www.sciencedirect.com/science/chapter/edited-volume/abs/pii/B9781845696955500039

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	M	S	S	S	M
CO2	H	S	S	S	M
CO3	H	S	S	S	M
CO4	H	S	S	S	H
CO5	S	H	S	S	S

S – Strong **H** – High **M** – Medium **L** – Low

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code : 26UHW401

B.Sc. Chemistry		
Title of the paper : **HEALTH AND WELLNESS**		
Batch 2026 – 2027	Semester IV	Credits 2

Skill Areas:

Physical Fitness, Nutrition, Mental Health, Awareness on Drug addiction and its effects

Purpose:

The Health & Wellness course focuses on teaching the elements of physical, mental, emotional, social, intellectual, environmental well-being which are essential for overall development of an individual. The course also addresses the dangers of substance abuse and online risks to promote emotional and mental health.

Learning Outcomes:

Upon completion of the Health & Wellness course, students will be able to:

1. Demonstrate proficiency in sports training and physical fitness practices.
2. Improve their mental and emotional well-being, fostering a positive outlook on health and life.
3. Develop competence and commitment as professionals in the field of health and wellness.
4. Awareness on drug addiction and its ill effects

Focus:

During the conduct of the Health & Wellness course, the students will benefit from the following focus areas:

1. Stress Management.
2. Breaking Bad Habits.
3. Improving Interpersonal Relationships.
4. Building Physical Strength & Inner Strength.

Role of the Facilitator:

The faculty plays a crucial role in effectively engaging with students and guiding them towards achieving learning outcomes. Faculty participation involves the following areas:

1. **Mentorship & Motivation:** The Facilitator mentors students in wellness and self-discipline while inspiring a positive outlook on health. Faculty teach stress management, fitness, and daily well-being.
2. **Promoting a Safe and Inclusive Environment:** The facilitator ensures a safe, inclusive, and respectful learning environment for active student participation and benefit.
3. **Individualised Support and Monitoring Progress:** The facilitator plays a crucial role in providing personalized support, monitoring and guidance to students.

Guided Activities:

In this course, several general guided activities have been suggested to facilitate the achievement of desired learning outcomes. They are as follows:

1. Introduction to Holistic Well-being.
2. Holistic Wellness Program- Nurturing Body and Mind
3. Breaking Bad Habits Workshop.
4. Improving the elements of physical, emotional, social, intellectual, environmental and mental well-being.
5. Creating situational awareness, digital awareness.
6. Understanding substance abuse, consequences and the way out.

Period Distribution

The following are the guided activities suggested for this Audit course.

The Physical Director should plan the activities by the students.

Arrange the suitable Mentor / Guide for the wellness activities.

Additional activities and programs can be planned for Health and Wellness.

S.No	Guided Activities	Period
1	**Introduction to Holistic Well-being** 1. Introduce the core components of Health & Well-being namely Physical, mental and emotional well-being 2. Provide worksheets on all the four components individually and explain the interconnectedness to give an overall understanding.	
2	**Wellness Wheel Exercise (Overall Analysis)**	

	• Guide students to assess their well-being in various life dimensions through exercises on various aspects of well – being, and explain the benefits of applying wellness wheel. • Introduce Tech Tools: • Explore the use of technology to support well-being. • Introduce students to apps for meditation, sleep tracking, or healthy recipe inspiration.	
3	**Breaking Bad Habits (Overall Analysis)** • Open a discussion on bad habits and their harmful effects. • Provide a worksheet to the students to identify their personal bad habits. • Discuss the trigger, cause, consequence and solution with examples. • Guide them to replace the bad habits with good ones through worksheets.	
4	**Physical Well-being** **1. Fitness** Introduce the different types of fitness activities such as basic exercises, cardiovascular exercises, strength training exercises, flexibility exercises, so on and so forth. (Include theoretical explanations and outdoor activity). **2. Nutrition** Facilitate students to reflect on their eating habits, their body type, and to test their knowledge on nutrition, its sources and the benefits. **3. Yoga & Meditation** Discuss the benefits of Yoga and Meditation for one's overall health. Demonstrate different yoga postures and their benefits on the body through visuals (pictures or videos)	

	4. Brain Health Discuss the importance of brain health for daily life. Habits that affect brain health (irregular sleep, eating, screen time). Habits that help for healthy brains (reading, proper sleep, exercises). Benefits of breathing exercises and meditation for healthy lungs. **5. Healthy Lungs** Discuss the importance of lung health for daily life. Habits that affect lung health (smoking, lack of exercises). Benefits of breathing exercises for healthy lungs. **6. Hygiene and Grooming** Discuss the importance of hygienic habits for good oral, vision, hearing and skin health. Discuss the positive effects of grooming on one's confidence level and professional growth. **Suggested Activities (sample):** **Nutrition:** Invite a nutritionist to talk among the students on the importance of nutrition to the body or show similar videos shared by experts on social media. Organize a 'Stove less/fireless cooking competition' for students where they are expected to prepare a nutritious dish and explain the nutritive values in parallel.	
5	**Emotional Well-being** **1. Stress Management** Trigger a conversation or provide self-reflective worksheets to identify the stress factors in daily life and their impact on students' performance. Introduce different relaxation techniques like deep breathing, progressive muscle relaxation, or guided imagery. (use audio recordings or visuals to guide them through these techniques). After practicing the techniques, have them reflect on how these methods can help manage stress in daily life. **2. Importance of saying 'NO'.**	

	Explain the students that saying 'NO' is important for their Physical and mental well-being, Academic Performance, Growth and Future, Confidence, Self-respect, Strong and Healthy Relationships, building reputation for self and their family (avoid earning a bad name). Factors that prevent them from saying 'NO'. How to practice saying 'NO". **3. Body Positivity and self-acceptance** Discuss the following with the students. • What is body positivity and self-acceptance? • Why is it important? • Be kind to yourself. • Understand that everyone's unique. **Suggested Activities(Sample):** (Importance of saying 'NO') Provide worksheets to self-reflect on... ...how they feel when others say 'no' to them ...the situations where they should say 'no' Challenge students to write a song or rap about the importance of saying no and how to do it effectively. Students can perform their creations for the class.	
6	**Social Well-Being** **1. Practicing Gratitude** Discuss the importance of practicing gratitude for building relationships with family, friends, relatives, mentors and colleagues. Discuss how one can show gratitude through words and deeds. Explain how practicing gratitude can create 'ripple effect'. **2. Cultivating Kindness and Compassion** Define and differentiate between kindness and compassion. Explore practices that cultivate these positive emotions. Self-Compassion as the Foundation.	

	The power of small gestures. Understanding another's perspective. The fruits of compassion. **3. Practising Forgiveness** Discuss the concept of forgiveness and its benefits. Forgiveness: What is it? and What it isn't? Benefits of forgiveness. Finding forgiveness practices. **4. Celebrating Differences** Appreciate the value of individual differences and foster inclusivity. The World: A Tapestry of Differences (cultures, backgrounds, beliefs, abilities, and appearances). Finding strength in differences (diverse perspectives and experiences lead to better problem-solving and innovation). Celebrating differences, not ignoring them (respecting and appreciating the unique qualities). Activities for celebrating differences (share culture, learn about others, embrace new experiences). **5. Digital Detox** **Introduce the students to:** The concept of a digital detox and its benefits for social well-being. How to disconnect from devices more often to strengthen real-world connections. **Suggested Activities (sample)**: (Practicing Gratitude) Provide worksheets to choose the right ways to express gratitude. Celebrate 'gratitude day' in the college and encourage the students to honour the house keeping staff in some way to express gratitude for their service.	
7.	**Intellectual Well-being** **1. Being a lifelong Learner** **Give students an understanding on:** The relevance of intellectual well-being in this 21st century to meet	

	the expectations in personal and professional well-being The Importance of enhancing problem-solving skills Cultivating habits to enhance the intellectual well-being (using the library extensively, participating in extra-curricular activities, reading newspaper etc.) **2. Digital Literacy** **Discuss:** The key aspects of digital literacy and its importance in today's world. It is more than just liking and sharing on social media. The four major components of digital literacy (critical thinking, communication, problem-solving, digital citizenship). Why is digital literacy important? Boosting one's digital skills. **3. Transfer of Learning** Connections between different subjects – How knowledge gained in one area can be applied to others. **Suggested Activities(sample):** Intellectual Well-being. Provide worksheets to students for teaching them how to boost intellectual well-being. Ask the students to identify a long-standing problem in their locality, and come up with a solution and present it in the classroom. Also organize an event like 'Idea Expo' to display the designs, ideas, and suggestions, to motivate the students to improve their intellectual well-being.	
8	**Environmental Well-being** 1.The Importance of initiating a change in the environment. **The session could be around:** Defining Environmental well-being (physical, chemical, biological, social, and psychosocial factors) – People's behaviour, crime, pollution, political activities, infra-structure, family situation etc. Suggesting different ways of initiating changes in the environment (taking responsibility, creating awareness, volunteering,	

	approaching administration). **Suggested Activities (sample):** Providing worksheets to self-reflect on how the environment affects their life, and the ways to initiate a change. Dedicate a bulletin board or wall space (or chart work) in the classroom for students to share their ideas for improving environmental well-being. Creating a volunteers' club in the college and carrying out monthly activities like campus cleaning, awareness campaigns against noise pollution, (loud speakers in public places), addressing anti-social behaviour on the campus or in their locality.	
9	**Mental Well-being** **1. Importance of self-reflection** **Discuss:** Steps involved in achieving mental well-being (self-reflection, self-awareness, applying actions, achieving mental well-being). Different ways to achieve mental well-being (finding purpose, coping with stress, moral compass, connecting for a common cause). The role of journaling in mental well-being. **2. Mindfulness and Meditation Practices** Benefits of practicing mindful habits and meditation for overall well-being. **1. Connecting with nature** Practising to be in the present moment – Nature walk, feeling the sun, listening to the natural sounds. Exploring with intention – Hiking, gardening to observe the nature. Reflecting on the emotions, and feeling kindled by nature. **2. Serving people** Identifying the needs of others. Helping others. Volunteering your time, skills and listening ear. Finding joy in giving. **3. Creative Expressions**	

	Indulging in writing poems, stories, music making/listening, creating visual arts to connect with inner selves. **Suggested Activities(Sample):** (Mindfulness and Meditation) – Conducting guided meditation every day for 10 minutes and directing the students to record the changes they observe.	
10	**Situational Awareness (Developing Life skills)** **1. Being street smart** **Discuss:** Who are street smarts? Why is it important to be street smart? Characteristics of a street smart person: Importance of acquiring life skills to become street smart – (General First-aid procedure, CPR Procedure, Handling emergency situations like fire, flood etc). **2. Digital Awareness** **Discuss:** Cyber Security Information Literacy Digital Privacy Fraud Detection **Suggested Activities** (sample): (Street Smart) Inviting professionals to demonstrate the CPR Procedure Conducting a quiz on Emergency Numbers	
11	**Understanding Addiction** **Plan this session around:** Identifying the environmental cues, triggers that lead to picking up this habit. Knowing the impact of substance abuse – Adverse health conditions, social isolation, ruined future, hidden financial loss and damaging the family reputation. Seeking help to get out of this addiction. **Suggested Activities**:	

	Provide Worksheets to check the students' level of understanding about substance addiction and their impacts. Share case studies with students from real-life. Play/share awareness videos on addiction/de-addiction, experts talk. *Conduct awareness programmes on Drugs and its ill effects. (Arrange Experts from the concerned government departments and NGOs working in drug addiction issues) and maintain the documents of the program.	

Closure:

Each student should submit a Handwritten Summary of their Learnings & Action Plan for the future.

Assessments:

- Use Self-reflective worksheets to assess their understanding.
- Submit the worksheets to internal audit/external audit.
- Every student's activities report should be documented and the same have to be assessed by the Physical Director with the mentor. The evaluation should be for 100 marks. No examination is required.

Scheme of Evaluation

Part	Description	Marks
A	Report	40
B	Attendance	20
C	Activities (Observation During Practice)	40
Total		100

References/Resource Materials:

The course acknowledges that individual needs for references and resources may vary. However, here are some general reference materials and resources that may be helpful:

1. **The Well-Being Wheel:**



2. **Facilities & Spaces:** Some activities may require access to specific facilities, resources or spaces. Students may need to coordinate with the college administration to reserve these as required.
3. **Online Resources:**
    1. United Nations Sustainable Development Goals - Goal 3 - Good Health & Well-Being: https://www.un.org/sustainabledevelopment/health/
    2. Mindfulness and Meditation: Stanford Health Library offers mindfulness and meditation resources: https://healthlibrary.stanford.edu/books-resources/mindfulness-meditation.html

3. Breaking Bad Habits: James Clear provides a guide on how to build good habits and break bad ones: https://jamesclear.com/habits
4. 6 Ways to Keep Your Brain Sharp
https://www.lorman.com/blog/post/how-to-keep-your-brain-sharp
5. What Is Social Wellbeing? 12+ Activities for Social Wellness
https://positivepsychology.com/social-wellbeing/
6. How Does Your Environment Affect Your Mental Health?
https://www.verywellmind.com/how-your-environment-affects-your-mental-health-5093687
7. How to say no to others (and why you shouldn't feel guilty)
https://www.betterup.com/blog/how-to-say-no

ALLIED PAPERS

Subject code : 26UCH1A1/ 26UCH3A3

Programme Code: 04		B.Sc., Biotechnology (I Year), Physics (II year), Botany (II Year), Biochemistry (II Year)			
Title of the paper		**ALLIED PAPER – I CHEMISTRY - I**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development**
2026 - 2027	**I/ III**	4	60	**4**	

Course Objectives

1.	To understand the fundamentals of Chemical bonding.
2.	To study various types of organic Reaction.
3.	To study the basic principles of thermodynamics and electrochemistry.

Course Outcomes (CO)

K1 – K5	CO1	Understanding the fundamental aspects of chemical bonding and Interhalogen compounds.
	CO2	To acquire knowledge of types for organic reaction
	CO3	Study on the various concepts in Thermodynamics.
	CO4	Study on the various concepts in Electrochemistry.
	CO5	Acquiring knowledge about Fuel gases and Chromatography

UNIT – I	**Concepts of Chemical bond**	**12 Hours**

1. Chemical Bonding - Molecular orbital theory- bonding, anti-bonding and non - bonding molecular orbitals - Energy order of MO's - Diamagnetism and Para magnetism - Bond order – Molecular orbital configuration of H_2, N_2, O_2 and F_2.
2. Inter halogen Compounds - Types of Inter halogen Compounds. Preparation, properties, uses and Structures of ICl, and BrF_3

UNIT-II	**Types of Organic Reactions**	**12 Hours**

Types of Organic Reactions and Reagents: Electrophiles, Nucleophiles and Free Radicals. Isomerism: Geometrical and Optical Isomerisms – Optical Isomerism in Lactic and Tartaric acids – Resolution. Geometrical Isomerism in Maleic and Fumaric acid. Keto – Enol Tautomerism – Orbital overlap – Types of Hybridization and Geometry of Methane, Ethylene and Acetylene.

UNIT-III	**Energetics**	**12 Hours**

Introduction - Scope and limitations - Basic terms - system, surroundings - Types of system, state of system, state variables. Thermodynamic processes - Isothermal, Adiabatic, Isobaric, Isochoric and cyclic processes - Reversible and irreversible processes - Spontaneous process. First law of thermodynamics - Mathematical formulation-limitations. Need for Second law - various statements of second law. Joule - Thomson effect.

UNIT-IV	**Electrochemistry**	**12 Hours**
Electrochemistry: Introduction - Electrolysis -Specific Conductance, Equivalent Conductance, Effect of Dilution on Conductance, Ostwalt's Dilution Law, Kohlrausch's Law – Applications. Importance of pH and Buffer Solution in Living Systems. **Corrosion**: Definition – Types of corrosion- Prevention methods: Principles of electroplating and its uses.		
UNIT-V	**Chemistry of Fuels**	**12 Hours**
1. **Fuel gases** - Qualities of good fuel. Advantages of gaseous fuels over solid and liquid fuels. Short accounts of natural gas, water gas, semi water gas, carburetted water gas, producer gas and oil gas (manufacturing details not required). **2. Chromatography:** Principles of Column, Paper and Thin Layer Chromatography.		
self study portion		

TEXT BOOKS:

1.	Arun Bahl and B.S. Bahl, (2012) **Advanced Organic Chemistry**, S. Chand and Co., New Delhi,
2.	R.D. Madan- **Modern Inorganic Chemistry**, S. Chand and company, New Delhi.
3.	Jain and Jain, **Engineering Chemistry**, Dhanpat Rai Publication limited, New Delhi.
4.	Arun Bahl and B.S. Bahl, Essentials of Physical Chemistry, S. Chand and Co., New Delhi,
5.	Puri B. R. Sharma L. R., M. S. Pathania, (2013) **Principles of Physical Chemistry**, Vishal Publishing Co., New Delhi.

REFERENCE BOOKS:

1.	I.L. Finar, (2009) **Organic Chemistry,** Vol.I and II, Addison-Wesley Longman.

E – resources:

1. https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_-_The_Central_Science_(Brown_et_al.)/08%3A_Basic_Concepts_of_Chemical_Bonding
2. https://www.youtube.com/watch?v=om7yDLgTIT4
3. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Electrochemistry

MAPPING (Physics)					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	M	M	M	M
CO2	S	H	M	H	M
CO3	S	M	M	M	M
CO4	S	H	H	H	H
CO5	S	H	H	M	S
S – Strong	**H** – High		**M** – Medium	**L** – Low	

MAPPING (Biochemistry)					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	M	M	M	M
CO2	S	M	M	H	H
CO3	S	M	M	H	M
CO4	S	H	H	H	H
CO5	S	S	H	M	S
S – Strong	**H** – High		**M** – Medium	**L** – Low	

MAPPING (Botany)					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	H	M	M	M
CO2	S	H	M	H	H
CO3	S	M	H	H	M
CO4	S	H	H	H	H
CO5	S	S	H	M	S
S – Strong	**H** – High		**M** – Medium	**L** – Low	

MAPPING (Biotechnology)					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	H	M	H	M
CO2	S	S	H	H	H
CO3	S	H	M	H	M
CO4	S	H	H	M	H
CO5	S	H	H	H	S
S – Strong	**H** – High		**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge

Signature of the HOD

Subject code : 26UCH2A2/ 26UCH4A4

Programme Code: 04		B.Sc., Biotechnology (I Year), Physics (II year), Botany (II Year), Biochemistry (II Year)			
Title of the paper		**ALLIED PAPER – II CHEMISTRY - II**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development**
2026 - 2027	II/ IV	4	60	**4**	

Course Objectives

1.	To know the fundamentals of Coordination compounds.
2.	To learn about some natural products, amino acids and proteins.
3.	To study about quantitative and qualitative analysis and synthetic polymer.

Course Outcomes (CO)

K1 – K5	CO1	Understanding the fundamental aspects and applications of coordination Chemistry.
	CO2	Study on the various heterocyclic compounds, carbohydrates and amino acids which include their classification, preparation and properties.
	CO3	To gain knowledge about amino acids and vitamins.
	CO4	To understand theoretical aspects of quantitative and qualitative analysis
	CO5	Acquire the knowledge about synthetic polymers, fibers and plastics

UNIT – I	**Coordination compounds**	**12 Hours**

Complexes (Mononuclear complexes only)
1. General aspects- central metal atom, Ligand- types of ligands. Coordination number of central metal atom, oxidation number of central metal atom
2. Theories of Complexes - Werner's theory, Sidgwick theory - EAN rule, Pauling's theory and its application to Potassium Hexacyanoferrate (II)
3. Structure and functions of Hemoglobin and Chlorophyll.

UNIT-II	**Quantitative analysis**	**12 Hours**

Volumetric analysis- Types- Examples. Principles of acid- base, Redox titration.
Standard solutions - Primary, secondary standards (Definitions only) Examples. Definition for normality, molarity, equivalent weight with examples.

UNIT-III	**Amino acids**	**12 Hours**

1.***Amino acids** – **Classification** - Preparation - Gabriel Phthalimide synthesis, Strecker synthesis, Amination of α - halo acid-properties.
2. Vitamins-Definition-Classification – Types (A, B6, B12, C, D)- Sources ,Deficiency-Disease.

UNIT-IV	**Qualitative analysis**	**12 Hours**

Detection of nitrogen, sulphur, phorporus, chlorine, Identification of functional groups (mono and diamide, carbohydrate, mono and dicarboxylic acid, primary amine, simple phenol theory only).

UNIT-V	**Polymers**	**12 Hours**

1.Polymers – Monomer, polymer, Natural polymers and synthetic polymers- Polymerisation– Addition and condensation polymerization.

2. Synthetic fibers – *Important requirement of a fiber, difference between natural and synthetic fiber, Preparation of nylon 6,6.

3. Synthetic plastics – Classification-thermosetting and thermoplastic plastics – differences

self study portion

TEXT BOOKS:

1.	Arun Bahl and B.S. Bahl, (2021) **Advanced Organic Chemistry**, S. Chand and Co., New Delhi,
2.	R.D. Madan, (2022) **Modern Inorganic Chemistry**, S. Chand and company, New Delhi.
3.	R. Gopalan, P.S. Subramanian & K. Rengarajan, (2021) **Elements of Analytical Chemistry**, Sultan Chand & Sons,
4.	Arun Bahl and B.S. Bahl, (2023) Essentials of Physical Chemistry, S. Chand and Co., New Delhi,
5.	Puri B. R. Sharma L. R., M. S. Pathania, (2022) **Principles of Physical Chemistry**, Vishal Publishing Co., New Delhi.

REFERENCE BOOKS:

1.	I.L. Finar, (2021) **Organic Chemistry,** Vol.I and II, Addison-Wesley Longman.
2.	R. Gopalan and V. Ramalingam, (2023) Concise Coordination Chemistry, Vikas Publishing House Pvt..Ltd, New Delhi.

e-Resources:

1.chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/http://www.vpscience.org/materials/US05CICH21%20UNIT1.pdf

2.https://www.youtube.com/watch?v=Pmr51HWgzVk

3.https://www.slideshare.net/slideshow/reactions-of-amino-acids/73662554

4.https://sathee.iitk.ac.in/ncert-books/udaan/udaan-che-12/chem-12-unit-15-polymers/

MAPPING (Physics)

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	M	H	M
CO2	S	S	H	H	H
CO3	S	H	M	H	M
CO4	S	H	H	M	H
CO5	S	H	H	M	H

S – Strong **H** – High **M** – Medium **L** – Low

MAPPING (Biochemistry)

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	M	H	M
CO2	S	M	H	M	H
CO3	S	H	H	H	M
CO4	S	H	H	M	M
CO5	S	H	H	H	M
S – Strong	**H** – High	**M** – Medium	**L** – Low		

MAPPING (Botany)

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	M	M	H	H
CO2	S	S	H	M	H
CO3	H	H	H	H	M
CO4	S	H	H	M	H
CO5	S	H	H	H	M
S – Strong	**H** – High	**M** – Medium	**L** – Low		

MAPPING (Biotechnology)

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	H	M	H	M
CO2	S	S	H	H	H
CO3	S	H	M	H	M
CO4	S	H	H	M	H
CO5	S	H	H	M	H
S – Strong	**H** – High	**M** – Medium	**L** – Low		

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code : 26UCH2AL/ 26UCH4AL

Programme Code: 04		B.Sc., Biotechnology (I Year), Physics (II year), Botany (II Year), Biochemistry (II Year)			
Title of the paper		**ALLIED PRACTICAL – I VOLUMETRIC AND ORGANIC ANALYSIS**			
Batch	**Semester**	**Hours / Week**	**Total Hours**	**Credits**	**Employability/ Skill Development/ Entrepreneurship**
2026 - 2027	**II/ IV**	3	90	2	

Course Objectives

1.	To demonstrate the basic laboratory technique of titration.
2.	To gain deep knowledge about analysis of organic substances.
3.	To identify the functional groups of unknown compounds.

Course Outcomes (CO)

K3 – K5	CO1	Remember the basics of volumetric titrations.
	CO2	Studying the use of indicators for various titrations.
	CO3	Understanding about preliminary analysis of organic compounds.
	CO4	Identification of the functional groups.
	CO5	Practice for getting accuracy in volumetric estimations

Volumetric Analysis	
1.	Estimation of Sodium hydroxide using standard Sodium Carbonate Solution
2.	Estimation of Hydrochloric acid-standard Oxalic acid
3.	Estimation of Oxalic acid- Standard sulphuric acid.
4.	Estimation of ferrous Sulphate –Standard Mohr salt solution.
5.	Estimation of Oxalic acid- Standard ferrous Sulphate solution.
6.	Estimation of Potassium permanganate- Standard sodium hydroxide solution
Organic Analysis	
1.	Detection of elements (N, S, Halogens).
2.	To distinguish between Aliphatic and Aromatic.
3.	To distinguish between Saturated and unsaturated.
4.	Functional group test for Phenol, acids, (mono and di), aromatic primary amine, amide (mono and di), dextrose.
5.	Systematic analysis of Organic compounds containing one functional group and characterization by confirmatory tests.

TEXT BOOKS:

1.	V. Venkateswaran, R. Veeraswmay, A.R. Kulandaivelu,(1997**Basic Principles of Practical Chemistry**, New Delhi, Sultan Chand and Sons.

REFERENCE BOOKS:	
1.	N. S. Gnanapragasam and G. Ramamoorthy, (2006) **Organic Chemistry Lab manual,** S. Viswanathan Private Limited, Chennai.

Time: 3 Hours			**Max. Marks: 30**
Distribution of Total Marks 30			
	Record	5	
	Volumetric	12	
	Organic Analysis	13	
Volumetric – 12 Marks			
	Error up to 2%	12	
	3%	9	
	4%	5	
	>4%	2	
Reduce 1 mark for each arithmetic error			
For wrong or no calculation, reduce 25% of the marks awarded. (Here, the examiners have to do the calculation and then, have to award marks)			
Organic Analysis - 13 Marks			
	Preliminary Tests	3	
	Aliphatic / Aromatic	2	
	Saturated / Unsaturated	2	
	Special elements	3	
	Functional group	3	

MAPPING (Physics)					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	H	M	H	M
CO2	S	S	H	H	H
CO3	S	H	M	H	M
CO4	S	H	H	M	H
CO5	S	H	H	H	M

S – Strong **H** – High **M** – Medium **L** – Low

MAPPING (Biochemistry)					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	H	M	H	M
CO2	S	M	H	M	H
CO3	S	H	H	H	M
CO4	S	H	H	M	M

CO5	S	H	H	M	S
S – Strong		**H** – High	**M** – Medium	**L** – Low	

MAPPING (Botany)					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	M	M	H	H
CO2	S	S	H	M	H
CO3	H	H	H	H	M
CO4	S	H	H	M	H
CO5	S	H	H	H	M
S – Strong		**H** – High	**M** – Medium	**L** – Low	

MAPPING (Biotechnology)					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	H	M	H	M
CO2	S	S	H	H	H
CO3	S	H	M	H	M
CO4	S	H	H	M	H
CO5	S	H	S	S	M
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

CERTIFICATE PROGRAMME ON DISASTER MANAGEMNT

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE – 641 029

Programme Name: **CERTIFICATE PROGRAMME – DISASTER MANAGEMENT**

PROGRAMME OUTCOME (PO)

On the successful completion of the programme, the following are the expected outcomes

PO1 – Comprehensive Disaster Awareness: Understand various natural and human-made disasters, their causes, effects, and historical case studies.

PO2 – Disaster Risk Reduction: Apply principles of safety engineering, risk analysis, and prevention techniques to reduce disaster impacts.

PO3 – Sustainable Development Integration: Recognize the importance of sustainable development goals and climate change mitigation in disaster management.

PO4 – Preparedness and Response: Develop skills in disaster preparedness, emergency response, and community-based disaster management.

PO5 – Health and Safety Management: Identify health hazards related to disasters and implement effective healthcare and safety strategies.

PO6 – Policy Understanding and Implementation: Comprehend national and international disaster management frameworks, including relief strategies and policies.

PO7 – Social Responsibility and CSR: Appreciate the role of Corporate Social Responsibility and ethical considerations in disaster relief and sustainable rehabilitation.

PO8 – Collaborative and Strategic Planning: Engage with community, governmental, and non-governmental organizations for effective disaster risk management and relief operations.

PROGRAMME SPECIFIC OUTCOMES (PSOS)

PSO1: Categorize and analyze different types of disasters and their specific management challenges.

PSO2: Apply safety analysis, engineering principles, and health risk assessments in disaster preparedness and mitigation.

PSO3: Design and implement community education and training programs focused on disaster preparedness and response.

PSO4: Evaluate and participate in national disaster relief strategies and policy frameworks for efficient response.

PSO5: Integrate sustainable development and CSR principles into holistic disaster management and recovery efforts.

Semester	Part	Subject Code	Title of the Paper	Instruction hours/cycle	Exam. Marks			Duration of Exam (hours)	Credits
					CIA	ESE	TOTAL		
-	-	**26CDM101**	Theory 1 – Disaster Management and Sustainable Development	4	25	75	100	3	2
		26CDM102	Theory 2 – Disaster Preparedness and response	4	25	75	100	3	2
		26CDM103	Theory 3 – Disaster recovery	4	25	75	100	3	2
	Total			**12**	-	-	300	-	**06**

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

K1-Remembering;**K2**-Understanding;**K3**-Applying;**K4**-Analyzing;**K5**-Evaluating

1. ESE Theory Examination:

(i) CIA I & II and ESE: 75 Marks

Knowledge Level	Section	Marks	Description	Total
K1 Q1 to 10	A (Answer all)	10 x 1 = 10	MCQ	75
K1 – K5 Q11 to 15	B (Either or pattern)	5 x 5 = 25	Short Answers	
K2 – K5 Q16 to 20	C (Either or pattern)	5 x 8 = 40	Descriptive / Detailed	

Components of Continuous Internal Assessment

Components		**Marks**	**Total**
Theory			
CIA I	75	(75+75 = 150/10) 15	25
CIA II	75		
Objective Capacity Testing */Seminar		5	
Attendance		5	

CERTIFICATE PROGRAMME – DISASTER MANAGEMENT			
Title of the paper:	THEORY 1 – DISASTER MANAGEMENT AND SUSTAINABLE DEVELOPMENT		
Hours / Week		**Total Hours**	Credit
4		60	2

Course Objectives

1.	To understand the basic aspects of History and Case Studies of Disasters and PipelineDisasters and oil Spills.
2.	To learn about Climate Changes and Disasters and gain knowledge about Disaster Management Education.
3.	To study about Concept and benefits of Corporate Social Responsibility (CSR).

Course Outcomes (CO)

K1 – K5	CO1	Understand the History and Case Studies of Disasters
	CO2	To understand the Pipeline Disasters and oil Spills & Land degradation and Droughts.
	CO3	Gain the knowledge about Climate Changes and Disasters.
	CO4	Study the basic principles of Disaster Management Education.
	CO5	Explore the Concept and benefits of Corporate Social Responsibility (CSR).

UNIT – I	**12 Hours**

History and Case Studies of Disasters

Introduction, Classification of disasters, History of Disasters, Orissa super Cyclone, Community – based Disaster preparedness (CBDP), Tenth Five Year plan (2002 – 07) and Orissa Super Cyclone,

Floods in Bangladesh

Sustainable Development and Disaster Reduction

Sustainable Development, Sustainable Development Goals (SDGs), Sustainable Development Goals report 2018, World conference on Disaster Risk Reduction, Measures to promote Sustainable Development, International Efforts and Co – operation.

UNIT-II	**12 Hours**

Pipeline Disasters and oil Spills

Pipeline Transportation, Oil Spills, Nigerian Dilemma

Land degradation and Droughts

Land pollution and Degradation, Consequences of Land degradation, Strategies to check land degradation, Droughts: causes, consequences and remedial strategies, programmes for treatment of degraded lands.

UNIT-III	**12 Hours**
Climate Changes and Disasters Climate Changes and Human Settlements, Climate Change and Water Supply, Occurrence of Droughts, River Hydrology and Inland flooding, Cyclonic storms, Strom Surges and Coastal Flooding, Sea level flooding, India's approach to climate change, National Action plan onclimate change (NAPCC), Eight National Missions of NAPCC.	
UNIT-IV	**12 Hours**
Disaster Management Education Role of education for Disaster Preparedness, Disaster Management education in India, National Disaster Management Training and education for Disaster preparedness, public education, training, rehearsal and experience for disaster preparedness, education, experience and risk perception for disaster preparedness.	
UNIT-V	**12 Hours**
Concept and benefits of Corporate Social Responsibility (CSR) CSR – Definition, main features of CSR, origins of CSR, Approaches to CSR, principle to Triple Bottom Line (TBL), potential business benefits of CSR, Convergence and Transparency of CSR practices, Globalization and CSR, promoting CSR : The challenges.	
self study portion	

TEXT BOOKS:

1.	Niranjan Sahoo (2019) **Disaster Management and Sustainable Development**, New Century Publications, New Delhi.
2.	**Disaster Management Guidelines**, GOI-UND Disaster Risk Program (2009-2012)
3.	Damon, P. Copola, (2006), **Introduction to International Disaster Management**, Butterworth Heineman.

REFERENCE BOOKS:

1.	Gupta A.K., Niar S.S and Chatterjee S. (2013) **Disaster management and Risk Reduction**, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
2.	Murthy D.B.N. (2012) **Disaster Management**, Deep and Deep Publication PVT. Ltd. New Delhi. 3.Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India ltd

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	H	M	M
CO2	S	S	S	S	S
CO3	S	S	M	H	M
CO4	S	S	H	M	S
CO5	S	S	H	H	S

S – Strong **H** – High **M** – Medium **L** – Low

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code : 26CDM102

CERTIFICATE PROGRAMME – DISASTER MANAGEMENT			
Title of the paper:	**THEORY 2 – DISASTER PREPAREDNESS AND RESPONSE**		
Hours / Week		**Total Hours**	Credit
4		60	2

Course Objectives

1.	To know about the region of Natural disasters and study Safety engineering and analysis techniques.
2.	To have insight about Natural disaster effects and fighting against threats and acquire knowledge about Health care and safety.
3.	To know about National disaster relief strategy and general preparedness.

Course Outcomes (CO)

K1 – K5	CO1	Understand the Types of disasters and causes of disasters.
	CO2	Gain the knowledge about Safety engineering and analysis techniques.
	CO3	Study about the Natural disaster effects and fighting against threats.
	CO4	Know about Health care and safety.
	CO5	Exploring the various National disaster relief strategy and general preparedness.

UNIT – I	**Natural disasters**	**12 Hours**

Types of disasters – causes of disasters – Human made disaster – role of education – Bush fire, earth quake, famine, floods, tsunami, droughts, cyclone, avalanches, volcanic eruption, disaster risk management, real kinship, ritual kinship, non-government organizations, financial resources, environmental issues.

UNIT-II	**Measures for safety**	**12 Hours**

Safety engineering, analysis techniques, safety certification, preventing failure, safety and reliability, containing failure, evolution of safety, evolution of safety management, safety organization in industry, safety culture, function of safety, safety benefits.

UNIT-III	**Natural disaster effects and fighting against threats**	**12 Hours**

Natural disaster effects as Stressors, conceptual guidelines and principles, threat phase, local disaster management cell, current practices, strategic thinking, government response in disasters, types of response.

UNIT-IV	**Health care and safety**	**12 Hours**

Health hazards, physical and mechanical hazards, identifying hazards, conformed space standard, susceptibility of the population, determination of the health service, climatic events, levels of intervention, curative actions, health education.

UNIT-V	**National strategy for relief**	**12 Hours**
National disaster relief strategy and general preparedness, general principles, disasters alert, relief phase, myths and reality, key aspects effective response, medical health care, food supplies, water supplies, hygiene, environmental sanitation, construction equipment, communications, logistics systems and facilities.		
self study portion		
TEXT BOOKS:		
1.	K.K. David (2020), **Disaster Management and Preparedness**, Rajat publicatios, New Delhi.	
2.	**Disaster Management Guidelines**, GOI-UND Disaster Risk Program (2009-2012)	
3.	Damon, P. Copola, (2006) **Introduction to International Disaster Management**, Butterworth Heineman.	
REFERENCE BOOKS:		
1.	Gupta A.K., Niar S.S and Chatterjee S. (2013) **Disaster management and Risk Reduction**, Role of Environmental Knowledge, Narosa Publishing House, Delhi.	
2.	Murthy D.B.N. (2012) **Disaster Management**, Deep and Deep Publication PVT. Ltd. New Delhi. 3.Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LT	

e- resources

1. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.adpc.net/UDRM/primer/web/floodprimer/04fp.pdf
2. https://www.slideshare.net/slideshow/disaster-preparedness-and-responseppt/254844179

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	H	M	M
CO2	S	S	S	S	S
CO3	S	S	M	H	M
CO4	S	S	H	M	S
CO5	S	S	H	H	S
S – Strong	**H** – High	**M** – Medium	**L** – Low		

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code : 26CDM103

CERTIFICATE PROGRAMME – DISASTER MANAGEMENT			
Title of the paper:	**THEORY 3 – DISASTER RECOVERY**		
Hours / Week		**Total Hours**	Credit
4		60	2

Course Objectives

1.	To learn group Causes of disaster and study about Disaster recovery plan.
2.	To know about Role of technology in disaster recovery management and study about Environmental disaster management.
3.	To learn about Disaster management to psychological perspectives.

Course Outcomes (CO)

K1 – K5	CO1	Gain the knowledge about Disaster recovery.
	CO2	Understand the basic aspects of Disaster recovery plan.
	CO3	Analyze and apply Role of technology in disaster recovery management.
	CO4	Understand about Brief history of the environment movement.
	CO5	To meet the contemporary challenges on Disaster management to psychological perspectives.

UNIT – I	**Introduction to disaster recovery**	**12 Hours**

Causes of disaster, Introduction, self-reliance, UN – DHA objective, operational fire management systems and organizations, role of military and civil defense assets, importance of disaster recovery planning, control measures, strategies, recovery time objective, recovery time actual, recovery consistency objective, recovery point objectives.

UNIT-II	**Disaster recovery plan**	**12 Hours**

Objectives, relationship to the business continuity plan, benefits, types of plan, types of disasters, planning methodology, caveats and controversies, disaster management apparatus, Sahana Foss disaster management system.

UNIT-III	**Role of technology in disaster recovery management**	**12 Hours**

IT network disaster recovery, emergency management systems, GPS, applications of GPS to disaster management, thermal infrared remote sensing technology, population dynamics model for disaster management. Integral view of space technologies.

UNIT-IV	**Environmental disaster management**	**12 Hours**

Brief history of the environment movement, environmental and the four phases of emergency management, environmental in the disaster context, the news of environmental management, development and disaster risk.

UNIT-V	**Disaster management to psychological perspectives**	**12 Hours**
Event of psychological impact of disasters, Psychological interventions to victims, Forms of psycho pathology resulting from disaster, psychological perspectives and disasters, disaster perspective and disaster relief.		
self study portion		
TEXT BOOKS :		
1.	Sachin Sehdev Paarikh (2018), Disaster Recovery, Random Publications, New Delhi	
2.	Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)	
3.	Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth Heineman.	
REFERENCE BOOKS:		
1.	Gupta A.K., Niar S.S and Chatterjee S. (2013) **Disaster management and Risk Reduction**, Role of Environmental Knowledge, Narosa Publishing House, Delhi.	
2.	Murthy D.B.N. (2012) **Disaster Management**, Deep and Deep Publication PVT. Ltd. New Delhi. 3.Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LT	

e- resources

1. https://www.youtube.com/watch?v=5ATF-eii6cQ
2. https://cloudian.com/guides/disaster-recovery/disaster-recovery-5-key-features-and-building-your-dr-plan/

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	H	M	M
CO2	S	S	S	S	S
CO3	S	S	M	H	M
CO4	S	S	H	M	S
CO5	S	S	H	H	S
S – Strong	**H** – High		**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

CERTIFICATE PROGRAMME ON INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE – 641 029

Programme Name: **CERTIFICATE PROGRAMME –**

INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS

(Applicable to the students admitted during the Academic Year 2026-2027)

PROGRAMME OUTCOME (PO)

On the successful completion of the programme, the following are the expected outcomes

PO1 – Foundational Knowledge: Acquire comprehensive knowledge of classical and modern analytical chemistry principles.

PO2 – Instrumental Proficiency: Understand the working principles and applications of UV-Visible, IR, and NMR spectroscopy.

PO3 – Analytical Accuracy: Apply concepts of error analysis, precision, and accuracy for reliable chemical measurements.

PO4 – Practical Application: Perform various chemical separation and purification techniques relevant to both academic and industrial labs.

PO5 – Chromatographic Techniques: Gain hands-on understanding of thin-layer and column chromatography for compound identification and isolation.

PO6 – Industrial Relevance: Demonstrate awareness of industrial processes such as electroplating, and biochemical systems including pH and buffers.

PO7 – Scientific Reasoning: Interpret experimental data logically using scientific and statistical approaches.

PO8 – Effective Communication: Document and communicate scientific observations and results clearly and accurately.

PROGRAMME SPECIFIC OUTCOMES (PSO)

After completing this course, students will be able to:

PSO1: Select and apply appropriate instrumental and spectroscopic techniques for qualitative and quantitative analysis.

PSO2: Interpret spectroscopic data (UV-Vis, IR, NMR) for structural and chemical identification of substances.

PSO3: Demonstrate skills in classical purification and modern chromatographic separation methods.

PSO4: Perform experiments with an understanding of error minimization, reproducibility, and safety.

PSO5: Apply analytical chemistry concepts in solving real-world problems in chemical, biochemical, and industrial settings.

Semester	Part	Subject Code	Title of the Paper	Instruction hours/cycle	Exam. Marks			Duration of Exam	Credits
					CIA	ESE	TOTAL		
-	-	**26CIM101**	Theory 1– Analytical Chemistry	4	25	75	100	3	2
		26CIM102	Theory 2 – Spectroscopic techniques	4	25	75	100	3	2
		26CIM1CL	Practical 1 Instrument and Chemical methods in day to day activity	4	40	60	100	3	2
	Total			**12**	-	-	300	-	**06**

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

K1-Remembering;**K2**-Understanding;**K3**-Applying;**K4**-Analyzing;**K5**-Evaluating

1. ESE Theory Examination:

(i) CIA I & II and ESE: 75 Marks

Knowledge Level	Section	Marks	Description	Total
K1 Q1 to 10	A (Answer all)	10 x 1 = 10	MCQ	75
K1 – K5 Q11 to 15	B (Either or pattern)	5 x 5 = 25	Short Answers	
K2 – K5 Q16 to 20	C (Either or pattern)	5 x 8 = 40	Descriptive / Detailed	

2. ESE Practical Examination:

Knowledge Level	Section	Marks	Total
K3	Experiments	50	60
K4	Record Work	10	
K5			

Components of Continuous Internal Assessment

Components		**Marks**	**Total**
Theory			
CIA I	75	(75+75 = 150/10) 15	25
CIA II	75		
Objective Capacity Testing */Seminar		5	
Attendance		5	

Subject code : 26CIM101

Certificate Programme – Instrumental methods of Chemical Analysis			
Title of the paper :	**THEORY 1 – ANALYTICAL CHEMISTRY**		
Hours / Week		**Total Hours**	Credit
4		60	2

Course Objectives

1.	To understand the key features of Analytical chemistry and know the basics of Errors, Accuracy and Precision.
2.	To identify different Separation techniques and describe about important purification techniques.
3.	To understand important of Analytical biochemistry and industrial process.

Course Outcomes (CO)

K1 – K5	CO1	Understand the various types of analytical methods.
	CO2	To know the Knowledge about basics of Errors, Accuracy and Precision.
	CO3	Analyze the importance of Separation techniques.
	CO4	Describe about various types of purification techniques.
	CO5	To gain knowledge about Analytical biochemistry and industrial process

UNIT – I	**Introduction to Analytical Chemistry**	**12 Hours**

Introduction – types of analytical methods, instruments for analysis, uncertainty in instrumental measurements, senility and detection limits for instruments.

UNIT-II	**Errors, Accuracy and precision**	**12 Hours**

Errors – types of errors, significant figures, precision and accuracy, methods of expressing accuracy, methods of expressing precision, confidence limit, photometric errors.

UNIT-III	**Separation techniques**	**12 Hours**

Precipitation, solvent extraction, dessicant, types of dessicant, relative efficiencies of dessicant, trying paper and temperature, choice of dissicants, distillation, theory of distillation, recrystallization, sublimation.

UNIT-IV	**Purification techniques**	**12 Hours**

Principles and techniques of semi micro analysis, filtration of precipitates, washing of precipitates, heating solutions, evaporation, transferring residue, methods of precipitating sulphides.

UNIT-V	**Analytical biochemistry and industrial process**	**12 Hours**
Definition of pH, pH in biological system, buffer system in animal kingdom, redox titration, electroplating-principle and process of electroplating, applications of electroplating.		
self study portion		
TEXT BOOKS :		
1.	Vogel, Arthur I: A **Text book of Quantitative Inorganic Analysis** (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman.	
2.	Willard, Hobert H. et al.: **Instrumental Methods of Analysis**, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.	
3.	Christian, Gary D; **Analytical Chemistry**, 6th Ed. John Wiley & Sons, New York, 2004.	
REFERENCE BOOKS:		
1.	Harris, Daniel C: **Exploring Chemical Analysis**, Ed. New York, W.H. Freeman, 2001.	
2.	2. Khopkar, S.M. **Basic Concepts of Analytical Chemistry**. New Age, International Publisher, 2009.	
3.	Skoog, D.A. Holler F.J. and Nieman, T.A. **Principles of Instrumental Analysis**, Thomson Asia Pvt. Ltd. Singapore.	
4.	Mikes, O. & Chalmes, R.A. **Laboratory Hand Book of Chromatographic & Allied Methods**, Elles Harwood Ltd. London.	
5.	Ditts, R.V. **Analytical Chemistry** – Methods of separation.	

E – reources

1. https://open.umn.edu/opentextbooks/textbooks/486
2. https://www.youtube.com/watch?v=kVlEphOywc0
3. https://www.chemistrystudent.com/ncert-class-11/8-organic-chemistry%E2%80%93some-basic-principles-and-techniques/methods-of-purification-of-organic-compounds.html

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	H	M	H
CO2	S	M	S	M	S
CO3	S	M	S	M	S
CO4	S	S	S	S	S
CO5	S	S	H	S	S
S – Strong	**H** – High	**M** – Medium	**L** – Low		

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code : 26CIM102

Certificate Programme – Instrumental methods of Chemical Analysis			
Title of the paper:	**THEORY 2 – SPECTROSCOPY AND CHROMATOGRAPHIC TECHNIQUES**		
Hours / Week		**Total Hours**	Credit
4		60	2

Course Objectives

1.	To study Ultra – Violet and visible spectroscopy and study about Infrared spectroscopy.
2.	To understand about Nuclear Magnetic Resonance (NMR) spectroscopy.
3.	To study about various types chromatography and understand experimental techniques of column chromatography,

Course Outcomes (CO)

K1 – K5	CO1	Understanding the fundamental aspect Ultra – violet and visible spectroscopy.
	CO2	Learn about Fundamental concepts of Infrared spectroscopy
	CO3	Acquire the knowledge of Nuclear Magnetic Resonance (NMR) spectroscopy.
	CO4	Study on the various types of chromatography.
	CO5	To inculcate knowledge about Column chromatography.

UNIT – I	**Ultra – violet and visible spectroscopy**	**12 Hours**

Electromagnetic spectrum and absorption of radiations, Principle of ultraviolet spectroscopy, the absorption laws- Lambert's law and Beer's law. Selection rules, instrumentation – Block Diagram, theory of electronic spectroscopy, types of electronic transitions.

UNIT-II	**Infrared spectroscopy**	**12 Hours**

Fundamental concepts of Infrared spectroscopy, molecular vibrations, vibrational frequency, number of fundamental vibrations, selection rules, scanning of infrared spectrum (instrumentation), finger print region.

UNIT-III	**Nuclear Magnetic Resonance (NMR) spectroscopy**	**12 Hours**

Introduction, conditions of resonance, Solvents used in NMR, relaxation process – spin –spin relaxation, spin – lattice relaxation and quadrupole relaxation. Number of signals, instrumentation, splitting of the signals in pure ethanol and chloroethane

UNIT-IV	**Thin layer chromatography**	**12 Hours**

Introduction, definition, types, thin layer chromatography – experimental techniques - coating materials - preparation of thin layer in plates – activation of adsorbents – purification of silica gel – sample application – development tank – solvent systems – plate development – detection of components, evaluation of chromatography.

UNIT-V	**Column chromatography**	**12 Hours**
Column chromatography – principle, experimental techniques – apparatus – adsorbents – preparation of adsorption columns – solvents used in successive elution – gradient elution.		
self study portion		
TEXT BOOKS:		
1.	Y.R, Sharma, (2007) Elementary **Organic Spectroscopy**	
2.	Jag Mohan, (2013) **Organic Spectroscopy – Principles and Applications**, Narosa publishing house.	
3.	Gurdeep R. Chatwal, (2002) **Instrumental Methods of Chemical Analysis**, Himalaya publishing house, Delhi.	
REFERENCE BOOKS:		
1.	P.S. Sindhu, Elements of (2007) **Molecular Spectroscopy**, New Age International Publishers, New Delhi.	
2.	H.S. Randhana, (2003) **Modern Molecular Spectroscopy**, Macmillan India Ltd, New Delhi.	

e- resources

1. https://www.chemguide.co.uk/analysis/uvvisiblemenu.htmlpectroscopy
2. https://www.khanacademy.org/science/chemistry
3. https://faculty.washington.edu/seattle/physics541/%202010-reading/nmr-spectroscopy.pdf
4. https://chem.libretexts.org/Courses/Purdue/Purdue%3A_Chem_26200%3A_Organic_Chemistry_II_(Wenthold)/Chapter_11%3A__IR_and_Mass_Spectrometry/11.06%3A_Introduction_to_Mass_Spectrometry
5. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Organic_Chemistry_Lab_Techniques_(Nichols)/02%3A_Chromatography/2.03%3A_Thin_Layer_Chromatography_(TLC)
6. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Instrumentation_and_Analysis/Chromatography/V._Chromatography/B._Column_Chromatography

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	H	M	H
CO2	S	M	S	M	S
CO3	S	M	S	M	S
CO4	S	S	S	S	S
CO5	S	S	H	S	S
S – Strong		**H** – High	**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge

Signature of the HOD

Subject code : 26CIM1CL

Certificate Programme – Instrumental methods of Chemical Analysis			
Title of the paper:	**PRACTICAL - 1 INSTRUMENT AND CHEMICAL METHODS IN DAY TO DAY ACTIVITY**		
Hours / Week		**Total Hours**	Credit
4		60	2

Course Objectives	
1.	Transformation of theoretical knowledge gain to practical aspects and have experience in handling organic compounds.
2.	To determine the dissolved oxygen in different types of water.
3.	To know about fat content in milk using Lactometer and analysis techniques and understand about Estimation of Hardness of water.

Course Outcomes (CO)		
K3 – K5	CO1	Understand the basic principles of Instrumental Methods of Chemical Analysis.
	CO2	Understand about the Colorimetric experiments.
	CO3	Determination of boiling point of organic compounds.
	CO4	Improve the accuracy of analysis.
	CO5	To gain knowledge about Biological Oxygen Demand (BOD).

Experiments	
1.	Detection of boiling point of organic compounds
2.	Detection of melting point of Inorganic and Organic compounds
3.	Colorimetric experiments
4.	Estimation of dissolved oxygen in different types of water
5.	Detection of fat content in milk using Lactometer and analysis techniques
6.	Detection of Biological Oxygen Demand (BOD)
7.	Detection of Hardness of water

UNIT-I	**Electromagnetic spectrum**	**12 Hours**

Electromagnetic spectrum and absorption of radiations, Principle of ultraviolet spectroscopy, the absorption laws- Lambert's law and Beer's law. Selection rules, instrumentation – Block Diagram, theory of electronic spectroscopy, types of electronic transitions.

UNIT-II	**Infrared spectroscopy**	**12 Hours**

Fundamental concepts of Infrared spectroscopy, molecular vibrations, vibrational frequency, number of fundamental vibrations, selection rules, Scanning of infrared spectrum (instrumentation), finger print region.

UNIT-III	**Nuclear Magnetic Resonance (NMR) spectroscopy**	**12 Hours**

Introduction, conditions of resonance, Solvents used in NMR, relaxation process – spin –spin relaxation, spin – lattice relaxation and quadrupole relaxation. Number of signals, instrumentation, splitting of the signals in pure ethanol and chloroethane

UNIT-IV	**Thin layer chromatography**	**12 Hours**
Introduction, definition, types, thin layer chromatography – experimental techniques - coating materials - preparation of thin layer in plates – activation of adsorbents – purification of silica gel – sample application – development tank – solvent systems – plate development – detection of components, evaluation of chromatography.		
UNIT-V	**Column chromatography**	**12 Hours**
Column chromatography – principle, experimental techniques – apparatus – adsorbents – preparation of adsorption columns – solvents used in successive elution – gradient elution.		
self study portion		

TEXT BOOKS :

1.	Vogel, A.I. **Quantitative Organic Analysis,** Part 3, Pearson (2012).
2.	Mann, F.G. & Saunders, B.C. **Practical Organic Chemistry**, Pearson Education (2009
3.	Ahluwalia, V.K. & Aggarwal, R. **Comprehensive Practical Organic Chemistry**: Preparation and Quantitative Analysis, University Press (2000).
4.	Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. **Practical Organic Chemistry**, 5th Ed., Pearson (2012)

REFERENCE BOOKS:

1.	Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).
2.	H.S. Randhana, (2003) **Modern Molecular Spectroscopy**, Macmillan India Ltd, New Delhi.

Time: 3 Hours	**Max. Marks: 60**
Distribution of Total Marks - 60	
Record	**10 mark**
Practical	**50 mark**

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	H	M	H
CO2	S	S	M	H	H
CO3	S	S	H	M	H
CO4	S	S	M	H	H
CO5	S	S	H	H	H

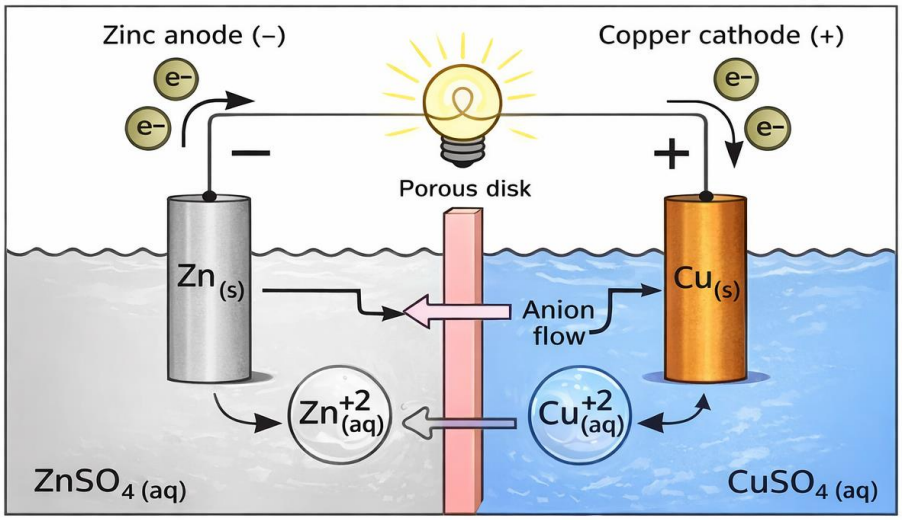
S – Strong **H** – High **M** – Medium **L** – Low

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

CERTIFICATE PROGRAMME – SCIENCE OF BATTERIES

BASIC BATTERY CHEMISTRY



$$Zn\,(s) + Zn^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu\,(s)$$

A Voltaic Cell

PROGRAMME OUTCOME (PO)

On the successful completion of the programme, the following are the expected outcomes

PO 1 Understand the basic concepts, fundamental principles, and scientific theories related to batteries, electrochemistry, and energy storage systems, and recognize their relevance in real-life applications.

PO 2 Acquire skills in handling electrochemical instruments, battery components, and planning/performing laboratory experiments related to power sources.

PO 3 Develop observation skills and draw logical, data-driven inferences from battery performance experiments and electrochemical measurements.

PO 4 Think creatively and critically to propose innovative ideas for battery applications, troubleshooting, and improving energy storage solutions.

PO 5 Demonstrate professional, ethical, and environmental responsibilities in working with electrochemical systems and handling chemicals safely.

PO 6 Identify potential areas for further study, research, and employability in battery technology, energy storage, and sustainable power solutions.

PO 7 Build problem-solving, critical-thinking, and analytical reasoning skills for addressing challenges in battery design, testing, and optimization.

PO 8 Gain exposure to industrial processes and applications of batteries, including their role in electric vehicles, portable electronics, and renewable energy integration.

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO 1 Develop a strong foundation in the fundamentals of battery chemistry, electrochemical principles, and advanced battery technologies.

PSO 2 Apply critical thinking and scientific inquiry to design, conduct, interpret, and document electrochemical laboratory experiments.

PSO 3 Explore career opportunities in energy storage industries, electric mobility, renewable energy, research laboratories, and academic institutions.

PSO 4 Acquire entrepreneurial insight to develop or work on battery-based solutions and products in emerging markets.

PSO 5 Contribute to sustainable development by promoting safe, ethical, and efficient use of electrochemical energy systems and natural resources.

KONGUNADU ARTS AND SCIENCE COLLEGE (AUTONOMOUS)
COIMBATORE – 641 029

Programme Name: **CERTIFICATE PROGRAMME – SCIENCE OF BATTERIES**

(Applicable to the students admitted during the Academic Year 2025-2026)

Semester	Part	Subject Code	Title of the Paper	Instruction hours/cycle	Exam. Marks			Duration of Exam (hours)	Credits
					CIA	ESE	TOTAL		
-	-	**25CSB101**	Theory 1 – SCIENCE AND TECHNOLOGY OF BATTERIES	4	25	75	100	3	2
	-	**25CSB1Z1**	Technical Report Preparation and Presentation	4	20	80	100	3	2
	-	**25CSB1CL**	Practical 1 - ELECTROCHEMICAL POWER SOURCES LABORATORY	4	40	60	100	3	2
			Total	**12**	-	-	300	-	**06**

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN

K1-Remembering;**K2**-Understanding;**K3**-Applying;**K4**-Analyzing;**K5**-Evaluating

1. ESE Theory Examination:

(i) CIA I & II and ESE: 75 Marks

Knowledge Level	Section	Marks	Description	Total
K1 Q1 to 10	A (Answer all)	10 x 1 = 10	MCQ	75
K1 – K5 Q11 to 15	B (Either or pattern)	5 x 5 = 25	Short Answers	
K2 – K5 Q16 to 20	C (Either or pattern)	5 x 8 = 40	Descriptive / Detailed	

2. ESE Practical Examination:

Knowledge Level	Section	Marks	Total
K3	Experiments	50	60
K4	Record Work	10	
K5			

Components of Continuous Internal Assessment

Components		**Marks**	**Total**
Theory			
CIA I	75	(75+75 = 150/10) 15	25
CIA II	75		
Objective Capacity Testing */Seminar		5	
Attendance		5	

PROGRAMME OUTCOME (PO)

On the successful completion of the programme, the following are the expected outcomes

PO 1 Understand the basic concepts, fundamental principles, and scientific theories related to batteries, electrochemistry, and energy storage systems, and recognize their relevance in real-life applications.

PO 2 Acquire skills in handling electrochemical instruments, battery components, and planning/performing laboratory experiments related to power sources.

PO 3 Develop observation skills and draw logical, data-driven inferences from battery performance experiments and electrochemical measurements.

PO 4 Think creatively and critically to propose innovative ideas for battery applications, troubleshooting, and improving energy storage solutions.

PO 5 Demonstrate professional, ethical, and environmental responsibilities in working with electrochemical systems and handling chemicals safely.

PO 6 Identify potential areas for further study, research, and employability in battery technology, energy storage, and sustainable power solutions.

PO 7 Build problem-solving, critical-thinking, and analytical reasoning skills for addressing challenges in battery design, testing, and optimization.

PO 8 Gain exposure to industrial processes and applications of batteries, including their role in electric vehicles, portable electronics, and renewable energy integration.

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO 1 Develop a strong foundation in the fundamentals of battery chemistry, electrochemical principles, and advanced battery technologies.

PSO 2 Apply critical thinking and scientific inquiry to design, conduct, interpret, and document electrochemical laboratory experiments.

PSO 3 Explore career opportunities in energy storage industries, electric mobility, renewable energy, research laboratories, and academic institutions.

PSO 4 Acquire entrepreneurial insight to develop or work on battery-based solutions and products in emerging markets.

PSO 5 Contribute to sustainable development by promoting safe, ethical, and efficient use of electrochemical energy systems and natural resources.

CERTIFICATE PROGRAMME – SCIENCE OF BATTERIES			
Title of the paper:	**THEORY 1 – Introduction to Batteries**		
Hours / Week		**Total Hours**	Credit
4		60	2

Course Objectives	
1.	To understand the basic concepts, construction, and working principles of batteries.
2.	To learn the classification of batteries and the fundamental electrochemical principles governing their operation.
3.	To analyze key battery performance parameters and explore their applications in daily life and industry.

Course Outcomes (CO)		
K1 – K5	CO1	Explain fundamental electrochemical principles, classify primary and secondary battery types, and analyze basic performance metrics.
	CO2	Analyze the electrochemistry, materials, and failure modes of Lithium-ion batteries, and quantify their key performance limitations.
	CO3	Evaluate the principles and material challenges of post-Li-ion technologies, specifically Sodium-Ion and Metal-Air battery systems.
	CO4	Analyze battery cycling protocols and explain the essential functions, metrics (SoC/SoH), and thermal management within a Battery Management System (BMS).
	CO5	Classify and determine the appropriate application of specialized high-reliability power sources, including Reserve and Defence Battery Systems.

UNIT – I	**Fundamentals of Electrochemical Cells**	**12 Hours**

Basic concepts-Components & Classification of Cells and Batteries-Operation of a Cell-Theoretical Cell Voltage, Capacity, and Energy - Upper Limits of Specific Energy and Energy Density - General Characteristics- Factors affecting Battery Performance- International Standards- -Types - Primary – Secondary -Reserve Batteries. Zinc-Carbon Batteries- Lead-Acid Batteries General Characteristics.

UNIT-II	**Li-ion Batteries: Principles Types and Advantages**	**12 Hours**

General Characteristics Chemistry - Characteristics of Lithium Primary Batteries - Safety and Handling of Lithium Batteries - Lithium / Sulfur Dioxide (Li /SO2) Batteries - Lithium /Thionyl Chloride (Li /SOCl2) Batteries. General Characteristics and Applications of Secondary Batteries- Lithium-Ion Batteries-General Characteristics - Chemistry - Construction of Cylindrical and Prismatic Li-Ion Cells and Batteries- Li-Ion Battery Performance - Polymer Li-Ion Batteries- Thin-Film, Solid-State Li-Ion Batteries.

UNIT-III	**Metal-Air Batteries**	**12 Hours**

General Characteristics of Metal-Air Battery System – Chemistry - Zinc / Air Batteries - Aluminum/ Air Batteries. Zinc/Air Batteries—Button Configuration- Chemistry. Construction - Performance Characteristics

UNIT-IV	Reserve and Defence Battery Systems	12 Hours
Classification of Reserve Batteries - Characteristics of Reserve Batteries- General Characteristics - Description of Electrochemical Systems - Cell Chemistry - Cell Construction of Magnesium Water-Activated Batteries- Zinc/Silver Oxide Reserve Batteries- Thermal Batteries.		
UNIT-V	**Advanced Batteries for Electric Vehicles and Emerging Applications**	**12 Hours**
Introduction -Performance Requirements for Advanced Rechargeable Batteries- Characteristics and Development of Rechargeable Batteries for Emerging Applications - General Characteristics – Chemistry – Cell design of Zinc/Bromine Batteries -Sodium-Beta Batteries - Lithium/Iron Sulfide Batteries.		
self-study portion		
Teaching Methods: Smart Class Room/ Power point Presentation/ Seminar/ Quiz/ Discussion/ Flipped Class		

TEXT BOOKS:

1.	Thomas B. Reddy (ed.), "Linden's Handbook of Batteries (4th Edition)", McGraw-Hill, USA, 2010
2.	M. Winter, "Rechargeable Lithium-Ion Batteries", The Electrochemical Society (ECS), USA, 2010
3.	A. Jossen and W. Weydanz, "Modern Battery Engineering: A Comprehensive Introduction", Springer, Germany, 2016

REFERENCE BOOKS:

1.	Bruno Scrosati, K. M. Abraham, W. van Schalkwijk, J. Hassoun (eds.), "Lithium Batteries: Advanced Technologies and Applications", John Wiley & Sons, USA, 2013
2.	H. A. Kiehne (ed.), "Battery Technology Handbook (2nd Edition)", CRC Press / Marcel Dekker, USA, 2003
3.	J. Ma, "Rechargeable Battery Electrolytes: Electrochemical Energy Storage and Conversion", Royal Society of Chemistry, UK, 2024
4.	D. Pavlov, "Lead–Acid Batteries: Science and Technology (2nd Edition)", Elsevier, Netherlands, 2017.
5.	K. M. Abraham and M. Winter (Eds.), "Rechargeable Lithium-Ion Batteries", The Electrochemical Society, USA, 2010.

E - resources

1. https://www.sciencedirect.com/topics/materials-science/lithium-ion-battery
2. https://en.wikipedia.org/wiki/Reserve_battery
3. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ceas3.uc.edu/ret/archive/2019/ret/docs/readings/Project%202/Handbook_of_Batteries_----_(Part_5_Advanced_Batteries_for_Electric_Vehicles_and_Emerging_Applicati...).pd

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	H	M	H
CO2	S	M	S	M	S
CO3	S	M	S	M	S
CO4	S	S	S	S	S
CO5	S	S	H	S	S
S – Strong	**H** – High	**M** – Medium	**L** – Low		

Content prepared by (Based on Inputs)

Signature of the Course in-charge

Signature of the HOD

CERTIFICATE PROGRAMME – SCIENCE OF BATTERIES			
Title of the paper:	**TECHNICAL REPORT PREPARATION AND PRESENTATION**		
	Hours / Week	Total hours	Credits
	4	30	2

Course Objectives

1.	To provide students with exposure to refer, read, and critically review research articles from reputed journals and conference proceedings in the field of batteries and fuel cells.
2.	To enhance students' technical writing, data interpretation, and report preparation skills in alignment with current research and industrial standards
3.	To improve scientific communication and presentation abilities, encouraging innovation and research contributions in sustainable energy technologies.

Course Outcomes (CO)

K1 – K5	CO1	Acquire the ability to identify, collect, and critically review recent research publications from reputed journals and conference proceedings in the areas of batteries and fuel cells.
	CO2	Demonstrate competence in organizing and synthesizing technical information into a coherent and well-structured written report following standard scientific formats.
	CO3	Develop proficiency in interpreting experimental data, analyzing results, and presenting findings with clarity and accuracy.
	CO4	Enhance oral communication and presentation skills through systematic mid-semester and final technical presentations using appropriate visual aids
	CO5	Exhibit professional ethics, teamwork, and self-learning abilities by engaging in guided discussions, constructive feedback, and independent report preparation.

Methodology

- Each student is allotted to a faculty of the department by the Course Coordinator.
- By mutual discussions, the faculty guide will assign a topic in the general / subject area to the student.
- The students have to refer the Journals and conference proceedings and collect the published literature.
- The student is exposed to collect at least 20 such Research papers published in the last 5 years.
- Using OHP/Power point, the student has to make presentation for 15-20 minutes followed by 10 minutes discussion.
- The student has to make two presentations, one at the middle and the other near the end of the semester.
- The student has to write a technical report for about 30-50 pages (Title page, one page Abstract, review of research paper under various subheading, Concluding remarks and List of References). The technical report has to b submitted to the HOD one week before the final presentation, after the approval of the faculty guide.

Cycle	Activity
I	Allotment of Faculty Guide by the HOD
II	Finalizing the topic with the approval of Faculty Guide
III	Collection of Technical papers

Execution	VI	Mid semester presentation
	V	Report writing
	VI	Report Submission
	VII	Final technical presentation

Evaluation	100 % Continuous Assessment 4 Hrs/week	
	Component	Weightage
	Phase – I Presentation	25 %
	Phase – II Presentation	25 %
	Report preparation and Submission	30 %
	Final presentation	20 %
	Total	100%

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S	S	H	M	H
CO2	S	M	S	M	S
CO3	S	M	S	M	S
CO4	S	S	S	S	S
CO5	S	S	H	S	S

S – Strong **H** – High **M** – Medium **L** – Low

Content prepared by (Based on Inputs)

Signature of the Course in-charge Signature of the HOD

Subject code:

25CSB1CL

CERTIFICATE PROGRAMME – SCIENCE OF BATTERIES			
Title of the paper:	PRACTICAL 1 -ELECTROCHEMICAL POWER SOURCES LABORATORY		
Hours / Week		**Total Hours**	Credit
4		60	2
Course Objectives			
1.	To provide hands-on experience in assembling, measuring, and analyzing the performance of electrochemical cells and batteries.		
2.	To study the effect of electrical configurations (series and parallel) on voltage, current, and overall capacity of a battery system.		
3.	To familiarize students with techniques for measuring capacity, internal resistance, cycle life, and temperature dependence in energy storage devices.		
Course Outcomes (CO)			
K1 – K5	CO1	Assemble and operate simple electrochemical cells to understand the fundamental principles of electrochemical energy conversion.	
	CO2	Identify and explain the role of key components—anode, cathode, and electrolyte—in determining cell voltage and performance.	
	CO3	Accurately measure the discharge capacity and energy output of commercial rechargeable cells using constant current methods.	
	CO4	Evaluate the impact of repeated charge–discharge cycles on capacity fade and predict the cycle life of rechargeable batteries.	
	CO5	Examine the effect of temperature on discharge behavior to understand the importance of thermal management in battery systems.	
Experiments			
1.	Assembly and Measurement of a Simple Electrochemical Cell		
2.	Understanding the basic components (anode, cathode, electrolyte) and the origin of voltage from a chemical reaction		
3.	Circuit Configuration and Effect on Output | Building circuits with commercial cells (e.g., AA) in Series and Parallel to demonstrate how total voltage, current, and capacity change		
4.	Capacity Determination: Constant Current Discharge		
5.	Performing a full Constant Current Discharge test on a commercial cell (e.g., NiMH, Li-ion) to accurately measure its Actual Capacity (Ah) and calculate energy (Wh).		
6.	Measurement of Internal Resistance and analyse its effect on terminal voltage		
7.	Running multiple charge/discharge cycles on a rechargeable cell to observe and quantify the decrease in capacity (Capacity Fade) over time		
8.	Testing a battery's discharge capacity at different temperatures to demonstrate the critical need for Thermal Management Systems (TMS)		

Subject code:

25CSB1CL

TEXT BOOKS:	
1.	W. van Schalkwijk and B. Scrosati (Eds.), "Advances in Lithium-Ion Batteries", Springer, USA, 2002.
2.	H. A. Kiehne (Ed.), "Battery Technology Handbook (2nd Edition)", CRC Press / Marcel Dekker, USA, 2003.
3.	A. Jossen and W. Weydanz, "Modern Battery Engineering: A Comprehensive Introduction", Springer, Germany, 2016.
4.	M. S. Whittingham, C. Julien, and D. Guyomard (Eds.), "Lithium Batteries: New Materials, Developments and Perspectives", Springer, USA, 2009.
REFERENCE BOOKS:	
1.	K. M. Abraham and M. Winter (Eds.), "Rechargeable Lithium-Ion Batteries", The Electrochemical Society, USA, 2010.
2.	J. Ma, "Rechargeable Battery Electrolytes: Electrochemical Energy Storage and Conversion", Royal Society of Chemistry, UK, 2024

Time: 3 Hours	**Max. Marks: 60**
Distribution of Total Marks - 60	
Record	**10 marks**
Practical	**50 marks**

MAPPING					
PSO / CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S	S	H	M	H
CO2	S	S	M	H	H
CO3	S	S	H	M	H
CO4	S	S	M	H	H
CO5	S	S	H	H	H
S – Strong	**H** – High		**M** – Medium	**L** – Low	

Content prepared by (Based on Inputs)

Signature of the Course in-charge

Signature of the HOD