Holy Cross College (Autonomous), Nagercoil

Kanyakumari District, Tamil Nadu.
Accredited with A^{++} by NAAC - V Cycle (CGPA 3.53)

Affiliated to
Manonmaniam Sundaranar University, Tirunelveli

Semester I - VI
UG Guidelines & Syllabus

DEPARTMENT OF CHEMISTRY

2023-2026
(With effect from the academic year 2025-2026)

Issued from
THE DEANS' OFFICE

Vision

Impart quality education, scientific skills, academic excellence, research attitude and skills to face global challenges.

Mission

- To develop intellectual and professional skills of the students
- To provide a firm foundation in chemical concepts, laws and theories
- To sharpen the scientific knowledge
- To enhance critical thinking, problem solving ability, scientific temper and innovation
- To apply chemistry in medicine, biology, industry and environment

Graduate Attributes

Graduates of our College develop the following attributes during the course of their studies.

- **Creative thinking:**
  Equipping students with hands-on-training through skill-based courses and promote startup.
- **Personality development:**
  Coping with increasing pace and change of modern life through value education, awareness on human rights, gender issues and giving counselling for the needful.
- **Environmental consciousness and social understanding:**
  Reflecting upon green initiatives and understanding the responsibility to contribute to the society; promoting social and cultural diversity through student training and service-learning programmes.
- **Communicative competence:**
  Offering effective communication skills in both professional and social contexts through bridge courses and activities of clubs and committees.
- **Aesthetic skills:**
  Engaging mind, body and emotions for transformation through fine arts, meditation and exercise; enriching skills through certificate courses offered by Holy Cross Academy.
- **Research and knowledge enrichment:**
  Getting in-depth knowledge in the specific area of study through relevant core papers; ability to create new understanding through the process of critical analysis and problem solving.
- **Professional ethics:**
  Valuing honesty, fairness, respect, compassion and professional ethics among students. The students of social work adhere to the *National Association of Social Workers Code of Ethics*
- **Student engagement in the learning process:**
  Obtaining extensive and varied opportunities to utilize and build upon the theoretical and empirical knowledge gained through workshops, seminars, conferences, industrial visits and summer internship programmes.
- **Employability:**
  Enhancing students in their professional life through Entrepreneur development, Placement & Career guidance cell.
- **Women empowerment and leadership:**
  Developing the capacity of self-management, team work, leadership and decision making through gender sensitization programmes.

Programme Educational Objectives (PEOs)

PEOs	Upon completion of B.A/B.Sc. Degree Programme, the graduates will be able to	Mapping with Mission
PEO1	apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.	M1& M2
PEO2	use practical knowledge for developing professional empowerment and entrepreneurship and societal services.	M2, M3, M4 & M5
PEO3	pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.	M3, M4, M5 & M6

Programme Outcomes (POs)

POs	Upon completion of B.Sc. Degree Programme, the graduates will be able to:	Mapping with PEOs
PO1	obtain comprehensive knowledge and skills to pursue higher studies in the relevant field of science.	PEO1
PO2	create innovative ideas to enhance entrepreneurial skills for economic independence.	PEO2
PO3	reflect upon green initiatives and take responsible steps to build a sustainable environment.	PEO2
PO4	enhance leadership qualities, team spirit and communication skills to face challenging competitive examinations for a better developmental career.	PEO1 & PEO3
PO5	communicate effectively and collaborate successfully with peers to become competent professionals.	PEO2 & PEO3
PO6	absorb ethical, moral and social values in personal and social life leading to highly cultured and civilized personality	PEO2 & PEO3
PO7	participate in learning activities throughout life, through self-paced and self-directed learning to improve knowledge and skills.	PEO1 & PEO3

Programme Specific Outcomes (PSOs)

PSOs	Upon completion of B.Sc Chemistry programme, the graduates will be able to:	Mapping with POs
PSO1	understand the fundamentals, theories and principles of organic, inorganic and physical chemistry.	PO1
PSO2	analyze physical and chemical properties of chemical compounds and their uses.	PO1& PO7
PSO3	interpret the mechanism of various chemical reactions.	PO3 &PO4
PSO4	synthesize organic and inorganic compounds using classical and modern methods.	PO2
PSO5	design and carry out scientific experiments, record and interpret the results with accuracy	PO1& PO4
PSO6	use concepts, tools and techniques related to chemistry to other branches of science.	PO5
PSO7	develop skills in the safe-handling of chemicals and their usage in day today life.	PO1&PO7
PSO8	develop entrepreneurial skills, empowered to fulfil the professional requirement and become self-dependent.	PO2& PO6

Mapping of POs and PSOs

POs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
PO1	S	S	S	S	S	S	S	S
PO2	S	S	M	M	S	S	M	S
PO3	M	M	M	S	S	S	S	S
PO4	S	S	S	M	M	S	M	M
PO5	S	M	M	M	S	S	S	S
PO6	M	M	M	M	S	S	S	S
PO7	S	S	S	S	S	S	S	S

Eligibility Norms for Admission

Eligibility: 10 + 2 pattern

Those who seek admission to B.Sc. Chemistry Course must have passed the Higher Secondary Examinations conducted by the Board of Higher Secondary Examinations, Tamil Nadu with Chemistry, Physics and Mathematics/Biology subjects or examination recognized and approved by the Syndicate of Manonmaniam Sundaranar University, Tirunelveli.

Duration of the Programme: 3 years

Medium of Instruction: English

Passing Minimum

A minimum of 40% in the external examination and an aggregate of 40% is required. There is no minimum pass mark for the continuous internal assessment.

Components of B.Sc Chemistry

Part III (Core Courses and Elective Courses)

Core Courses	Core-Theory	8 x 100	800
	Core Research Project	1x100	100
	Core Lab Course	6 x 100	600
	Discipline Specific Elective- Theory	4 x 100	400
	Total Marks		**1900**
Elective Courses	Theory	4 x 100	400
	Lab Course	4 x 100/ 2x100*	400/200*
	Total Marks		**800/600***
	Total Marks		**2700/2500***

***Mathematics Elective**

- Core and Elective Practical Courses carry 100 marks each.
- Practical examination will be conducted at the end of each semester for Core and Elective Courses.

Course Structure

Distribution of Hours and Credits

Curricular Courses

Course	S I	S II	S III	S IV	S V	S VI	Total	
							Hours	**Credits**
Part I –Language	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	**12**
Part II-English	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	**12**
Part-III								
Core Course Core Lab Course	5(5) 3(3)	5(5) 3(3)	5(5) 3(3)	5(5) 3(3)	5 (4) + 5 (4) + 5 (4) +	6 (5) + 6 (5) + 6 (4) +	70	**62**

Core Research Project					- 5 (4)			
Elective /Discipline Specific Elective Courses	4 (3) 2(2)	4(3) 2(2)	4 (3) 2(2)	4(3) 2(2)	4 (3) 4(3)	5 (3) 5 (3)	42	**32**
Part IV								
Non-major Elective	2 (2)	2 (2)					4	**4**
Skill Enhancement Course		2 (2)	2(2) + 2 (2)	2 (2)			8	**8**
Foundation Course	2 (2)						2	**2**
Environmental Studies				2 (2)			2	**2**
Internship					(2)		-	**2**
Professional Competency Skill					2 (2)	2 (2)	4	4
Total	**30 (23)**	**30 (23)**	**30 (23)**	**30 (23)**	**30 (26)**	**30 (22)**	**180**	**140**

Co-curricular Courses

Course	**S I**	**S II**	**S III**	**S IV**	**S V**	**S VI**	**Total**
LST (Life Skill Training)	-	(1)	-	(1)			2
Skill Development Training (Certificate Course)	(1)						1
Field Project		(1)					1
Specific Value-added Course	(1)		(1)				2
Generic Value-added Course				(1)		(1)	2
MOOC	(2)						2
Student Training Activity: Clubs & Committees / NSS				(1)			1
Community Engagement Activity: RUN				(1)			1
Human Rights, Justice and Ethics					(1)		1
Gender Equity and Inclusivity						(1)	1
Total							**14**

Total number of Compulsory Credits = Academic credits + Non-academic credits: **140 + 14**

Courses Offered

SEMESTER I

Course	**Course Code**	**Title of the Course**	**Credits**	**Hours /Week**
Part I	TU231TL1 FU231FL1	Language: Tamil French	3	6
Part II	EU241EL1	English: A Stream	3	6
	EU241EL2	English: B Stream		
	EU241EL3	English: C Stream		
Part III	CU231CC1	Core Course I: General Chemistry-I	5	5
	CU231CP1	Core Lab Course I: Quantitative Inorganic estimation (titrimetry) and Inorganic Preparations	3	3

	CU231EC1	Elective Course I: Chemistry for Biological Sciences-I	3	4
	CU231EP1	Elective Lab Course I: Chemistry Practical for Biological Sciences-Volumetric Analysis	2	2
Part IV	CU231NM1	Non-Major Elective NME I: Food Chemistry	2	2
	CU231FC1	Foundation Course: Basics of Chemistry	2	2
Total			**23**	**30**

SEMESTER II

Course	Course Code	Title of the Course	Credits	Hours /Week
Part I	TU232TL1 FU232FL1	Language: Tamil French	3	6
Part II	EU242EL1	English: A Stream	3	6
	EU242EL2	English: B Stream		
	EU242EL3	English: C Stream		
Part III	CU232CC1	Core Course II: General Chemistry-II	5	5
	CU232CP1	Core Lab Course II: Organic Estimation and Preparation of Organic Compounds	3	3
	CU232EC1	Elective Course II: Chemistry for Biological Sciences-II	3	4
	CU232EP1	Elective Lab Course II: Systematic Analysis of Organic Compounds	2	2
Part IV	CU232NM1	Non-Major Elective NME II: Cosmetics and Personal Grooming	2	2
	CU232SEI	Skill Enhancement Course SEC I: Dairy Chemistry	2	2
Total			**23**	**30**

SEMESTER III

Course	Course Code	Title of the Course	Credits	Hours / Week
Part I	TU233TL1 FU233FL1	Language: Tamil French	3	6
Part II	EU243EL1	English: A Stream	3	6
	EU243EL2	English: B Stream		
	EU243EL3	English: C Stream		
Part III	CU233CC1	Core Course III: General Chemistry - III	5	5
	CU233CP1	Core Lab Course III: Organic Analysis and Determination of Physical Constants	3	3
	CU233EC1	Elective Course III: Chemistry for Physical Sciences - I	3	4
	CU233EP1	Elective Lab Course III: Chemistry Practical for Physical Sciences - Volumetric Analysis	2	2
Part IV	CU233SE1	Skill Enhancement Course SEC II: Applied Chemistry	2	2
	UG23CSE1	Skill Enhancement Course SEC III: Fitness for Wellbeing	2	2

		Total	**23**	**30**

SEMESTER IV

Course	Course Code	Title of the Course	Credits	Hours / Week
Part I	TU234TL1 FU234FL1	Language: Tamil French	3	6
Part II	EU244EL1	English: A Stream	3	6
	EU244EL2	English: B Stream		
	EU244EL3	English: C Stream		
Part III	CU234CC1	Core Course IV: General Chemistry - IV	5	5
	CU234CP1	Core Lab Course IV: Physical Chemistry Practical – I (Conductometric and Potentiometric Titrations)	3	3
	CU234EC1	Elective Course IV: Chemistry for Physical Sciences – II	3	4
	CU234EP1	Elective Lab Course IV: Chemistry Practical for Physical Sciences – Systematic Analysis of Organic Compounds	2	2
Part IV	UG23CSE2	Skill Enhancement Course SEC IV: Digital Fluency	2	2
	UG234EV1	Environmental Studies (EVS)	2	2
		Total	**23**	**30**

SEMESTER V

Course	Course Code	Title of the Course	Credits	Hours/ Week
Part III	CU235CC1	Core Course V: Organic Chemistry – I	4	5
	CU235CC2	Core Course VI: Physical Chemistry - I	4	5
	CU235CP1	Core Lab Course V: Physical Chemistry Practical II	4	5
	CU235RP1	Core Research Project	4	5
	CU235DE1	Discipline Specific Elective I: a) Inorganic Chemistry – I	3	4
	CU235DE2	Discipline Specific Elective I: b) Applied Chemistry		
	CU235DE3	Discipline Specific Elective I: c) Rubber Technology		
	CU235DE4	Discipline Specific Elective II: a) Industrial Chemistry	3	4
	CU235DE5	Discipline Specific Elective II: b) Polymer Chemistry		
	CU235DE6	Discipline Specific Elective II: c) Biochemistry		
Part IV	UG235PS1	Professional Competency Skill I: Career Skills	2	2
	CU235IS1	Internship	2	-
Total			**26**	**30**

SEMESTER VI

Course	Course Code	Title of the Course	Credits	Hours/ Week
Part III	CU236CC1	Core Course VII: Organic Chemistry -II	5	6
	CU236CC2	Core Course VIII: Physical Chemistry -II	5	6
	CU236CP1	Core Lab Course VI: Gravimetric Estimation and Semi micro inorganic mixture analysis	4	6
	CU236DE1	Discipline Specific Elective III: a) Inorganic Chemistry-II	3	5
	CU236DE2	Discipline Specific Elective III: b) Fundamentals of organic Spectroscopy		
	CU236DE3	Discipline Specific Elective III: c) Soil and Agricultural Chemistry		
	CU236DE4	Discipline Specific Elective IV:a) Nano Chemistry	3	5
	CU236DE5	Discipline Specific Elective IV: b) Pharmaceutical Chemistry		
	CU236DE6	Discipline Specific Elective IV: c) Green Chemistry		
	CU236PS1	Professional Competency Skill II: Analytical and Computational Chemistry	2	2
Total			**22**	**30**
Total			**140**	**180**

Co-curricular Courses

Part	Semester	Code	Title of the Course	Credit
Part V	I & II	UG232LC1	Life Skill Training I: Catechism	1
		UG232LM1	Life Skill Training I: Moral	
	I	UG231C01 –	Skill Development Training (SDT) - Certificate Course	1
	II	CU232FP1	Field Project	1
	I & III	CU231V01 -	Specific Value-added Course	1+1
	VI	UG236OC1 & UG236OC2	MOOC	2
	III & IV	UG234LC1	Life Skill Training II: Catechism	1
		UG234LM1	Life Skill Training II: Moral	
	IV & VI	GVAC2401 -	Generic Value-added Course	1 +1
	I – IV	UG234ST1	Student Training Activity – Clubs & Committees / NSS	1
	IV	UG234CE1	Community Engagement Activity - RUN	1
	V	UG235HR1	Human Rights, Justice and Ethics	1
	VI	UG236GE1	Gender Equity and Inclusivity	1
Total				**14**

Specific Value-added Course

Semester	Course code	Title of the course	Credits	Total hours
I	CU231V01	Articles in Every Day Life	1	30
I	CU231V02	Polymer Chemistry	1	30
I	CU231V03	Chemistry of Cosmetics	1	30
III	CU233V01	Agrochemicals and pesticides	1	30
III	CU233V02	Water Resources and Management	1	30
III	CU233V03	Food Adulteration	1	30

Self-Learning Course

Semester	Title of the Course	Course Code
III / V	Nutritional Chemistry	CU233SL1/CU235SL1
IV/ VI	Chemistry of Fuels	CU234SL1/CU236SL1

Examination Pattern

Each paper carries an internal component. There is a passing minimum for external component. A minimum of 40% in the external examination and an aggregate of 40% is required.

i. Part I – Tamil, Part II – English, Part III - (Core Course/ Elective Course)

Ratio of Internal and External= 25:75

Continuous Internal Assessment (CIA)

Internal Components and Distribution of Marks

Components	Marks
Internal test (2) - 40 marks	10
Quiz (2) - 20 marks	5
Assignment: (Model Making, Exhibition, Role Play, Seminar, Group Discussion, Problem Solving, Class Test, Open Book Test etc. (Minimum three items per course should be included in the syllabus & teaching plan) (30 marks)	10
Total	**25**

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 4 x 1(No choice)	4	Part A 10 x 1 (No choice)	10
Part B 2 x 6 (Internal choice)	12	Part B 5 x 6 (Internal choice)	30
Part C 2 x 12 (Internal choice)	24	Part C 5 x 12 (Internal choice)	60
Total	**40**	**Total**	**100**

ii. Lab Course:

Ratio of Internal and External= 25:75

Total: 100 marks

Internal Components and Distribution of Marks

Internal Components	Marks
Performance of the Experiments	10
Regularity in attending practical and submission of records	5
Record	5
Model exam	5
Total	**25**

Question pattern

External Exam	Marks
Major Practical	75
Minor Practical / Spotters /Record	
Total	**75**

iii. Core Research Project

Ratio of Internal and External = 25:75

Components	Marks
Internal	25
External	
Core Research Project Report	40
Viva voce	35
Total	**100**

Part - IV

i. Non-major Elective, Skill Enhancement Course I & II, Foundation Course and Professional Competency Skill

Ratio of Internal and External = 2**5: 75**

Internal Components and Distribution of Marks

Components	Marks
Internal test (2) – 25 marks	10
Quiz (2) – 20 marks	5
Assignment: (Model Making, Exhibition, Role Play, Album, Group Activity, etc. (Minimum three items per course)	10
Total	**25**

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 2 x 2 (No Choice)	4	Part A 5 x 2 (No Choice)	10
Part B 3 x 4 (Open choice **Three** out of **Five**)	12	Part B 5 x 4 (Open choice any **Five** out of **Eight**)	20
Part C 1 x 9 (Open choice **One** out of **Three**)	9	Part C 5 x 9 (Open choice any **Five** out of **Eight**)	45
Total	**25**	**Total**	**75**

ii. Skill Enhancement Course III & IV

Digital Fluency

Components	Marks
Internal	
Quiz (15 x 1)	15
Lab Assessment (5 x 2)	10
Total	**25**
External	
Practical (2 x 25)	50
Procedure	25
Total	**75**

Fitness and Wellbeing

Components	Marks
Internal	
Quiz (15 x 1)	15
Exercise (2 x 5)	10
Total	**25**
External	
Written Test: Part A: Open choice – 5 out of 8 questions (5 x 5) Part B: Open choice – 5 out of 8 questions (5 x 10)	25 50
Total	**75**

iii. Environmental Studies

Internal Components	Marks
Project Report	15
Viva voce	10
Total	**25**

Question Pattern

External Exam	Marks
Part A 5 x 2 (No Choice)	10
Part B 5 x 4 (Open choice any **Five** out of **Eight**)	20
Part C 5 x 9 (Open choice any **Five** out of **Eight**)	45
Total	**75**

iv. Internship

Components	Marks
Industry Contribution	50
Report & Viva-voce	50
Total	**100**

v. Professional Competency Skill

Internal Components	Marks
Test – 20 marks	5
Individual Activity	10
Group Activity	10
Total	**25**
External Exam	**Marks**
Part A 5 x 2 (No Choice)	10
Part B 5 x 4 (Open choice any **Five** out of **Eight**)	20
Part C 5 x 9 (Open choice any **Five** out of **Eight**)	45
Total	**75**

Co-Curricular Courses:

i. Life Skill Training: Catechism & Moral

Human Rights, Justice and Ethics

Gender Equity and Inclusivity

Internal Components

Component	Marks
Project - Album on current issues	25
Group Activity	25
Total	**50**

External Components

Component	Marks
Written Test: Open choice – 5 out of 8 questions (5 x 10)	50
Total	**50**

ii. Skill Development Training - Certificate Course:

Components	Marks
Attendance & Participation	50
Skill Test	50
Total	**100**

iii. Field Project:

Components	Marks

Field Work	50
Field Project Report & Viva-voce	50
Total	**100**

iv. Specific Value-Added Courses & Generic Value-Added Courses:

Components	**Marks**
Internal	25
External	75
Total	**100**

v. Student Training Activity: Clubs and Committees

Compulsory for all I & II year students (1 credit).

Component	**Marks**
Attendance	25
Participation	75
Total	**100**

vi. Community Engagement Activity: Reaching the Unreached Neighbourhood (RUN)

Components	**Marks**
Attendance & Participation	50
Field Project	50
Total	**100**

vii. Self Learning Course

Internal Test	**Marks**	**External Exam**	**Marks**
Part A 3x5 (Three out of five)	15	Part A 5 x 5 (Internal choice)	25
Part B 1 x 10 (One out of three)	10	Part B 5 x 10 (Five out of eight)	50
Total	**25**	**Total**	**75**

Outcome Based Education (OBE)

(i) Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S. No.	**Level**	**Parameter**	**Description**
1	KI	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis /Creating	The learner creates a new product or point of view

(ii) Weightage of K – Levels in Question Paper

Number of questions for each cognitive level:

Programme	**Assessment**	**Lower Order Thinking**									**Higher order thinking**			**Total number of questions**
		K1			**K2**			**K3**			**K4, K5, K6**			
	Part	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	
I UG	Internal	2	1	-	1	1	1	1	-	1	-	-	-	**8**
	External	5	2	1	3	2	2	2	1	2	-	-	-	**20**
II UG	Internal	1	1	-	1	1	1	1	-	1	1	-	-	**8**
	External	5	1	1	4	1	1	-	3	1	1	-	2	**20**
	Internal	1	-	-	1	-	1	1	1	1	1	1	-	**8**

III UG	External	5	1	1	4	1	1	-	3	1	1	-	2	**20**

The levels of assessment are flexible and it should assess the cognitive levels and outcome attainment.

Evaluation

i. The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade points.

ii. Evaluation of each course shall be done by Continuous Internal Assessment (CIA) by the course teacher as well as by an end semester examination and will be consolidated at the end of the semester.

iii. There shall be examinations at the end of each semester, for odd semesters in October/November; for even semesters in April/ May.

iv. A candidate who does not pass the examination in any course(s) shall be permitted to reappear in such failed course(s) in the subsequent examinations to be held in October/ November or April/May. However, candidates who have arrears in practical examination shall be permitted to reappear for their areas only along with regular practical examinations in the respective semester.

v. Viva-voce: Each project group shall be required to appear for Viva -voce examination in defence of the project.

vi. The results of all the examinations will be published in the college website.

Conferment of Bachelor's Degree

A candidate shall be eligible for the conferment of the Degree of Bachelor of Arts / Science / Commerce only if the minimum required credits for the programme thereof (140 + 18 credits) is earned.

Grading System

For the Semester Examination:

Calculation of Grade Point Average for End Semester Examination:

$$\textbf{GPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the course}}{\text{Sum of the credits of the courses (passed) in a semester}}$$

For the entire programme:

Cumulative Grade Point Average (CGPA) $\Sigma_n\Sigma_i C_{ni}G_{ni} / \Sigma_{ni}\Sigma_i C_{ni}$

$$\text{CGPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$$

where

C_i - Credits earned for course i in any semester

G_i - Grade point obtained for course i in any semester

n - semester in which such courses were credited

Final Result

Conversion of Marks to Grade Points and Letter Grade

Range of Marks	Grade Points	Letter Grade	Description
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
40-49	4.0-4.9	C	Satisfactory
00-39	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

Overall Performance

CGPA	Grade	Classification of Final Result
9.5-10.0	O+	First Class – Exemplary*

9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction*
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
4.0 and above but below 5.0	C	Third Class
0.0 and above but below 4.0	U	Re-appear

*The candidates who have passed in the first appearance and within the prescribed semester are eligible for the same.

SEMESTER I

CORE COURSE I: GENERAL CHEMISTRY - I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231CC1	5	-	-	-	5	5	75	25	75	100

Prerequisites: Higher secondary chemistry

Learning Objectives

1. To understand various atomic models and atomic structure
2. To realize the wave particle duality of matter
3. To learn periodic table, periodicity in properties and its application in explaining the chemical behaviour
4. To know the nature of chemical bonding, and
5. To understand the fundamental concepts of organic chemistry

Course Outcomes

On the successful completion of the course, student will be able to:		
1	remember the atomic structure, periodic properties, bonding, electronic configuration and properties of compounds.	**K1**
2	understand and classify the elements in the periodic table, types of bonds, reaction intermediates, electronic effects in organic compounds and types of reagents.	**K2**
3	apply the theories to calculate energy of spectral transition, electronegativity, percentage ionic character and bond order.	**K3**
4	analyse the relationship existing between electronic configuration, bonding, geometry of molecules, structure reactivity and electronic effects	**K4**
5	evaluate the trends in periodic properties, assess the properties of elements, and explain hybridization in molecules, nature of H – bonding and organic reaction mechanisms.	**K5**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate

Unit	Contents	No. of Hours
I	**Atomic structure and Periodic trends** History of atom (J.J.Thomson, Rutherford); Moseley's Experiment and Atomic number, Atomic Spectra; Black-Body Radiation and Planck's quantum theory - Bohr's model of atom; The Franck-Hertz Experiment; Interpretation of H-spectrum; Photoelectric effect, Compton effect; Dual nature of Matter- De-Broglie wavelength-Davisson and Germer experiment Heisenberg's Uncertainty Principle; Electronic Configuration of Atoms and ions- Hund's rule, Pauli'exclusion principle and Aufbau principle. Numerical problems involving the core concepts**.**	**15**
II	**Introduction to Quantum mechanics** Classical mechanics, Wave mechanical model of atom, distinction between a Bohr orbit and orbital; Postulates of quantum mechanics; probability interpretation of wavefunctions, Formulation of Schrodinger wave equation - Probability and electron density-visualizing the orbitals -Probability density and significance of Ψ and Ψ^2. **Modern Periodic Table** **Cause of periodicity**; Features of the periodic table; classification of elements - Periodic trends for atomic size- atomic radii, ionic and covalent radii; ionization energy, electron affinity, electronegativity-electronegativity scales Mulliken and	**15**

	Paulings scales of electronegativity, applications of electronegativity. Problems involving the core concepts	
III	**Structure and bonding – I** **Ionic bond** Ionic bond-definition; properties of ionic compounds; Energy involved in ionic compounds; Born Haber cycle – lattice energies-applications of lattice energy, Ion polarisation– polarising power and polarizability; Fajans' rules - effects of polarisation on properties of compounds; problems involving the core concepts. **Covalent bond** Shapes of orbitals, overlap of orbitals – σ and Π bonds; hybridization-types-sp,sp^2,sp^3-examples. VSEPR theory - shapes of molecules of the type AB_2, AB_3, AB_4, AB_5, AB_6 and AB_7 Partial ionic character of covalent bond-dipole moment, percentage ionic character- numerical problems based on calculation of percentage ionic character.	**15**
IV	**Structure and bonding – II** VB theory – application to hydrogen molecule; concept of resonance - resonance structures of some inorganic species – CO_2, NO_2, CO_3^{2-} NO_3^- limitations of VBT; MO theory - bonding, antibonding and non bonding orbitals, bond order; MO diagrams of H_2, C_2, O_2, O_2^+, O^{2-} , O^{2-} ,N_2 , NO, HF, CO; magnetic characteristics, comparison of VB and MO theories. Co-ordinate bond: Definition, Formation of BF_3, NH_3 molecules Metallic bond-electron sea model, VB model; Band theory-mechanism of conduction in solids; conductors, insulator, semiconductor – types, applications of semiconductors Weak Chemical Forces - Vander Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces; Hydrogen bonding – Types, inter and intramolecular- special properties of water, ice, viscosity of glycerol, melting and boiling points.	**15**
V	**Basic concepts in Organic Chemistry and Electronic effects** Types of bond cleavage – heterolytic and homolytic; arrow pushing in organic reactions; reagents and substrates; types of reagents - electrophiles, nucleophiles, free radicals; reaction intermediates – carbanions, carbocations, carbenes, arynes and nitrynes. Inductive effect - reactivity of alkyl halides, acidity of halo acids, basicity of amines; inductive and electromeric effects. Resonance – resonance energy, conditions for resonance - acidity of phenols, basicity of aromatic amines, stability of carbonium ions, carbanions and free radicals, reactivity of vinyl chloride, dipole moment of vinyl chloride and nitrobenzene, steric inhibition to resonance Hyperconjugation - stability of alkenes, orienting effect of methylgroup, dipole moment of aldehydes and nitromethane. Types of organic reactions- addition, substitution, elimination and rearrangements.	**15**
	TOTAL	**75**
Self study	Atomic models, Periodic table, Chemical bonding, Theories of bonding and Electronic effects	

Textbooks

1. Madan, R.D. Sathya Prakash. 2003. Modern Inorganic Chemistry, 2nd ed.; S. Chand and Company, New Delhi.

2. Rao, C.N. R. 2000. University General Chemistry, Macmillan Publication: New Delhi.
3. Puri, B. R., L. R. Sharma. 2002. Principles of Physical Chemistry, 38th ed.; Vishal Publishing Company: Jalandhar.
4. Bruce, P. Y., K. J. R. Prasad. 2008. Essential Organic Chemistry, Pearson Education, New Delhi.
5. Dash, U.N., O.P. Dharmarha, P . L . Soni. 2 0 1 6 . Textbook of Physical Chemistry, Sultan Chand & Sons: New Delhi.

Reference Books

1. Maron, S. H., C.P. Prutton. 1972. Principles of Physical Chemistry, 4th ed., The Macmillan Company: Newyork.
2. Lee, J. D. 1991. Concise Inorganic Chemistry, 4th ed., ELBS WilliamHeinemann, London.
3. Gurudeep Raj, 2001. Advanced Inorganic Chemistry, 26th ed., Goel Publishing House: Meerut.
4. Atkins, P.W., J. Paula. 2014. Physical Chemistry, 10th ed., Oxford University Press: New York.
5. Huheey, J. E. 1993. Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed.Addison, Wesley Publishing Company: India.

Web Resources

1. https://onlinecourses.nptel.ac.in
2. http://www.mikeblaber.org/oldwine/chm1045/notes_m.htm
3. http://www.ias.ac.in/initiat/sci_ed/resources/chemistry/Inorganic.html
4. https://swayam.gov.in/course/64-atomic-structure-and-chemical-bonding
5. https://www.chemtube3d.com/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	3	2	2	3	3	2	2	2	2	3	3	2
CO2	3	2	3	3	2	2	3	3	3	2	2	2	3	3	2
CO3	3	2	2	3	2	2	3	3	3	3	2	3	3	2	2
CO4	3	2	2	3	2	2	3	3	3	3	2	2	3	2	2
CO5	3	2	2	3	2	2	3	3	3	3	2	2	3	2	2
TOTAL	**15**	**10**	**12**	**15**	**10**	**10**	**15**	**15**	**14**	**13**	**10**	**11**	**15**	**12**	**10**
AVERAGE	**3**	**2**	**2.4**	**3**	**2**	**2**	**3**	**3**	**2.8**	**2.6**	**2**	**2.2**	**3**	**2.4**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

CORE LAB COURSE I: QUANTITATIVE INORGANIC ESTIMATION (TITRIMETRY) AND INORGANIC PREPARATIONS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231CP1	-	-	3	-	3	3	45	25	75	100

Prerequisites: Higher secondary chemistry

Learning Objectives

1. To understand the concepts of quantitative analysis
2. To recognize the indicators, acid and bases used in volumetric analysis
3. To gain knowledge on laboratory safety and handling glasswares
4. To utilize mathematical skills for calculation
5. To get knowledge on the preparation of inorganic compounds

Course Outcomes

On the successful completion of the course, student will be able to:		
1	explain the basic principles involved in titrimetric analysis and inorganic preparations.	**K1**
2	compare the methodologies of different titrimetric analysis.	**K2**
3	calculate the concentrations of unknown solutions in different ways and develop the skill to estimate the amount of a substance present in a given solution.	**K3**
4	assess the yield of different inorganic preparations and identify the end point of various titrations	**K4**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze

S.No	Contents	No. of Hours
I.	**Chemical Laboratory Safety in Academic Institutions** Introduction - importance of safety education for students, common laboratory hazards, assessment and minimization of the risk of the hazards, prepare for emergencies from uncontrolled hazards; concept of MSDS; importance and care of PPE; proper use and operation of chemical hoods and ventilation system; fire extinguishers-types and uses of fire extinguishers, demonstration of operation; chemical waste and safe disposal. **Common Apparatus Used in Quantitative Estimation (Volumetric)** Description and use of burette, pipette, standard flask, measuring cylinder, conical flask, beaker, funnel, dropper, clamp, stand, wash bottle, watch glass, wire gauge and tripod stand. **Principle of Quantitative Estimation (Volumetric)** Equivalent weight of an acid, base, salt, reducing agent, oxidizing agent; concept of mole, molality, molarity, normality; primary and secondary standards, preparation of standard solutions; theories of acid-base, redox, complexometric, iodimetric and iodometric titrations**;** indicators – types, theory of acid–base, redox, metal ion and adsorption indicators, choice of indicators.	**15**
2.	**Quantitative Estimation(Volumetric)** Preparation of standard solution, dilution from stock solution **Permanganometry** Estimation of oxalic acid using standard ferrous ammonium sulphate **Dichrometry** Estimation of Ferrous Ammonium Sulphate using standard dichromate	**15**

	(external indicator) Estimation of Ferrous Ammonium Sulphate using standard dichromate (internal indicator) **Iodometry** Estimation of copper in copper sulphate using standard dichromate **Argentometry** Estimation of chloride in barium chloride using standard sodium chloride/	
3.	**Complexometry** Estimation of hardness of water using EDTA Estimation of Zinc using EDTA Estimation of Magnesium using EDTA Estimation of Lead using EDTA **Preparation of Inorganic compounds** Potash alum Tetra ammine copper (II) sulphate Prussian Blue Mohr's Salt	**15**
	TOTAL	**45**
Self study	Equivalent weight and Calculation of normality	

Textbooks

1.Venkateswaran, V., R. Veeraswamy, A.R. Kulandivelu. 1997. Basic Principles ofPractical Chemistry, 2nd ed., Sultan Chand &Sons, New Delhi

2.Nad, A. K., B. Mahapatra, A. Ghoshal.,2002.An advanced course in Practical

3. Thomas, A.O. 1999. Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore.

4. Vogel, A.I. 1990. A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans

Reference Book

1. Mendham, J., R.C. Denney, J.D. Barnes, M. Thomas, B. Sivasankar. 2000, Vogel's Textbook of Quantitative Chemical Analysis, 6th ed.; PearsonEducation Ltd, New Delhi.

Web Resources

1.http://www.federica.unina.it/agraria/analytical-chemistry/volumetric- analysis

2.https://chemdictionary.org/titration-indicator/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	3	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	3	2	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	2
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	2	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	3
TOTAL	**15**	**12**	**14**	**13**	**13**	**10**	**10**	**15**	**10**	**10**	**10**	**11**	**10**	**10**	**11**
AVERAGE	**3**	**2.4**	**2.8**	**2.6**	**2.6**	**2**	**2**	**3**	**2**	**2**	**2**	**2.2**	**2**	**2**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER I
ELECTIVE COURSE I: BOTANY AND ZOOLOGY MAJOR
CHEMISTRY FOR BIOLOGICAL SCIENCES - I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231EC1	4	-	-	-	3	4	60	25	75	100

Prerequisites: Higher secondary chemistry

Learning Objectives

1. To gain knowledge on the significance and shapes of atomic orbitals
2. To understand the basics of biophysical analysis and industrial chemistry
3. To recognize the role of drugs, separation and purification techniques.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	remember the atomic structure, the preparation and uses of various compounds	K1
2	understand the efficiencies and uses of various drugs, fertilizers and fuels.	K2
3	explain and apply various theories behind osmosis, catalysis and chromatography	K3
4	differentiate the structure and uses of antibiotics, anaesthetics, antipyretics and artificial sugars.	K4
5	analyse various methods to separate chemical compounds	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

Unit	Contents	No. of Hours
I	**Atomic Structure** Dual nature of electron - de-Broglie equation - Davisson and Germer experiment. Heisenberg's uncertainty principle and its significance. Compton effect - Schrodinger's wave equation and its significance - eigen values and eigen functions - quantum numbers and their significance. Atomic orbitals - significance - shapes - difference between orbit and orbital. Rules for filling up of orbitals - Pauli's exclusion principle - Aufbau principle - Hund's rule. Electronic configuration of elements up to 20.	12
II	**Industrial Chemistry** Fuels: Fuel gases: Natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones: Synthesis, properties and uses of silicones. Fertilizers: Urea, ammonium sulphate, potassium nitrate NPK fertilizer, superphosphate, triple superphosphate.	12
III	**Biophysical Analysis and Catalysis** Osmosis - osmotic pressure - isotonic solutions. Determination of molar mass by osmotic pressure measurement. Reverse osmosis. Adsorption - types - factors influencing adsorption and applications. Catalysis - types - theories - intermediate compound formation theory and adsorption theory.	12
IV	**Drugs and Speciality Chemicals** Definition and uses - Antibiotics- penicillin, chloramphenicol and streptomycin. Anaesthetics - chloroform and ether. Antipyretics - aspirin, paracetamol and ibuprofen. Artificial Sweeteners - saccharin, aspartame and cyclamate .Organic Halogen compounds – freon and teflon.	12

V	**Analytical Chemistry** Introduction qualitative and quantitative analysis. Principles ofvolumetric analysis. Separation and purification techniques: extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography.	**12**
TOTAL		**60**
Self Study	Electronic configuration of elements, Properties and uses of silicones, Types of Catalysis, Artificial sweetners and Applications of chromatography.	

Textbooks

1. Veeraiyan, V. 2009. Textbook of Ancillary Chemistry; High mount publishing house, Chennai, first edition.
2. Vaithyanathan, S. 2006. Text book of Ancillary Chemistry; Priya Publications, Karur.
3. Arun Bahl, B.S.Bahl. 2012. Advanced Organic Chemistry; S.Chand and Company, New Delhi, twenty third edition.
4. Soni, P.L., H.M. Chawla. 2007. Text Book of Inorganic Chemistry, Sultan Chand & sons, New Delhi, twenty ninth edition.

Reference Books

1. Soni, P. L., Mohan Katyal. 2007. Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition.
2. Sharma, B.K. 2014. Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition.
3. Jayashree Gosh, Fundamental Concepts of Applied Chemistry;

Web Resources

1. https://alison.com/course/chemistry-atomic-structure
2. https://www.udemy.com/course/atomic-structure/
3. https://www.classcentral.com/course/swayam-industrial-inorganic-chemistry-12912
4. https://nptel.ac.in/courses/104105103
5. https://www.udemy.com/topic/Analytical-Chemistry/?utm_source=adwords&utm_medium=udemyads&utm_campaign=DSA_

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	2	3	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	3
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	3	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	2
TOTAL	**15**	**11**	**13**	**13**	**13**	**10**	**10**	**15**	**10**	**10**	**10**	**10**	**11**	**11**	**11**
AVERAGE	**3**	**2.2**	**2.6**	**2.6**	**2.6**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2.2**	**2.2**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

ELECTIVE LAB COURSE I: VOLUMETRIC ANALYSIS

(BOTANY AND ZOOLOGY MAJOR)

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231EP1	-	-	2	-	2	2	30	25	75	100

Prerequisites:

Higher secondary chemistry

Learning Objectives

1. To understand the basics of preparation of solutions.
2. To understand the principles and practical experience of volumetric analysis.

Curse Outcomes

On the successful completion of the course, student will be able to:		
1	understand the principles of titrimetric methods.	**K1**
2	gain knowledge on the usage of standard flask, pipette and burette.	**K2**
3	design, carry out, record and interpret the results of various titrations and apply their skill in the estimation of various compounds.	**K3**
4	analyze the suitable indicators for various titrations	**K4**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

Contents	No. of Hours
VOLUMETRIC ANALYSIS 1. Estimation of sodium hydroxide using standard sodium carbonate. 2. Estimation of sulphuric acid acid using standard oxalic acid. 3. Estimation of ferrous sulphate using standard Mohr's salt. 4. Estimation of oxalic acid using standard ferrous sulphate. 5. Estimation of zinc using EDTA. 6. Estimation of magnesium using EDTA. 7. Estimation of ferrous ion using potassium dichromate.	**30**
TOTAL	**30**
Self Study Demonstration	

Textbooks

1. Venkateswaran, V., R. Veeraswamy, A.R. Kulandivelu. 1997. Basic Principles of Practical Chemistry,2nd ed.; Sultan Chand &Sons: New Delhi.
2. Nad, A. K., B. Mahapatra, A. Ghoshal, An advanced course in Practical
3. Thomas, A.O. 1999. Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore.
4. Vogel, A.I. (1990). A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans.

Reference Books

1.V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic Principles of PracticalChemistry; Sultan Chand & sons, Second edition, 1997.

Web Resources

1. http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-Analysis

2.https://chemdictionary.org/titration-indicator

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	3	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	3	2	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	2
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	2	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	3
TOTAL	**15**	**12**	**14**	**13**	**13**	**10**	**10**	**15**	**10**	**10**	**10**	**11**	**10**	**10**	**11**
AVERAGE	**3**	**2.4**	**2.8**	**2.6**	**2.6**	**2**	**2**	**3**	**2**	**2**	**2**	**2.2**	**2**	**2**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

NON-MAJOR ELECTIVE NME I: FOOD CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231NM1	2	-	-	-	2	2	30	25	75	100

Pre-requisite:

Students should have basic knowledge on food chemistry.

Learning Objectives:

1. To know about adulterations used in food and their impact on health.
2. To learn the different types of additives used in food.
3. To gain knowledge on diseases caused by beverages

Course Outcomes

On the successful completion of the course, student will be able to:		
1	remember and recall the different types of adulterants in food, edible oils used in foods and beverages.	**K1**
2	understand the effect of chemicals in common food and their adverse impact on health.	**K2**
3	apply various methods to detect various adulterants in food and to determine the values of oils and fats.	**K3**
4	analyze the effects of contaminants and additives in food.	**K4**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze;

Unit	Contents	No. of Hours
I	**Food Adulteration** Sources of food, types, advantages and disadvantages. Food adulteration - contamination of wheat, rice, milk, butter etc. with clay stones, water and toxic chemicals -Common adulterants, Ghee adulterants and their detection. Detection of adulterated foods by simple analytical techniques.	**6**
II	**Food Poison** Food poisons - natural poisons (alkaloids - nephrotoxin) - pesticides, (DDT, BHC, Malathion) -Chemical poisons - First aid for poison consumed victims.	**6**
III	**Food Additives** Food additives - artificial sweeteners-Saccharin-Cyclomate and Aspartate-Food flavours - esters, aldehydes and heterocyclic compounds – Food colours – Emulsifying agents – preservatives -leavening agents. Baking powder – yeast – tastemakers – MSG - vinegar.	**6**
IV	**Beverages** Beverages-soft drinks-soda-fruit juices-alcoholic beverages-examples. Carbonation-addiction to alcohol– diseases of liver and social problems.	**6**
V	**Edible Oils** Fats and oils - Sources of oils - production of refined vegetable oils - preservation. Saturated and unsaturated fats and oils-examples - iodine value - determination of iodine value, acid value, RM value, saponification values and their significance- Role of MUFA and PUFA in preventing heart diseases.	**6**
	Total	**30**

Self study	Contamination of wheat, Saccharin, Food colours, Sources of oils

Textbooks

1. Chopra, H.K., Panesar, P.S. 2010. Food chemistry, Narosa publishing house.
2. Jayashree Ghosh. 2006. Fundamental Concepts of Applied Chemistry(Second edition), Chand& Co.Publishers.
3. Belitz,H.D., Grosch, W., Schieberle. P. 2009. Food Chemistry (Fourth revised and extended edition), Springer.
4. Subbulakshmi,G. Shobha. A. U, Padmini .S. G.2021. Food processing and preservation (Second edition). New age international publishers.

Reference Books

1. Belitz,H.D., Werner, G. 2009.Food Chemistry(Fourth Edition) .Springer Science & Business Media,2009.
2. Swaminathan,M, 1979. Food Science and Experimental Foods, Ganesh and Company.
3. Hasenhuettl, G. L., Hartel, R. W. 2008. Food Emulsifiers and their applications (Second Edition) Springer New York.
4. Belitz,H.D., Grosch, W., Schieberle. P. 2009. Food Chemistry (Fourth revised and extended edition), Springer.
5. John, M., D., John W. F., Jefferey, W. Principles of food chemistry(Fourth Edition). Springer.

Web Resources

1. https://authors.library.caltech.edu.in
2. http://ecoursesonline.iasri.res.in/course/view.php?id=89
3. https://onlinecourses.swayam2.ac.in/cec20_ag10/preview
4. https://www.igmpiindia.org/FoodCampaign/Adword.php?gclid=Cj0
5. https://www.classcentral.com/course/swayam-food-chemistry-14061

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	2	2	3	2	3	2	2	3	2	2	2	2
CO2	3	2	3	3	3	2	2	3	2	2	3	2	2	3	2
CO3	3	2	3	3	3	2	2	3	2	2	2	3	2	2	2
CO4	3	2	3	2	2	2	2	3	2	2	3	2	2	2	2
CO5	3	2	3	2	3	2	2	3	2	2	2	2	2	3	2
TOTAL	**15**	**10**	**15**	**12**	**13**	**11**	**10**	**15**	**10**	**10**	**13**	**11**	**10**	**11**	**10**
AVERAGE	**3**	**2**	**3**	**2.4**	**2.6**	**2.2**	**2**	**3**	**2**	**2**	**2.6**	**2.2**	**2**	**2.2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

FOUNDATION COURSE: BASICS OF CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231FC1	2	-	-	-	2	2	30	25	75	100

Pre-requisite:

Higher secondary Chemistry

Learning Objectives:

1. To understand the concepts of periodic classification, chemical bonding, nomenclature of organic compound, isomerism and state of matter.
2. To acquire knowledge on various spectroscopic techniques.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	remember the basic concepts of periodic classification, chemical bonding, nomenclature of organic compound, isomerism and state of matter.	**K1**
2	understand the periodic properties, types of bonding, hybridization, stereo isomerism, properties of matter and spectroscopy.	**K2**
3	apply the concepts of valence bond theory, hybridization, isomerism IUPAC nomenclature and spectroscopy to chemical compounds.	**K3**
4	analyze the periodic properties of elements, magnetic properties, characteristic of solids and types of spectroscopic techniques.	**K4**
5	evaluate quantum numbers and their significance and percentage of ionic character of compounds.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** – Evaluate

Units	Contents	No. of Hours
I	**Structure of atom and periodic classification of Elements and properties** Atomic structure - Fundamental particles - Atomic mass - Atomic number - Isotopes - Isobars - Isotones - Orbitals - Quantum number and their significance. Shapes of s,p and d orbitals - Rules governing electronic configuration in various atomic orbitals. Periodic table - periodic laws (Mendeleev and Mosley) - Classification of elements into s, p, d and f-blocks. Metals - Non-metals - Periodic properties - Concept, Variation and factors affecting various periodic properties - Inert pair effect.	**6**
II	**Chemical Bonding** Definition - Types of chemical bond - Ionic bond - Ion polarization - Dipole moment and Percentage of ionic character - Covalent bond -Definition - Postulates of Valence bond theory and Concept of hybridization (sp, sp^2, sp^3, sp^3d, sp^3d^2, dsp^2, d^2sp^3) - Magnetic properties - Paramagnetic - Diamagnetic - Ferromagnetic. Co-ordinate covalent bond - Definition - Examples - Co-ordination compounds (basic concepts only).	**6**
III	**Nomenclature and Isomerism in Organic compounds** Carbon compounds - Uniqueness of carbons - Classification of hydrocarbons - IUPAC Nomenclature of Organic compounds Isomerism: Structural and Stereoisomerism Structural Isomerism: Chain isomerism, Functional isomerism, Positional isomerism and Meta isomerism. Stereoisomerism: Geometrical and Optical isomerism - Chiral molecule - Enantiomers - Diastereomers - Meso compounds - Racemic mixture.	**6**
IV	**States of Matter**	**6**

	Gaseous state: Kinetic theory of gases - Ideal and Non-ideal gases - Ideal gas equation - Deviation of ideal gas from ideal behaviour - vander Waal's equation and Liquification of gases. Liquids: Intermolecular forces, Vapour pressure and Boiling point of liquid - Surface tension - Viscosity - Factors affecting surface tension and viscosity. Solids: Definition - Characteristics of solids- Amorphous and Crystalline solids - Space lattice and unit cells - Close packed structure of solids-Radius ratio rule.	
V	**Introduction to Spectroscopy** Electromagnetic radiation - General characteristics of Wave - Wavelength - Frequency - Amplitude - Wave number - Electromagnetic spectrum- Absorption and Emission spectrum - Quantization of Energy level - Selection rule - Intensity of the Spectral lines - Width of Spectral lines. Types of spectroscopy: Microwave spectroscopy, Infrared spectroscopy, UV-Visible spectroscopy, Nuclear Magnetic Resonance spectroscopy, Electron spin resonance spectroscopy.	**6**
	Total	**30**
Self-study	Periodic table - periodic laws (Mendeleev and Mosley) ,Types of chemical bonds, Classification of hydrocarbons ,Characteristics of solids, Electromagnetic radiation and general characteristics of Wave	

Textbooks

1. Puri, B.R., Sharma, L.R., Kalia, K.C., 2014, Principles of Inorganic chemistry (Thirty First Edition). Milestone Publishers and Distributors, New Delhi.
2. Banerjee, S.P., 2017, Advanced Inorganic Chemistry (Second Edition). Arunabha Sen, Books and Allied (P) Ltd., Kolkata.
3. Tewari, K.S., Mehrothra, S.N., Vishnoi, N.K., 1998, Text book of Organic Chemistry (Second Edition). Vikas publishing House, New Delhi.
4. Puri, B.R., Sharma, L.R., Pathania, M.S., 2019, Principles of Physical Chemistry (Fourty Seventh Edition). Vishal Publishers, India.
5. Sharma, Y.R., 2013, Elementary Organic Spectroscopy (Fifth Edition). S. Chand Publishing, New Delhi.

Reference Books

1. Madan, R.D., 2014, Modern Inorganic Chemistry (Thirteenth Edition). Sultan Chand Publishers, India.
2. Jain, M.K., Sharma, S.C., 2015, Modern Organic Chemistry. Vishal Publishers, India.
3. Soni, P.L., 2000, Text book of Organic Chemistry (Twentieth Edition). Sultan Chand Publishers, India.
4. Kundu, N., Jain S.K., 2000, A Text Book of Physical Chemistry. S Chand & Company Ltd., New Delhi.
5. Kalsi, P.S., 2004, Spectroscopy of Organic Compounds (Sixth Edition). New Age International Ltd., India.
6. Kaur, H., 2006, Spectroscopy (Third Edition). Pragati Prakasan Publications, Meerut.
7. BanWell, C.N., Mccash, E.M., 1997, Fundamentals of Molecular Spectroscopy. Tata Mc Grow Hill, New Delhi.

Web Resources

1. https://www.udemy.com/course/chemistry-periodic-classification-of-elements/
2. https://alison.com/topic/learn/128224/chemical-bonding-learning-outcomes
3. http://www.adichemistry.com/organic/basics/iupac1/organic-iupac-nomenclature.html
4. https://byjus.com/chemistry/matter-solid-liquid-gas/
5. https://onlinecourses.nptel.ac.in/noc23_cy35/preview

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	2	2	2	3	3	2	2	2	2	2	2	2
CO2	3	2	2	2	2	2	3	3	2	2	2	2	3	2	2
CO3	3	2	2	2	2	2	3	3	3	2	2	2	3	2	2
CO4	3	2	2	2	2	2	3	3	3	2	2	2	3	2	2
CO5	3	2	2	2	2	2	3	3	3	2	2	2	3	2	2
TOTAL	**15**	**10**	**10**	**10**	**10**	**10**	**15**	**15**	**13**	**10**	**10**	**10**	**14**	**10**	**10**
AVERAGE	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2.6**	**2**	**2**	**2**	**2.8**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

SPECIFIC VALUE-ADDED COURSE: ARTICLES IN EVERY DAY LIFE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231V01	2	-	-	-	1	2	30	25	75	100

Pre-requisite: Knowledge about the usage of chemicals in daily use.

Learning Objectives

1. To develop skill in preparing chemicals of every day use.
2. To know the uses and side effects of various chemicals.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	know about oils, fats and soaps	**K1**
2	understand the methods to prepare some articles in daily use	**K2**
3	apply the prepared things in daily life	**K3**
4	remember the hazards of chemicals	**K2**
5	analyze and use the safety compounds for their use	**K4**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4 -** Analyze

Unit	Contents	No. of Hours
I	Oils – difference between oils and fats –refining of oil–manufacture of soaps – toilet and transparent soaps -washing and shaving soaps, liquid soap-methods of preparation, cleaning action of soaps. – Detergents – synthetic detergents –classification and manufacture of anionic, cationic and non-ionic detergents and shampoo-Eco-friendly detergents.	**6**
II	Chemistry of face creams, cold cream, vanishing creams, toilet powders, hand lotion and creams, nail bleach, nail lacquer, nail lacquer removers, lipstick, eye-makeup, eye lid, hair oils, hair creams, hair dyes, hair removers, hazards of cosmetics.	**6**
III	Perfumes-definition- classification as natural and synthetic-composition or ingredients. Fixatives: Name of the oil, source, components.	**6**
IV	Tooth paste, tooth powder, boot polish, gum paste, sealing wax, phenoyle, moth balls, liquid blues, chalk crayons, inks, agarpattis and camphor tablets	**6**
V	Preparation, properties and uses of washing soda, baking powder ,vinegar , bleaching powder, shampoo, washing powder and sugar.	**6**
	Total	**30**

Self-study	Fixatives, Detergents

Textbooks:

1. Text book of Allied Chemistry by Dr. T. Syed Ismail, Aashiq Publications, 2011.
2. Applied Chemistry by D.M. Yusuff, Nisa Publications, 2010.

Reference Books

1. Mitchell Schlossman.2008. *Chemistry and manufacture of Cosmetics* , Science Edition,
2. Marsh, Madeleine.2014. *Compacts and Cosmetics*: Beauty from Victorian Times to the Present Day. Casemate Publishers.

Web Resources

1. https://www.sciencedirect.com>topics>materials
2. https://www.afmworkshop.com>applications
3. https://www.cosmeticsandskin.com>references
4. https://taylorandfrancis.com>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	3	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	3	2	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	2
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	2	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	3
TOTAL	**15**	**12**	**14**	**13**	**13**	**10**	**10**	**15**	**10**	**10**	**10**	**11**	**10**	**10**	**11**
AVERAGE	**3**	**2.4**	**2.8**	**2.6**	**2.6**	**2**	**2**	**3**	**2**	**2**	**2**	**2.2**	**2**	**2**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

SPECIFIC VALUE-ADDED COURSE: POLYMER CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231V02	2	-	-	-	1	2	30	25	75	100

Pre-requisite: Knowledge about polymers

Learning Objectives

1.To know about the different types of polymers.

2.To understand the importance and the biomedical application of polymers

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	to know about different polymers	**K1**
2.	understand the properties of polymers	**K2**
3.	use the methods and synthesis of polymers and plastics	**K3**
4.	analyse the properties and uses of polymers, plastics and resins	**K4**
5.	evaluate the types of polymers, methods of synthesis and applications	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	General characteristics of polymers. Distinction among plastics, elastomers and fibres Homo and hetero polymers, copolymers. Plastics: thermosetting and thermo plastics.Type of polymerization – addition, condensation and co-polymerization.	**6**
II	Methods of polymerization – bulk, suspension, emulsion and solution polymerization. Synthesis, properties and application of the following polymers - Phenol – formaldehyde resin, Melamine – formaldehyde resin, Polyurethane's, Epoxy resins.	**6**
III	Synthetic polymers – poly ethylene – HDPE, LDPE, LLDPE, poly propylene, poly vinyl chloride – grades of PVC, Teflon, polyesters, polyamide – Nylon 66. Natural polymers – cellulose, starch, cellulose acetate and cellulose nitrate.	**6**
IV	Synthesis of monomers – terephthalic acid, DTM, Caprolactam, hexamethylene diamine, ethylene glycol, adipic acid and acrylonitrile. Properties-Viscosity, Solubility, optical, electrical, thermal and mechanical properties of polymers.	**6**
V	Degradation of polymers by thermal, oxidative, mechanical and chemical methods. Polymer processing – compression moulding, injection moulding, transfer moulding, extrusion moulding, casting, extrusion of fibres and spinning.	**6**
	Total	**30**

Self-study	Types of polymers, Properties of polymers

Textbooks

1. Bhatnagar M.S 2004. *A text book of Polymers,* S. Chand and Company Ltd., New Delhi
2. Gowariker V.R Viswanathan N.V and Jayadev Sreedhar.1986. *Polymer Chemistry*, New Age International (P) Ltd., India.

Reference Books

1. Bill Meyer F.W. 1984. *Text book of Polymer Science*, John Wiley and Sons.
2. Arora G.D .2010. *Polymer Chemistry*, Sarup Book Publishers Pvt. Ltd.
3. Misra.G.1996. *Introductory Polymer Chemistry*, New Age International (P) Ltd., Publishers.
4. Fred. W, Billmeyer. J.R .1994.*A text book of Polymer Science*, John Wiley and Sons,.
5. John W.Nicholson 1985. *The Chemistry of polymers*,Royal society of polymers,Cambridge, UK.

Web Resources

1.https://www.rsc.org>polymer- chemistry

2.https://www.rsc.org>applied polymers
3.https://www.sciencedirect.com>topics>materials
4.https://www.afmworkshop.com>applications
5.https://www.sciencedirect.com>topics>polymer-chemistry

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	1	2	3	3	2	2	3	3	2	2	2	3	3	3
CO2	3	3	1	2	3	2	3	3	3	2	2	2	3	3	3
CO3	3	2	2	2	3	2	3	3	3	3	3	1	2	2	3
CO4	3	2	2	2	3	2	3	3	3	3	3	2	3	2	3
CO5	3	2	3	3	1	2	3	3	3	3	3	3	3	3	3
TOTAL	**15**	**10**	**10**	**10**	**13**	**10**	**14**	**15**	**15**	**13**	**13**	**10**	**14**	**13**	**15**
AVERAGE	**3**	**2**	**2**	**2**	**2.6**	**2**	**2.8**	**3**	**3**	**2.6**	**2.6**	**2**	**2.8**	**2.6**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER I

SPECIFIC VALUE-ADDED COURSE: CHEMISTRY OF COSMETICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231V03	2	-	-	-	1	2	30	25	75	100

Pre-requisite: Students should have knowledge on Chemicals and Cosmetics

Learning Objectives:

1. To know the preparation of Cosmetics.
2. To understand the harmful effects of the ingredients in Cosmetics.

On the successful completion of the course, students will be able to:		
1.	to know about different cosmetics like face creams, nailpolish, hair oil and soaps	**K1**
2.	understand the properties of different chemicals in cosmetics	**K2**
3.	predict the applications of cosmetics in daily life	**K3**
4.	analyse the properties and uses of different cosmetics	**K4**
5.	evaluate the hazards of different cosmetics	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	Face creams – types – cold cream – basic formula – preparation – special additives – uses – vanishing cream – formulation – preparation and uses. Face powders – types – composition – hand lotion and creams – making a simple hand lotion and cream.	**6**
II	Nail polish preparation – Nail bleach, nail lacquers – film forming substances – plasticizers – solvents – colourants – make up preparation – lipstick – composition – Rouge – types and formulation – eye makeup – mascara.	**6**
III	Dentifrices – types – composition – use -detergents in dentifrices – sodium N-lauryl sarcosinate – humectants – binders – flavours – special ingredients in dentifrices – fluoride– chlorophyll – peroxide – antibacterials.	**6**
IV	Shaving soaps – composition – brushless shaving creams – ingredients used , toilet soaps – types – composition – preparation – transparent soaps – special ingredients in toilet soaps.	**6**
V	Hair oil –hair tonics – special ingredients in hair oil and tonics – hair creams – shampoos – types - special ingredients in shampoos – hair dyes -hazards of cosmetics – quality control of cosmetics in India.	**6**
	Total	**30**

Self-study	Hazards of creams, oils and make-up chemicals

Textbooks

1. Thankamma Jacob. 1979. *Applied Chemistry for Home Science and Allied Sciences*, Macmillan Company,.
2. Arun Bahl. S. 2013. *Advanced Organic Chemistry*, Chand & Company,

Reference Books

1.Bilensoy, Erem. 2011. *Cyclodextrins in Pharmaceutics, Cosmetics, and Biomedicine :* Current and Future Industrial Applications. John Wiley & Sons,
2. Mitchell Schlossman.2008. *Chemistry and manufacture of Cosmetics* , Science Edition,

3. Marsh, Madeleine.2014. *Compacts and Cosmetics*: Beauty from Victorian Times to the Present Day. Casemate Publishers.
4. Pallingston, J 1998. *Lipstick: A Celebration of the World's Favourite Cosmetic*. St. Martin's Press.
5. Angeloglou, 1970. Maggie. *The History of Make-up*. First ed. Great Britain: The Macmillan Company,

Web Resources

1. https://www.cosmeticsandskin.com>references
2. https://taylorandfrancis.com>
3. https://www.grafiati.com>literature-selections>cosmetics
4. https://www.juestrich-cosmetics.ch>cosmetics-references
5. https://citationssy.com>Style Guides

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	3	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	3	2	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	2
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	2	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	3
TOTAL	**15**	**12**	**14**	**13**	**13**	**10**	**10**	**15**	**10**	**10**	**10**	**11**	**10**	**10**	**11**
AVERAGE	**3**	**2.4**	**2.8**	**2.6**	**2.6**	**2**	**2**	**3**	**2**	**2**	**2**	**2.2**	**2**	**2**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER II

CORE COURSE II: GENERAL CHEMISTRY - II

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232CC1	5	-	-	-	5	5	75	25	75	100

Pre-requisite : General Chemistry – I

Learning Objectives

1.To understand the chemistry of acids, bases and ionic equilibrium

2. To know the chemistry of hydrocarbons, applications of acids and bases

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	explain the concept of acids, bases and ionic equilibria; periodic properties of s and pblock elements, preparation and properties of aliphatic and aromatic hydrocarbons	**K1**
2.	discuss the periodic properties of s and p- block elements, reactions of aliphatic and aromatic hydrocarbons and strength of acids	**K2**
3.	classify hydrocarbons, types of reactions, acids and bases, examine the properties s and p-block elements, reaction mechanisms of aliphatic and aromatic hydrocarbons	**K3**
4.	explain theories of acids, bases and indicators, buffer action and important compounds of s-block elements	**K3**
5.	assess the application of acids, indicators, buffers, compounds of s and p- block elements and hydrocarbons	**K4**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4**-Analyze

Units	Contents	No. of Hours
I	**Acids, bases and Ionic equilibria** Concepts of Acids and Bases - Arrhenius concept, Bronsted-Lowry concept, Lewis concept; Relative strengths of acids, bases and dissociation constant; ionic product of water, pH scale, pH of solutions; Degree of dissociation, common ion effect, factors affecting degree of dissociation; acid base indicators, theory of acid base indicators – action of phenolphthalein and methyl orange, titration curves - use of acid base indicators; Buffer solutions – types, mechanism of buffer action in acid and basic buffer, Henderson-Hasselbalch equation; Salt hydrolysis - salts of weak acids and strong bases, weak bases and strong acids - hydrolysis constant - degree of hydrolysis and relation between hydrolysis constant and degree of hydrolysis; Solubility product - determination and applications.	**15**
II	**Chemistry of s and p - Block Elements** Hydrogen: Position of hydrogen in the periodic table. General characteristics of alkali metals and alkaline earth metals-Electronic configuration, oxidation states, ionisation energy, reducing property, flame colouration, uses of alkali metals. Comparative study of oxides and hydroxides of alkali metals. Diagonal relationship of Li with Mg. Preparation, properties and uses of sodium cyanide, sodamide and potassium cyanide. Extraction of Be and its uses. General characteristics of p-Block Elements (Group 13 & 14)-Electronic configuration, oxidation states and metallic character, preparation and structure of diborane and borazine. Chemistry of borax. Extraction of Al and its uses. Comparison of carbon with silicon. Carbon-di-sulphide – Preparation, properties, structure and uses.	**15**
III	**Chemistry of P Block Elements (Group 15-18)** General characteristics of elements of Group 15; chemistry of H_2N-NH_2,	**15**

	NH_2OH and HNO_3. Chemistry of PH_3, PCl_3, PCl_5, $POCl_3$, P_2O_5 and oxy acids of phosphorous (H_3PO_3 and H_3PO_4). General properties of elements of group16 - chemistry of ozone - Classification and properties of oxides - oxides of sulphur and selenium – Oxy acids of sulphur (Caro's and Marshall's acids). Chemistry of Halogens: General characteristics of halogen with reference to electro-negativity, electron affinity and oxidation states. Peculiarities of fluorine. Inter-halogen compounds (ICl, ClF_3, BrF_5 and IF_7), pseudo halogens. Noble gases: Position in the periodic table-uses of noble gases.	
IV	**Hydrocarbon Chemistry-I** Petroproducts: Fractional distillation of petroleum; cracking, Alkenes-Nomenclature, general methods of preparation – Mechanism of β- elimination reactions – E_1 and E_2 mechanism - orientation – Hofmann and Saytzeff rules. Reactions of alkenes – addition reactions – mechanisms – Markownikoff's rule, Kharasch effect, oxidation reactions – hydroxylation, epoxidation, ozonolysis; polymerization. Diels–Alder reactions – polymerisation – polybutadiene, polyisoprene (natural rubber), vulcanization , polychloroprene. Alkynes Nomenclature; general methods of preparation (any two) and reactions; acidic nature of terminal alkynes and acetylene. Cycloalkanes: Nomenclature, Relative stability of cycloalkanes, Bayer's strain theory and its limitations.	**15**
V	**Hydrocarbon Chemistry - II** Benzene: structure of benzene, stability of benzene ring, aromaticity, Huckel's (4n+2) rule. Electrophilic substitution reactions - General mechanism of aromatic electrophilic substitution - nitration, sulphonation, halogenation, Friedel-Craft's alkylation and acylation. Mono substituted and disubstituted benzene - Effect of substituent – orientation and reactivity. Polynuclear Aromatic hydrocarbons: Naphthalene –Haworth synthesis; reactions – electrophilic substitution reaction, nitration, sulphonation, halogenation, Friedel – Crafts acylation, alkylation, and oxidation – uses. Anthracene – synthesis by Haworth synthesis; reactions - Diels-Alder reaction -uses.	**15**
	Total	**75**

Self-study	General characteristics of s and p block elements and hydrocarbons

Textbooks

1. Madan, R.D, Sathya Prakash, 2003, Modern Inorganic Chemistry, (second edition), S. Chand and Company, New Delhi.
2. Soni, P.L, 2000, Text book of Inorganic Chemistry.(Twentieth edition), Sultan Chand Publishers.
3. Puri, Sharma, Kalia, 2021,Principles of Inorganic Chemistry, (Thirty third edition),Vishal Publishers.

Reference Books

1. Bruce, P. Y., K. J. R. Prasad, 2008, Essential Organic Chemistry, PearsonEducation, New Delhi.
2. Arun Bahl and Bahl. B.S , 2016, A Text Book of Organic Chemistry, (Twenty second edition), S. Chand & Company Ltd.
3. Gurudeep Raj, 2001, Advanced Inorganic Chemistry, (Twenty Second), Goel PublishingHouse: Meerut.
4. I. L. Finar, 2004, Organic Chemistry Vol-1& 2, (Sixth Edition), Pearson Education Asia.
5. N. Tewari, 2011, Advanced Organic Reaction Mechanism, (Third Edition), Books & Allied (P) Ltd.

Web Resources

1. https://onlinecourses.nptel.ac.inhttp://cactus.dixie.edu/smblack/chem1010/lec

ture_notes/4B.html
2. http://nptel.ac.in/courses/104101090/Classification of elements and periodic properties http://nptel.ac.in/courses/104101090/
3. http://www.auburn.edu/~deruija/pdareson.pdfhttps://swayam.gov.in/course/64 -atomic-structure-and-chemical-bonding MOOC components
4. https://en.m.wikipedia.org
5. https://www.sciencedirect.com

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	1	2	3	3	2	2	3	3	2	2	2	3	3	3
CO2	3	3	1	2	3	2	3	3	3	2	2	2	3	3	3
CO3	3	2	2	2	3	2	3	3	3	3	3	1	2	2	3
CO4	3	2	2	2	3	2	3	3	3	3	3	2	3	2	3
CO5	3	2	3	3	1	2	3	3	3	3	3	3	3	3	3
TOTAL	**15**	**10**	**10**	**10**	**13**	**10**	**14**	**15**	**15**	**13**	**13**	**10**	**14**	**13**	**15**
AVERAGE	**3**	**2**	**2**	**2**	**2.6**	**2**	**2.8**	**3**	**3**	**2.6**	**2.6**	**2**	**2.8**	**2.6**	**3**

3 - Strong, 2- Medium, 1- Low

SEMESTER II

CORE LAB COURSE II: ORGANIC ESTIMATION AND PREPARATION OF ORGANIC COMPOUNDS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232CP1	-	-	3	-	3	3	45	25	75	100

Pre-requisite: General Chemistry II

Learning Objectives:

1. To develop skill in estimating organic compounds
2. To prepare organic compounds

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	explain the basic principles involved in organic estimation	**K1**
2.	know the methods of preparing organic compounds.	**K2**
3.	assess the yield of different organic preparations	**K3**
4.	compare the methodologies in preparing various compounds	**K4**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4**-Analyse

S.No	Contents
I	**Organic estimation** 1. Estimation of Phenol 2. Estimation of Aniline 3. Estimation of Ethyl methyl ketone – course work
II	**Preparation of Organic Compounds** i. Beta naphthyl benzoate from beta naphthol ii. p-bromo acetanilide from acetanilide iii. Benzoic acid from benzaldehyde iv. Benzoic acid from methyl benzoate v. Salicylic acid from methyl salicylate vi. Benzoic acid from benzamide

Textbooks

1. Venkateswaran, V.; Veeraswamy, R.; Kulandaivelu, A.R, 2012, *Basic Principles of Practical Chemistry*, (Second edition), Sultan Chand: New Delhi.
2. Manna, A.K, 2018, *Practical Organic Chemistry*, Books and Allied: India.

Reference Books

1. Thomas, A.O. 1999. Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore
2. Gurtu, J. N; Kapoor, R, 1987, *Advanced Experimental Chemistry (Organic)*,Sultan Chand: New Delhi.
3. Furniss,B. S.; Hannaford, A. J.; Smith, P. W. G.; Tatchell, A.R,1987, *Vogel's Textbook of Practical Organic Chemistry* (Fifth edition), Pearson: India,

Web Resources

1. https://authors.library.caltech.edu.in
2. https://www.vlab.co.in/broad-area-chemical-sciences

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	3	2	2	3	3	2	2	2	2	3	3	2
CO2	3	2	3	3	2	2	3	3	3	2	2	2	3	3	2
CO3	3	2	2	3	2	2	3	3	3	3	2	3	3	2	2
CO4	3	2	2	3	2	2	3	3	3	3	2	2	3	2	2
TOTAL	**12**	**8**	**10**	**12**	**8**	**8**	**12**	**12**	**11**	**10**	**8**	**9**	**12**	**10**	**8**
AVERAGE	**3**	**2**	**2.5**	**3**	**2**	**2**	**3**	**3**	**2.8**	**2.5**	**2**	**2.25**	**3**	**2.5**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER II

ELECTIVE COURSE II: CHEMISTRY FOR BIOLOGICAL SCIENCES – II

BOTANY AND ZOOLOGY MAJOR

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232EC1	**4**	**-**	**-**	**-**	**3**	**4**	**60**	**25**	**75**	**100**

Prerequisites:

Chemistry for Biological Sciences – I

Learning Objectives

1. To know about amino acids, lipids, essential elements of biosystem and fundamentals of photochemistry.
2. To understand the characteristics and structure of nucleic acids and vitamins.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	remember the importance of amino acids and learn the . basic concepts of Ayurveda	**K1**
2	understand the importance of nucleic acids and vitamins	**K2**
3	know the biological functions of lipids, oils and fats	**K1**
4	understand the function and deficiency of metals in human system	**K2**
5	outline the various type of photochemical process.	**K3**

K1 - Remember; K2 - Understand; K3 - Apply

Unit	Contents	No. of Hours
I	**Amino Acids and Essential elements of biosystem** Classification - preparation and properties of alanine,preparation of dipeptides using Bergmann method - Proteins- classification – structure - Colour reactions – Biological functions. Basic concepts of Ayurveda, Important test of Ayurveda and Ayurvedic view of the cause of diseases.	**6**
II	**Nucleic acids and Vitamins** Nucleic acids –nucleosides and nucleotides. Structure of DNA - denaturation and renaturation of DNA - replication of DNA. Hydrogen bonding in DNA. Stabilizing forces in protein and DNA - Vander waal's forces, dipole-dipole and dipole-induced dipole interactions. Structure of RNA - Types of RNA. Difference between DNA and RNA. **Vitamins**: Classification, source, biological function and deficiency diseases of Vitamin A, B, C, D, E and K.	**6**
III	**Lipids, oils and fats** Lipids - classification - properties - biological functions. Biological functions of phospholipids and glycolipids. Oils and fats - definition - characteristics and uses. Common fatty acids in oils and fats. Extraction and refining of oils. Estimation of fats and oils - acid value, saponification value and Iodine value. Distinction between animal and vegetable fats. Hydrogenation and Rancidity.	**6**
IV	**Minerals and water** **Minerals:** Introduction – source, function, deficiency and toxicity of calcium, phosphorous, sodium, potassium, iron and iodine. **Water**: Source and distribution of water in the body – functions of water – absorption, metabolism and storage of water.	**6**
V	**Photochemistry**	**6**

	Importance of photochemistry. Difference between thermal and photochemical reactions. Laws of photochemistry -Beer-Lambert's Law - Grother's-Drapers law -Stark-Einstein's law - quantum efficiency. Electronic excitations - singlet and triplet states - Jablonski diagram - internal conversion - intersystem crossing - fluorescence - phosphorescence. Difference between fluorescence and phosphorescence. Photochemical rate law - kinetics of photochemical combination of H_2 and Cl_2 - decomposition of HI. Photosensitization - photosensitizers - chemiluminescence - bioluminescence.	
	TOTAL	**30**

Self-study	Nucleic acids, Classification of carbohydrates, RNA and DNA classification of lipids and Electronic excitations

Textbooks

1. Veeraiyan V, 2009,Textbook of Ancillary Chemistry; High mountpublishing house, Chennai, first edition.
2. Vaithyanathan S, 2012, Text book of Ancillary Chemistry; PriyaPublications, Karur.
3. Arun Bahl, B.S.Bahl, 2006,Advanced Organic Chemistry; S.Chandand Company, New Delhi, twenty third edition,.
4. Soni P.L, H.M.Chawla, 2007, Text Book of Organic Chemistry; SultanChand & sons, New Delhi.

Reference Books

1. Arun Bahl, B.S.Bahl, 2012, Advanced Organic Chemistry; 23 rd edition, S.Chand and Company, New Delhi.
2. Soni P.L., Chawla H.M., 2007, Text Book of Organic Chemistry, 29 th edition, Sultan Chand & sons, New Delhi.
3. Puri B.R.,.Sharma L.R, Pathania M.S., 2018, Text book Physical Chemistry, 47 th edition ,Vishal Publishing Co., New Delhi.
4. Soni P.L., Mohan Katyal, 2007, Text book of Inorganic chemistry, 20 th edition, Sultan Chand and Company, New Delhi.

Web Resources

1. https://www.hsph.harvard.edu/nutritionsource/carbohydrates/
2. https://my.clevelandclinic.org/health/articles/22243-amino-acids
3. https://www.hsph.harvard.edu/nutritionsource/carbohydrates/
4. https://my.clevelandclinic.org/health/articles/22243-amino-acids
5. https://onlinecourses.nptel.ac.in/noc23_cy21/preview

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	2	3	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	3
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	3	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	2
TOTAL	**15**	**11**	**13**	**13**	**13**	**10**	**10**	**15**	**10**	**10**	**10**	**10**	**11**	**11**	**11**
AVERAGE	**3**	**2.2**	**2.6**	**2.6**	**2.6**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2.2**	**2.2**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER II

ELECTIVE LAB COURSE II: SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS

BOTANY AND ZOOLOGY MAJOR

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232EP1	-	-	2	-	2	2	30	25	75	100

Prerequisites:

Higher secondary chemistry

Learning Objectives

1. To identify of organic functional groups
2. To determine elements in organic compounds.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	learn to test the organic substances	**K1**
2	identify the functional group present in the organic compounds	**K2**
3	detect the elements present	**K3**
4	distinguish between aliphatic, aromatic, saturated and unsaturated compounds	**K3**
5	analyze the given organic substance	**K4**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

Unit	Contents	No. of Hours
I	**SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS** The analysis must be carried out as follows: (a) Functional group tests [phenol, mono carboxylic acids, ester, aldehyde and carbohydrate]. (b) To distinguish between aliphatic and aromatic compounds. (c) To distinguish – Saturated and unsaturated compounds.	**30**
TOTAL		**30**
Self Study	Study of functional groups	

Reference Books

1. Thomas, A.O. (1999). Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore
2. Mendham, J.; Denney, R. C.; Barnes, J. D.; Thomas, M.; Sivasankar, B.; 2000, *Vogel's Textbook of Quantitative Chemical Analysis*, 6th ed.; Pearson Education Ltd: New Delhi,.

Textbooks

1 Venkateswaran, V.; Veeraswamy, R.; Kulandivelu, A.R.2002, *Basic Principles of Practical Chemistry*,2nd ed.; Sultan Chand &Sons:, New Delhi.
2 Nad, A. K.; Mahapatra, B.; Ghoshal, 2003, *An advanced course in Practical*
3. Thomas, A.O. 1999. Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore.

4 Vogel, A.I. 1990. A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans.

Web Resources

1. http://www.federica.unina.it/agraria/analytical-chemistry/volumetric- analysis
2. https://chemdictionary.org/titration-indicator/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	3	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	3	2	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	2
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	2	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	3
TOTAL	**15**	**12**	**14**	**13**	**13**	**10**	**10**	**15**	**10**	**10**	**10**	**11**	**10**	**10**	**11**
AVERAGE	**3**	**2.4**	**2.8**	**2.6**	**2.6**	**2**	**2**	**3**	**2**	**2**	**2**	**2.2**	**2**	**2**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER II

NON-MAJOR ELECTIVE NME II: COSMETICS AND PERSONAL GROOMING

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232NM1	2				2	2	30	25	75	100

Pre-requisite:

Students should have elementary knowledge on cosmetics and self-care.

Learning Objectives:

1. To provide basic knowledge of the Cosmetics.
2. To know the chemicals, present in hair and skin care products

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	remember the composition of various chemicals in cosmetic products	**K1**
2.	understand the methods of beauty treatments and their advantages and disadvantage	**K2**
3.	apply the functions of various chemicals in cosmetics	**K3**
4.	analyze the advantages and hazards of cosmetics	**K4**
5.	evaluate the quality of cosmetics on the basis of their chemical composition	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Unit	Contents	No. of Hours
I	**Skin care** Nutrition of the skin, skin care and cleansing of the skin; face powder – ingredients; creams and lotions – cleansing, moisturizing all purpose, shaving and sunscreen (formulation only); Gels – formulation and advantages; astringent and skin tonics – key ingredients, skin lightness, depilatories. Hazards of skin care products.	**6**
II	**Hair care** Shampoos – types – powder, cream, liquid, gel – ingredients; conditioner –types – ingredients – Hair dye. Disadvantages of hair care products. **Dental care** Tooth pastes – ingredients and preparation of tooth paste – mouth wash	**6**
III	**Make up** Base – foundation – types- liquid - powder – stick. Ingredients, lipstick, eyeliner, mascara, eyeshadow, concealers, rouge.	**6**
IV	**Perfumes** Classification - Natural – plant origin – parts of the plant used – isolation of essential oils – preparation of odorous substances – methyl anthranilate-citronellol-coumarin-vanillin-diphenyl oxide.	**6**
V	**Beauty treatments** Facials - types – advantages – disadvantages; face masks – types; bleach -types – advantages– disadvantages; shaping the brows; eyelash tinting; perming types; hair colouring and dyeing ; permanent waving – hair straightening; wax types – waxing; pedicure, manicure - advantages – disadvantages	**6**
TOTAL		**30**
Self study	Astringent, skin tonics, ingredients of hair dye, Classification of perfumes and hair colouring	

Textbooks

1. Thankamma Jacob, 1997. Foods, drugs and cosmetics – A consumer guide,Macmillan publication, London.
2. André ,O. B., Howard, I. M., Marc, P.2009.Handbook of Cosmetic Science and Technology, (Third Edition). CRC Press

Reference Books

1. George Howard, 1987. Principles and practice of perfumes and cosmetics Stanley Therones, Chettenham.
2. Wilkinson, J. B. E., Moore R. J., 1997. Harry's cosmeticology, (Seventh Edition).Chemical Publishers, London.

Web Resources

1. http://www.khake.com/page75.html
2. https://www.healthline.com/health/beauty-skin-care/astringent#vs-toner
3. https://makeupandbeauty.com/beauty-treatments-home/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	2	3	2	2	2	3	3	2	3	3	2	2	3	2	2
CO2	3	2	2	2	3	2	2	2	3	2	2	2	2	2	2
CO3	2	2	2	3	3	2	2	2	3	3	2	2	2	3	2
CO4	3	2	3	3	2	2	2	2	3	2	2	3	2	2	2
CO5	2	2	3	3	3	2	2	2	3	2	2	3	2	3	2
TOTAL	**12**	**10**	**12**	**13**	**13**	**11**	**10**	**10**	**15**	**12**	**10**	**12**	**11**	**12**	**10**
AVERAGE	**2.4**	**2**	**2.4**	**2.6**	**2.6**	**2.2**	**2**	**2**	**3**	**2.4**	**2**	**2.4**	**2.2**	**2.4**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER II

SKILL ENHANCEMENT COURSE SEC I: DAIRY CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232SE1	1	-	1	-	2	2	30	25	75	100

Pre-requisite:

Higher secondary Chemistry

Learning Objectives:

1. To understand the composition and processing of milk.
2. To know the constituents and preparation of milk and milk products.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	remember the composition of milk and its processing.	**K1**
2	understand the physio-chemical properties, pasteurization process and manufacture of milk and milk products	**K2**
3	apply the procedure for milk processing and determine the adulterants present in dairy products	**K3**
4	analyze the ingredients, nutritive values and manufacture of special milks and dairy products.	**K4**
5	evaluate fat, SNF, specific gravity, acidity, pH, surface tension, viscosity and physio-chemical properties of milk and milk products.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Composition of Milk** Milk - definition - general composition of milk - constituents of milk - lipids, proteins, carbohydrates, vitamins and minerals - physical properties of milk - colour, odour, acidity, specific gravity, viscosity and conductivity - Factors affecting the composition of milk.	**6**
II	**Processing of Milk** Microbiology of milk - destruction of micro - organisms in milk, physico-chemical changes taking place in milk due to processing - boiling, pasteurization - types of pasteurization - Bottle, Batch and High Temperature Short Time (HTST) - Vacuum pasteurization - Ultra High Temperature (UHT) pasteurization.	**6**
III	**Major Milk Products** Cream - definition - composition - chemistry of creaming process - gravitational and centrifugal methods of separation of cream. Butter - definition - composition - theory of churning - desi butter - salted butter, estimation of acidity and moisture content in butter. Ghee - major constituents - common adulterants added to ghee and their detection.	**6**
IV	**Special Milk** Standardised milk - definition - merits - reconstituted milk - definition - flow diagram of manufacture - Homogenised milk - flavoured milk - vitaminised milk - toned milk - Incitation milk - Vegetable toned milk - humanized milk - condensed milk - definition, composition and nutritive value.	**6**
V	**Estimation and Preparation of milk and milk products** Estimation of fat, SNF, specific gravity and acidity of milk. Determination of pH, surface tension and viscosity of milk. Preparation of butter - ghee - milk	**6**

	powder and ice cream. Preparation of indigenous milk products - khoa - chenna - paneer and kulfi.	
	Total	**30**

Self-study	General composition and constituents of milk, physico-chemical changes in milk processing, composition of cream, butter and ghee, nutritive value of special milks, Preparation of milk products

Text Books

1. Bagavathi Sundari K., 2006. *Applied Chemistry* (First Edition). MJP Publishers, Chennai.
2. Mathur M.P., Datta Roy, D., Dinakar, P., 2008. *Text Book of Dairy Chem*istry (First Edition). Indian Council of Agricultural Research, New Delhi.
3. Saurav Singh, 2013. *A Text Book of Dairy Chemistry* (First Edition). Daya Publishing House, India.
4. Choudhary P.L., 2021. *Text Book of Dairy Chemistry*. Bio-Green Book Publishers, New Delhi.

Reference Books

1. Robert Jenness, Patom, S., 2005. *Principles of Dairy Chemistry*. John Wiley & Sons, New York.
2. Wond, F.P., 2006. *Fundamentals of Dairy Chemistry*. Springer Publications, Singapore.
3. Sukumar De, 2021. *Outlines of Dairy Technology*. Oxford University Press, NewDelhi.
4. Fox, P.F., McSweeney, P.L.H., 2016. *Dairy Chemistry and Biochemistry* (Second Edition). Springer Publication, Singapore.
5. Fox, P.F., Uniacke-Lowe, T., McSweeney, P.L.H., O'Mahony, J.A., 2015. *Dairy Chemistry and Biochemistry* (Second Edition). Springer Publication, Singapore.

Web Resources

1. https://authors.library.caltech.edu.in
2. http://ecoursesonline.iasri.res.in/course/view.php?id=88
3. https://onlinecourses.nptel.ac.in/noc23_ag18/preview
4. https://www.academia.edu/28720946/fundamentals_of_dairy_chemistry_3_rd_edition
5. https://www.agrimoon.com/wp-content/uploads/chemistry-of-milk.pdf
6. http://students.aiu.edu/submissions/profiles/resources/onlineBook/U7Y2y8_Dairy_Chemistry_and_Biochemistry.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	2	2	3	3	2	2	2	2	3	2	2
CO2	3	3	2	3	2	2	3	3	2	2	2	2	3	2	3
CO3	3	3	2	3	2	2	3	3	3	2	2	2	3	2	3
CO4	3	3	2	3	2	2	3	3	3	2	2	2	3	2	3
CO5	3	3	2	3	2	2	3	3	3	3	2	3	3	2	3
TOTAL	**15**	**14**	**10**	**15**	**10**	**10**	**15**	**15**	**13**	**11**	**10**	**11**	**15**	**10**	**14**
AVERAGE	**3**	**2.8**	**2**	**3**	**2**	**2**	**3**	**3**	**2.6**	**2.2**	**2**	**2.2**	**3**	**2**	**2.8**

3 – Strong, 2- Medium, 1- Low

SEMESTER I & II
LIFE SKILL TRAINING I: CATECHISM

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG232LC1	1	-	-	-	1	1	15	50	50	100

Objectives:

1. To develop human values through value education
2. To understand the significance of humane and values to lead a moral life
3. To make the students realize how values lead to success

On the successful completion of the course, student will be able to:		
1	understand the aim and significance of value education	K1,K2
2	develop individual skills and act confidently in the society	K3
3	learn how to live lovingly through family values	K3
4	enhance spiritual values through strong faith in God	K6
5	learn good behaviours through social values	K6

K1 - Remember **K2**-Understand; **K3**-Apply; **K6**- Create

Units	Contents	No. of Hours
I	**Value Education:** Human Values – Types of Values – Growth – Components – Need and Importance - Bible Reference: Matthew: 5:3-16	3
II	**Individual Values: Esther** Vanishing Humanity – Components of Humanity – Crisis – Balanced Emotion – Values of Life - Bible Reference: Esther 8:3-6	3
III	**Family Values: Ruth the Moabite** Respecting Parents – Loving Everyone – Confession – True Love Bible Reference: Ruth 2:10-13 **Spiritual Values: Hannah** Faith in God – Wisdom – Spiritual Discipline – Fear in God – Spiritually Good Deeds -Bible Reference: 1 Samuel 1:24-28	3
IV	**Social Values: Deborah** Good Behaviour – Devotion to Teachers – Save Nature – Positive Thoughts – The Role of Youth in Social Welfare - Bible Reference: Judges 4:4-9	3
V	**Cultural Values**: **Mary of Bethany** Traditional Culture – Changing Culture – Food – Dress – Habit – Relationship – Media – The Role of Youth - Bible Reference: Luke 10:38-42	3
	Total	15

Textbook

Humane and Values. Holy Cross College (Autonomous), Nagercoil
The Holy Bible

SEMESTER I & II

LIFE SKILL TRAINING I: MORAL

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG232LM1	1	-	-	-	1	1	15	50	50	100

Objectives:

1. To develop human values through value education
2. To understand the significance of humane and values to lead a moral life
3. To make the students realize how values lead to success

Course Outcomes

On the successful completion of the course, student will be able to:		
1	understand the aim and significance of value education	K1, K2
2	develop individual skills and act confidently in the society	K3
3	learn how to live lovingly through family values	K3
4	enhance spiritual values through strong faith in God	K6
5	learn good behaviours through social values	K6

K1 - Remember **K2**-Understand; **K3**-Apply; **K6**- Create

Units	Contents	No. of Hours
I	**Value Education:** Introduction – Limitations – Human Values – Types of Values – Aim of Value Education – Growth – Components – Need and Importance	3
II	**Individual Values:** Individual Assessment – Vanishing Humanity – Components of Humanity – Crisis – Balanced Emotion – Values of Life.	3
III	**Family Values:** Life Assessment – Respecting Parents – Loving Everyone – Confession – True Love.	3
IV	**Spiritual Values:** Faith in God – Wisdom – Spiritual Discipline – Fear in God – Spiritually Good Deeds.	3
V	**Social Values:** Good Behaviour – Devotion to Teachers – Save Nature – Positive Thoughts – Drug Free Path – The Role of Youth in Social Welfare. **Cultural Values**: Traditional Culture – Changing Culture – Food – Dress – Habit – Relationship – Media – The Role of Youth.	3
	Total	15

Textbook

Humane and Values. Holy Cross College (Autonomous), Nagercoil

SEMESTER III

CORE COURSE III: GENERAL CHEMISTRY III

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU233CC1	5	-	-	-	5	5	75	25	75	100

Pre-requisite: General Chemistry – I and II

Learning Objectives:

1. To know the properties of applications of chemical compounds
2. To analyse the kinetics of gases, crystal systems, nuclear radioactivity and chemical reactions

Course Outcomes

On the successful completion of the course, students will be able to:		
1	remember the classification and properties of chemical compounds	**K1**
2	understand the basic concepts of states of matter, nuclear radioactivity and organic reactions	**K2**
3	apply the concepts and mechanism in gases, liquids, solids, radioactivity and organic reactions	**K3**
4	analyze the properties of gases, liquids, solids and mechanisms of chemical reactions	**K4**
5	evaluate the kinetics of gases, crystal structure, nuclear reactions and properties of organic reactions	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Gaseous state** General characteristics of gases - postulates and derivation from the kinetic gas equation - The Maxwell-Boltzmann distribution of speed of molecules - average, root mean square and most probable velocity and average kinetic energy. Collision frequency - collision diameter - mean free path and viscosity of gases. Real gases - deviations from ideal gas behaviour compressibility factor - Z and its variation with pressure for different gases. Equations of states for real gases - Virial equation and van der waal's equation	15
II	**Liquid and Solid State** Properties of liquids - surface tension and viscosity. Crystalline and amorphous - isotropy and anisotropy - isomorphism and polymorphism. Crystals - size and shape - symmetry elements - plane, centre and axis - Miller indices - unit cells and space lattices. Classification of crystal systems - Bravais lattices - X - ray diffraction and Bragg's equation. Packing in atomic solids - simple cubic - body centered cubic - face centered and hexagonal close packing. Co-ordination number in typical structures - NaCl - CsCl - ZnS and TiO_2. Structure and properties of diamond and graphite. Defects in solids - stoichiometric and nonstoichiometric defects.	15
III	**Nuclear Chemistry** Natural radioactivity - α, β and γ rays - half-life period - Fajan-Soddy group displacement law - Geiger-Nattal rule - isotopes - isobars - isotones - nuclear isomerism - radioactive decay series - magic numbers - units - Curie - Rutherford - Roentgen - nuclear stability - neutron-proton ratio - binding energy - packing fraction and mass defect. Derivation of decay constant - half-life period and radiocarbon dating. Nuclear energy - nuclear fission and fusion - major nuclear reactors in India -	15

	radiation hazards - disposal of radioactive waste and safety measures. Applications of radioactivity in medicine, agriculture and industry.	
IV	**Halogen Compounds** **Aliphatic halogen compounds** General methods of preparation - physical and chemical properties. Mechanism and stereochemistry of aliphatic S_N1 and S_N2 reactions. Difference between S_N1 and S_N2 mechanism. Factors influencing the rate of aliphatic nucleophilic substitution reaction. Preparation - properties and uses of chloroform - iodoform and carbon tetrachloride. **Aromatic halogen compounds** General methods of preparation - physical and chemical properties. properties of aryl halides. Mechanism of aromatic S_N1, S_N^{Ar} and benzyne reactions. Preparation - properties and uses of D.D.T and B.H.C	**15**
V	**Alcohols and Phenols** **Alcohols** General methods of preparation - physical and chemical properties. Ascent and descent series. Preparation - properties and uses of allyl alcohol, ethylene glycol and glycerol. Estimation of number of hydroxyl groups in polyhydroxy alcohols. **Phenols** General methods of preparation - physical and chemical properties. Acidic character of phenol and effect of substituent on the acidity of phenol. Electrophilic substitution reactions - Reimer-Tiemann - Kolbe-Schmidt - Gatermann synthesis - Libermann nitroso and phthalein reactions. Preparation, properties and uses of catechol - resorcinol - quinol and pyrogallol.	**15**
	Total	**75**

Self-study	Nomenclature and classification of halogen derivatives , phenols and alcohols

Textbooks:

1. Puri, B.R., Sharma, L.R., Pathania, M.S., 2020. *Principles of Physical Chemistry*, (47th Edition), Vishal Publishing Co., India.
2. Puri, B.R., Sharma, L.R., Kalia, K.C., 2020. *Principles of Inorganic Chemistry*, (31st Edition), Vishal Publishing Co., India.
3. Arnikar, H.J., 2011. *Essentials of Nuclear Chemistry*, (4th Edition), New Age International Private Limited, India.
4. Jain, M.K., Sharma, S.C., 2024. *Modern Organic Chemistry*, Vishal Publishing Co., India.
5. Morrison, R.T., Boyd, R.N., Bhattacharjee, S.K., 2010. *Organic Chemistry*, (7th Edition), Pearson Education, India.

Reference Books:

1. Atkins, P., De Paula, J., 2014. *Physical Chemistry*, (10th Edition), Oxford University Press, Oxford.
2. Bahl, B.S., Tuli, G.D., Bahl, A., 2020. *Essentials of Physical Chemistry*, (24th Edition), S. Chand and Company Limited, India.
3. Madan, R.D., 2014. *Modern Inorganic Chemistry*, (13th Edition). Sultan Chand Publishing Limited, India.
4. Lee, J.D., 2005. *Concise Inorganic Chemistry*, (5th Edition), Wiley Blackwell Science, U.S.A
5. Soni, P.L., 2012. *Text book of Organic Chemistry*, (29th Edition). Sultan Chand & Sons Publishing, India.

Web Resources:

1. https://www.khanacademy.org/science/chemistry/gases-and-kinetic-molecular-theory
2. https://www.khanacademy.org/science/ap-chemistry

3. https://study.com/academy/lesson/how-atoms-molecules-form-solids-patterns-crystals.html
4. https://gchem.cm.utexas.edu/nuclear/index.php#opening-statement.php
5. https://www.vedantu.com/chemistry/preparation-alkyl-halides

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	2	2	3	3	2	2	2	2	2	2	2
CO2	3	2	2	3	2	2	3	3	3	2	3	2	2	2	2
CO3	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO4	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO5	3	2	2	3	2	2	3	3	3	2	2	2	2	2	2
TOTAL	**15**	**10**	**10**	**15**	**10**	**10**	**15**	**15**	**14**	**12**	**13**	**12**	**10**	**10**	**10**
AVERAGE	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2.8**	**2.4**	**2.6**	**2.4**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER III

CORE LAB COURSE III: ORGANIC ANALYSIS AND DETERMINATION OF PHYSICAL CONSTANTS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU233CP1	-	-	3	-	3	3	45	-	75	100

Pre-requisite: Organic compounds and their functional groups

Learning Objectives:

1. To identify the functional groups in organic compounds through qualitative tests
2. To determine the physical constants of organic compounds

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	remember the basic concepts of organic analysis	**K1**
2	understand the methods to identify the functional groups	**K2**
3	apply the procedure for identifying the functional groups	**K3**
4	analyse the functional groups and physical constants of organic compounds	**K4**
5	evaluate the melting and boiling points of organic compounds	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** – Analyse, **K5** - Evaluate

Contents	No. of Hours
A. Qualitative Organic Analysis i) Preliminary examination, detection of special elements - nitrogen, sulphur and halogens ii) Aromatic and aliphatic nature, Test for saturation and unsaturation, identification of functional groups using solubility tests iii) Confirmation of functional groups • monocarboxylic acid, dicarboxylic acid • monohydric phenol, polyhydric phenol • aldehyde, ketone, ester • carbohydrate • primary amine • monoamide, diamide iv) Preparation of derivatives for functional groups **Demonstration** **B. Determination of melting/boiling point of organic compounds.**	**45**

Self Study	Theory behind the preparation of organic compounds and melting/boiling point of organic compounds

Textbooks

1. Venkateswaran, V.Veeraswamy, R., Kulandaivelu, A.R., 2012, *Basic Principlesof Practical Chemistry*, (Second edition), Sultan Chand, New Delhi.
2. Manna, A.K., 2018, *Practical Organic Chemistry, Books and Allied*: India.
3. Vogel, A. I., 1994, *Elementary Practical Organic Chemistry*, The English Language Book Society and Longmans.

Reference Books

1. Gurtu, J. N., Kapoor, R., 1987. *Advanced Experimental Chemistry (Organic),* Sultan Chand, New Delhi.
2. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., Tatchell, A.R.,1987. *Vogel'sTextbook of*

Practical Organic Chemistry (Fifth edition), Pearson, India,
3. Bansal, (1990), *Laboratory Manual of Organic Chemistry*, Second Edition., Wiley Eastern Ltd., New York.
4. Soni, P.L., 2012. *Text book of Organic Chemistry*, (29th Edition). Sultan Chand & Sons Publishing, India.
5. Morrison, R.T., Boyd, R.N., Bhattacharjee, S.K., 2010. *Organic Chemistry*, (7th Edition), Pearson Education, India.

Web Resources

1. https://authors.library.caltech.edu.in
2. https://www.vlab.co.in/broad-area-chemical-sciences
3. https://fac.ksu.edu.sa/sites/default/files/vogel-practicalorganicchemistry_longmans-3rdedrevised-1957_.pdf
4. https://www.vedantu.com/chemistry/preparation-alkyl-halides
5. https://chem.libretexts.org/Bookshelves/Organic_Chemistry

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	2	2	2	2	2	2	2	2	3	2	3	2	2	2	2
CO3	2	2	2	2	2	2	2	3	3	3	3	3	2	2	2
CO4	2	2	2	2	2	2	2	3	3	3	3	3	2	2	2
CO5	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2
TOTAL	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**12**	**14**	**12**	**13**	**12**	**10**	**10**	**10**
AVERAGE	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2.4**	**2.8**	**2.4**	**2.6**	**2.4**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER III

ELECTIVE COURSE III: CHEMISTRY FOR PHYSICAL SCIENCES – I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU233EC1	4	-	-	-	3	4	60	25	75	100

Prerequisites: Structure of atom and bonding

Learning Objectives

1. To know the basics of atomic orbitals, chemical bonds and hybridization
2. To understand the concepts of thermodynamics, phase rule, nuclear chemistry and its applications.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	gain in-depth knowledge about the theories of chemical bonding, nuclear reactions and its applications.	**K1**
2	understand the efficiencies and uses of various fuels and fertilizers.	**K2**
3	explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.	**K2**
4	apply various thermodynamic principles, systems and phase rule.	**K3**
5	analyze various methods for the separation of chemical components	**K4**

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

Unit	Contents	No. of Hours
I	**Chemical Bonding and Nuclear Chemistry** Chemical Bonding: Molecular Orbital Theory-bonding, antibonding and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties. Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions - group displacement law. Nuclear binding energy - mass defect - calculations. Nuclear fission and nuclear fusion - differences – Stellar energy. Applications of radioisotopes – carbon dating, rock dating and medicinal applications.	**12**
II	**Industrial Chemistry** Fuels: Fuel gases-Natural gas, water gas, semi water gas, carburetted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones: Synthesis, properties and uses of silicones. Fertilizers: Urea, ammonium sulphate, potassium nitrate, NPK fertilizer, superphosphate, triple superphosphate.	**12**
III	**Fundamental Concepts in Organic Chemistry** Hybridization: Orbital overlap, hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6. Electronic effects: Inductive effect and consequences on Ka and Kb of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric effect - examples. Reaction mechanisms: Types of reactions–aromaticity (Huckel's rule) – aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation. Heterocyclic compounds: Preparation, properties of pyrrole and pyridine.	**12**
IV	**Thermodynamics and Phase Equilibria** Thermodynamics: Types of systems, reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes. Statements of first law and second law of thermodynamics. Carnot's cycle and efficiency of heat engine. Entropy and its significance. Free energy change and its importance (no	**12**

	derivation). Conditions for spontaneity in terms of entropy and Gibbs free energy. Relationship between Gibbs free energy and entropy. Phase Equilibria: Phase rule - definitions. Applications of phase rule to water system. Two component system - Reduced phase rule and its application to a simple eutectic system (Pb-Ag).	
V	**Analytical Chemistry** Introduction to qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques – extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography.	**12**
TOTAL		**60**

Self - Study	Types of chemical bonding, types of hybridisation, aromaticity, laws of thermodynamics, various types of systems and phase rule

Textbooks

1. Veeraiyan, V., 2015. Text book of Ancillary Chemistry; High mount publishing house, Chennai, first edition.
2. ArunBahl, S., Bahl, B.S., 2012. Advanced Organic Chemistry; S.Chand and Company, New Delhi, twenty third edition.
3. Bahl, B.S., Tuli, G.D., Bahl, A., 2020. *Essentials of Physical Chemistry*, (24th Edition), S. Chand and Company Limited, India.
4. Soni, P.L., 2012. *Text book of Organic Chemistry*, (29th Edition). Sultan Chand & Sons Publishing, India.

Reference Books

1. Atkins, P., De Paula, J., 2014. *Physical Chemistry*, (10th Edition), Oxford University Press, Oxford.
2. Madan, R.D., 2014. *Modern Inorganic Chemistry*, (13th Edition). Sultan Chand Publishing Limited, India.
3. Lee, J.D., 2005. *Concise Inorganic Chemistry*, (5th Edition), Wiley Blackwell Science, U.S.A
4. Azaroff, L.V., 2017. *Introduction to Solids*, McGraw Hill Education, India.
5. Bryan, J.C., 2023. *Introduction to Nuclear Science*, (4th Edition), CRC Press, U.S.A

Web Resources

1. https://alison.com/course/chemistry-atomic-structure
2. https://www.udemy.com/course/atomic-structure/
3. https://www.classcentral.com/course/swayam-industrial-inorganic-chemistry-12912
4. https://nptel.ac.in/courses/104105103
5. https://www.udemy.com/topic/Analytical-Chemistry/?utm_source=adwords&utm_medium=udemyads&utm_campaign=DSA_

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	2	3	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	3
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	3	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	2
TOTAL	**15**	**11**	**13**	**13**	**13**	**10**	**10**	**15**	**10**	**10**	**10**	**10**	**11**	**11**	**11**
AVERAGE	**3**	**2.2**	**2.6**	**2.6**	**2.6**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2.2**	**2.2**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER III

ELECTIVE LAB COURSE III: CHEMISTRY PRACTICAL FOR PHYSICAL SCIENCES - VOLUMETRIC ANALYSIS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU233EP1	-	-	2	-	2	2	30	25	75	100

Prerequisites: Types of titrations

Learning Objectives

1.To understand the basics of preparation of solutions.

2.To understand the principles and practical experience of volumetric analysis.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	understand the principles of titrimetric methods.	**K1**
2	gain knowledge on the usage of standard flask, pipette and burette.	**K2**
3	design, carry out, record and interpret the results of various titrations and apply their skill in the estimation of various compounds.	**K3**
4	analyze the suitable indicators for various titrations	**K4**
5	evaluate the end points of various titrations	**K5**

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze, K5 - Evaluate

Contents	No. of Hours
VOLUMETRIC ANALYSIS **Acidimetry** 1. Estimation of sulphuric acid using standard oxalic acid. **Alkalimetry** 2. Estimation of sodium hydroxide using standard sodium carbonate. **Permanganometry** 3. Estimation of oxalic acid using standard ferrous sulphate. 4. Estimation of ferrous sulphate using $KMnO_4$. **Dichrometry** 5.Estimation of Ferrous Sulphate using standard dichromate 6. Estimation of Ferrous Ammonium Sulphate using standard dichromate **Complexometry** 7. Estimation of zinc using EDTA. 8. Estimation of magnesium using EDTA.	**30**

Self Study	Normality, Molarity, Molality and Preparation of Standard solution

Textbooks

1. Venkateswaran, V., R. Veeraswamy, A.R. Kulandivelu. 1997. *Basic Principles of Practical Chemistry*,2nd ed.; Sultan Chand &Sons: New Delhi.
2. Thomas, A.O. 1999. *Practical Chemistry for B.Sc Main students.* Scientific book centre, Cannanore.

Reference Books

1. Vogel, A.I. 1990. *A Text Book for Qualitative Inorganic Analysis*. The English Language Book Society and Longmans
2. . Madan, R.D., 2014. *Modern Inorganic Chemistry*, (13th Edition). Sultan Chand Publishing Limited, India.

3. Charlot .G.2007.*Qualitative Inorganic Analysis.*Thomas Press.
4. Berry A.J, 2013. *Qualitative Inorganic Analysis*. Cambridge University Press.
5. Treadwell F.P . 2019. *Analytical Chemistry Qualitative Analysis.*Alpha Edition.

Web Resources

1. http://www.federica.unina.it/agraria/analytical-chemistry/volumetric- analysis
2. https://chemdictionary.org/titration-indicator/
3. https://cuils.cuchd.in/cgi-bin/koha/opac-detail.pl?biblionumber=29190&shelfbrowse_itemnumber=158886
4. https://www.sciencedirect.com/book/9780125033541/chemistry-inorganic-qualitative-analysis-in-the-laboratory
5. https://link.springer.com/book/10.1007/978-1-4899-6383-3

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	3	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	3	2	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	2
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	2	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	3
TOTAL	**15**	**12**	**14**	**13**	**13**	**10**	**10**	**15**	**10**	**10**	**10**	**11**	**10**	**10**	**11**
AVERAGE	**3**	**2.4**	**2.8**	**2.6**	**2.6**	**2**	**2**	**3**	**2**	**2**	**2**	**2.2**	**2**	**2**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER III

SKILL ENHANCEMENT COURSE SEC-II: APPLIED CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU233SE1	2	-	-	-	2	2	30	25	75	100

Pre-requisite: Use of chemicals in every day life

Learning Objectives:

1. To transform the acquired theoretical knowledge to industry and vice-versa
2. To familiarize with synthesis of chemicals used in day today life and to develop entrepreneurship skills.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	remember the synthesis of chemicals used in day today life	**K1**
2	understand the effects of adulteration in food	**K2**
3	illustrate the different processes of water softening and estimation of hardness of Water	**K3**
4	analyze the purity of water	**K4**
5	evaluate the composition of blood	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Soaps and Detergents** Soaps: Definition- classification-raw materials used in the manufacture of soap manufacture of toilet soap. Detergents: Definition -various types with examples-advantages of detergents over soaps -cleansing action of soap.	6
II	**Chemicals of everyday use** Preparation and uses of the following articles. Tooth powder, tooth paste, writing inks, gum paste, boot polish, talcum powder, chalk crayons, agar battis, phenyl and moth balls.	6
III	**Adulteration in Food** Adulteration of Food Simple methods to find adulteration of milk, food, oils (edible and-mineral) and honey - Food poisoning and its prevention - Antibodies - Food preservation, coloring, flavoring and sweetening agents in catering technology - Carcinogens of food materials.	6
IV	**Water Treatment** Water treatment: hardness of water temporary and permanent hardness, disadvantages of hard water. Estimation of hardness by EDTA method. Water purification process – ion exchange, reverse osmosis, activated charcoal treatment, Desalination, Disinfection – ozone, UV, chlorination, BIS-specification of drinking water.	6
V	**Clinical Chemistry** Composition of blood - blood grouping - identification of blood groups and matching. Determination of glucose in serum, estimation of glucose in urine. Tests for salts in serum and urine. Estimation of cholesterol in serum.	6
	Total	**30**

Self-study	Advantages of detergents over soaps, Preparation and uses of phenyl and moth balls Carcinogens of food materials, Disadvantages of hard water, Blood grouping

Textbooks:

1. Sharma, B. K. 1994. *Industrial Chemistry: Including Chemical Engineering*, Goel Publishing house, Meerut, India.
2. Jain, P. C.. Jain, M. 2015.*Engineering chemistry*, 15th edn, Dhanpat Rai publications.
3. De Man, John M., 1999.*Principles of Food Chemistry*, 3rd edn, Springer.
4. Jaya Shree Gosh, 1992.*Text book of Pharmaceutical Chemistry*: Sultan Chand and Co.S.Chand and Company .Ram Nagar, N.Delhi.

Reference Books:

1. Zalucha, D. J. and Abbey, K. J. 2007. *Kent and Riegel's Handbook of Industrial Chemistry and Biotechnology*. Springer.
2. Shafiur Rahman, M. 2007. *Handbook of Food Preservation*, 2nd edn, CRC Press, Taylor & Francis Group.
3. Ashutoshkar , 2010.*Medicinal Chemistry*, New age International (p) Ltd, publishers.
4. Heaton, C. A. 1996. *An Introduction to Industrial Chemistry*, Springer Science & Business Media.
5. Kuriakose, J. C. Rajaram, J. 2001. *Chemistry in engineering and technology*, Vol. 2,Tata Mcgraw hill: New Delhi.

Web Resources:

1. https://www.udemy.com/course/detergents-course/?couponCode=ST8MT40924
2. https://www.khanacademy.org/partner-content/mit-k12/mit-k12-math-and-engineering/mit-k12-materials/v/what-is-soap
3. https://www.allenoverseas.com/blog/chemistry-in-everyday-life-facts-examples-and-importance/
4. https://www.sciencedirect.com/book/9780125033541/chemistry-inorganic-qualitative-analysis-in-the-laboratory
5. https://atlas-scientific.com/blog/water-analysis-methods/#:~:text=Water%20analysis%20refers%20to%20the,determine%20the%20quality%20of%20water.

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	2	3	2	3	2	2	3	3	2	2	2	2	2	2	2
CO2	3	2	2	3	2	2	3	3	3	2	3	2	2	2	2
CO3	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO4	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO5	3	2	2	3	2	2	3	3	3	2	2	2	2	2	2
TOTAL	**14**	**11**	**10**	**15**	**10**	**10**	**15**	**15**	**14**	**12**	**13**	**12**	**10**	**10**	**10**
AVERAGE	**2.8**	**2.2**	**2**	**3**	**2**	**2**	**3**	**3**	**2.8**	**2.4**	**2.6**	**2.4**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER III / IV

SKILL ENHANCEMENT COURSE SEC-III: FITNESS FOR WELLBEING

Course Code	L	T	P	S	Credits	Total Hours	Marks		
							CIA	External	Total
UG23CSE1	1	-	1	-	2	30	25	75	100

Pre-requisites: Basic understanding of health and wellness concepts

Learning Objectives

1. To understand the interconnectedness of physical, mental, and social aspects of well-being, and recognize the importance of physical fitness in achieving holistic health.
2. To develop proficiency in mindfulness techniques, yoga practices, nutritional awareness, and personal hygiene practices to promote overall wellness and healthy lifestyle.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	know physical, mental, and social aspects of health	K1
2	understand holistic health and the role of physical fitness.	K2
3	apply mindfulness and yoga for stress management and mental clarity.	K3
4	implement proper personal hygiene practices for cleanliness and disease prevention.	K3
5	evaluate and implement right nutritional choices.	K5

K1-Remember; **K2**-Understand; **K3**-Apply; **K5**-Evaluate

Unit	Contents	No. of Hours
I	**Understanding Health and Physical Fitness** Health – definition- holistic concept of well-being encompassing physical, mental, and social aspects. Physical fitness and its components- muscular strength- flexibility, and body composition. Benefits of Physical Activity- its impact on health and well-being.	6
II	**Techniques of Mindfulness** Mind – Mental frequency, analysis of thought, eradication of worries Breathing Exercises – types and its importance Mindfulness –pain management - techniques for practicing mindfulness - mindfulness and daily physical activities.	6
III	**Foundations of Fitness** Stretching techniques to improve flexibility. Yoga-Definition, yoga poses (asanas) for beginners, Sun Salutations (Surya Namaskar), Yoga Nidra – benefits of yoga nidra.	6
IV	**Nutrition and Wellness** Role of nutrition in fitness - macronutrients, micronutrients - mindful eating practices, balanced diet - consequences of overeating. Components of healthy food. Food ethics.	6
V	**Personal Hygiene Practices** Handwashing- techniques, timing, and importance, oral hygiene- brushing, flossing, and dental care, bathing and showering- proper techniques and frequency, hair care- washing, grooming, and maintaining cleanliness, maintaining personal hygiene, dangers of excessive cosmetic use.	6
	Total	30

Self-study	Balance diet and basic excercises

Textbook:

Bojaxa A. Rosy and Virgin Nithya Veena. V. 2024. *Fitness for Wellbeing*.

Reference Books:

1. Arul Raja Selvan S. R, 2022. *Yogasanam and Health Science*. Self publisher.
2. Vision for Wisdom. 2016. *Value Education*. The World Community Service Centre Vethathiri Publications.
3. WCSC – Vision for Wisdom. 2016. *Paper 1: Yoga and Empowerment*. Vazhga Valamudan Offset Printers Pvt Ltd 29, Nachiappa St, Erode.
4. Lachlan Sleigh. 2023. *Stronger Together the Family's Guide to Fitness and Wellbeing*. Self Publisher.
5. William P. Morgan, Stephen E. Goldston. 2013. *Exercise And Mental Health*. Taylor & Francis.

Web Resources:

1. https://www.google.co.in/books/edition/Psychology_of_Health_and_Fitness/1lYOAwAABAJ?hl=en&gbpv=1&dq=fitness+for+wellbeing&printsec=frontcover
2. https://www.google.co.in/books/edition/The_Little_Book_of_Active_Wellbeing/aA6SzgEACAAJ?hl=en
3. https://www.google.co.in/books/edition/Physical_Activity_and_Mental_Health/yu96DwAAQBAJ?hl=en&gbpv=1&dq=fitness+for+wellbeing&printsec=frontcover
4. https://www.google.co.in/books/edition/The_Complete_Manual_of_Fitness_and_Well/pLPAXPLIMv0C?hl=en&gbpv=1&bsq=fitness+for+wellbeing&dq=fitness+for+wellbeing&printsec=frontcover
5. https://www.google.co.in/books/edition/The_Wellness_Code/4QGZtwAACAAJ?hl=en

SEMESTER III

SPECIFIC VALUE-ADDED COURSE: AGROCHEMICALS AND PESTICIDES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU233V01	2	-	-	-	1	2	30	25	75	100

Prerequisite: Knowledge about the usage of agrochemicals and pesticides in agriculture.

Learning Objectives:

1. To recognize the role of agrochemicals and pesticides in agriculture
2. To analyse the fertilizers and pesticides used in agriculture

Course Outcomes

On the successful completion of the course, students will be able to:		
1	remember the classifications of agrochemicals and pesticides	**K1**
2	understand the nature and role of fertilizers and pesticides used in agriculture	**K2**
3	apply the agrochemical and pesticide formulations and techniques in agriculture	**K3**
4	analyze the preparation and factors influencing the efficacy of fertilizers and pesticides	**K4**
5	evaluate the applications of agrochemicals and pesticides	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Agrochemicals** Introduction - types - role of agrochemicals in agriculture - merits and demerits - effect of agrochemicals on environment - soil - human and animal health - management of agrochemicals for sustainable agriculture.	6
II	**Fertilizers** Introduction - need for fertilizers - classification of fertilizers - natural inorganic and organic fertilizers - artificial fertilizers - nitrogenous fertilizers. Preparation of urea - phosphate - super phosphate - triple super phosphate and NPK fertilizers.	6
III	**Pesticides** Classifications based on chemical nature and target organisms - insecticides - herbicides - fungicides and rodenticides. Selectivity and specificity of pesticides. Factors influencing the efficacy of pesticides - application methods and environmental conditions.	6
IV	**Pesticide Formulations and Application Techniques** Types of pesticide formulations - liquid concentrates – dusts - granules, and aerosols. Factors influencing pesticide formulations. Equipment used in pesticide application – sprayers - dusters and applicators. Safety precautions and regulations for pesticide handling and application.	6
V	**Insecticides and Fungicides** Insecticides - classification - inorganic insecticides - arsenic compounds and mercury compounds. Natural insecticides - nicotine and rotenone. Organic insecticides - gammexane - chlorodane and aldrin. Fungicides - preparation of Bordeaux mixture.	6
	Total	30

Self-study	Role of agrochemicals in agriculture, Classification of fertilizers, Classification of pesticides, Types of pesticide formulations and Classification of insecticides

Textbooks:

1. Rajakumar, G.R., Patil, S.V., 2023. *Agrochemicals Manures Fertilizers and Growth Regulators*, Satish Serial Publishing House, India.
2. Singh, A., Dutta, A., Patanjali, N., Parmar, B.S., 2020. *Basics of Agrochemical Formulations*, Brillion Publishing, India.
3. Roy, N.K., 2023. *Chemistry of Pesticides*, CBS Publishers and Distributors, India.
4. Kumari, R., 2022. *A Beginner's Guide to Pesticide Chemistry*, Prestige Publishers, India.

Reference Books:

1. Waxman, M.F., 2020. *The Agrochemical and Pesticides Safety Handbook*, (1st Edition), CRC Press, New York.
2. Buchel, K.H., 1983. *Chemistry of Pesticides*, John Wiley & Sons, New York.
3. Rakshit, A., Raha, P., Nirmal De., 2023. *Manures, Fertilizers and Pesticides: Theory and Applications*, CBS Publishers and Distributors Pvt. Ltd., India.
4. Paliwal, P.C., Goel, K., Gupta, R.K., 1974. *Insecticides, Pesticides and Argobased Industries*, Small Business Publications, Delhi.
5. Panda, H., 2022. *The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides (Agrochemicals)*, 2nd Edition, Niir Project Consultancy Services, India.

Web Resources:

1. https://www.khanacademy.org/science/ap-college-environmental-science/x0b0e430a38ebd23f:land-and-water-use/x0b0e430a38ebd23f:effects-of-land-and-water-use-i/v/impacts-of-agricultural-practices
2. https://www.youtube.com/watch?v=qLjmTc-mKSQ
3. https://www.youtube.com/watch?v=LItihxFLUrs
4. https://www.youtube.com/watch?v=AAXcFeRRZDk
5. https://www.youtube.com/watch?v=xuSZFRf0EpY

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	2	2	3	3	2	2	2	2	2	2	2
CO2	3	2	2	3	2	2	3	3	3	2	3	2	2	2	2
CO3	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO4	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO5	3	2	2	3	2	2	3	3	3	2	2	2	2	2	2
TOTAL	**15**	**10**	**10**	**15**	**10**	**10**	**15**	**15**	**14**	**12**	**13**	**12**	**10**	**10**	**10**
AVERAGE	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2.8**	**2.4**	**2.6**	**2.4**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER III

SPECIFIC VALUE-ADDED COURSE: WATER RESOURCES AND MANAGEMENT

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU233V02	2	-	-	-	1	2	30	25	75	100

Pre-requisite: Knowledge in Water quality parameters and pollution

Learning Objectives:

1. To realize the importance of quality water in day-to-day life
2. To understand quality standards of water

Course Outcomes

On the successful completion of the course, student will be able to:		
1	remember and recall the different sources of water pollution	**K1**
2	understand the different water treatment and purification techniques	**K2**
3	apply various methods to measure various physico-chemical parameters of water	**K3**
4	analyze the environmental, social, and economic consequences of water management	**K4**
5	determine the hardness of water and other parameters	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5**-Evaluate

Units	Contents	No. of Hours
I	**Water Pollution** Definition-sources of water pollution-types of water pollutants: sewage and domestic wastes, industrial effluents, agricultural discharges, detergents, disease causing agents and radioactive materials. Eutrophication and its effects.	6
II	**Water Quality Parameters** Physical, chemical and biological water quality parameters-water quality standards for drinking water –BIS and WHO. Determination of pH, Total hardness, DO, BOD and COD.	6
III	**Water Purification** Purification of water for drinking purposes: Sedimentation, filtration and disinfection Desalination: reverse osmosis-Purification of water for industrial purposes: water softening permutit process and ion-exchange process.	6
IV	**Waste Water Treatment** Elementary ideas of waste water treatment: pre-treatment-primary treatment-secondary treatment: aerobic and anaerobic processes –tertiary treatment: evaporation adsorption – chemical precipitation.	6
V	**Restoration and Management** Importance of lakes and rivers-stresses on the Indian rivers and their effects –A restoration case study: Ganga Action Plan: objectives implementation and drawbacks. Rain water harvesting –water recycling-The Water Prevention and control of Pollution Act.	6
	Total	30

Textbooks :

1. De, A. K. 2018. *Environmental Chemistry*, 10th edition, Wiley Eastern Ltd., New Delhi.
2.Sharma, B. K 2014. *Environmental Chemistry*, Goel Publishing House, Meerut.
3. Sawyer,C.N., McCarty,P.L. and Parkin,G.F.2003.*Chemistry for Environmental Engineering and Science.* 5th edition, McGraw -Hill Publishers.

Reference books :

1. Trivedy R. K. and Goel P. K. 1984. Chemical and biological methods for water pollution studies, Environmental Publications, Karad, India.
2. BIS, 1991. Specification for drinking water, Bureau of Indian Standards, New Delhi
3. WHO, 1992. *International standards for drinking water*, World Health Organisation, Geneva.
4. Nollet,L.M.L and De Gelder,L.S.P.2013.*Hand book of water Analysis*, 3rd edition, CRC Press.
5. APHA,2017. *Standard Methods for the Examination of Water and waste water*.23rd edition.American Public Health Association.

Web Resources

1. https://www.epa.gov/wqs-tech
2. https://www.cdc.gov/healthywater/drinking/public/water_quality.html
3. https://www.who.int/water_sanitation_health/publications/drinking-water-quality-guidelines-4th-edition/en/
4. https://www.lib.berkeley.edu/
5. https://asuonline.asu.edu/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	3	2	2	3	3	2	2	2	3	3	3
CO2	3	2	1	2	3	2	3	3	3	2	2	2	3	3	3
CO3	3	2	2	2	3	2	3	3	3	3	3	1	2	2	3
CO4	3	2	2	2	3	2	3	3	3	3	3	2	3	2	3
CO5	3	2	3	3	1	2	3	3	3	3	3	3	3	3	3
TOTAL	**15**	**2**	**10**	**10**	**13**	**10**	**14**	**15**	**15**	**13**	**13**	**10**	**14**	**13**	**15**
AVERAGE	**3**	**2**	**2**	**2**	**2.6**	**2**	**2.8**	**3**	**3**	**2.6**	**2.6**	**2**	**2.8**	**2.6**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER III

SPECIFIC VALUE-ADDED COURSE: FOOD ADULTERATION

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU233V03	2	-	-	-	1	2	30	25	75	100

Pre-requisite: Knowledge about food adulterants

Learning Objectives:

1. To identify adulterants in different food samples
2. To implement quality control measures in food processing to prevent adulteration.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	remember the classifications of agrochemicals and pesticides	**K1**
2.	understand the sources and impacts of environmental contaminants	**K2**
3.	apply various methods to detect adulterants in common food items	**K3**
4.	analyze the stability of flavours during food processing and storage	**K4**
5.	evaluate the roles and impacts of food additives	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Adulteration** Food Adulteration-Definition – Types- Poisonous substances-Foreign matter- Cheap substitutes- Spoiled parts. Food Additives – Definitions-Classification and Functions- Legitimate uses of Additives in foods-Intentional and Non Intentional additives- Indirect food additives. Difference between Additives and Adulterants-Toxicological evaluation of food additives.	6
II	**Adulteration of Common Foods and Methods of Detection** Methods of detection of adulterants in the following Foods; Milk, Oil, Grain, Sugar, Spices and condiments, Processed food, Fruits and vegetables. Additives and Sweetening agents (at least two methods of detection for each food item).	6
III	**Colours and Flavours** Colours and Flavours (synthetic and natural) Types of flavours, Flavours generated during processing – reaction flavours, Stability of flavours during food processing, flavour emulsions; essential oils and oleoresins.	6
IV	**Impacts of Adulterants** Chemicals generated during food processing - acrylamide, benzene, hydroxymethyl furfural and nitrosamines. Health impacts-Stomach and liver disorders- mutogenic effects-food poisoning-glaucoma-rhenal failure-cardiac-lungs and brain disorders.	6
V	**Food Quality Standards** Food Safety and Standards-FSSA-Authority of India–Rules and Procedures of Local Authorities. Role of voluntary agencies Suchas, Agmark, I.S.I. Private testing laboratories, Quality control laboratories of consumer co-operatives. Consumer education-Consumer's problems rights and responsibilities-Offenses and Penalties-Procedures to complaint-Compensation to victims**.**	6
	Total	**30**

Self-study	Legitimate uses of Additives in foods, Flavour emulsions, polychlorinated biphenyls, Rules and Procedures of Local Authorities.

Textbooks:

1. Belitz, H.D., Grosch, W., and Schieberle, P., 2008. *Food Chemistry*, (3rd Edition), Springer Berlin.
2. Sathe,A.Y., 1999. *A first course in Food Analysis*, New Age International (P) Ltd.
3. Sehgal,S., *A Laboratory Manual of Food Analysis*, Wiley Publishers.

Reference Books:

1. Leo M.L., Nollet, Leo M.L., Nollet., 2004. *Handbook of Food Analysis*, (2nd Edition), CRC Press, New York.
2. Pomeraz, Y., and MeLoari, C.E., 1996. *Food Analysis: Theory and Practice*, CBS publishers and Distributor, New Delhi.
3. Kirk, R.S, and Sawyer, R., 1991. *Pearson's Composition and Analysis of Foods*, Longman Scientific and Technical. (9th Edition), England.
4. Morton, I.D., & Macleod, A.J., 1990. *Food Flavours*. Part A, BC. Elsevier.
5. Branen, A.L., Davidson, P.M, & Salminen, S., 2001. *Food Additives*. (2nd Edition). Marcel Dekker.

Web Resources:

1. https://indianlegalsolution.com/laws-on-food-adulteration/
2. https://www.vnmkv.ac.in/Content/Home/pdf/student-academic/FCN-246.pdf
3. https://www.vedantu.com/biology/food-adulteration
4. https://egyankosh.ac.in/bitstream/123456789/10014/1/Unit%204.pdf
5. https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004061923053802Sanjana_Mittal_Adulteration.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	3	2	2	3	3	2	2	2	3	3	3
CO2	3	2	1	2	3	2	3	3	3	2	2	2	3	3	3
CO3	3	2	2	2	3	2	3	3	3	3	3	1	2	2	3
CO4	3	2	2	2	3	2	3	3	3	3	3	2	3	2	3
CO5	3	2	3	3	1	2	3	3	3	3	3	3	3	3	3
TOTAL	**15**	**2**	**10**	**10**	**13**	**10**	**14**	**15**	**15**	**13**	**13**	**10**	**14**	**13**	**15**
AVERAGE	**3**	**2**	**2**	**2**	**2.6**	**2**	**2.8**	**3**	**3**	**2.6**	**2.6**	**2**	**2.8**	**2.6**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER III/V

SELF-LEARNING COURSE: NUTRITIONAL CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU233SL1/ CU235SL1	-	-	-	-	1	-	-	**25**	**75**	**100**

Pre-requisite: Previous knowledge on nutrients

Learning Objectives:

1. To make the students understand the different types of nutrients essential for growth.
2. To have an idea about food poisoning and its prevention.

Course Outcome

On the successful completion of the course, students will be able to:		
1	remember nutrients present in food	**K1**
2	understand and amino acids and proteins	**K2**
3	apply the skills to identify and prevent food poisoning	**K3**
4	analyse minerals, vitamins and enzymes	**K4**
5	evaluate blood sugar and digestion	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Textbooks

Units	Contents
I	**Nutrients:** Discovery of nutrients-total energy need for the human body, energy and nutrient-calorific value of food. **Carbohydrates:** Definition – classification - sources and energy released from sucrose, lactose and maltose, tests for carbohydrates, manufacture of sucrose, function of carbohydrates-digestion and absorption - regulation of blood sugar-important sources-carbohydrate in the diet.
II	**Proteins:** Definition **-** amino acids - classification and function. Classification-sources and function of common proteins viz egg albumin, insulin, casein, collagen, keratin and haemoglobin -tests for proteins - nucleic acids-RNA, DNA (Structure not necessary). **Lipids:** Definition-biological significance-tests for lipids-preservation of egg, milk, meat, fish, fruits and vegetables by physical (temperature control refrigeration) and chemical methods (preservative).
III	**Minerals:** Calcium – sources – deficiency, phosphorus - food sources – functions, iron – sources – deficiency and potassium - functions, deficiency. **Vitamins:** Classification - sources - deficiency diseases. Food poisoning and its prevention, food preservation, colouring, flavouring and sweeting agents in catering technology. Carcinogens in food materials.
IV	**Enzymes:** Introduction, properties, nomenclature and classifications of enzymes. Oxido-reducatases, transferases, hydrolases, lyases, isomeases, ligases. Cofactors and coenzymes. Mechansim of enzyme catalysis, factors affecting enzyme activity, regulation of enzyme activity. Reversible/ competitive inhibitors and irreversible / noncompetitive inhibitors.
V	**Hot beverages** – Tea, coffee and soups. **Tea** - Quality of the ingredients, time of extraction **Coffee**: Methods of preparation-filtration-percolation-instant coffee powder. **Soup**: Clear soup, cream soup, chowder soup and vegetable soup. **Cold beverages**-Lassi-definition-composition-nutritive value. Fresh juices - orange, mosuombi and mango. Synthetic fruit flavoured drinks-carbonated drinks-alcoholic beverages.

Textbooks

1. Swaminathan, M. 1977. Handbook of Food and Nutrition, (1st ed.). Chennai: Ganesh & Co.
2. Satish Gupte, 2003. A text book of Microbiology"' 1st edition, Jaypee Brothers Medical publishers (P) Ltd., New Delhi.

Reference Books

1. S. S. Marwahaand Arora, 2000. Food Processing: Biotechnological Applications, Asiatech publications, New Delhi.
2. Muddambi S.R. and Rajgopal M. V., 1987. *Fundamentals of Food and Nutrition*, Wiley Eastern Ltd., New Delhi.
3. Shubhangini Joshi, 2000. *Textbook of food and nutrition*, Tata Macgro hill Publishing Co., New Delhi.
4. Norman N. Potter 1996. *"Food science*", 5th edition, CBS publishers and Distributors.
5. Branen, A.L., Davidson, P.M, & Salminen, S., 2001. *Food Additives*. (2nd Edition). Marcel Dekker.

Web Resources

1. https://wikieducator.org/Nutritional_Chemistry_and_Biochemistry
2. https://www.vsu.edu/agriculture/agricultural-research-station/food-sciences/food chemistry.php
3. http://www2.tmsc.org/sms/nutrionchem6.pdf.
4. https://www.nestacertified.com/the-chemistry-of-nutrition/
5. https://www.cambridge.org/core/books/cambridge-humandisease/nutritionalchemistry

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	2	2	3	3	2	2	2	2	2	2	2
CO2	3	2	2	3	2	2	3	3	3	2	3	2	2	2	2
CO3	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO4	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO5	3	2	2	3	2	2	3	3	3	2	2	2	2	2	2
TOTAL	**15**	**10**	**10**	**15**	**10**	**10**	**15**	**15**	**14**	**12**	**13**	**12**	**10**	**10**	**10**
AVERAGE	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2.8**	**2.4**	**2.6**	**2.4**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER IV

CORE COURSE IV: GENERAL CHEMISTRY - IV

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU234CC1	5	-	-	-	5	5	75	25	75	100

Pre-requisite: General Chemistry III

Learning Objectives:

1. To provide a comprehensive knowledge on thermodynamic concepts and transition elements
2. To know the organic chemistry of ethers, aldehydes, ketones and carboxylic acids

Course Outcomes

On the successful completion of the course, students will be able to:		
1	define the terms in thermodynamics, periodic properties of transition elements and to recognize the properties of aldehydes, ketones and carboxylic acids.	**K1**
2	discuss the fundamentals in the chemistry of ethers, epoxides and carbonyl compounds and to understand the principles behind thermodynamics	**K2**
3	apply the laws of thermodynamics and to synthesise various organic compounds	**K3**
4	classify transition elements into series and to analyse the properties of ethers, acids, epoxides, halogen derivatives and thermodynamical concepts	**K4**
5	determine the thermodynamic relations and to evaluate the oxidation, reduction and other properties of organic compounds	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Thermodynamics I** Terminology – Intensive, extensive variables, state, path functions; isolated, closed and open systems; isothermal, adiabatic, isobaric, isochoric, cyclic, reversible and irreversible processes; First law of thermodynamics – Concept and significance of heat (q), work (w), internal energy (E), enthalpy (H); calculations of q, w, E and H for reversible, irreversible expansion of ideal and real gases under isothermal and adiabatic conditions; relation between heat capacities (Cp & Cv); Joule Thomson effect- inversion temperature. Thermochemistry - heats of reactions, standard states; types of heats of reactions and their applications; effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions; Hess's law and its applications.	**15**
II	**Thermodynamics II** Second Law of thermodynamics - Limitations of first law, spontaneity and randomness; Carnot's cycle; Concept of entropy, entropy change for reversible and irreversible processes, entropy of mixing, calculation of entropy changes of an ideal gas and a van der Waals gas with changes in temperature, volume and pressure, entropy and disorder. Free energy and work functions - Need for free energy functions, Gibbs free energy, Helmholtz free energy - their variation with temperature, pressure and volume, criteria for spontaneity; Gibbs-Helmholtz equation – derivations and applications; Maxwell relationships. Third law of thermodynamics - Nernst heat theorem; Applications of thirdlaw - evaluation of absolute entropies from heat capacity measurements, exceptions to third law.	**15**

III	**General Characteristics of d-block elements** **Transition Elements**- Electronic configuration - General periodic trend variable valency, oxidation states, stability of oxidation states, colour, magnetic properties, catalytic properties and tendency to form complexes. Comparative study of transition elements and non transition elements – comparison of II and III transition series with I transition series. Group study of Titanium, Vanadium, Chromium, Manganese, Iron, Cobalt, Nickel and Zinc groups. Extraction and uses of Titanium, Vanadium and Chromium.	**15**
IV	**Ethers and Thio ethers** Ethers-Nomenclature, general methods of preparations, (any two) Zeisel's method of estimation of methoxy group.. Thioethers - nomenclature, structure, preparation and uses. **Aldehydes and Ketones** General methods of preparation and physical properties. Nucleophilic addition reactions, base catalysed reactions with mechanism- Aldol, Cannizzaro's reaction, Perkin reaction, Benzoin condensation, Haloform reaction, Knoevenagel reaction. Oxidation of aldehydes. Baeyer - Villiger oxidation of ketones. Reduction: Clemmensen reduction, Wolf - Kishner reduction, Meerwein – Pondorf Verley reduction, reduction with $LiAlH_4$ and $NaBH_4$.,Addition reactions of unsaturated carbonyl compounds: Michael addition.	**15**
V	**Carboxylic Acids**: Structure, preparation, acidic nature, HVZ reaction, Claisen ester condensation, decarboxylation, Hunsdiecker reaction. **Carboxylic acid Derivatives:** Preparations of aliphatic and aromatic acid chlorides, esters, amides and anhydrides. Schottan- Baumann reaction, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann bromamide degradation and Curtius rearrangement. **Halogen substituted acids –** alpha, Beta halogenated substituted acids, Preparation and properties.	**15**
	Total	**75**

Self-study	Nomenclature of acids, ethers, aldehydes and ketones.

Textbooks:

1. Madan, R.D, Sathya Prakash, 2003, *Modern Inorganic Chemistry*, (2nd edition), S.Chand and Company, New Delhi.
2. Soni, P.L, 2000, *Text book of Organic Chemistry*. (20th edition), Sultan Chand Publishers.
3. Puri, Sharma, Kalia, 2021,*Principles of Inorganic Chemistry,* (33rd edition),Vishal Publishers.
4. Puri B.R., Sharma L.R. and Pathania, 2017, *Principles of Physical Chemistry*, (33rd edition) ShobanLal Nagin Chand and Co., Vishal Publishers.
5. Kapoor, K. L., 2009.*A Textbook of Physical chemistry*, volume-2, (3rd edition) Macmillan, India Ltd

Reference Books:

1. Maron, S. H. and Prutton C. P. *Principles of Physical Chemistry* ,4thed.; The Macmillan Company: Newyork.
2. Lee, J. D. 1991, *Concise Inorganic Chemistry, (*4th edition) ELBS William Heinemann: London.
3. Gurudeep Raj, 2001, *Advanced Inorganic Chemistry, (*26thedition); Goel Publishing House: Meerut.
4. Atkins, P.W. and Paula, J. 2014, *Physical Chemistry*, (10th edition.); OxfordUniversity Press:New York.

5. Huheey, J. E. 1993, *Inorganic Chemistry: Principles of Structure and Reactivity, (*4th edition) Addison Wesley Publishing Company: India.

Web Resources:

1. https://nptel.ac.in/courses/112102255 Thermodynamics
2. https://nptel.ac.in/courses/104101136
3. http://nptel.ac.in/courses/104101090/Classification of elements and periodic properties
4. http://nptel.ac.in/courses/104101090/
5. https://www.sciencedirect.com

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	1	2	3	3	2	2	3	3	2	2	2	3	3	3
CO2	3	3	1	2	3	2	3	3	3	2	2	2	3	3	3
CO3	3	2	2	2	3	2	3	3	3	3	3	1	2	2	3
CO4	3	2	2	2	3	2	3	3	3	3	3	2	3	2	3
CO5	3	2	3	3	1	2	3	3	3	3	3	3	3	3	3
TOTAL	**15**	**10**	**10**	**10**	**13**	**10**	**14**	**15**	**15**	**13**	**13**	**10**	**14**	**13**	**15**
AVERAGE	**3**	**2**	**2**	**2**	**2.6**	**2**	**2.8**	**3**	**3**	**2.6**	**2.6**	**2**	**2.8**	**2.6**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER IV

CORE LAB COURSE IV: PHYSICAL CHEMISTRY PRACTICAL - I

CONDUCTOMETRIC AND POTENTIOMETRIC TITRATIONS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU234CP1	-	-	3	-	3	3	45	-	75	100

Pre-requisite: General Chemistry – I and II

Learning Objectives:

1. To understand the principle of conductometric and potentiometric titrations
2. To determine the concentration, conductance and dissociation constant of compounds

Course Outcomes

On the successful completion of the course, students will be able to:		
1	remember the theoretical concepts of the experiments	**K1**
2	understand the concepts of conductometric and potentiometric titrations	**K2**
3	apply the principles of conductometry and potentiometry to determine the strength of unknown solutions.	**K3**
4	analyze the strength of unknown solution by potentiometric method	**K4**
5	evaluate the concentration , conductance , dissociation constant of compounds	**K5**

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Self-study	Theory behind potentiometric and conductometric titrations

Contents	No. of Hours
Conductometric Titrations 1) Comparison of the strengths of given hydrochloric acids using NaOH 2) Estimation of the strength of hydrochloric acid using Std. HCl and NaOH 3) Estimation of strength of weak acid and strong acid using NaOH **Potentiometric Titrations** 4) Determination of the strength of $FeSO_4$ using Std. Ferrous Ammonium Sulphate and link – $K_2Cr_2O_7$ 5) Determination of the strength of Ferrous Ammonium Sulphate using Std.$FeSO_4$ and link $KMnO_4$ 6) Determination of solubility product of a sparingly soluble substance 7) Determination of heat of solution by solubility method (Benzoic acid, Ammonium oxalate) **Demonstration** 8) Determination of heat of hydration of copper sulphate- Demo 9) Determination of concentration of copper sulphate solution – Demo	**45**

Textbooks

1. Viswanathan, B., Raghavan, P.S., 2005. *Practical Physical Chemistry*. Viva Books Ltd, India.
2. Sienko, M.J., Plane, R.A.. Martu, S.T., 1984, *Experimental Chemistry*. International student Edn.

Reference Books

1. Thomas, A. O., 1989. *Practical Chemistry for B.Sc Main students*, Scientific book centre, Cannanore.
2. Shoemaker, D.P., Garland, C.W., Nibler, J.W., 1974. *Experiments in Physical Chemistry*. McGraw-Hill International.
3. Levitt, B.P., 1972. *Findlay's Practical Physical Chemistry*. (Nineth Edition), Longman Group Ltd. New York.
4. Vishwanathan ,B.,Raghavan, P.S.2005. *Practical Physical Chemisry*.M.V.Learning.

5. Yadav, J.B.2016.*Advanced Practical Physical Chemistry*, Krishna Prakashan Media.

Web Resources

1. https://edu.rsc.org/experiments/titrating-sodium-hydroxide-with-hydrochloric-acid/697.article
2. https://egyankosh.ac.in/bitstream/123456789/43276/1/Exp-3.pdf
3. https://heartwarit.files.wordpress.com/2018/03/titration-lab-report.pdf
4. https://nitm.ac.in/ckfinder/userfiles/files/CY%20151_Labmanual%20Chemistry%20B_Tech%201st%20year.pdf
5. https://www.vivabooksindia.com/book/practical-physical-chemistry

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	2	2	3	3	2	2	2	2	2	2	2
CO2	3	2	2	3	2	2	3	3	3	2	3	2	2	2	2
CO3	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO4	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO5	3	2	2	3	2	2	3	3	3	2	2	2	2	2	2
TOTAL	**15**	**10**	**10**	**15**	**10**	**10**	**15**	**15**	**14**	**12**	**13**	**12**	**10**	**10**	**10**
AVERAGE	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2.8**	**2.4**	**2.6**	**2.4**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER IV

ELECTIVE COURSE IV: CHEMISTRY FOR PHYSICAL SCIENCES – II

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU234EC1	4	-	-	-	3	4	60	25	75	100

Prerequisites: Chemistry for physical sciences -I

Learning Objectives

1.To know co-ordination Chemistry, Water Technology and catalysis

2.To understand Carbohydrates, Amino acids and electrochemistry

Course Outcomes

On the successful completion of the course, student will be able to:		
1	write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology	**K1**
2	explain the preparation and property of carbohydrate, amino acids and nucleic acids.	**K2**
3	apply/demonstrate the electrochemistry principles in corrosion, electroplating and fuel cells.	**K3**
3	determine the reaction rate, order of chemical reaction	**K3**
4	analyze the various type of photochemical process and catalysis.	**K4**
5	evaluate the nature of carbohydrates, reaction rates and electroplating metals	**K5**

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze, K5 - Evaluate

Unit	Contents	No. of Hours
I	**Co-ordination Chemistry and Water Technology** Co-ordination Chemistry: Definition of terms-IUPAC Nomenclature - Werner's theory - EAN rule - Pauling's theory – Postulates - Applications to [Ni(CO)4], [Ni(CN)4]2-,[Co(CN)6]3- Chelation - Biological role of Haemoglobin and Chlorophyll (elementary idea) – Applications in qualitative and quantitative analysis. Water Technology: Hardness of water, determination of hardness of water using EDTA method, zeolite method-Purification techniques- BOD, COD.	**12**
II	**Carbohydrates and Amino acids** Carbohydrates: Classification, preparation and properties of glucose, fructose and sucrose. Discussion of open chain ring structures of glucose and fructose. Glucose –fructose interconversion. Properties of starch and cellulose. Amino acids: Classification - preparation and properties of alanine, preparation of dipeptides using Bergmann method. RNA and DNA (elementary idea only).	**12**
III	**Electrochemistry** Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials -electrochemical series. Strong and weak electrolytes - ionic product of water -pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method – buffer solutions and its biological applications - electroplating - Nickel and chrome plating – Types of cells -fuel cells-corrosion and its prevention.	**12**
IV	**Kinetics and Catalysis** Order and molecularity. Integrated rate expression for I and II (2A Products) order reactions. Pseudo first order reaction, methods of determining order of a reaction – Half-life period – Catalysis - homogeneous and heterogeneous, catalyst used in Contact and Haber's processes. Concept of energy of activation and Arrhenius equation.	**12**

V	**Photochemistry** Grothus-Draper's law and Stark-Einsteins law of photochemical equivalence, Quantum yield - Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).	**12**
TOTAL		**60**

Self Study	Co-ordination compounds, fundamentals of Carbohydrate, basics of amino acids, rate of reactions, photochemical reactions

Textbooks

1. Veeraiyan, V., 2015. *Text book of Ancillary Chemistry*; High mount publishing house, Chennai, first edition.
2. ArunBahl, S., Bahl, B.S., 2012. *Advanced Organic Chemistry*; S.Chand and Company, New Delhi, twenty third edition.
3. Bahl, B.S., Tuli, G.D., Bahl, A., 2020. *Essentials of Physical Chemistry*, (24th Edition), S. Chand and Company Limited, India.
4. Soni, P.L., 2012. *Text book of Organic Chemistry*, (29th Edition). Sultan Chand & Sons Publishing, India.

Reference Books

1. Atkins, P., De Paula, J., 2014. *Physical Chemistry*, (10th Edition), Oxford University Press, Oxford.
6. Madan, R.D., 2014. *Modern Inorganic Chemistry*, (13th Edition). Sultan Chand Publishing Limited, India.
7. Lee, J.D., 2005. *Concise Inorganic Chemistry*, (5th Edition), Wiley Blackwell Science, U.S.A
8. Azaroff, L.V., 2017. *Introduction to Solids*, McGraw Hill Education, India.
9. Bryan, J.C., 2023. *Introduction to Nuclear Science*, (4th Edition), CRC Press, U.S.A

Web Resources

1. https://alison.com/course/chemistry-atomic-structure
2. https://www.udemy.com/course/atomic-structure/
3. https://www.classcentral.com/course/swayam-industrial-inorganic-chemistry-12912
4. https://nptel.ac.in/courses/104105103
5. https://www.udemy.com/topic/Analytical-Chemistry/?utm_source=adwords&utm_medium=udemyads&utm_campaign=DSA_

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	2	2	3	3	2	2	2	2	2	2	2
CO2	3	2	2	3	2	2	3	3	3	2	3	2	2	2	2
CO3	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO4	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO5	3	2	2	3	2	2	3	3	3	2	2	2	2	2	2
TOTAL	**15**	**10**	**10**	**15**	**10**	**10**	**15**	**15**	**14**	**12**	**13**	**12**	**10**	**10**	**10**
AVERAGE	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2.8**	**2.4**	**2.6**	**2.4**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER IV

ELECTIVE LAB COURSE IV: CHEMISTRY PRACTICAL FOR PHYSICAL SCIENCES: SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU234EP1	-	-	2	-	2	2	30	25	75	100

Prerequisites:

Students should have knowledge about organic compounds

Learning Objectives

1.To identify organic functional groups

2.To detect elements in organic compounds.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	learn to test the organic substances	**K1**
2	identify the functional group present in the organic compounds	**K2**
3	detect the elements present	**K3**
4	distinguish between aliphatic, aromatic, saturated and unsaturated compounds	**K3**
5	analyze the given organic substance	**K4**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze

Contents	No. of Hours
SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS The analysis must be carried out as follows: a)Functional group tests [phenol, mono carboxylic acids, ester, aldehyde, diamide and carbohydrate]. b) To distinguish between aliphatic and aromatic compounds. c)To distinguish – Saturated and unsaturated compounds. d)Elements present or absent	**30**

Self-study	Saturated and unsaturated compounds

Textbooks

1. Thomas, A.O. 1999. *Practical Chemistry*, Scientific book centre, Cannanore.
2. Mendham, J.; Denney, R. C.; Barnes, J. D.; Thomas, M.; Sivasankar, B.; 2000, *Vogel's Textbook of Quantitative Chemical Analysis*, 6th ed.; PearsonEducation Ltd: New Delhi,.

Reference Books

1. Venkateswaran, V.; Veeraswamy, R.; Kulandivelu, A.R.2002, *Basic Principles ofPractical Chemistry,*2nd ed.; Sultan Chand &Sons:, New Delhi.
2. Thomas, A.O. 1999. Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore.
3. Mohan Roa Gangula, 2021.*Qualitative Analysis of Organic Compounds.*
4. Gurtu, J. N., Kapoor, R., 1987. *Advanced Experimental Chemistry (Organic),* Sultan Chand, New Delhi
5. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., Tatchell, A.R.,1987. *Vogel'sTextbook of Practical Organic Chemistry* 5thed., Pearson, India,

Web Resources

1. http://www.federica.unina.it/agraria/analytical-chemistry/volumetric- analysis
2. https://chemdictionary.org/titration-indicator/
3. https://www.vlab.co.in/broad-area-chemical-sciences

4. https://fac.ksu.edu.sa/sites/default/files/vogel-practicalorganicchemistry_longmans-
    a. 3rdedrevised-1957_.pdf
5. https://chem.libretexts.org/Bookshelves/Organic_Chemistry

MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	3	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	3	2	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	2
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	2	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	3
TOTAL	**15**	**12**	**14**	**13**	**13**	**10**	**10**	**15**	**10**	**10**	**10**	**11**	**10**	**10**	**11**
AVERAGE	**3**	**2.4**	**2.8**	**2.6**	**2.6**	**2**	**2**	**3**	**2**	**2**	**2**	**2.2**	**2**	**2**	**2.2**

3 – Strong, 2- Medium, 1- Low

SEMESTER III / IV

SKILL ENHANCEMENT COURSE SEC IV: DIGITAL FLUENCY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG23CSE2	2	-	-	-	2	2	30	50	50	100

Pre-requisite: Basic computer knowledge

Learning Objectives:

1. To provide a comprehensive suite of productivity tools that enhance efficiency
2. To build essential soft skills that are needed for professional success.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	work with text, themes and styles	**K1**
2.	produce a mail merge	**K2**
3.	secure information in an Excel workbook	**K2**
4.	perform documentation and presentation skills	**K2, K3**
5.	add special effects to slide transitions	**K3**

K1 - Remember; **K2** - Understand; **K3** – Apply

Units	Contents	No. of Hours
I	**Microsoft Word 2010:** Starting Word 2010 - Understanding the Word Program Screen - Giving Commands in Word - Using Command Shortcuts – Document: Creating - Opening - Previewing - Printing and Saving. Getting Started with Documents: Entering and Deleting Text - Navigating through a Document - Viewing a Document. Working with and Editing Text: Spell Check and Grammar Check- Finding and Replacing Text - Inserting Symbols and Special Characters – Copying, Moving, and Pasting Text.	**6**
II	**Formatting Characters and Paragraphs**: Changing Font Type, Font Size, Font Color, Font Styles and Effects, Text Case, Creating Lists, Paragraph Alignment, Paragraph Borders and Shadings, Spacing between Paragraphs and Lines. Formatting the Page: Adjusting Margins, Page Orientation and Size, Columns and Ordering, Headers and Footers, Page Numbering. Working with Shapes, Pictures and SmartArt: Inserting Clip Art, Pictures and Graphics File, Resize Graphics, Removing Picture's Background, Text Boxes, Smart Art, Applying Special Effects. Working with Tables: Create Table, Add and delete Row or Column, Apply Table Style - Working with Mailings.	**6**
III	**Microsoft Excel 2010:** Creating Workbooks and Entering Data: Creating and Saving a New Workbook - Navigating the Excel Interface, Worksheets, and Workbooks - Entering Data in Worksheets - Inserting, Deleting, and Rearranging Worksheets. Formatting Worksheets: Inserting and Deleting Rows, Columns and Cells - Formatting Cells and Ranges - Printing your Excel Worksheets and Workbooks. Crunching Numbers with Formulas and Functions: Difference between Formulae and Functions - Applying Functions. Creating Powerful and Persuasive Charts: Creating, Laying Out, and Formatting a Chart.	**6**
IV	**Microsoft PowerPoint 2010:** Creating a Presentation - Changing the Slide Size and Orientation - Navigating the PowerPoint Window - Add content to a Slide - Adding, Deleting, and Rearranging Slides - Using views to work on Presentation. Creating Clear and Compelling Slides: Planning the Slides in Presentation - Choosing Slide Layouts to Suit the Contents - Adding Tables, SmartArt, Charts, Pictures, Movies, Sounds, Transitions and Animations - Slideshow.	**6**

V	**Digital Platforms:** Graphic Design Platform: Canva - Logo Making, Invitation Designing. E-learning Platform: Virtual Meet – Technical Requirements, Scheduling Meetings, Sharing Presentations, Recording the Meetings. Online Forms: Creating Questionnaire, Publishing Questionnaire, Analyzing the Responses, Downloading the Response to Spreadsheet.	**6**
	Total	**30**

Self-study	Parts of a computer and their functions

Textbook:

Anto Hepzie Bai J. & Divya Merry Malar J.,2024, Digital Fluency, Nanjil Publications, Nagercoil.

Reference Books:

1. Steve Schwartz, 2017, *Microsoft Office 2010 for Windows,* Peachpit Press.
2. Ramesh Bangia, 2015, Learning Microsoft Office 2010, Khanna Book Publishing Company.
3. Bittu Kumar, 2018, *Mastering MS Office*, V & S Publishers.
4. James Bernstein, 2020, *Google Meet Made Easy*, e-book, Amazon.
5. Zeldman, Jeffrey, 2005, *Web Standards Design Guide*, Charles River Media.

Web Resources:

1. https://www.youtube.com/watch?v=oocieLn6umo
2. https://www.youtube.com/watch?v=pPSwbK4_GdY
3. https://www.youtube.com/watch?v=DKAiSDhU4To
4. https://www.youtube.com/watch?v=sbeyPahs-ng
5. https://www.youtube.com/watch?v=fACEzzmXelY

SEMESTER IV

ENVIRONMENTAL STUDIES

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG234EV1	2	-	-	-	2	2	30	25	75	100

Pre-requisite: Interest to learn about nature and surrounding.

Learning Objectives

1.To know the different types of pollutions, causes and effects

2.To understand the importance of ecosystem, resources and waste management

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	know the different kinds of resources, pollution and ecosystems	K1
2.	understand the biodiversity and its constituents	K2
3.	use the methods to control pollution and, to conserve the resources and ecosystem	K3
4.	analyse the factors behind pollution, global warming and health effects for sustainable development	K4
5.	evaluate various water, disaster and waste management systems	K5

K1 - Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Nature of Environmental Studies** Multidisciplinary nature of environmental studies- scope of environmental studies - environmental ethics-importance- types- natural resources - renewable and non-renewable resources – forest, land, water and energy resources.	6
II	**Biodiversity and its Conservation** Definition: genetic, species of biodiversity - biodiversity hot-spots in India - endangered and endemic species of India – Red Data Book - In-situ and Ex-situ conservation of biodiversity. Ecosystem- types - structure and function - food chain - food web- ecological pyramids- forest and pond ecosystems.	6
III	**Environmental Pollution** Pollution - causes, types and control measures of air, water, soil and noise pollution. Role of an individual in prevention of pollution. Solid waste management: Causes, effects and control measures of urban and industrial wastes. Disaster management– cyclone, flood, drought and earthquake.	6
IV	**Environmental Management and Sustainable Development** From unsustainable to sustainable development -Environmental Law and Policy – Objectives; The Water and Air Acts-The Environment Protection Act - Environmental Auditing-Environmental Impact Assessment-Life Cycle Assessment- Human Health Risk Assessment, Water conservation, rain water harvesting, watershed management.	6
V	**Social Issues and the Environment** Population explosion-impact of population growth on environment and social environment. Women and Child Welfare, Role of information technology in environment and human health. Consumerism and waste products. Climate change - global warming, acid rain and ozone layer depletion. **Field work:** Address environmental concerns in the campus (or) Document environmental assets- river / forest / grassland / hill / mountain in the locality (or) Study a local polluted site-urban / rural / industrial / agricultural area.	6
	Total	30

Self-study	Pollutants, Ecosystems and Resources

Textbook

Punitha A and Gladis Latha R, 2024. Fundamentals of Environmental Science.

Reference Books

1. Agarwal, K.C., 2001. *Environmental Biology*, Nidi Publishers. Ltd. Bikaner.
2. Brunner R.C., 1989, *Hazardous Waste Incineration*, McGraw Hill Ltd.
3. Gorhani, E & Hepworth, M.T. 2001. *Environmental Encyclopedia*, Jaico Publ. House, Mumbai.
4. De A.K.,2018. *Environmental Chemistry*, Wiley Eastern Ltd.
5. Gleick, H.P. 1993. *Water in crisis*, Pacific Institute for Studies Oxford Univ. Press.

Web Resources

1.https://www.sciencenews.org/topic/environment
2.https://news.mongabay.com/2024/05/
3. https://www.sciencedaily.com/news/earth_climate/environmental_issues/
4.https://wildlife.org/rising-oryx-numbers-may-distress-new-mexico-ecosystem/
5. https://phys.org/news/2024-02-global-wild-megafauna-ecosystem-properties.html

SEMESTER III & IV
LIFE SKILL TRAINING II: CATECHISM

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG234LC1	1	-	-	-	1	1	15	50	50	100

Learning Objectives:

1. To develop human values through value education
2. To understand the importance of personal development to lead a moral life

Course Outcomes

On the successful completion of the course, student will be able to:		
1	know and understand the aim and importance of value education	K1,K2
2	get rid of inferiority complex and act confidently in the society	K3
3	live lovingly by facing loneliness and make decisions on their own	K3
4	develop human dignity and able to stand bravely in adversity	K6
5	learn unity in diversity and grow in a life of grace	K6

K1 - Remember **K2**-Understand; **K3**-Apply; **K6**- Create

Units	Contents	No. of Hours
I	**Face Loneliness:** Loneliness – Causes for Loneliness – Loneliness in Jesus Christ Life – Ways to Overcome Loneliness – Need and Importance Bible Reference: Matthew: 6:5-6	3
II	**Inferiority Complex:** Inferiority Complex - Types – Ways to Get Rid of Inferiority Complex – Words of Eric Menthol – Balanced Emotion – Jesus and his Disciples. Bible Reference: Luke 8:43-48	3
III	**Decision Making:** Importance of Decision Making – Different Steps – Search – Think – Pray – Decide- Jesus and his Decisions Bible Reference: Mathew 7:7-8 **Independent:** Freedom from Control – Different Types of Freedom - Jesus the Liberator Bible Reference: Mark 10:46-52	3
IV	**Human Dignity:** Basic Needs – Factors that Degrade Human Dignity – How to Develop Human Dignity. Bible Reference: Luke 6:20-26 **Stand Bravely in Adversity:** Views of Abraham Maslow – Jesus and his Adversity. Bible Reference: Luke 22:43	3
V	**Unity in Diversity:** Need for Unity – The Second Vatican Council on the Mission of Christian Unity. Bible Reference: I Corinthians 1:10 **To Grow in a Life of Grace:** Graceful Life – View of Holy Bible – Moses – Amos – Paul – Graceful Life of Jesus Bible Reference: Amos 5:4	3
TOTAL		15

Textbooks

Valvukku Valikattuvom, Christian Life Committee, Kottar Diocese
The Holy Bible

SEMESTER III & IV

LIFE SKILL TRAINING II: MORAL

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG234LM1	1	-	-	-	1	1	15	50	50	100

Learning Objectives:

1. To cultivate human values through value education
2. To comprehend the importance of humane and morals to lead ethical and moral life.

Course Outcome

On the successful completion of the course, student will be able to:		
1	know the significance of life	**K1**
2	understand the importance of self-care	**K2**
3	realise the duty of youngsters in the society and live up to it	**K3**
4	analyse how to achieve success in profession	**K4**
5	develop mystical values by inculcating good thoughts	**K5**

K1 - Remember; K2 - Understand; K3 – Apply; K4 - Analyse; K5 – Evaluate

Unit	Contents	No. of Hours
I	**Edu Care:** Introduction- -Personal Care-Temple of Mind-Emotional stability-Inner views- Internal and external Beauty- Life is a Celebration	**3**
II	**Self-care:** Self- discipline- Selfishness in doing good things- Adolescence stage-What am I? - Self-esteem- Self-Confidence- Respect for womanhood	**3**
III	**Profession based Values:** Time Management-Continuous effort- What next? –Present moment is yours, Hard work and Smart Work-Broad view- destruct your failures	**3**
IV	**Mystical Values:** Thoughts- Positive and negative thoughts- Origin of negative thoughts-Moralisation of needs- Elimination of obstacles	**3**
V	**Society and you:** Knowing Humanity-Thankfulness- love and happiness- Honesty-Heroism -Youth is gift of God-Youngsters in politics and social media utilization.	**3**
TOTAL		**15**

Textbook

"Munaetrathin Mugavari", G. Chandran, Vaigarai Publisher.

SEMESTER IV/VI

SELF-LEARNING COURSE: CHEMISTRY OF FUELS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU234SL1/ CU236SL1	-	-	-	-	1	-	-	**25**	**75**	**100**

Pre-requisite: Students should have basic knowledge on fuels

Learning Objectives:

1. To distinguish conventional petroleum-based fuels and alternative & renewable fuels.
2. To gain the knowledge of the origin of petroleum, crude oil and different refining processes.

Course Outcome

On the successful completion of the course, students will be able to:		
1	remember the classifications of coals and lubricants	**K1**
2	understand the properties and definitions of solid, liquid, and gaseous fuels	**K2**
3	apply the skills to optimize fuel processing techniques	**K3**
4	analyze and compare renewable and non-renewable energy sources	**K4**
5	evaluate the applications of fuels in various industries	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents
I	**History of Fuels** Review of energy sources (renewable and non-renewable). History of solid, liquid and gaseous fuels, Definitions and properties of solid fuels, Definitions and properties of liquid and gaseous fuels, Production and Consumption pattern of fuels. Calorific value - Gross calorific value and Net calorific value, Determination of calorific value -Bomb calorimeter and Dulong's Method.
II	**Gaseous fuels:** Qualitative treatment of non-petroleum fuels -Natural gas, Synthetic gases- their composition & properties. Producer gas, Water gas, Coal Gas, LPG, CNG, and Hydrogen as fuel.
III	**Petroleum** Composition of crude petroleum, Different types of petroleum products and their applications. Principle and process of fractional distillation, Cracking - Thermal and catalytic cracking
IV	**Coal** Coal classification, Coal mining, Coal preparation and washing, Combustion of coal and coke making, Action of heat on different coal samples, Different types of coal combustion techniques, Coal tar distillation, Coal liquefaction, Direct liquefaction, Indirect liquefaction, Coal gasification(Hydro gasification and Catalytic gasification), Uses of coal (fuel and nonfuel) in various industries
V	**Lubricants** Classification of lubricants, lubricating oils (conducting and non-conducting), Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants – viscosity index, cloud point, pore point.

Textbooks

1. Uttam Ray Chaudhuri., 2010. *Fundamentals of Petroleum and Petrochemical Engineering*, Satish Serial Publishing House, India.
2. Sharma,B.K., 2000. *Industrial Chemistry*, Goel Publishing House, Meerut.
3. Jain,P.C., Jain,M., 1988. *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.

Reference Books:

1. Richard, A., Dave, I.P., 2000. *Modern Petroleum Technology*,Vol 1,6th edition.

2. Alan, G., Lucas, I.P., 2000. *Modern Petroleum Technology*. Vol 2, Downstream,Ed., 6th ed., John Wiley & Sons. Ltd.
3. Bhaskar Rao,B.K., 2003. *Modern Petroleum Refining Processes*, 4th ed., Oxford & IBH Publishing Co.Pvt. Ltd.
4. John Griswold.,2006. Fuels *Combustion and Furnaces*, Mc-Graw Hill Book Company, New York
5. Nelson, W, L., *Petroleum Refinery Engineering*, 4th ed. Mc-Graw Hill Book Company, New York

Web Resources:

1. https://www.aiche.org/sites/default/files/community/262801/aiche-community-site-event/514546/petroleumrefining-aiche-rbt11-15-19.pdf
2. https://www.fkit.unizg.hr/_download/repository/PRPP_2013_Refinig_intro_H2_tech.pdf
3. https://tameson.com/pages/lubricants
4. https://www.wbdg.org/ffc/dod/cpc-source/petroleum-oil-lubricants-storage-distribution-systems-knowledge-area
5. https://combustion.in/en_US/standard-gaseous-fuels-high-calorific-value-gas-fuels/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	2	2	3	3	2	2	2	2	2	2	2
CO2	3	2	2	3	2	2	3	3	3	2	3	2	2	2	2
CO3	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO4	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO5	3	2	2	3	2	2	3	3	3	2	2	2	2	2	2
TOTAL	**15**	**10**	**10**	**15**	**10**	**10**	**15**	**15**	**14**	**12**	**13**	**12**	**10**	**10**	**10**
AVERAGE	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2.8**	**2.4**	**2.6**	**2.4**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

CORE COURSE V: ORGANIC CHEMISTRY - I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU235CC1	5	-	-	-	4	5	75	25	75	100

Pre-requisite:

Knowledge on the synthesis and properties of organic compounds.

Learning Objectives:

1. To understand the stereochemical concepts, chemical transformations and spectroscopic characterization of organic compounds.
2. To know the chemistry of nitro compounds, amines and heterocyclic compounds.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recall the fundamental concepts of stereochemistry, nitrogen compounds, heterocyclic compounds, and spectroscopy.	**K1**
2.	explain the preparation and properties of organic compounds and interpret the principles of UV-Visible and IR spectroscopy for the identification of organic compounds.	**K2**
3.	apply the stereochemical notations, organic reaction outcomes, and spectroscopic rules to identify molecular properties.	**K3**
4.	analyze the properties, reactions and spectral data of organic compounds.	**K4**
5.	evaluate the significance of stereochemistry, synthetic methods, and spectroscopic data for understanding molecular interactions, synthesis, and structure determination.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** - Evaluate

Units	Contents	No. of Hours
I	**Stereochemistry** **Optical Isomerism:** Optical activity - elements of symmetry - specific rotation - asymmetry - enantiomers and diastereoisomers. Molecules with one and two chiral centres - lactic and tartaric acids. Racemisation - methods of racemization - resolution - methods of resolution. Cahn-Ingold and Prelog rules - R/S notations for one and two chiral centres. Optical activity of allenes and biphenyls. Chirality and stereochemical significance of Ayurvedic medicine - santalol - menthol and camphor Projection Formula: Flying wedge, Fischer Projection, Newmann and Sawhorse representations and their interconversions. **Geometrical isomerism:** Cis-trans isomerism - E/Z notations. Methods of distinguishing geometrical isomers. **Conformational isomerism:** Conformational analysis of ethane, butane and cyclohexane.	15
II	**Chemistry of Nitrogen Compounds** **Nitroalkanes and nitroarenes:** Preparation and chemical reactions. Pseudo acid character and nitro - aci nitro tautomerism. **Alkyl and aryl amines:** Preparation of alkyl and aryl amines - Ritter reaction - Hofmann ammonolysis - Leuckart reaction - Ullmann reaction and Gabriel	15

	phthalimide reaction. Physical and chemical properties of alkyl and aryl amines. Basicity of amines. Distinction between primary, secondary and tertiary amines - Hinsberg's and Hofmann's method. **Diazonium compounds:** Preparation and properties of diazomethane and benzene diazonium chloride.	
III	**Heterocyclic Compounds - I** **Five-membered heterocyclic compounds:** General characteristics - aromatic character and reactivity of pyrrole - furan and thiophene. **Pyrrole:** Preparation from succinimide and Paal Knorr synthesis. Reactions - reduction - basic character - acidic character - electrophilic substitution reactions and ring opening. **Furan:** Preparation from mucic acid and pentosan. Reactions - hydrogenation - reaction with oxygen - Diels Alder reactions - formationof thiophene and pyrrole and electrophilic substitution reactions. **Thiophene:** Preparation from acetylene. Reactions - reduction - oxidation and electrophilic substitution reactions.	**15**
IV	**Heterocyclic Compounds – II** **Six-membered heterocyclic compounds:** **Pyridine:** Preparation from acetylene. Physical properties. Reactions - basic character - oxidation - reduction - electrophilic substitution and nucleophilic substitution reactions. **Condensed ring systems:** **Quinoline:** Skraup synthesis and Friedlander's synthesis. Reactions - basic nature - reduction - oxidation - electrophilic substitutions - nucleophilic substitutions and Chichibabin reaction. **Isoquinoline:** Preparation from Bischler-Napieralski reaction. Reactions - reduction - oxidation and electrophilic substitution reaction. **Indole:** Fischer indole synthesis and reactions of indole.	**15**
V	**Spectroscopy I** **UV-Visible spectroscopy:** principle - instrumentation - types of electronic excitations - chromophore - auxochrome - bathochromic - hypsochromic - hypochromic and hyperchromic shifts. Woodward-Fieser rules to calculate λ_{max} values of conjugated dienes - α,β-unsaturated carbonyl compounds and aromatic compounds. UV-Visible spectroscopy of ancient dyes - indigo - alizarin red and curcumin. **IR spectroscopy:** principle - instrumentation - Hooke's law - types of molecular vibrations - normal degrees of freedom and finger print region. Factors influencing the vibrational frequency. Identification of functional groups in organic compounds.	**15**
	Total	**75**

Self-study	Basic concepts of stereochemistry, aromaticity, UV-Visible and IR spectroscopy.

Text Books

1. Jain, M.K., Sharma, S.C., 2016. *Modern Organic Chemistry*, (4th ed.), Vishal Publishers, India
2. Soni, P.L., Chawla, H.M., 2012. *A Text book of Organic chemistry*, (29th ed.), Sultan Chand and Sons, India.

Reference Books

1. Kalsi, P.S., 2015. *Stereochemistry: Conformation and Mechanism*, New Age International Private Limited, India.
2. Eliel, E.L., Wilen, S.H., 2003. *Stereochemistry of Organic Compounds*, (1st ed.), Wiley New York.
3. March, J., 2006. *Advanced Organic Chemistry*, (4th ed.), John Wiley and Sons, New York.
4. Finar, I.L., 2002. *Organic Chemistry: Stereochemistry and Chemistry Natural Products*, Volume 2, (5th ed.), Pearson Education, India.
5. Tewari, N., 2020. *Advanced Organic Chemistry*, (2nd ed.), Books and Allied Private Limited, India.

Web Resources

1. https://www.khanacademy.org/science/organic-chemistry/stereochemistry-topic/chirality-r-s-system/v/stereoisomer-enantiomer-jay
2. https://www.youtube.com/watch?v=O7uZayxy_bE
3. https://www.youtube.com/watch?v=RjccXQZa6Jc&list=PLwrNygi_4kJN4UkWPT9Z5ASeawXn1Wvkk&index=1
4. https://www.youtube.com/watch?v=Kzm61ubVQmE
5. https://www.khanacademy.org/science/organic-chemistry/aromatic compounds/aromatic-stability/v/aromatic-heterocycles-i

MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	1	1	1	3	3	2	2	2	2	3	2	3
CO2	3	2	2	1	1	1	3	3	3	2	3	3	3	2	3
CO3	3	2	2	1	1	1	3	3	3	3	3	3	3	2	3
CO4	3	2	2	1	1	1	3	3	3	3	3	3	3	2	3
CO5	3	2	2	1	1	1	3	3	3	3	3	3	3	2	3
TOTAL	**15**	**10**	**10**	**5**	**5**	**5**	**15**	**15**	**14**	**13**	**14**	**14**	**15**	**10**	**15**
AVERAGE	**3**	**2**	**2**	**1**	**1**	**1**	**3**	**3**	**2.8**	**2.6**	**2.8**	**2.8**	**3**	**2**	**3**

3 - Strong, 2- Medium, 1- Low

SEMESTER V

CORE COURSE VI: PHYSICAL CHEMISTRY - I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU235CC2	5	-	-	-	4	5	75	25	75	100

Pre-requisite: Knowledge on the basic principles of Physical Chemistry

Learning Objectives:

1. To know the properties of solutions and kinetics of reactions.
2. To analyze the catalysis and point groups of compounds.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	define the basic terms in solutions, colligative properties, chemical kinetics, catalysis and adsorption	**K1**
2	understand the concepts of group theory and determine the point groups of molecules	**K2**
3	apply the concepts of chemical kinetics to predict the rate and order of the reaction and predict the effect of temperature on reaction rate	**K3**
4	analyze the colligative properties and characteristics of catalytic and photochemical reactions	**K4**
5	evaluate the rate of catalytic reactions and utilize the concepts of photochemistry in fluorescence, phosphorescence, chemiluminescence and colour perception of vision.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Solutions and Colligative Properties** Solutions of non-electrolytes – solutions of liquids in liquids – vapour pressure of non-ideal solutions - type I, type II and type III. Vapour pressure - composition and boiling point - composition curves of completely miscible binary solutions - type I, type II and type III. Theory of fractional, azeotropic and steam distillations. Solubility of partially miscible liquids - phenol-water system, triethylamine – water system and nicotine water system. Colligative properties – definition and examples. Osmotic pressure, Laws of osmotic pressure – van't Hoff theory of dilute solutions - isotonic solution. Elevation of boiling point - molol boiling point elevation constant or ebullioscopic constant - determination of molar mass from elevation of boiling point. Depression of freezing point - molol freezing point depression constant or cryoscopic constant - determination of molar mass by depression of freezing point. Abnormal results and van't Hoff factor.	**15**
II	**Chemical kinetics** Rate of reaction – expression of rate – factors influencing rate of reaction – order and molecularity - definition and examples – differences between order and molecularity–zero, first and second order reaction – definition- examples - derivation of rate constant and half life period. Methods of determining order of reaction – differential, integral, half-life and Ostwald's isolation methods.	**15**

	Temperature dependence of reaction rates (Arrhenius equation) –significance – temperature coefficient – energy of activation – effect of catalyst – calculation of energy of activation– theories of reaction rates – collision theory of bimolecular gaseous reactions, activated complex theory – comparison of collision theory and activated complex theory. Lindeman's theory of unimolecular reactions.	
III	**Catalysis and Adsorption** Catalysis- characteristics- different types - homogeneous, heterogeneous, acid-base catalysis and auto catalysis-theories of catalysis-intermediate compound formation theory and adsorption theory- kinetics of enzyme catalysis –Michaelis-Menten equation - derivation – applications of catalysis. Adsorption – definition-physisorption and chemisorption – differences - factors influencing adsorption of gases on solids - adsorption isotherms –types - Freundlich and Langmuir monolayer adsorption isotherms, Gibbs adsorption isotherm - BET theory of multilayer adsorption – applications of adsorption . Adsorption indicators.	**15**
IV	**Group theory** Symmetry elements and symmetry operations – definition of identity (E), proper rotational axis (n) – mirror plane (σ) – inversion centre (i) and rotation reflection axis (Sn). Symmetry operations generated by symmetry elements- H_2O, NH_3, BF_3, $[PtCl_4]^{2-}$, H_2O_2 (cis and trans) and CH_4 as examples. Matrix representation of symmetry operations. Comparison of molecular and crystallographic symmetry. Group postulates – abelian and cyclic groups – group multiplication table – molecular point groups – Point group assignment to simple molecules like H_2, HCl, CO, H_2O, NH_3 and CO_2. Determination of point groups.	**15**
V	**Photochemistry** Laws of photo chemistry – Lambert – Beer, Grothus – Draper and Stark – Einstein. Quantum efficiency. Photochemical reactions – rate law – Kinetics of H_2-Cl_2, H_2-Br_2 and H_2-I_2 reactions, comparison between thermal and photochemical reactions. Fluorescence – applications including fluorimetry – sensitised fluorescence, phosphorescence – applications - chemiluminescence and photosensitisation – examples Chemistry of Vision – 11 cis retinal – vitamin A as a precursor - colour perception of vision. (Problems wherever necessary).	**15**
	TOTAL	**75**

Self-study	Theories of catalysis-intermediate compound formation theory and adsorption theory

Textbooks:

1. B.R. Puri and L.R. Sharma, 2021.*Principles of Physical Chemistry*, (48th ed.); Shoban Lal Nagin Chand and Co.
2. Peter Atkins, and Julio de Paula, James Keeler,2018. *Physical Chemistry*, (11th ed.); Oxford University press.

Reference Books:

1. Atkins, P., De Paula, J., 2014. *Physical Chemistry*, (10th ed.); Oxford University Press, Oxford.
2. Bahl, B.S., Tuli, G.D., Bahl, A., 2020. *Essentials of Physical Chemistry*, (24th ed.), S.Chand and Company Limited, India.
3. Keith J. Laidler, 2003. *Chemical Kinetics*, (3rd ed.), Pearson.
4. P. W. Atkins, and Julio de Paula, 2002. *Physical Chemistry*, (7th ed.); Oxford University press.
5. K. L. Kapoor, 2009. *A Textbook of Physical Chemistry*, (3rd ed.), Macmillan India Ltd.

6. B.R. Puri, L.R. Sharma and M.S. Pathania, 2001.*Principles of Physical Chemistry*, (41st ed.) Shobanlal Nagin Chand and Co. Jalendhar.

Web Resources:

1. https://nptel.ac.in
2. https://swayam.gov.in
3. www.epgpathshala.nic.in
4. https://www.vedantu.com/chemistry/photochemical-reactions
5. https://www.int-ads-soc.org/what-is-adsorption

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	2	2	3	3	2	2	2	2	2	2	2
CO2	2	2	2	3	2	2	3	3	3	2	3	2	2	2	2
CO3	3	2	2	3	2	3	3	3	3	3	3	3	2	2	2
CO4	3	2	2	2	2	3	3	3	3	3	3	3	2	2	2
CO5	3	2	2	3	2	2	3	3	3	2	2	2	2	2	2
TOTAL	**14**	**10**	**10**	**15**	**10**	**12**	**15**	**15**	**14**	**12**	**13**	**12**	**10**	**10**	**10**
AVERAGE	**2.8**	**2**	**2**	**3**	**2.8**	**2.4**	**3**	**3**	**2.8**	**2.4**	**2.6**	**2.4**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

CORE LAB COURSE V: PHYSICAL CHEMISTRY PRACTICAL - II

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
CU235CP1	-	-	5	-	4	5	75	-	75	100

Pre-requisite:

Theoretical knowledge on physical chemistry

Learning Objectives:

1. To understand the basic concepts and principles of phase rule, chemical kinetics, molecular weight determination, adsorption and chromatography.
2. To determine the eutectic temperature, concentration, rate constant, molecular weight and adsorption isotherm of compounds.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recall the theoretical concepts of physical chemistry.	**K1**
2.	explain the methodology for determining the physical constants and concentration of compounds.	**K2**
3.	apply the principles of phase rule, chemical kinetics, molecular weight determination, adsorption and chromatographic techniques for various experiments.	**K3**
4.	analyze the composition, rate constant and concentration of unknown solutions.	**K4**
5.	evaluate the physical and chemical parameters of compounds.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** - Evaluate

Contents	No. of Hours
Phase diagrams 1.Determination of eutectic temperature and composition of naphthalene-diphenyl system. 2.Determination of Critical Solution Temperature (CST) of Phenol-Water system and determination of the concentration of the unknown NaCl solution. **Chemical Kinetics** 3..Determination of rate constant of acid catalyzed hydrolysis of an ester (methyl acetate). 4.Determination of order of reaction between iodide and persulphate (initial rate method). 5.Polarimetry: Determination of rate constant of acid catalysed inversion of cane sugar **Molecular weight** 6.Determination of molecular weight by Rast macro method. 7.Determination of molecular weight by transition temperature method **Adsorption** 1.Construction of Freundlich isotherm for the adsorption of aceticacid on activated charcoal 2.Chromatography (Course work) 3.Column chromatography 4.Thin Layer Chromatography	**75**
Total	**75**

Self-study	Theoretical concepts of phase rule, chemical kinetics, molecular weight determination, adsorption and chromatography

Text Books

1. Sindhu, P.S., 2005. *Practicals in Physical Chemistry*, Macmillan India, New Delhi.
2. Thomas, A.O., 1989. *Practical Chemistry for B.Sc Main students*, Scientific book center, Cannanore.

Reference Books

1. Khosla, B.D., Garg, V.C., Gulati, A., 2018. *Senior Practical Physical Chemistry*, (18th ed.), R. Chand and Company. New Delhi.
2. Gupta, R., 2017. *Practical Physical Chemistry*, (1st ed.), New Age International, New Delhi.
3. Yadav, J.B., 2023. *Advanced Practical Physical Chemistry*, Krishna's Educational Publishers, India.
4. Bhattacharyya, K.R., 2016. *Physical Chemistry Practical*, New Academic Publisher, India.
5. Arora, C., Bhattacharya, S., 2022. *Advanced Physical Chemistry Practical Guide*, Bentham Science Publishers, Singapore.

Web Resources

1. https://htv-au.vlabs.ac.in/heat-thermodynamics/Study_of_Phase_Change/
2. https://www.vlab.co.in/ba-nptel-labs-chemical-sciences
3. https://vlab.amrita.edu/index.php?sub=2&brch=190
4. https://www.scribd.com/document/269192528/Experiment-1-Kinetics-study-of-the-hydrolysis-of-methyl-acetate-by-acid-base-titration
5. https://www.youtube.com/watch?v=TUOqYLBA0ew

MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	2	1	1	1	3	3	2	2	2	3	3	3	3
CO2	3	3	2	1	1	1	3	3	3	2	3	3	3	3	3
CO3	3	3	2	1	1	1	3	3	3	3	3	3	3	3	3
CO4	3	3	2	1	1	1	3	3	3	3	3	3	3	3	3
CO5	3	3	2	1	1	1	3	3	3	3	3	3	3	3	3
TOTAL	**15**	**15**	**10**	**5**	**5**	**5**	**15**	**15**	**14**	**13**	**14**	**15**	**15**	**15**	**15**
AVERAGE	**3**	**3**	**2**	**1**	**1**	**1**	**3**	**3**	**2.8**	**2.6**	**2.8**	**3**	**3**	**3**	**3**

3 - Strong, 2- Medium, 1- Low

SEMESTER V
CORE RESEARCH PROJECT

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
CU235RP1	**-**	**-**	**5**	**-**	**4**	**5**	**75**	**25**	**75**	**100**

Guidelines

- All the students must undertake project work at the final year (V semester) as a group (5 students per group).

Distribution of marks for project 25:75

Internal Components

Internal Viva= 15marks
Regularity and Systematic work= 10marks

External Components

Dissertation =30marks
Innovation =15marks
Presentation and Viva =30marks

Project frame work

1. The Project format should be in:
   - Font–Times New Roman
   - Heading–Fontsize14(Bold)– Uppercase
   - Subheadings–Fontsize12(Bold)—Lowercase; should be numbered.(Eg: Introduction 1; Subheading 1.1; 1.2)
   - Text, the content of the dissertation—Font size– 12 (Normal).
   - Linespace–1.5
   - Margin–2"ontheleftand1"ontheright,Gutter–0.5.
   - Page Numbering Bottom middle alignment; excluding initial pages and reference
   - Total number ofpagesMinimum30, Maximum40 (Excluding initial pages and reference).
   - The Tables and Figures should be included subsequently after referring them in the text of the Report.

II. Project Report must be completed within the stipulated time.

III. Submission of Project Report:

- One soft copy (PDF format)
- Hard copy (soft binding) duly signed and endorsed by the Supervisor and the Head.

The Project Report will have three main parts:

I. Initial Pages–in the following sequence

i). Title Page
ii). Certificate from the Supervisor
iii). Declaration by the candidate endorsed by the Supervisor and HOD
iv). Acknowledgement (within one page–signed by the candidate).
v). Table of Contents
vi). List of abbreviations

II. Main body of the dissertation

i) Introduction and Objectives

ii) Methodology
iii) Results
iv) Discussion
v) Summary
vi) References

The guidelines for reference

Journal Article: with Single Author

Waldron, S2008,"GeneralizedWelchboundequality sequences are tight frames", IEEE Transactions on Information Theory, vol.49, no. 9, pp. 2307 – 2309.

Journal Article: with Two Authors

Conley, TG & Galeson, DW 1998,"Nativity and wealth in mid–nineteenth century cities", Journal of Economic History, vol. 58, no.2, pp. 468– 493.

Journal Article: with more than two Authors

Alishahi, K, Marvasti, F, Aref, VA & Pad, P 2009, "Bounds on the sum capacity of synchronous binary CDMA channels", Journal of Chemical Education, vol. 55, no. 8, pp.3577– 3593.

Books

Holt, DH 1997, Management Principles and Practices, Prentice–Hall, Sydney.

Centre for Research, MS University–Ph.D.Revised GuidelinesPage|39/41

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE I: a) INORGANIC CHEMISTRY - I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU235DE1	4	-	-	-	3	4	60	25	75	100

Prerequisites:

Knowledge on basic concepts of Inorganic Chemistry

Learning Objectives:

1. To gain basic knowledge on nomenclature, isomerism, structure and applications of coordination complexes.
2. To recognize the importance of metalloenzymes, inorganic polymers and inner transition elements.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	know the principles, characteristics, classification and applications of coordination chemistry, organometallic compounds, metalloenzymes and inorganic polymers	**K1**
2.	explain the principles, characteristics, classification, and applications of coordination chemistry, organometallic compounds, metalloenzymes and inorganic polymers	**K2**
3.	apply inorganic substances in scientific and industrial contexts.	**K3**
4.	analyze the chemistry and characteristics of coordination compounds, organometallic compounds, metalloenzymes, and inorganic polymers	**K4**
5.	assess properties of inorganic compounds	**K5**

K1 - Remember; **K2 -** Understand; **K3 -** Apply; **K4** - Analyze; **K5** - Evaluate

Unit	Content	No. of hours
I	**Co-ordination Chemistry – I** IUPAC Nomenclature of coordination compounds, Isomerism in coordination compounds. Werner's coordination theory – effective atomic number –interpretation of geometry and magnetic properties by Pauling's theory Chelates – types of ligands forming chelates – stability of chelates, applications of chelates in qualitative and quantitative analysis– application of DMG and oxine in gravimetric analysis –estimation of hardness of water using EDTA, metal ion indicators. Role of metal chelates in living systems – haemoglobin and chlorophyll	**12**
II	**Co-ordination Chemistry – II** Crystal field theory –Crystal field splitting of energy levels in octahedral and tetrahedral complexes, Crystal field stabilization energy (CFSE), spectrochemical series - calculation of CFSE in octahedral and tetrahedral complexes - factors influencing the magnitude of crystal field splitting, crystal field effect on ionic radii, lattice energies, interpretation of magnetic properties, - Jahn – Teller effect. Stability of complexes in aqueous solution, stability constants- factors affecting the stability of a complex ion, thermodynamic and kinetic	**12**

	stability (elementary idea). Comparison of VBT and CFT.	
III	**Organometallic compounds** **Metal Carbonyls :** Mono and polynuclear carbonyls, General methods of preparation and properties of carbonyls - structure and bonding in carbonyls of Ni, Fe, Cr, Co, Mn, Ru and Os. EAN rule as applied to metal carbonyls. Spectroscopic methods of characterization of metal carbonyls. Applications of metal carbonyls in industry and as catalyst. Ferrocene-Methods of preparation, physical and chemical properties.	**12**
IV	**Metallo enzymes** Isomerase and synthetases, structure of cyanocobalamin (Vitamin B12), nature of Co-C bond; Metalloenzymes - functions of carboxy peptidase A, zinc metalloenzyme – mechanism and uses, Zn-Cu enzyme - structure and function, carbonic anhydrase, Vitamin B-12 as transferase and isomerase - Iron-sulphur proteins - 2Fe-2S – rubredoxin, 4Fe-2S – ferridoxin, Iron sulphur cluster enzymes. Invivo and Invitro nitrogen fixation – biological functions of nitrogenase and molybdo enzymes.	**12**
V	**Inorganic polymers** General properties – classification of inorganic polymers based on element in the backbone (Si, S, B and P) - preparation and properties of silicones (polydimethylsiloxane and polymethylhydrosiloxane) phosphorous based polymer (polyphosphazines and polyphophonitrilic chloride), sulphur based polymer (polysulfide and polymeric sulphur nitride), boron based polymers (borazine polymers) – industrial applications of inorganic polymers.	**12**
	TOTAL	**60**

Self Study	General concepts of coordination compounds, advantages of metalloenzymes, electronic configuration of inner transition elements

Textbooks

1. Madan, R.D. Sathya Prakash. 2003. *Modern Inorganic Chemistry*, 2nd ed.; S. Chand and Company, New Delhi.
2. W V Malik, G D Tuli, R D Madan, (2000), *Selected Topics in Inorganic Chemistry,* S. Chand and Company Ltd.

Reference Books

1. Gurudeep Raj, 2001. *Advanced Inorganic* Chemistry*,* 26th ed., Goel Publishing House: Meerut.
2. B.R. Puri, L.R Sharma, K.C. Kalia, Principles of Inorganic Chemistry, Vishal Publishing CO, Jalandhar, third edition, 2023.
3. W V Malik, G D Tuli, R D Madan, (2000), Selected Topics in Inorganic Chemistry, S. Chand and Company Ltd.
4. Gopalan R, (2009) Inorganic Chemistry for Undergraduates, Ist Edition, University Press (India) Private Limited, Hyderabad
5. Peter Atkins, Tina Overton, Jonathan Rourke and Mark Weller, Chemistry, Oxford University Press, sixth edition, 2014.

Web Resources

1. https://onlinecourses.nptel.ac.in
2. http://www.mikeblaber.org/oldwine/chm1045/notes_m.htm
3. http://www.ias.ac.in/initiat/sci_ed/resources/chemistry/Inorganic.html
4. https://swayam.gov.in/course/64-atomic-structure-and-chemical-bonding
5. https://www.chemtube3d.com/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO 1	3	3	2	2	3	3	3	2	2	3	2	2	3	2	3
CO 2	3	3	3	2	2	3	3	3	2	2	3	2	2	3	2
CO 3	3	2	2	2	3	2	2	2	3	2	3	3	3	2	3
CO 4	2	3	2	2	3	2	3	3	2	3	3	2	2	3	3
CO 5	3	3	2	2	3	3	2	3	3	2	2	3	2	3	2
Total	**14**	**14**	**11**	**10**	**14**	**13**	**13**	**13**	**12**	**10**	**13**	**12**	**12**	**13**	**13**
Average	**2.8**	**2.8**	**2.2**	**2**	**2.8**	**2.6**	**2.6**	**2.6**	**2.4**	**2**	**2.6**	**2.4**	**2.4**	**2.6**	**2.6**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE I: b) APPLIED CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU235DE2	4	-	-	-	3	4	60	25	75	100

Pre-requisite:

Knowledge on the applications of various chemicals

Learning Objectives:

1. To understand the fundamental concepts, preparation methods, properties, and applications of industrial chemicals.

2. To learn about the chemical principles and mechanisms involved in lubrication, polymerization, pesticide action, water purification, corrosion prevention and industrial coating techniques.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	recall the basic concepts, types, and mechanisms of lubricants and polymers	**K1**
2	understand the functions, mechanisms, properties, and applications of lubricants and polymers used in various industries.	**K2**
3	classify pesticides based on their use and chemical composition and understand the preparation, structure, and uses of major insecticides, fungicides, and rodenticides..	**K3**
4	analyze water treatment processes, determine water quality parameters, and solve problems related to water softening and boiler troubles in industrial applications.	**K4**
5	compare the action of various drugs design common drugs and interpret their therapeutic uses.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** - Evaluate

Units	Contents	No. of Hours
I	**Lubricants:** Functions of' lubricant, Mechanism of lubrication, Fluid or Hydrodynamic Lubrication, Thin film or Boundary lubrication & Extreme pressure lubrication. Lubricants for Extreme ambient conditions and for special applications. Properties of lubricants and tests. Polymers: Types of Polymerization. Thermoplastics & thermosetting polymers. Preparation, properties and applications of the Polyethylene, Teflon, PVC, Nylon, Phenol formaldehyde & Urea Formaldehyde, Elastomers: Natural rubber, Vulcanization of rubber & Synthetic rubber.	12
II	**Pesticides:** Pesticides - classification based on the use and chemical composition. Insecticides - structure and uses of lead arsenate - calcium arsenate - methoxychlor - baygon - malathion - D.D.T. - BHC. Fungicides - preparation and uses of lime sulphur - bordeaux mixture. Rodenticides - preparation and uses of zinc phosphide - aluminium phosphide - warfarin.	12
III	**Match Industry:** Raw materials - Types of matches - Composition of match head striking surface manufacture of safety matches - Pyrotechnics - Colored matches. Pyrotechnics and explosives, Classification of explosives, Requirements and classification of a good explosives TNT, RDX , Picric acid, Gun powder, Ammonium nitrate.	12
IV	**Water Quality Standards and Treatment Techniques:** Standards for drinking water, Methods of Treatment of water for domestic and industrial purposes:	12

	Sedimentation, Coagulation, Filtration, Sterilization, Break point chlorination. Determination of alkalinity of water, Hardness of water: Units, determination. Demineralization of water. Softening of water: Lime-soda Process, Ion exchange process, Zeolite process. Boiler Troubles: Carry Over, Priming, Foaming, Scale, Sludge, Corrosion, Caustic Embrittlement. Internal treatment of water: Carbonate conditioning, Phosphate conditioning, Colloidal conditioning, Calgon conditioning. Calculations on water softening by Lime-soda process, Zeolite process, determination of alkalinity and hardness of water**.**	
V	**Corrosion and Protective Coatings:** Theories of corrosion: Acid, Direct Chemical attack, Electrochemical, Corrosion reactions, Factors affecting corrosion, Protective measures against corrosion, Sacrificial anode, Impressed current cathode protection. Paints: Constituents, functions & mechanism of drying. Varnishes and Lacquers; surface preparation for metallic coatings, electroplating (gold) and electrodeless plating (Nickel), anodizing, phosphate coating, powder coating & antifouling coating.	**12**
Total		**60**

Self-study	Colloidal conditioning, Direct Chemical attack, Gun powder, Ammonium nitrate and Synthetic rubber.

Textbooks

1. Jain, P.C., Jain, M., 2015. *Engineering Chemistry* (16th ed.), Dhanpat Rai Publishing, India.
2. Dara, S.S., Umare, S.S., 2010. *A Textbook of Engineering Chemistry* (12th ed.), S. Chand & Company Ltd, India.

Reference Books

1. Gowariker, V.R., Viswanathan, N.V., Sreedhar, J., 2012. *Polymer Science* (2nd ed.), New Age International Publishers, India.
2. Braithwaite, E.R., 1996. *Lubrication and Lubricants* (1st ed.), Elsevier Applied Science, UK.
3. Odian, G., 2004. *Principles of Polymerization* (4th ed.), Wiley-Interscience, USA.
4. Katyal, S.K., Mehta, G.C., 2000. *Pesticides: Methods of Their Residues Estimation* (1st ed.), CBS Publishers, India.
5. Garg, S.K., 2017. *Water Supply and Waste Water Engineering* (32nd ed.), Khanna Publishers, India.
6. Roberge, P.R., 2008. *Corrosion Engineering: Principles and Practice* (1st ed.), McGraw Hill, USA.

Web Resources

1. https://www.machinerylubrication.com/Read/30737/lubrication-basics
2. https://www.americanchemistry.com/chemistry-in-america/polymer-science
3. https://www.epa.gov/pesticides
4. https://www.epa.gov/dwreginfo/drinking-water-treatment-technology-unit-cost-models
5. https://www.paint.org/coatings-education/introduction-to-coatings/

MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	2	2	2	2	2	2	3	3	2	2	2	2	3	2	2
CO2	2	2	2	2	2	2	3	3	3	2	3	3	3	2	3
CO3	2	2	2	2	2	2	2	3	3	3	3	3	3	2	2
CO4	2	2	2	2	2	2	2	3	3	3	3	3	3	2	3
CO5	3	2	2	2	2	2	3	3	3	3	3	3	3	2	2
TOTAL	**11**	**10**	**10**	**10**	**10**	**10**	**13**	**15**	**14**	**13**	**14**	**14**	**15**	**10**	**12**
AVERAGE	**2.2**	**2**	**2**	**2**	**2**	**2**	**2.6**	**3**	**2.8**	**2.6**	**2.8**	**2.8**	**3**	**2**	**2.4**

3 - Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE I: c) RUBBER TECHNOLOGY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU235DE3	4	-	-	-	3	4	60	25	75	100

Pre-requisite:

Knowledge on the applications of rubber

Learning Objectives:

1. To understand the preparation and properties of rubber
2. To know the importance of commercial rubber

Course Outcomes

On the successful completion of the course, student will be able to:		
1	understand the principles, techniques, catalysts of rubber technology	**K1**
2	explain the important techniques and directions in the synthesise of rubber	**K2**
3	apply the various method for the preparation of commercial rubber	**K3**
4	synthesize various compounds by suitable methods	**K4**
5	evaluate the importance of rubber technology in day-to-day life	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** - Evaluate

Units	Contents	No. of Hours
I	Importance of rubber, Rubber plants. Types of rubber - Chlorinated, oxygenated rubber and cyclo rubber. Latex - Coagulation of rubber, action of coagulating agents, crude natural rubber. Gutta parcha, Guayule rubber, Balata, Refining of crude rubber.	**12**
II	Raw rubber - drawbacks, Rubber fabrication-calendering, moulding and extruding. Vulcanisation - types - non sulphur vulcanisation, sulphur vulcanisation, techniques of vulcanisation - Properties of vulcanised rubber. Physical properties of rubber, Properties of raw rubber and vulcanised rubber.	**12**
III	Chemical properties of rubber - solvents for natural rubber. Classification of rubber - Synthetic rubber-addition polymerization, condensation polymerisation, Polyisoprene rubber - preparation, Lactoprene - preparation, SBR rubber-manufacture of SBR-hot and cold processes, properties. Neoprene rubber - preparation, properties of neoprene.	**12**
IV	Buna-N rubber- preparation, properties of Buna- N. Butyl rubber- preparation and properties of Butyl rubber, Thiokol rubber - preparation, properties of Thiokol. Silicone rubber -preparation – properties of silicone number, Polyurethane rubber- preparation, properties of urethane rubber. Spandex-preparation, properties and uses. Development of mesoporous supports by liquid crystal templating – neutral templating methods – heterogeneous catalyst – solid supported catalyst.	**12**
V	Reclaimed rubber – properties of reclaimed rubber, Advantages of reclaimed rubber, sponge rubber, Foam rubber-chemical foaming, properties of rubber foam. Laminates- types-ply wood, laminated plastics, laminated glass. Rubber cement, Thermocole. Applications of rubber. Rubber derivatives.	**12**
TOTAL		**60**

Self-study	Properties of raw rubber and vulcanised rubber.

Textbooks

1. Sharma, B.K. 2002, *Industrial Chemistry*, 13th edn. Goel Publishing House, Meerut.
2. James E Mark, 2013, *The Science and Technology of Rubber* (4th edn), Elsevier Academic Press.

References

1. Simpson, R.B. 2017, *Rubber basics* (1st edn.). Sanfoundary publishers.
2. Sharma, B.K 2002, *Polymer Chemistry*, (1st edn.). Goel publishing house, Meerut.
3. Bhatnagar, M.S. 2004, *A text book of Polymers* (1st edn.). S. Chand publishers.
4. Werner Hofmann, 1989, *Rubber Technology Hand Book*, Hanser publishers.
5. John S. Dick, 2020, *Rubber Technology – Compounding and Testing for Performance*, 3rd Edn, Hanser Publication.

Web Resources

1. https://www.youtube.com/watch?v=LEFfXmD0x6w
2. https://www.youtube.com/watch?v=COAUwK4hZK4
3. https://www.youtube.com/watch?v=KV3TBgRN6Bw
4. https://link.springer.com/content/pdf/10.1007/978-1-4615-7823-9_18.pdf
5. https://www.youtube.com/watch?v=tpoS9oBDmrc

MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	2	2	2	3	3	2	2	2	2	3	2	3
CO2	3	2	2	2	2	2	3	3	3	2	3	3	3	2	3
CO3	3	2	2	2	2	2	3	3	3	3	3	3	3	2	3
CO4	3	2	2	2	2	2	3	3	3	3	3	3	3	2	3
CO5	3	2	2	2	2	2	3	3	3	3	3	3	3	2	3
TOTAL	**15**	**10**	**10**	**10**	**10**	**10**	**15**	**15**	**14**	**13**	**14**	**14**	**15**	**10**	**15**
AVERAGE	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2.8**	**2.6**	**2.8**	**2.8**	**3**	**2**	**3**

3 - Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE II: a) INDUSTRIAL CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU235DE4	4	-	-	-	3	4	60	25	75	100

Prerequisites: Knowledge on the articles of day today life.

Learning Objectives

1.To know the classifications and characteristics of fuels and the preparation of cosmetics.

2.To understand the manufacture of sugar, paper, cement and leather and food processing.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	summarize the properties of fuels which include petroleum, water gas, natural gas and propellants	**K1**
2	identify the properties of cosmetic products, soaps and detergents.	**K2**
3	apply the principles behind the manufacture of sugar, food spoilages and food additives	**K3**
4	explain and analyse the properties of abrasives, leather and paper	**K4**
5	evaluate the properties and uses of lubricants and cement	**K5**

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze; K5- Evaluate

Units	Contents	No. of Hours
I	**Fuels** Solid fuels: coal - classification; analysis of coal- proximate analysis and ultimate analysis; calorific value- determination, carbonization of coal. Liquid fuels: Petroleum - characteristics; Gasoline aviation petrol knocking in internal combustion engines, antiknock agents; unleaded petrol-octane number, cetane number. Gaseous fuels: water gas, producer gas - preparations - uses. Natural gas: LPG-composition, advantages, application; gobar gas production, composition, advantages, application.	**12**
II	**Cosmetics** Skin care: ingredients and preparations – powders, creams and lotions- shaving cream and sunscreen. Hair care: shampoos-types, ingredients and preparation. Perfumes: natural-plant origin-parts of the plant used, chief constituents; animal origin - amber gries and musk; synthetic classification esters- amyl salicylate alcohols-citronellol; terpeneols - gereniol and nerol; ketones-muskone, coumarin; aldehydes-vanilin. **Soaps and Detergents** Soaps-properties, manufacture of soap Detergents-definition, properties-cleansing action; anionic, cationic and non-ionic , uses of detergents as surfactants.	**12**
III	**Sugar Industry** Manufacture from sugar cane; recovery of sugar from molasses.Food Preservation and processing- Food spoilage – causes; Food preservation - methods – high temperature, low temperature, drying, radiation; Food additives – preservatives, flavours, colours, anti-oxidants, sweetening agents; hazards of using food additives; Food standards – Agmark and Codex alimentarius.	**12**

IV	**Abrasives** Definition, characteristics, types-natural and synthetic; natural abrasives – diamond, corundum, composition, uses; synthetic abrasives – carborundum, aluminium carbide **Leather Industry** Manufacture of leather – pretanning process – curing, liming, beating, pickling; methods of tanning vegetable **Paper Industry** Manufacture of pulp - mechanical, chemical processes; sulphate pulp, rag pulp; manufacture of paper- beating, refining, filling, sizing, coloring, calendaring; cardboard.	**12**
V	**Lubricants** Definition, classification-liquid, semi-solid, solid and synthetic; properties-viscosity index, flash point, cloud point, pour point, aniline point and drop point; greases-properties, types. **Cement Industry** Cement – types, raw materials; manufacture-wet process, constituent of cement, setting of cement; properties of cement-quality, setting time, soundness, strength; mortar, concrete, RCC; curing and decay of concrete.	**12**
TOTAL		**60**
Self Study	Hazards of using food additives	

Textbooks

1. Sharma, B.K. 1998. *Industrial Chemistry*, (9th ed.); Goel Publishing House: Meerut.
2. Jayashree Ghosh. 2006. *Applied Chemistry*, S. Chand : New Delhi.

Reference Books

1. Jain, P.C.; Jain, M. 1992. *Engineering Chemistry*, (16thed); Dhanapet Rai: Delhi.
2. George Howard. 1987. *Principles and Practice of Perfumes and Cosmetics*, Stanley Therones, Cheltenham: UK.
3. Thankamma Jacob. 1997. *Foods, Drugs and Cosmetics - A Consumer Guide*, Macmillan : London.
4. Shankuntala Manay, N.; Shadaksharaswamy, M. 2008. *Food Facts and Principles*, (3rd ed.), New Age Publication.
5. Wilkinson, J.B.E. Moore, R.J. Harry.1982. *Cosmeticology*, (7th ed.); Chemical Publishers New York.

Web Resources

1. http://www.sciencecases.org/irradiation/irradiation_notes.asp
2. http://discovery.kcpc.usyd.edu.au//9.5.5/
3. https://www.wipo.int/about-ip/en/
4. www.nptel.ac.in
5. http:/swayam.gov.in

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	2	2	3	3	2	2	2	2	2	2	2
CO2	3	2	2	3	2	2	3	3	3	2	3	2	2	2	2
CO3	2	2	2	3	3	2	3	3	3	3	3	3	2	2	2
CO4	3	2	2	3	3	2	3	3	3	3	3	3	2	2	2
CO5	3	2	2	3	2	2	3	3	3	2	2	2	2	2	2
TOTAL	**14**	**10**	**10**	**15**	**12**	**10**	**15**	**15**	**14**	**12**	**13**	**12**	**10**	**10**	**10**
AVERAGE	**2.8**	**2**	**2**	**3**	**2.4**	**2**	**3**	**3**	**2.8**	**2.4**	**2.6**	**2.4**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE II: b) POLYMER CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU235DE5	4	-	-	-	3	4	60	25	75	100

Prerequisites: Knowledge on polymerization and polymers.

Learning Objectives

1. To know about the different types of polymerization reactions.
2. To understand the importance and the biomedical application of polymers.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	recall the general characteristics and types of polymers	**K1**
2	understand the nomenclature, structure, and classification of polymers	**K2**
3	apply the knowledge of polymerization methods to suggest suitable techniques for specific applications.	**K3**
4	compare the properties and applications of various synthetic polymers	**K4**
5	assess the suitability of different polymer types for specific industrial and commercial applications.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Polymer types and types of polymerizations:** Distinction among plastics, elastomers and fibres – nomenclature of polymers – homo and hetero polymers – copolymer – tacticity – isotactic, atactic, syndiotactic polymers. General characteristics of polymers in comparison with common organic compounds. Plastics – thermosetting and thermoplastics – differences. Functionality – cross linking – linear, branched and crosslinked polymers. Types of polymerization – addition, condensation and copolymerization. Mechanism of addition polymerization –initiation, propagation and termination processes. Initiators and inhibitors. Methods of polymerization – bulk, suspension, emulsion and solution polymerization. Block and graft copolymers.	**12**
II	**Synthetic polymers:** Synthesis, properties and applications of phenol-formaldehyde resin, melamine – formaldehyde resin, polyurethanes and epoxy resins. Grades, Curing processes and its importance with mechanisms. Polycarbonates, natural rubber - vulcanization. Synthetic rubber – styrene rubber, nitrile rubber, butyl rubber, polysulphide rubber and neoprene. Synthetic polymers – polyolefins – polyethylene – HDPE, LDPE, LLDPE – polypropylene – polyvinylchloride – grades of PVC – teflon, polymethylmethacrylate (Plexiglass) – polystyrene. Homopolymers, copolymers (SBR, ABS, SAN) – polyester, polyamide – nylon 66, natural polymers – cellulose, starch, silk, wool – cellulose acetate and cellulose nitrate.	**12**
III	**Properties of polymers:** Molecular mass – number average, weight average, viscosity average. Practical significance of molecular mass distribution – size of polymers. Kinetics of polymerization and Carother's equation. Viscosity, solubility, optical, electrical, thermal and mechanical properties of polymers. Degradation of polymers by thermal, oxidative, mechanical, chemical ultrasonic waves, high energy radiation and photodegradation methods.	**12**
IV	**Glass transition Temperature:** Glass transition temperature and crystallinity – factors influencing glass transition temperature – glass transition temperature and molecular weight – glass transition temperature and plasticizers – glass transition temperature of	**12**

	copolymers – glass transition temperature and melting point. Heat distortion temperature, e-determination of glass transition temperature – significance of glass transition temperature. Crystalline solids and their behavior towards X-rays – polymers of X-ray diffraction – degree of crystallinity – crystallisability – polymer crystallization – crystallites – factors affecting crystallinity – Helix structures – spherulites – polymers single crystals – folding of chains during formation – effect of crystallinity on properties of polymers.	
V	**Polymer dissolution and Advances in polymers:** Process of polymer dissolution – thermodynamics of polymer dissolution – general principles – effect of molecular weight on solubility – solubility of crystalline and amorphous polymers. Flory-Huggins theory of polymer solution. Heat of dissolution and solubility parameters. Biomedical applications of polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells. High temperature and fire resistant polymers. Silicones & conducting polymers - poly sulphur nitrite, poly phenylene, poly pyrrole and poly acetylene.	**12**
TOTAL		**60**

Self-Study	General characteristics of polymers in comparison with common organic compounds.

Text Books

1. Bhatnagar, M.S., 2004. *A text book of Polymers*, (1st ed.), New Delhi :S. Chand and Company Ltd.
2. Billmeyer, F.W., 1984. *Textbook of Polymer Science*, (3rd ed.), Wiley.
3. Ghosh, P. 2011. *Polymer Science and Technology: Plastics, Rubbers, Blends, and Composites*, (3rd ed.), Tata McGraw-Hill.
4. Ravve, A. 2012. *Principles of Polymer Chemistry*, (3rd ed.), Springer.

Reference Books

1. Billmeyer, F.W. 1984. *Text book of Polymer Science*, (3rd ed.), John Wiley and Sons.
2. Gowarikar, Viswanathan, N.V & Sreedhar, J. 2015. *Polymer Science*. (2nd ed.), New Age International Publishers.
3. P.K Palanisamy, 2015. *Material Science* (2nd ed.). Chennai : Scitech Publication India, Pvt. Ltd..
4. Odian, G, 2004 . *Principles of Polymerization*, (4th ed.), Wiley.
5. Fried, J.R.,2014. *Polymer Science and Technology*, (3rd ed), Pearson.

Web Resources

1. https://ocw.mit.edu/courses/materials-science-and-engineering/
2. https://polymerdatabase.com/
3. https://polyacs.org/
4. https://nptel.ac.in/courses/113/105/113105028/
5. https://www.sciencedirect.com/journal/polymer

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	2	2	2	3	3	2	2	2	2	3	2	3
CO2	3	2	2	2	2	2	3	3	3	2	3	3	3	2	3
CO3	3	2	2	2	2	2	3	3	3	3	3	3	3	2	3
CO4	3	2	2	2	2	2	3	3	3	3	3	3	3	2	3
CO5	3	2	2	2	2	2	3	3	3	3	3	3	3	2	3
TOTAL	**15**	**10**	**10**	**10**	**10**	**10**	**15**	**15**	**14**	**13**	**14**	**14**	**15**	**10**	**15**
AVERAGE	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2.8**	**2.6**	**2.8**	**2.8**	**3**	**2**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE II: c) BIO CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU235DE6	4	-	-	-	3	4	60	25	75	100

Pre-requisites : Knowledge on basic concepts of Bio - Inorganic Chemistry

Learning objectives :

1. To gain knowledge about the composition, structure and functions of biomolecules.
2. To understand the mechanism of biomolecular reactions.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	know the classification, structure and importance of biomolecules.	**K1**
2.	explain the role of biomolecules in daily life.	**K2**
3.	apply the concepts of biochemistry for the physiological processes and biochemical mechanisms in living organisms.	**K3**
4.	relate the structure of biomolecules with their functions.	**K4**
5.	assess the biochemical processes and their clinical implications in living organisms.	**K5**

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate

Units	Content	No. of hours
I	**Logic of Living Organisms:** Relationship of Biochemistry and Medicine Blood - Composition of Blood, Blood Coagulation – Mechanism. Hemophilia and Sickle Cell Anaemia Maintenance of pH of Blood – Bicarbonate Buffer, Acidosis, Alkalosis.	**12**
II	**Peptides and Proteins Amino acids:** nomenclature, classification – essential and Non- essential; Synthesis - Gabriel Phthalimide, Strecker; properties – zwitter ion and isoelectric point, electrophoresis and reactions. **Peptides** – peptide bond-nomenclature- synthesis of simple peptides-solution and solid phase. Determination of structure of peptides, N- terminal analysis- Sanger's & E Dmann method; C terminal analysis- Enzymatic method. **Proteins** – classification based on composition, functions and structure; properties and reactions – colloidal nature, coagulation, hydrolysis, oxidation, denaturation, renaturation; colour tests for proteins; structure of proteins – primary, secondary, tertiary and quaternary. Metabolism of Amino acids – general aspects of metabolism (a brief outline); urea cycle. Proenzymes, antienzymes, coenzymes and isoenzymes; allosteric enzyme regulation. Vitamins as coenzymes – functions of TPP, lipoic acid, NAD, NADP, FMN, FAD, pyridoxal phosphate, CoA, folic acid, biotin, cyanocobalamin.	**12**
III	**Enzymes and Vitamins:** Nomenclature and classification, charcteristics, factors influencing enzyme activity – mechanism of enzyme action – Lock and Key hypothesis, Koshland's induced fit model. Proenzymes, antienzymes, coenzymes and isoenzymes; allosteric enzyme regulation. Vitamins as coenzymes – functions of TPP, lipoic acid, NAD, NADP, FMN,FAD, pyridoxal phosphate, CoA, folic acid, biotin, cyanocobalamin.	**12**
IV	**Amino acids:** Components of nucleic acids - nitrogenous bases and pentose, sugars, structure of nucleosides and nucleotides, DNA- structure & functions; RNA	**12**

	–types– structure - functions; biosynthesis of proteins **Hormones:** Adrenalin and thyroxine — chemistry, structure and functions (No structure elucidation).	
V	**Lipids:** Occurrence, biological significance of fats, classification of lipids. **Simple lipids** – Oils and fats, chemical composition, properties, reactions – hydrolysis, hydrogenation, trans-esterification, saponification, rancidity; analysis of oils and fats – saponification number, iodine number, acid value, R.M. value. Distinction between animal and vegetable fats. **Compound lipids** – Lipoproteins - VLDL, LDL, HDL, chylomicrons – biological significance. Cholesterol – occurrence, structure, test, physiological activity. Metabolism of lipids: β-oxidation of fatty acids.	**12**
TOTAL		**60**
Self Study	Composition of blood, characteristics of enzymes, functions of harmones	

Textbooks

1. Asim K Dhas, Mahua Das, 2017. Bioinorganic Chemistry, Books and Allied Private Limited.
2. Stephen J Lippard, Jeremy M Berg, 1994. Principles of Bioinorganic Chemistry, Univ Science Books.

Reference Books

1. Uday Kumar, 2012. Chemistry of Enzymes, Global Press, Delhi.
2. Syed Aftab Iqbal, 2013.Synthetic of Proteins, Discovery Publishing House Pvt. Ltd, New Delhi.
3. Srivastava M.L, 2008. Microbial Biochemistry, Narosa Publishing House.
4. Bhutani, 2017. Chemistry of Biomolecules, Ane Books Pvt. Ltd.
5. Bhat S.V, Nagasampagi B.A, Sivakumar M, 2013, Chemistry of Natural Products, Narosa Publishing House.

Web Resources

1. http://labs.icb.ufmg.br/lbcd/prodabi3/integrantes/cibele/lehn01.pdf
2. https://www.sciencedirect.com/science/article/pii/B9780128160619000138
3. https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Basics_of_General_Organic_and_Biological_Chemistry_(Ball_et_al.)/18%3A_Amino_Acids_Proteins_and_Enzymes/18.09%3A_Enzyme_Cofactors_and_Vitamins
4. https://en.wikipedia.org/wiki/Amino_acid
5. https://www.britannica.com/science/lipid

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	3	2	2	3	2	3	2	3	3	2	3	2
CO2	2	3	3	3	2	3	3	3	2	3	3	2	3	3	3
CO3	3	3	3	2	3	2	2	2	2	3	2	2	3	2	2
CO4	2	2	2	2	3	3	3	2	3	2	2	3	2	3	3
CO5	3	3	3	3	2	2	2	3	2	3	3	3	3	2	2
Total	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**3**
Average	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

SEMESTER V

PROFESSIONAL COMPETENCY SKILL I- CAREER SKILLS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG235PS1	1	1	-	-	2	2	30	25	75	100

Pre-requisite: A foundational understanding of the basic communication skills and computer literacy.

Learning Objectives

1. To develop effective communication and interpersonal skills to enhance workplace interactions and teamwork
2. To build job readiness skills such as resume writing, interview techniques, and professional ethics

Course Outcomes

On the successful completion of the course, students will be able to:		
1	**outline** key career skills such as communication, teamwork, and problem-solving	**K1**
2	explain the importance of professional ethics, workplace etiquette, and time management	**K2**
3	demonstrate effective resume writing, interview techniques, and job application strategies	**K3**
4	**a**ssess different workplace scenarios to determine appropriate communication and conflict resolution strategies	**K4**
5	develop a personal career plan with clear goals, skills assessment, and strategies for professional growth	**K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**- Analyse; **K5**- Evaluate

Units	Contents	No. of Hours
I	**Linguistic Skills** Vocabulary, Resume Writing, Report Writing, Technical Writing, Agenda Preparation, Preparing Minutes, E-mail.	**6**
II	**Employability Skills** Social Etiquette, Telephone Etiquette, Interview Skills, Types of Interviews, Mock Interview, Group Discussion.	**6**
III	**Digital Capabilities** Digital Learning, Digital Participation, ICT Proficiency, Creative Production, Digital Identity, Digital well-being	**6**
IV	**Body Language** Defining Body Language, Scope and Relevance, Proxemics, Oculesics, Haptics, Kinesics, Paralanguage, Chronemics, Chromatics and Olfactics	**6**
V	**Coping Mechanisms** Goal Setting, Emotional Intelligence, Team Management, Stress Management, Time Management, Leadership Skills, Problem solving Skills, Decision Making.	**6**
	Total	**30**

Self-study	Basic language skills and communication skills

Textbook

Virgin Nithya Veena. V & Jemi A.R. 2025. *New Age Career Skills*.

Reference Books

1. Herta A. Murphy and Herbert W. Hildebrandt. 1997. *Effective Business Communication*. 7th edition. McGraw- Hill.
2. Jeff Butterfield. 2020. *Soft Skills for Everyone*. Cengage India Pvt. Ltd.
3. Jayaprakash N Satpathy. 2024. *Soft Skills for Career*. Urania Publishing House.
4. S. Xavier Alphonse S. J. 2008. *Change or Be Changed*. ICRDCE. Sri Venkateswara Printers. Chennai.
5. AK. Xavier. 2025. *Employability Skills*. JKP Publications. Madurai.

Web Resources

1. https://exchange.nottingham.ac.uk/content/uploads/Professional-Competencies-Handbook-Sept-2018.pdf
2. https://vpge.stanford.edu/professional-development/competencies-grad-grow
3. https://vpge.stanford.edu/professional-development/competencies-grad-grow
4. https://www.indeed.com/career-advice/resumes-cover-letters/core-competencies-and-skills-valued-by-employers
5. https://resources.hrsg.ca/blog/what-s-the-difference-between-skills-and-competencies

SEMESTER V
INTERNSHIP

Course Code	L	T	P	S	Credits	Inst. Hours	Marks
CU235IS1	-	-	-	-	2	-	100

FRAMEWORK FOR INTERNSHIP

- Preparatory Inputs
- Industrial Visit
- Internship
- Periodic reviews by industry supervisor and faculty guide
- Report Writing
- Viva-voce

Note: Industries allowed – Govt./NGO/MSME/Rural Internship/Innovation / Entrepreneurship / Private Industry.

S.No.	Components	Marks
1	Industry Contribution	50
2	Report & Viva-voce	50

GUIDELINES FOR PREPARING INTERNSHIP REPORT

The training report should be presented in the following format only:

a) The report should be printed in A4 sheets.

b) Text Format in the report:
   - Times New Roman 12 Font size, with 1.5 line spacing.
   - Margins 1.5" left and 1" all other sides of the report.

c) Page numbers should be placed at the bottom middle position.

d) Chapters should be numbered as I, II, III and IV.

e) The tables and charts should be in the format of 1.1, 1.2, etc.

f) The training report should have a minimum of 25 pages and should not exceed 50 pages.

g) Students should submit 2 hard copies of report (department copy + student copy) duly signed by the faculty guide and the HOD.

h) The hard copy should be in bound format with soft binding as the cover page.

i) Students are eligible for training evaluation only if she has completed 25 days of

training.

FORMAT FOR INTERNSHIP REPORT

The report should be bound with pages in the following sequence:

1) Cover page - Outer cover of the report.
2) Front page - The format of cover page and front page should be one and the same.
3) Certificate
4) Company Certificate
5) Declaration
6) Acknowledgement
7) Contents
8) List of Tables if any
9) List of Figures/Charts if any
10) List of Abbreviations, if any
11) Chapter I, II, III and IV
12) Appendices
13) Bibliography

GUIDELINES FOR WRITING ACKNOWLEDGEMENT

The summer training report should contain acknowledgements in the following order:

- Principal & Secretary, College Management
- The Head of the Department
- Faculty guide and Industry supervisor
- Management of the organization in which training was taken up.

GUIDELINES FOR WRITING CHAPTERWISE REPORT

- **Chapter I** of the report should be titled as "**INTRODUCTION**". The Introduction chapter should include Introduction, Importance, Objectives, Scope and Period of the training.
- **Chapter II** of the report should be titled as "**COMPANY PROFILE**".
- **Chapter III** of the report should be titled as "**ACTIVITIES DONE."** The third chapter should cover the objectives of the different departments and its functioning and also the learning outcome.

  Tables and figures in a chapter should be placed in the immediate vicinity of the reference where they are cited.
- **Chapter IV should be titled as "CONCLUSION".** The Conclusion part should include the observations made by the trainee in each department and the extent of fulfillment of training objectives and also reflections.

SEMESTER V

HUMAN RIGHTS, JUSTICE AND ETHICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG235HR1	1	-	-	-	1	1	15	50	50	100

Learning Objectives

1. To identify issues, problems, and violations of human rights.
2. To promote awareness of social justice, equality and human dignity.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	explain human rights principles and the role of the UN, with a focus on human rights issues in India.	**K1, K2**
2.	apply ethical principles in social, national, and professional contexts.	**K3**
3.	analyse social justice issues like untouchability, casteism, and discrimination.	**K4**
4.	examine legal frameworks for women's and child rights in India.	**K4**
5.	assess media's influence on values, digital rights, and consumerism.	**K5**

K1-Remember; **K2** - Understand; **K3** – Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Social Justice:** Concept and need for social justice-Parameters of social justice - Issues: untouchability, casteism, and discrimination	**3**
II	**Foundations of Human Rights:** Concept and principles of human rights- United Nations and Human Rights- Human rights concerns in India	**3**
III	**Women's Rights and Child Rights:** UN and women's rights – major issues -Constitutional and legal provisions for women in India - Child rights in India – Major Issues -legal framework and enforcement	**3**
IV	**Values and social media:** Media Power- Socio, cultural and political consequences of mass mediated culture - New media prospects and challenges - Role of media in value building -Digital Rights and Privacy- Consumerist culture	**3**
V	**Ethics:** Meaning and Importance- Social ethics: Tolerance, equity, justice for all -Nationalism: love for nation, pride for nature- Professional ethics: Dedication to work and duty**.**	**3**
	Total	**15**

Self-study	Mass Media: Effects and Influence on youth and children

Reference Books

1. Baxi, Upendra. 2008 *The Future of Human Rights*. Oxford University Press,.
2. Donnelly, Jack. 2013. *Universal Human Rights in Theory and Practice*. Cornell University Press.
3. Agnes, Flavia. *Law and Gender Inequality: The Politics of Women's Rights in India*. Oxford University Press, 2001.
4. *State of the World's Children 2021*. UNICEF
5. McLuhan, Marshall. *Understanding Media: The Extensions of Man*. MIT Press, 1994.
6. Zuboff, Shoshana. *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power*. PublicAffairs, 2019.
7. Singer, Peter. *Practical Ethics*. Cambridge University Press, 2011.

Web Recourses

1. http://www.oxfordreference.com/views/BOOK_SEARCH.html?book=t286
2. http://globetrotter.berkeley.edu/humanrights/bibliographies/
3. https://libguides.princeton.edu/history/humanrights

SEMESTER VI

CORE COURSE VII: ORGANIC CHEMISTRY - II

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236CC1	6	-	-	-	5	6	90	25	75	100

Pre-requisite:

Knowledge on the preparation and properties of organic compounds.

Learning Objectives:

1. To understand the preparation and properties of alkaloids, terpenes, carbohydrates, organic reagents and mechanism of molecular rearrangement.
2. To apply spectroscopic techniques for the structural elucidation of organic compounds.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	remember the classification and properties of organic compounds	**K1**
2	explain the preparation, properties and basic concepts of natural products, carbohydrates, organic reagents and spectroscopy	**K2**
3	apply the reactions and spectroscopic concepts for the synthesis and characterisation of compounds	**K3**
4	analyse the physical and chemical properties of compounds with synthetic importance	**K4**
5	evaluate the structure and mechanism of natural products, carbohydrates and spectroscopic techniques in organic analyses.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** – Evaluate

Units	Contents	No. of Hours
I	**Alkaloids:** Classification - isolation - general properties and Hofmann exhaustive methylation. Structure elucidation - coniine - piperine and nicotine. **Terpenes:** Classification - Isoprene rule - isolation and structural elucidation of citral - alpha terpineol - menthol - geraniol and camphor.	**18**
II	**Carbohydrates:** Definition - classification - stereochemistry of carbohydrates - D- and L configurations - erythro and threo diastereomers - anomers and epimers. **Monosaccharides**: classification of monosaccharides. Glucose - properties - epimerisation - anomers of glucose and mutarotation. Fructose and its properties. Conversion of aldose to ketose and ketose to aldose - Formation of osazone and glycosides - Fischer open structure - Haworth projection cyclic structures - pyranose and furanose and evidences for cyclic structures of glucose and fructose - Stepping up - Kiliani- Fischer synthesis and stepping down - Ruff degradation of monosaccharides. **Disaccharides**: α- and β- glucosidic linkages - 1,4' and 1,5' linkages - structure and properties of sucrose. **Polysaccharides**: Cellulose and starch - reactions and structure.	**18**
III	**Molecular rearrangements:** Classification of molecular rearrangements. Mechanism and applications of Pinacol-pinacolone - Wagner-Meerwein - dienone-phenol - benzidine - Clasien - Fries - Wolff - Cope - Baeyer-Villiger and benzil-benzilic acid rearrangements.	**18**
IV	**Special reagents in organic synthesis:** Preparation and properties of Azobisisobutyronitrile (AIBN) - 9-Borabicyclo[3.3.1]nonane (9-BBN) - (2,2′-	**18**

	bis(diphenylphosphino)-1,1′-binaphthyl) (BINAP) - tert-butyloxycarbonyl (BOC) - (1,4-diazabicyclo[2.2.2]octane) (DABCO) - dicyclohexylcarbodiimide (DCC) - diisobutylaluminium hydride (DIBAL) - 4-Dimethylaminopyridine (DMAP) - N-bromosuccinimide (NBS) - N-Methyl-2-pyrrolidone (NMP), pyridinium chlorochromate (PCC) and tert-Butyl hydroperoxide (TBHP).	
V	**Spectroscopy II: NMR Spectroscopy:** Basic principle of Proton Magnetic Resonance - chemical shift and factors influencing chemical shift. Significance of number of peaks and peak area. Spin-spin coupling and coupling constant. Interpretation of NMR spectra of simple compounds - ethyl alcohol - benzene - methyl chloride - benzaldehyde and mesitylene. **Mass Spectrometry:** Basic principle - molecular ion peak - base peak - meta stable peak and isotopic peaks. McLafferty rearrangement and Retro Diel's Alder reaction.	**18**
Total		**90**

Self-study	Properties of starch and cellulose. Basic concepts of NMR and mass spectrometry.

Textbooks

1. Jain, M.K., Sharma, S.C., 2016. *Modern Organic Chemistry*, (4th ed.), Vishal Publishers, India
2. Soni, P.L., Chawla, H.M., 2012. *A Text book of Organic chemistry*, (29th ed.), Sultan Chand and Sons, India.

Reference Books

1. Finar, I.L., 2002. *Organic Chemistry: Stereochemistry and Chemistry Natural Products*, Volume 2, (5th ed.), Pearson Education, India.
2. Clayden, J., Greeves, N., Warren, S., 2014. *Organic Chemistry*, (2nd ed.), Oxford University Press, U.S.A.
3. Tewari, N., 2020. *Advanced Organic Chemistry*, (2nd ed.), Books and Allied Private Limited, India.
4. Morrison, R.T., Boyd, R.N., Bhattacharjee, S.K., 2010. *Organic Chemistry*, (9th ed.), Pearson Education, India.
5. Sharma, Y.R. 2009. *Elementary Organic Spectroscopy*. (4th ed), S. Chand Publication.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc23_cy09/preview
2. https://lkouniv.ac.in/site/writereaddata/siteContent/202003291612341624kuaum_yadav_structure_and_properties_of_carbohydrates.
3. https://www.google.com/search?q=claisen+and+fries+rearrangement&sca_esv=2ed3e680b7b247df&rlz=1C1JJTC_
4. https://www.youtube.com/watch?v=yQK1KsueL6M
5. https://www.youtube.com/watch?v=b7hFBnyWxoY
6. https://www.youtube.com/watch?v=6_mBFpyruNQ

MAPPING WITH PROGRAMME OUTCOMES

AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	1	1	1	3	3	2	2	2	2	3	2	3
CO2	3	2	2	1	1	1	3	3	3	2	3	3	3	2	3
CO3	3	2	2	1	1	1	3	3	3	3	3	3	3	2	3
CO4	3	2	2	1	1	1	3	3	3	3	3	3	3	2	3
CO5	3	2	2	1	1	1	3	3	3	3	3	3	3	2	3
TOTAL	**15**	**10**	**10**	**5**	**5**	**5**	**15**	**15**	**14**	**13**	**14**	**14**	**15**	**10**	**15**
AVERAGE	**3**	**2**	**2**	**1**	**1**	**1**	**3**	**3**	**2.8**	**2.6**	**2.8**	**2.8**	**3**	**2**	**3**

3 - Strong, 2- Medium, 1- Low

SEMESTER VI

CORE COURSE VIII: PHYSICAL CHEMISTRY -II

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236CC2	6	-	-	-	5	6	90	25	75	100

Pre-requisite: Knowledge on Physical Chemistry – I

Learning Objectives:

1. To gain a fundamental knowledge on electrochemistry and phase equilibria.
2. To understand the principles and applications of various spectral techniques.

Course Outcomes

On the successful completion of the course, students will be able to:		
1	explain the concepts of conductance, transport number, and factors affecting electrolytic conductance.	**K1**
2	understand the principles of electrochemical cells, electrode potentials and phase diagrams	**K2**
3	apply Woodward-Fieser rules to predict the absorption maxima of conjugated dienes and α, β-unsaturated ketones	**K3**
4	analyze electronic transitions in molecules using UV-Visible spectroscopy and predict spectral properties using Woodward-Fieser rules.	**K4**
5	explain the principles of NMR spectroscopy, including chemical shifts, spin-spin coupling, and structural elucidation of organic compounds	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** – Evaluate

Units	Contents	No. of Hours
I	**Electrochemistry – I:** Definition – conductance, specific conductance, equivalent conductance and molar conductance – factors affecting conductance of a solution. Transport number – determination of transport number by Hittorf's method and moving boundary method-Strong and weak electrolytes–variation of equivalent conductance with dilution. Debye-Huckel theory of strong electrolytes – Debye-Huckel Onsagar equation. Kohlrausch's law and its applications-Applications of conductance measurements – Determination of λ infinity of weak acid and weak base-degree of dissociation of weak electrolytes-solubility and solubility products of sparingly soluble salts and conductometric titrations. (Problems wherever necessary).	18
II	**Electrochemistry – II:** Electrochemical cells –chemical cells – reversible and irreversible cells -EMF of cells – determination. Cell representation. Single electrode potential – types of electrodes – metal- metal ion electrodes, amalgam electrodes, gas electrodes, metal –insoluble metal salt electrodes and oxidation – reduction electrodes. Standard electrode – hydrogen electrode (SHE) and calomel electrode. Nernst equation for electrode potential – Nernst equation for emf of cells – standard electrode potential – electro chemical series – thermodynamics of galvanic cells –ΔG, ΔH and ΔS and equilibrium constant (K). Concentration cells – with transference and without transference – liquid junction potential and its elimination. Applications of EMF measurements –determination of transport number, valency of an ion, pH of a solution using hydrogen, quinhydrone and glass electrode. Potentiometric titrations - acid-base, oxidation – reduction and precipitation titrations. Decomposition potential and overvoltage (Problems wherever necessary).	18
	Phase Equilibria: Concept of phase – components and degrees of freedom (definitions	

III	and examples), derivation of Gibb's phase rule. Phase diagram for one component system – water and sulphur system. Two component system – reduced phase rule – simple eutectic system – lead-silver system – Pattinson's process of de-silverisation of lead-freezing mixtures-KI-H_2O system. Formation of compounds with congruent melting point – zinc-magnesium system and $FeCl_3$-H_2O system. Formation of compounds with incongruent melting points – Na_2SO_4-H_2O system. Solid-gas equilibria – $CuSO_4$-H_2O system. Efflorescence, deliquescence and hygroscopy.	**18**
IV	**Ultraviolet and Visible spectroscopy:** Electronic spectra of diatomic molecules (Born Oppenheimer approximation) - vibrational coarse structure - rotational fine structure of electronic vibration transitions - Frank Condon principle. σ-σ *, π-π*, n-σ*, n- π * transitions. Applications of UV-Woodward - Fieser rules as applied to conjugated. dienes and a, ß - unsaturated ketones. **Infrared spectroscopy:** Vibration spectra diatomic molecules - harmonic oscillator and anharmonic oscillator; Vibration - rotation spectra - diatomic molecule as rigid rotator and anharmonic oscillator (Born-Oppenheimer approximation oscillator) - selection rules, vibrations of polyatomic molecules - stretching and bending vibrations - applications determination of force constant, moment of inertia and internuclear distance - application of IR spectra to simple organic and inorganic molecules (group frequencies).	**18**
V	**Raman and Nuclear magnetic resonance spectroscopy:** Raman Spectroscopy - Rayleigh scattering and Raman scattering of light - Raman shift - classical theory of Raman effect - quantum theory of Raman effect - Vibrational Raman spectrum - selection rules - mutual exclusion principle - instrumentation (block diagram) - applications. Nuclear magnetic resonance spectroscopy- PMR - theory of PMR - instrumentation - number of signals - chemical shift - peak areas and proton counting - spin-spin coupling - applications. Problems related to shielding and deshielding of protons, chemical shifts of protons in hydrocarbons, and in simple monofunctional organic compounds.	**18**
	TOTAL	**90**

Self-study	Efflorescence, deliquescence and hygroscopy.

Textbooks:

1. B.R. Puri and L.R. Sharma, 2021, *Principles of Physical Chemistry*, (48th ed.) Shoban Lal Nagin Chand and Co.
2. Peter Atkins, and Julio de Paula, James Keeler, 2018, *Physical Chemistry*, (11th ed.) Oxford University press.

Reference Books:

1. Atkins, P., De Paula, J., 2014. *Physical Chemistry*, (10th ed.), Oxford University Press,Oxford.
2. Carl H. Hamann, Andrew Hamnett, and Wolf Vielstich, ,2007, *Electrochemistry* , (10th ed.), Wiley.
3. C.N. Banwell and E.M. McCash, 2017, *Fundamentals of Molecular Spectroscopy* (5th edition), McGraw-Hill Education.
4. P.S. Kalsi, 2007, *Spectroscopy of Organic Compounds*, (6th Edition), New Age International Publishers.
5. B.R. Puri, L.R. Sharma and M.S. Pathania, 2001, *Principles of Physical Chemistry*, Shobanlal Nagin Chand and Co.

Web Resources:

1. https://nptel.ac.in
2. https://swayam.gov.in
3. www.epgpathshala.nic.in
4. https://www.khanacademy.org
5. https://pubs.acs.org/journal/jpcafh

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	2	2	3	3	2	2	2	2	2	2	2
CO2	2	2	2	3	2	2	3	3	3	2	3	2	2	2	2
CO3	3	2	2	3	2	3	3	3	3	3	3	3	2	2	2
CO4	3	2	2	2	2	3	3	3	3	3	3	3	2	2	2
CO5	3	2	2	3	2	2	3	3	3	2	2	2	2	2	2
TOTAL	**14**	**10**	**10**	**15**	**10**	**12**	**15**	**15**	**14**	**12**	**13**	**12**	**10**	**10**	**10**
AVERAGE	**2.8**	**2**	**2**	**3**	**2.8**	**2.4**	**3**	**3**	**2.8**	**2.4**	**2.6**	**2.4**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

CORE LAB COURSE V: GRAVIMETRIC ESTIMATION AND SEMI MICRO INORGANIC MIXTURE ANALYSIS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								Internal	External	Total
CU236CP1	-	-	6	-	4	6	90	25	75	100

Pre-requisite:

Basic knowledge of Inorganic Chemistry

Learning Objectives:

1. To understand the principle and basic concepts of gravimetric estimation and semi micro analysis.
2. To analyze the cations and anions present in the chemical compounds.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recall the principles of precipitation, filtration and weighing techniques used in gravimetric analysis.	**K1**
2.	explain the theoretical concepts behind gravimetric estimation and qualitative inorganic analysis.	**K2**
3.	apply gravimetric analysis on different substances and quantify the metal ions using standard procedures.	**K3**
4.	analyze the cations and anions in unknown inorganic mixtures through systematic semi micro analysis.	**K4**
5.	evaluate the accuracy and reliability of gravimetric estimations and qualitative inorganic mixture analysis.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** - Evaluate

Contents	No. of Hours
Gravimetric Analysis 1. Estimation of Lead as Lead Chromate 2. Estimation of Barium as Barium Chromate 3. Estimation of Calcium as Calcium oxalate monohydrate 4. Estimation of Copper as Cuprous thiocyanate - course work 5. Estimation of Nickel as Nickel Dimethyl Glyoximate - course work	**30**
Analysis of an Inorganic mixture containing two anions and two cations. Two anions and two cations may be selected from the following: **Anions** 1. Carbonate 2. Sulphate 3.Nitrate 4. Chloride 5. Oxalate 6. Borate 7.Fluoride 8. Phosphate **Cations** 1. Lead 2. Copper 3.Bismuth 4. Cadmium 5. Manganese 6. Nickel 7. Cobalt 8.Zinc 9. Barium 10. Strontium 11. Calcium 12. Magnesium 13. Ammonium	**60**
TOTAL	**90**

Self-study	Fundamental concepts of precipitation, filtration and weighing techniques.

Text Books

1. Thomas, A.O., 1999. *Practical Chemistry for B.Sc Main students*, Scientific book center, Cannanore.
2. Vogel, I., 1990. *A Text Book for Qualitative Inorganic Analysis*, English Language Book Society and Longmans, New York.

Reference Books

1. Sharma, L.R., 2021. *Practical Inorganic Chemistry*, Evincepub Publishing, India.
2. Gulati, S., Sharma, J.L., Manocha, S., 2019. *Practical Inorganic Chemistry*, CBS Publishers and Distributors Private Limited, India.
3. Pandey, O.P., Bajpai, D.N., Giri, S., 2010. *Practical Chemistry*, S. Chand and Company Limited, New Delhi.
4. Sharma, L.R., 2021. *Chemistry Practical Handbook - Semi-micro Qualitative Inorganic Analysis*, Mayas Publication, India.
5. Svehla, G., 1979. *Vogel's Text Book of Macro and Semimicro Qualitative Inorganic Analysis*, (5^{th} ed.), Longman Group Limited, New York.

Web Resources

1. https://praxilabs.com/en/3d-simulations/test-for-lead-radical-virtual-lab-simulation
2. https://scienceinfo.com/gravimetric-analysis/
3. https://www.labster.com/simulations/demo
4. https://www.youtube.com/watch?v=QV7Y2HP7i4o
5. https://www.ddl.unimi.it/labsim/index_en.htm

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	1	1	1	3	3	2	2	2	3	3	3	3
CO2	3	2	2	1	1	1	3	3	2	2	2	3	3	3	3
CO3	3	2	2	1	1	1	3	3	3	2	2	3	3	3	3
CO4	3	2	2	1	1	1	3	3	3	2	2	3	3	3	3
CO5	3	2	2	1	1	1	3	3	3	2	2	3	3	3	3
TOTAL	**15**	**10**	**10**	**5**	**5**	**5**	**15**	**15**	**13**	**10**	**10**	**15**	**15**	**15**	**15**
AVERAGE	**3**	**2**	**2**	**1**	**1**	**1**	**3**	**3**	**2.6**	**2**	**2**	**3**	**3**	**3**	**3**

3 - Strong, 2- Medium, 1- Low

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE III: a) INORGANIC CHEMISTRY - II

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236DE1	5	-	-	-	3	5	75	25	75	100

Pre-requisite: General Chemistry

Learning Objectives:

1. To know the properties and applications of chemical compounds
2. To analyse the role of elements in biological systems, and the steps in determining errors.

Course Outcomes

On the successful completion of the course, students will be able to:		
6.	identify the role of trace elements, inner transition elements, ionic conductors, silicon compounds and analytical chemistry	**K1**
7.	interpret the properties and uses of trace elements, f block elements, ionic conductors, silicon compounds and analytical chemistry	**K2**
8.	utilize trace elements, f block elements, conducting materials, silicon compounds and error calculations in various fields.	**K3**
9.	analyze the properties of trace elements, f block elements, ionic conductors, silicon compounds and statistical parameters	**K4**
10	assess the applications and properties of elements in biological system, inner transition elements, nanomaterials, silicon compounds and statistical parameters	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyse; **K5** - Evaluate

Units	Contents	No. of Hours
I	**Bioinorganic Chemistry:** Essential and trace elements: Role of sodium, potassium, calcium, magnesium, copper, Iron and Zinc in biological systems. Effect of excess intake (Toxicity) of metal ions- trace elements - As, Cd, Pb, Hg. Metallo proteins-types and functions. Biological functions of myoglobin, haemoglobin-oxygen transport - Bohr effect. Sodium-potassium pump, metal complexes of copper and platinum as therapeutic agents	**15**
II	**Inner transition elements:** Lanthanides and Actinides- Electronic configuration, oxidation states, colour, spectral and magnetic properties. Causes and consequences of lanthanide contraction– *extraction of lanthanides from monazite sand - separation of lanthanides by ion-exchange method* - uses of lanthanides. Comparison between lanthanides and actinides. *Extraction, properties and uses of thorium and uranium.* compounds of uranium-zinc uranyl acetate and uranium hexa fluoride.	**15**
III	**Material Chemistry:** Ionic conductors – sodium, β- alumina, sodium-sulphur battery, Lithium battery. Intercalation – layered compounds – graphitic compounds. Nanophase materials- Introduction - techniques for synthesis of nanophase materials-sol-gel synthesis- electro deposition–properties of nanophase materials-optical and electrical properties–applications of nanophase materials. Superconductors-examples of superconducting oxides – applications of superconducting materials.	**15**
IV	**Compounds of Silicon:** General properties of silicates, structure–types of silicates– ortho silicates(zircon), pyrosilicates (thortveitite), chain silicates(pyroxenes), ring silicates(beryl), sheet silicates(talc, mica, asbestos), silicates having three	**15**

	dimensional structure (feldspars, zeolites, ultramarines). Preparation and uses of silica, silicic acid and silica gel. Silicones -preparation and uses. Silicon carbide-preparation, properties and uses.	
V	**Analytical Chemistry:** Types of errors- determinate and indeterminate errors-minimization of errors. Precision and accuracy in measurements - ways of expressing precision. statistical validation- statistical treatment of finite data -mean, median, Standard deviation- mean deviation – relative mean deviation and coefficient of variance. Accuracy- absolute error- relative error- confidence limit-Rejection of a doubtful value – Q Test-comparison of results-student's t test - F test and related problems. Significant figures - computation rules, Methods for reporting analytical data.	**15**
	TOTAL	**75**

Self-study	Conductors, Compounds of P block elements

Textbooks:

1. Puri, B.R., Sharma, L.R., Kalia, K.C., 2020. *Principles of Inorganic Chemistry*, 31st Edition, Vishal Publishing Co., India.
2. Madan, R.D., 2014. *Modern Inorganic Chemistry*, 13th Edition. Sultan Chand Publishing Limited, India.

Reference Books:

1. Banerjee, S.P. 2017. Advanced Inorganic Chemistry.2nd edition. Arunabha Sen, Books and Allied (P) Ltd., Kolkata.
2. Lee, J.D., 2005. *Concise Inorganic Chemistry*, 5th Edition, Wiley Blackwell Science, U.S.A
3. Skoog, D. A. and. West, D. M. 1996. Fundamental of Analytical Chemistry, 7th Edition, Saunders College Publishing, Philadelphia, Holt, London,
4. Soni, P.L. 2000. Text Book of Inorganic Chemistry,20thedition. Sultan Chand Publishers.
5. Lehninger, Nelson , 2006. Principles of Bio Chemistry, 2nd edition. CBS publishers.

Web Resources:

1. https://www.khanacademy.org/science/ap-chemistry
2. https://study.com/academy/lesson/how-atoms-molecules
3. https://libguides.tulane.edu/c.php?g=182438&p=1202740
4. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry
5. https://en.wikipedia.org/wiki/Nanochemistry

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	2	2	3	3	2	2	2	2	2	2	2
CO2	3	2	2	3	2	2	3	3	3	2	3	2	2	2	2
CO3	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO4	3	2	2	3	2	2	3	3	3	3	3	3	2	2	2
CO5	3	2	2	3	2	2	3	3	3	2	2	2	2	2	2
TOTAL	**15**	**10**	**10**	**15**	**10**	**10**	**15**	**15**	**14**	**12**	**13**	**12**	**10**	**10**	**10**
AVERAGE	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2.8**	**2.4**	**2.6**	**2.4**	**2**	**2**	**2**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE III: b) FUNDAMENTALS OF SPECTROSCOPY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236DE2	5	-	-	-	3	5	75	25	75	100

Pre-requisite:

Basics knowledge in chemistry

Learning Objectives:

1. To understand the principle and instrumentations of various spectroscopic techniques.
2. To apply the spectroscopic concepts and techniques for structural elucidation.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recall the fundamental concepts of electrical and magnetic properties of molecules and the interaction of light with matter.	**K1**
2.	explain the theoretical concepts behind microwave, UV-Visible, IR, Raman, NMR, and mass spectrometry.	**K2**
3.	apply various spectroscopic techniques for elucidating the structure of chemical compounds.	**K3**
4.	analyze the spectral characteristics of molecules by interpreting spectral data from various techniques.	**K4**
5.	evaluate the structure of the compounds using various spectroscopic techniques.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** - Evaluate

Units	Contents	No. of Hours
I	**Electrical and Magnetic properties of molecules:** Dipole moment - polar and non-polar molecules - polarisability of molecules. Application of dipole moments in the study of organic and inorganic molecules. Magnetic permeability - volume susceptibility - mass susceptibility and molar susceptibility. Determination of magnetic susceptibility using Guoy balance - diamagnetism - paramagnetism - ferromagnetism, and anti-ferromagnetism. **Microwave spectroscopy:** Rotation spectra - diatomic molecules (rigid rotator approximation) selection rules - determination of bond length, effect of isotopic substitution -instrumentation and applications.	15
II	**Ultraviolet and Visible spectroscopy:** Electronic spectra of diatomic molecules (Born Oppenheimer approximation) -vibrational coarse structure - rotational fine structure of electronic vibration transitions - Frank Condon principle - dissociation in electronic transitions - Birge Sponer method of evaluation of dissociation energy - pre-dissociation transition -σ-σ*, π-π*, n-σ* and n-π* transitions. Applications of UV - Woodward-Fieser rules to conjugated dienes and α, β-unsaturated ketones. Elementary Problems. Colorimetry - principle and applications (estimation of Fe^{3+})	15
III	**Infra-red spectroscopy:** Vibration spectra - diatomic molecules - harmonic oscillator and anharmonic oscillator. Vibration-rotation spectra - diatomic molecule as rigid rotator and anharmonic oscillator (Born-Oppenheimer approximation oscillator) - selection rules, vibrations of polyatomic molecules - stretching and bending vibrations - applications - Determination of force constant - moment of inertia - internuclear distance and isotopic shift. Applications of IR spectra to simple organic and inorganic molecules. **Raman Spectroscopy:** Rayleigh scattering and Raman scattering of light - Raman shift -	15

	Classical theory of Raman effect - quantum theory of Raman effect - Vibrational Raman spectrum - selection rules - mutual exclusion principle - instrumentation (block diagram) and applications. Analysis of Ayurvedic Bhasma (metallic formulations) - ancient glassmaking techniques and mineral characterization using Raman and IR spectroscopy.	
IV	**Nuclear magnetic resonance spectroscopy:** PMR - theory of PMR - instrumentation - number of signals - chemical shift - peak areas and proton counting - spin-spin coupling - applications. Problems related to shielding and deshielding of protons - chemical shifts of protons in hydrocarbons and simple mono functional organic compounds. Spin-spin splitting of neighbouring protons in vinyl and allyl systems. Spectroscopic evaluation of medicinal plant extracts and traditional formulations using NMR spectroscopy.	**15**
V	**Mass spectrometry:** Principle - different kinds of ionization - instrumentation - types of ions - determination of molecular formula. Fragmentation and structural elucidation. Mc Lafferty rearrangement and Retro Diels Alder reaction. Illustration of mass spectrum of simple organic molecules. Application of mass spectrometry in analyzing traditional medicinal compounds - ancient metallurgical products and organic extracts. Solving structure elucidation problems using multiple spectroscopic data (NMR, MS, IR and UV-Vis).	**15**
	Total	**75**

Self-study	Basic concepts of microwave, UV-Visible, IR, Raman, NMR spectroscopy and mass spectrometry.

Text Books

1. Drago, R.S., 2016. *Physical Methods for Chemists*, (2nd ed.), Affiliated East West Press Private Limited, New Delhi.
2. Mohan, J., 2001. *Organic Spectroscopy Principles and Applications*, Narosa publishing house, India.

Reference Books

1. Sharma, Y.R. 2009. *Elementary Organic Spectroscopy*, (4th ed.), S. Chand Publication. India.
2. Banwell, C.N., McCash, E.M., 2017. *Fundamentals of Molecular Spectroscopy*, (4th ed.), Tata McGraw Hill, New Delhi.
3. Aruldhas, G., 2007. *Molecular Structure and Spectroscopy*, (2nd ed.), Prentice Hall India Learning Private Limited, India.
4. Sharma, B.K., 2011. *Spectroscopy*, (22nd ed.), Goel Publishing House, India.
5. Skoog, D.A., Crouch, S.R., Holler, F.J., West, D.M., 2013. *Fundamentals of Analytical Chemistry*, (9th ed.), Har court college Publishers, USA.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc22_cy10/preview
2. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
3. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==
4. https://microbenotes.com/mass-spectrometry-ms-principle-working-instrumentation-steps-applications/
5. https://www.youtube.com/watch?v=SBir5wUS3Bo

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	1	1	1	2	3	2	2	2	2	3	2	2
CO2	3	2	2	1	1	1	2	3	3	2	2	2	3	2	2
CO3	3	2	3	1	1	1	2	3	3	3	3	3	3	2	3
CO4	3	2	2	1	1	1	2	3	3	3	3	3	3	2	3
CO5	3	2	2	1	1	1	2	3	3	3	3	3	3	2	3
TOTAL	**15**	**10**	**11**	**5**	**5**	**5**	**10**	**15**	**14**	**13**	**13**	**13**	**15**	**10**	**13**
AVERAGE	**3**	**2**	**2.2**	**1**	**1**	**1**	**2**	**3**	**2.8**	**2.6**	**2.6**	**2.6**	**3**	**2**	**2.6**

3 - Strong, 2- Medium, 1- Low

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE III: c) SOIL AND AGRICULTURAL CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236DE3	5	-	-	-	3	5	75	25	75	100

Prerequisites: Knowledge on basic concepts of soil.

Learning objectives:

1. To gain knowledge about the origin, composition and the role of nutrients present in soil.
2. To test the physical properties and composition of soil.

Course Outcome

On the successful completion of the course, student will be able to:		
1	know the origin, properties, composition and methods of testing soil.	**K1**
2	explain the characteristics and methods of testing soil.	**K_2**
3	test the properties and composition of soil.	**K3**
4	relate the composition of soil with their properties.	**K4**
5	assess the nature of soil based on its composition and properties.	**K5**

K1 - Remember**; K2 -** Understand**; K3 -** Apply**; K4 -** Analyze**; K5 -** Evaluate

Unit	Content	No. of Hours
I	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 soils, Industries and agriculture. Major soil groups of Tamilnadu – soil survey and its importance – soil profile study, soil resource management – use of satellite date for source inventory.	**15**
II	Physical properties of soil – soil texture and textual classification – pore space – Bulk density, partied density – soil structure and soil colour – surface area – soil colloids – plasticity – shrinkage – flocculation and deflocculation. Factors affecting soil p^H – soil p^H and nutrient availability.	**15**
III	Origin of problems soils, their properties – acid, alkali and saline soils – Diagnosis – remediation of acid and salt affected soils – soil organism their role – nitrification, denitrification, nitrogen fixation in soils biological nitrogen fixation. Microbial interrelationship in soil – microbes in pest and disease management – Bio-conversion of agricultural wastes.	**12**
IV	Plant nutrients – Macro and Micronutrients 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 requirement of crops, their availability, fixation and release of nutrients.	**15**
V	Soil testing – concept, objectives and basis – soil sampling, tools, collection processing, dispatch of soil and water samples, Determination of available nitrogen, organic matter, potassium and phosphate.	**15**
	TOTAL	**75**
Self Study	Main components of soil, Physical properties of soil, Origin of problems soils	

Text Books

1. Miller C.E. et al., *Fundamentals of soil science,*1990 (4thed.), Arcata Graphics Company.
2. Daji J.A, Kadam J.R, Patil N.D, *A textbook of soil science,* 1980, Imprint Unknown

Reference Books

1. Inamuddin, Mohd Imran Ahamed, Rajender Boddula, Tariq Altalhi, 2021, Applied Soil Science, John Wiley & Sons.
2. D.A. Sankaran, Baver et al. *Series of soil Science and Agricultural chemistry book.*
3. Daniel G. Strawn, Hinrich L Bohn, George A. O.Connor,2019, John Wiley & Sons.
4. Hesse P.R, 2002, A Textbook of Soil Chemical Analysis, CBS Publishers & Distributors Pvt. Ltd.
5. Sodhi G.S, 2005, Fundamental Concepts of Environmental Chemistry, Second Edition, Narosa Publishing House.

Web Resources

1. http://library.med.utah.edu/NetBiochem/nucacids.html
2. http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/E/EnzymeKine tics.html
3. https://swayam.gov.in/courses/4384-biochemistry Biochemistry
4. https://onlinecourses.nptel.ac.in/noc19_cy07/preview Experimental Biochemistry
5. https://ag.umass.edu/greenhouse-floriculture/greenhouse-best-management-practices-bmp-manual/soil-testing

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	1	1	1	2	3	2	2	2	2	3	2	2
CO2	3	2	2	1	1	1	2	3	3	2	2	2	3	2	2
CO3	3	2	3	1	1	1	2	3	3	3	3	3	3	2	3
CO4	3	2	2	1	1	1	2	3	3	3	3	3	3	2	3
CO5	3	2	2	1	1	1	2	3	3	3	3	3	3	2	3
TOTAL	**15**	**10**	**11**	**5**	**5**	**5**	**10**	**15**	**14**	**13**	**13**	**13**	**15**	**10**	**13**
AVERAGE	**3**	**2**	**2.2**	**1**	**1**	**1**	**2**	**3**	**2.8**	**2.6**	**2.6**	**2.6**	**3**	**2**	**2.6**

3 – Strong, 2- Medium, 1- Low

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE IV: a) NANOCHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236DE4	5	-	-	-	3	5	75	25	75	100

Pre-requisite:

Basics knowledge in chemistry

Learning Objectives:

1. To understand the basic concepts, properties and characterization of nanomaterials.
2. To know the preparation and applications of various nanomaterials.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	recall the fundamental concepts, properties, and types of nanomaterials.	**K1**
2	explain the synthesis, characterization techniques, and properties of nanomaterials.	**K2**
3	apply the nanochemical principles to synthesize, modify, and characterize various nanomaterials.	**K3**
4	analyze the structural, optical, electronic, and magnetic properties of different nanomaterials.	**K4**
5	evaluate the synthesis, characterization techniques and applications of nanomaterials in biomedical, electronics, agricultural and industrial fields.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** - Evaluate

Units	Contents	No. of Hours
I	**Introduction to nanochemistry:** Nanoscience - nanoparticles - clusters - quantum dots - nanostructures and nanocomposites. Electron behaviour in free space, bulk material and nanomaterials. Synthesis and stabilization of nanomaterials. Top-down approach(physical methods) - mechanical dispersion - ball milling - ion sputtering - spray pyrolysis - aerosol synthesis and nanolithography. Bottom-up approach (chemical methods) - solvothermal synthesis - photochemical method - gamma radiolysis - sonochemical synthesis - electro deposition and sol-gel method.	**15**
II	**Properties of nanomaterials:** Optical properties - surface plasmon resonance (SPR) - surface enhanced Raman spectra (SERS) - quantum confinement effect and tuning of optical spectrum. Chemical properties - chemical process on the surface of nanoparticles and catalysis. Magnetic properties and supra magnetic properties. Electronic and mechanical properties.	**15**
III	**Characterisation of nanomaterials:** (Principles and block diagram only) Spectroscopy - UV-Visible and photoelectron spectroscopy. Electron microscopy - scanning electron microscopy (SEM) - transmission electron microscopy (TEM) - scanning probe microscopy (SPM) - atomic force microscopy (AFM) - scanning tunneling microscopy (STM) - Optical microscopy - confocal microscopy, X-ray diffraction (XRD).	**15**
IV	**Special nanomaterials:** Carbon nanotubes - introduction - types - zigzag, armchair, helical, synthesis by CVD, Functionalization of Carbon Nanotubes, Reactivity of Carbon Nanotubes, Field emission, Fuel Cells, Display devices. Semiconductor nanoparticles - quantum dots - synthesis and properties. Self-assembled nanomaterials - self-assembled monolayers (SAMS) - inorganic,	**15**

	organic molecules.	
V	**Application of nanomaterials:** Biomedical applications - drug delivery - biolabeling - artificial implants - cancer treatment. Therapeutic applications of Ayurvedic nanoparticles - Swarna Bhasma (gold nanoparticles) - Rajata Bhasma (silver nanoparticles) - Tamra Bhasma (copper nanoparticles) - Lauha Bhasma (iron oxide nanoparticles) and Yashada Bhasma (zinc nanoparticles). Sensors - natural nanoscale sensors - chemical sensors - biosensors and electronic noses.Optics and electronics applications - nanomaterials in the next generation computer technology - high definition TV and flat panel displays Agricultural applications - Fertilizer and pesticides nanomaterials for water purification.Industrial applications - nanomaterials in food and packaging materials and fabric industry.	**15**
TOTAL		**75**

Self-study	Basic concepts of nanochemistry and classification of nanomaterials.

Text Books

1. Puri, N.K., 2021. *Nanomaterials Synthesis, Properties and Applications*, (1st ed.), I.K. International Private Limited, New Delhi.
2. Shah, M.A., Ahmad, T., 2010. *Principles of Nanoscince and Nanotechnology*, Narosa Publishing House, New Delhi.

Reference Books

1. Prasad, S.K., 2008. *Modern Concepts in Nanotechnology*, Discovery Publishing House Private Limited, New Delhi.
2. Salomon, P., 2008. *A Handbook of Nanochemistry*, Dominant Publishers and Distributors, Delhi.
3. Rathi, R., 2009. *Nanotechnology*, S. Chand and Company Limited, New Delhi.
4. Srinivasan, R., 2008. *Nanotechnology for Cancer Therapy*, Cyber Tech Publications, New Delhi.
5. Brecket, A.G., 2008. *A Handbook on Nanotechnology*, Dominant Publishers and Distributors, Delhi.

Web Resources

1. https://ggu.ac.in/gguold/download/Class-Note13/Intriduction%20to%20Nanosc.24.10.13.pdf
2. https://fredrol.folk.ntnu.no/Nanomaterials%20and%20Nanochemistry.pdf
3. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=5VgWkgm+I3FGq9cGlsbNmQ==
4. https://www.nano.gov/about-nanotechnology/applications-nanotechnology
5. https://www.youtube.com/watch?v=UxO-EmNm4KE

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	1	1	1	2	3	2	2	2	2	3	2	2
CO2	3	2	2	1	1	1	2	3	3	2	2	2	3	2	2
CO3	3	2	3	1	1	1	2	3	3	3	3	3	3	2	3
CO4	3	2	2	1	1	1	2	3	3	3	3	3	3	2	3
CO5	3	2	2	1	1	1	2	3	3	3	3	3	3	2	3
TOTAL	**15**	**10**	**11**	**5**	**5**	**5**	**10**	**15**	**14**	**13**	**13**	**13**	**15**	**10**	**13**
AVERAGE	**3**	**2**	**2.2**	**1**	**1**	**1**	**2**	**3**	**2.8**	**2.6**	**2.6**	**2.6**	**3**	**2**	**2.6**

3 - Strong, 2- Medium, 1- Low

SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVE IV: b) PHARMACEUTICAL CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236DE5	5	-	-	-	3	5	75	25	75	100

Pre-requisite:

Knowledge on drugs and their uses.

Learning Objectives:

1. To understand the mechanisms of drug action, metabolism and interactions within the human body.
2. To learn about various diseases, causes, symptoms, and treatment methods using pharmaceutical drugs.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	recall the symptoms common diseases, nature and sources of drugs and treatment methods.	**K1**
2	understand the characteristics, classification and sources of drugs.	**K2**
3	interpret the chemical structure and pharmacological activities of drugs.	**K3**
4	analyze the properties and reactions of organic compounds.	**K4**
5	compare the action of various drugs design common drugs and interpret their therapeutic uses.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** - Evaluate

Units	Contents	No. of Hours
I	**Classification and sources of drugs:** Important terminologies used in pharmaceutical chemistry - pharmacy - pharmacology - pharmacodynamics - pharmacokinetics-pharmacophore -metabolites-antimetabolites – actinomycetes - chemotherapy -pharmacopoeia-pharmacognosy-pharmacotherapeutics. Classification of drugs - drugs acting on central and peripheral nervous system -chemotherapeutic drugs - pharmacodynamic agents. Drugs for metabolic diseases and endocrine function. Nature and sources of drugs- various sources of drugs - drug development - pre-clinical and clinical trials - patenting and legal issues - chemical and process development.	**15**
II	**Drug Design and chemicals in medicine:** Introduction - physical and chemical properties of drugs - designing of drugs - procedures followed - lead component - methods of lead discovery - lead modification. Prodrugs – types – applications - drawbacks - soft drug - advantages. Physical and chemical factors of drug design. Chemical structure and pharmacological activities of drugs. Preparation, properties and uses of alum - aluminum hydroxide gel - phosphoric acid - arsenous anhydride - ferrous fumarate - ferric ammonium citrate - mercury with chalk (Grew powder).	**15**
III	**Indian medicinal plants:** Some important Indian medicinal plants – tulsi, neem, kizhanelli, mango, semparuthi, adadodai, turmeric and thoothuvalai – uses. **Blood and haemotological agents:** Blood– composition, grouping – physiological functions of plasma proteins – mechanism of clotting; Coagulants	**15**

	– vitamin K, protamine sulphate, dry thrombin; Anti coagulants – coumarins, citric acid and heparin; antifibrinolytic agents – aminocaproic acid and tranexamic acid. Anemia– causes, types and control – anti anemic drugs. Blood tests – blood count – complete haemotogram – Hb, RBC, GTT, TC, DC, platelets, PCV, ESR; bleeding and clotting time –- glucose tolerance test	
IV	**Antibiotics:** Definition-classification based on chemical structure and biological action - structure and therapeutic uses of chloramphenicol - Penicillin - Streptomycin - Tetracyclin - Erythromycin. Antiseptics and Disinfectant - distinction between antiseptics and disinfectants. Disinfectant - definition - examples - phenol - preparation and uses - chloroxylenol - structure - properties and uses. Antiseptics - Chloramine T - preparation and uses - crystal violet - structure and uses. **Analgesics and antipyretic agents:** Analgesics - definition - classification - narcotic - non-narcotic - examples - therapeutic uses. Antipyretics - definition - examples - aspirin - methyl salicylate - paracetamol, phenacetin - preparation and therapeutic uses.	**15**
V	**Common diseases and treatment:** Insect born diseases - malaria and filariasis. Airborne diseases – diphtheria - influenza and TB. Waterborne diseases - cholera and typhoid. Blood pressure - definition - factors affecting blood pressure-systolic pressure - diastolic pressure - pulse pressure - blood pressure levels. Hyper tension-types - control antihypertensive agents. Hypotension - measurement. Anemia - symptoms and causes - types – anti-anemic drugs -types. Cardiovascular drugs - cardiac glycosides - cardiovascular action - antiarrhythmic drugs - functions - therapeutic uses. Vasodilators - definition-examples - antianginal drugs - example. Cancer - causes - antineoplastic agents - cis-platin - vinblastine and mustine.	**15**
Total		**75**

Self-study	Preparation of Aspirin and paracetamol, symptoms of anaemia and mechanism of different types of drug action.

Text Books

1. Jayashree Ghosh. S., 2010. *A text book of pharmaceutical chemistry*, (1st ed.), Chand and company, New Delhi.
2. Lakshmi, S., 2012. Pharmaceutical chemistry, (2nd ed.). Sultan Chand publishers.

Reference Books

1. Ashutoshkar, 2010. *Medical Chemistry*, (7th ed.). New age international pvt. Ltd, India.
2. Satoskar, R.S., and Bhandarkar, S.D., 2015. *Pharmacology and Pharmatherapeutics*, (24th ed.), Elsevier publishers.
3. Gurdeep .R. Chatwal., 2009. *Synthetic Drugs*, (3rd ed.). Goel Publishing Company.
4. Chatwal, G.R., 2018. *Pharmaceutical* Chemistry, Inorganic Vol 1, Himalaya Publishing House, India
5. John M. Beale. and John H. Block, 2010, *Textbook of Organic Medicinal and Pharmaceutical Chemistry*, (12th ed.).

Web Resources

1. https://bspublications.net/downloads/0635bb37694844_Ch1_GD%20Gupta_Pharmaceutical%20Chemistry.pdf
2. https://www.slideshare.net/slideshow/pharmaceuticalchemistry2dpharmnotespdf/260411931
3. https://depthofbiology.com/bpharm-notes/2nd-year-notes/semester-4-notes/bp402t-medicinal-chemistry-i-notes/#google_vignette
4. https://depthofbiology.com/bpharm-notes/2nd-year-notes/semester-4-notes/bp402t-medicinal-chemistry-i-

notes/#google_vignette

5. https://www.youtube.com/watch?v=kEqHzmG-oLc&list=PLgYo-rVN9YQ4dmmipyBA2_E1ZQEZSi3an

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2
CO2	2	2	2	2	2	2	3	3	3	2	3	3	3	2	2
CO3	3	2	2	2	2	2	2	2	2	3	3	3	3	2	3
CO4	2	2	2	2	2	2	3	3	3	3	3	3	3	2	3
CO5	3	2	2	2	2	2	3	3	2	3	3	3	3	2	2
TOTAL	**12**	**10**	**10**	**10**	**10**	**10**	**13**	**13**	**12**	**13**	**14**	**14**	**15**	**10**	**12**
AVERAGE	**2.4**	**2**	**2**	**2**	**2**	**2**	**2.6**	**2.6**	**2.4**	**2.6**	**2.8**	**2.8**	**3**	**2**	**2.4**

3 - Strong, 2- Medium, 1- Low

SEMESTER VI
DISCIPLINE SPECIFIC ELECTIVE IV: c) GREEN CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236DE6	5	-	-	-	3	5	75	25	75	100

Pre-requisite:
Basic knowledge on eco friendly synthesis of compounds.

Learning Objectives:
1. To understand the important techniques of green synthesis.
2. To know the green method for organic preparation.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	interpret the principles, techniques, catalysts of green chemistry	**K1**
2	explain the important techniques and directions in practicing green chemistry	**K2**
3	apply the green method for organic synthesis	**K3**
4	synthesize various compounds by microwave and ultrasound assisted methods	**K4**
5	evaluate the importance of Green chemistry in day to day life	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** - Evaluate

Units	Contents	No. of Hours
I	**Introduction to green chemistry:** Definition – need for green chemistry – scope of green chemistry. Concept of atom economy – yield – mass intensity and atom economy. Calculation of atom economy, mass intensity, mass productivity and carbon efficiency. Different types of reactions and atom economy – addition, substitution, elimination and rearrangements. Concept of selectivity – enantioselectivity, chemoselectivity, regioselectivity and diastereoselectivity.	**15**
II	**Basic principles of green chemistry:** Twelve principles of green chemistry – choice of starting materials – biomimitic, multifunctional reagents – materials reagents. Combinatorial green chemistry – Green *Chemistry in sustainable developments. Importance of Green chemistry in day to day life*, versatile bleaching agents and analgesic drugs.	**15**
III	**Green solvents:** Super critical fluids- Introduction – extraction of super critical fluids – solvents of super critical fluid – advantages and applications. Carbondioxide as a super critical fluid – features of technique for using super critical carbondioxide – advantages and application. Chemical reaction in supercritical water and near critical water region. Extraction of natural products, dry cleaning, supercritical polymerization, hydrogenation and hydroformylation. Ionic liquid as green solvent: Introduction – synthesis of ionic liquids– acidic ionic liquid and neutral ionic liquids – applications in organic synthesis.	**15**
IV	**Green catalyst:** Catalysis over view: acid catalyst – basic catalyst- oxidation catalyst- polymer supported catalyst – photosensitized super acid catalyst and Tetra Amido Macrocylic Ligand (TAML) catalyst. *Biocatalyst: microbial oxidation, microbial reduction, enzyme catalyzed hydrolytic process*, per fluorinated catalyst	**15**

	and modified biocatalyst. Development of mesoporous supports by liquid crystal templating – neutral templating methods – heterogeneous catalyst – solid supported catalyst.	
V	**Green synthesis:** Green synthesis of the following compounds – Adipic acid, Catechol, Benzoyl bromide, Acetaldehyde, Citral, Ibuprofen and Paracetamol. Microwave assisted reactions in water – Hoffmann Elimination, hydrolysis of benzyl chloride and methyl benzoate – oxidation of toluene and alcohols. Microwave assisted reactions in organic solvents – esterification, Fries rearrangement, Clasien Rearrangement Diels - Alder Reaction and decarboxylation. Ultra sound assisted reactions – esterification, saponification, alkylation, oxidation, reduction, coupling reactions and Cannizaro reactions.	**15**
TOTAL		**75**

Self-study	Importance of Green chemistry in day to day life, versatile bleaching agents and analgesic drugs.

Textbook

1. Ahluwalia, V.K. & Kidwai, M.R. (2005).*New Trends in Green Chemistry*, Anamalaya Publishers.

Reference books

1. Anastas, P.T. & Warner, J.K. (1998).*Green Chemistry Theory and Practical*, Oxford University Press
2. Matlack, A.S.(2001). *Introduction to Green Chemistry*, Marcel Dekker
3. Lancaster, M. (2010). *Green Chemistry*, (2nded.). *An Introductory Test* RSC Publishing.
4. Ahluwalia V.K &Rajender S. Varma (2009), *Green Solvents for Organic synthesis*, Narosa Publishing House Pvt. Ltd.
5. Ahluwalia V. K and Kidwai M.(2004), New trends in Green Chemistry, Springer Nature links.

Web Resources

1. https://www.youtube.com/watch?v=C0K1XRT1myg&t=25s
2. https://www.youtube.com/watch?v=MfhZVMnyLAM&t=5s
3. https://www.slideshare.net/Santachem/green-chemistry-15990119
4. https://www. https://slideplayer.com/slide/13081363/
5. http://youtube.com/watch?v=p7iCl597qBQ&t=3s

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	2	2	2	3	3	2	2	2	2	3	2	3
CO2	3	2	2	2	2	2	3	3	3	2	3	3	3	2	3
CO3	3	2	2	2	2	2	3	3	3	3	3	3	3	2	3
CO4	3	2	2	2	2	2	3	3	3	3	3	3	3	2	3
CO5	3	2	2	2	2	2	3	3	3	3	3	3	3	2	3
TOTAL	**15**	**10**	**10**	**10**	**10**	**10**	**15**	**15**	**14**	**13**	**14**	**14**	**15**	**10**	**15**
AVERAGE	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2.8**	**2.6**	**2.8**	**2.8**	**3**	**2**	**3**

3 - Strong, 2- Medium, 1- Low

SEMESTER VI
PROFESSIONAL COMPETENCY SKILL II:
ANALYTICAL AND COMPUTATIONAL CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU236PS1	2	-	-	-	2	2	30	25	75	100

Pre-requisite:

Basic knowledge on chromatography, spectroscopy and chemistry softwares

Learning Objectives:

1. To enable students to understand and apply analytical techniques including chromatography and spectroscopy for chemical analysis.
2. To equip students with skills to use chemistry-related software, cheminformatics and sources for research.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	list the definitions and classifications of chromatography, spectroscopy sampling techniques, cheminformatics notations and research types.	**K1**
2	infer the chromatographic principles, sample preparation techniques, research methodologies and software functions.	**K2**
3	use the chromatography techniques, sample preparation protocols and chemistry software tools in lab and documentation work.	**K3**
4	analyze and compare analytical techniques, identify ethical issues and differentiate between molecular representations.	**K4**
5	evaluate tools and methods in spectroscopy, cheminformatics, and research practices for scientific reliability and accuracy.	**K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze: **K5** - Evaluate

Units	Contents	No. of Hours
I	**Chromatography** Chromatography: Definition - classification - plate and rate theories. Paper chromatography: Principle - types and applications. Column chromatography: Principle - experimental technique and applications. Thin layer chromatography: Principle - experimental technique and applications.	**6**
II	**Sampling Techniques in Spectroscopy** UV-Visible spectroscopy: Solution preparation - concentration - dilution and solvent selection. IR spectroscopy: Solid samples - KBr pellet method and Nujol mull technique. Liquid samples: neat liquids and liquid cells. Gas samples: Gas cells. NMR spectroscopy: Sample purity - solvent selection - concentration and volume.	**6**
III	**Research Methodology and Ethics** Source of chemical information - primary - secondary and tertiary sources. Types of research - fundamental *vs*. applied. Data collection and analysis - basic statistics for chemistry. Scientific misconduct - plagiarism and falsification. Ethical considerations in chemistry research and publication.	**6**
IV	**Chemistry Software** Chemdraw: Writing chemical equations and schemes - structure to IUPAC name conversion and vice versa - transporting picture to word and image	**6**

	document. Origin: Importing and exporting data - scientific graphing and data analysis - transporting graph to tag image file format.	
V	**Cheminformatics** Cheminformatics: Definition and applications in drug discovery - materials science and chemical databases. Representing molecules: line notation - Inchi - SMILES and WLN. Query languages - SMARTS. Connection tables and line notation versus connection tables.	**6**
TOTAL		**30**

Self-study	Basics of research and principles in Analytical Techniques

Textbooks:

1. Polanski, J., 2009. *Chemoinformatics*, Elsevier Publications, Poland.
2. Kaur, H., 2014. *Instrumental Methods of Chemical Analysis*, Pragati Prakashan Publishing Ltd., India.

Reference Books:

1. Gasteiger, J. & Engel, T., 2003. *Chemoinformatics*, Wiley, New York.
2. Kaur, H., 2007. *An Introduction to Chromatography* (2nd ed.), Pragati Prakashan Publishing Ltd., India.
3. Christian, G.D., 2007. *Analytical Chemistry* (6th ed.), John Wiley & Sons, New York.
4. Chatwal, G.R. & Anand, S.K., 2002. *Instrumental Methods of Chemical Analysis* (5th ed.), Himalaya Publishing House, India.
5. Marczyk, G., Dematteo, D. & Festinger, D., 2005. *Essentials of Research Design and Methodology*, John Wiley & Sons, New York.

Web Resources:

1. https://www.khanacademy.org/test-prep/mcat/chemical-processes/separations-purifications/a/principles-of-chromatography
2. https://www.niu.edu/clas/chembio/research/analytical-lab/ftir/sample-preparation.shtml
3. https://www.ncbi.nlm.nih.gov/books/NBK214564/
4. https://web.chemdoodle.com/demos/2d-sketcher
5. http://dl.saintgits.org/jspui/bitstream/123456789/1133/1/Research%20Methodology%20C%20R%20Kothari%20%28Eng%29%201.81%20MB.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	2	2	1	3	3	3	3	3	3	2	2	3
CO2	3	2	2	2	2	1	3	3	3	3	3	3	2	3	3
CO3	3	2	2	2	2	2	3	3	3	3	3	3	2	3	3
CO4	3	2	2	2	2	2	2	3	3	3	3	3	3	2	2
CO5	3	2	2	2	2	2	2	3	3	3	3	3	3	2	3
TOTAL	**15**	**10**	**11**	**10**	**10**	**8**	**13**	**15**	**15**	**15**	**15**	**15**	**12**	**12**	**14**
AVERAGE	**3**	**2**	**2.2**	**2**	**2**	**1.6**	**2.6**	**3**	**3**	**3**	**3**	**3**	**2.4**	**2.4**	**2.8**

3 - Strong, 2- Medium, 1- Low

SEMESTER VI

GENDER EQUITY AND INCLUSIVITY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
UG236GE1	1	-	-	-	1	1	15	50	50	100

Learning Objectives

1. To understand the challenges faced by women in the society.
2. To analyze the legitimate rights and laws that aid women to march towards emancipation and empowerment.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	interpret the life struggles of women and to promote equality	K1
2	identify the socio-cultural and religious practices that subjugate women	K2
3	probe deep into the root cause of marginalization of women and to promote an inclusive nature	K3
4	investigate the challenges faced by women in practical life	K4
5	evaluate exploitation of women as commercial commodities in advertisements and media	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate

Unit	Contents	No. of Hours
I	**Life Struggle of a Woman:** Challenges faced by girl students, education and religion, woman and society, working environment.	3
II	**Cultural Traits:** Myths and religious texts, opposition and rebuttal, contemporary literature, cultural decay, opportunities provided by social media.	3
III	**Women's Rights:** Democratic women's association, Laws for women's rights, essential legal rights of girl child in India, gender justice, millennium development goals, Political parties.	3
IV	**Women's Liberation:** Struggle for social rebirth, role of government and NGO's- self-help group for women, Indian political of legal profession and gender representation. the supreme courts efforts, challenging patriarchal narratives, global responsibility, women in sustainable development.	3
V	**Inclusivity:** Equal opportunities for women and men, equal access and opportunities for disabled people, indigenous populations, refugees and migrants - Importance of challenging and redefining gender roles - value and respect towards all gender identities.	3
TOTAL		15

Reference Books

1. Hosoda, M. 2021. Promoting Gender Diversity and Inclusion at Workplace: A Case Study of Japanese Retail and Financial Service Company. Rikkyo University
2. Palo, S., Jha, K. K. 2020. Introduction to Gender. Tata Institute of Social Sciences.
3. Debois, E. and L. Dumenil. 2005. Through Women's Eyes: An American History With Documents. St. Martin Press.
4. Carter, Sarah. Mansell, 1990. Women's Studies: A Guide to Information Sources
5. .Datchana Moorthy Ramu.2020. Gender Equality and Sustainable development Goals,Notion Press.

Web Resources

1. https://en.wikipedia.org/wiki/Women%27s_studies
2. https://libguides.berry.edu/wgs/reference
3. https://www.albany.edu/~dlafonde/women/wssresguide9602
4. https://openbooks.library.umass.edu/introwgss/chapter/references-feminist-movements/
5. https://libguides.niu.edu/womensandgenderstudies/ReferenceSources