

# **MAHENDRA ARTS & SCIENCE COLLEGE**

**(AUTONOMOUS)**

**(Affiliated to Periyar University, Salem)**

**[Accredited by NAAC with “A++” Grade & Recognized u/s 2(f) and 12(B) of the UGC act 1956]**

**KALIPPATTI – 637501.**



**BACHELOR OF SCIENCE**

**SYLLABUS FOR B.Sc. CHEMISTRY**

**OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM**

**FOR THE STUDENTS ADMITTED FROM  
THE ACADEMIC YEAR 2023 – 2024 ONWARDS**

# **MAHENDRA ARTS & SCIENCE COLLEGE**

**(Autonomous)**

**(Affiliated to Periyar University)**

## **DEPARTMENT OF CHEMISTRY**

### **REGULATIONS FOR B.Sc. CHEMISTRY PROGRAMME**

#### **OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM**

**(Effective from the Academic Year 2023-2024)**

#### **I. PREAMBLE**

Chemistry is a fundamental science and has contributed immensely to the improvement of the life of human beings by providing many of human requirements and essentialities. The developments in chemistry during last few decades are phenomenal. It is also seen that these developments are crossing the traditional vertical boundaries of scientific disciplines. New branches of chemistry are emerging and gaining importance, such as bioorganic chemistry, materials chemistry, nano-chemistry, computational chemistry, etc. A chemist cannot isolate himself from other disciplines. Thus a symbiotic interdisciplinary approach now seems to be more relevant. The practice of chemistry over a span of more than a century has also created concomitant and perhaps unavoidable impacts of human environment. The chemical industry is now pressurized from both the government and the society to develop eco-friendly processes and products which will reduce waste and prevent toxic substances from entering the environment. The principles and applications of chemistry should be learnt on this background.

#### **II. GRADUATES ATTRIBUTES**

- **In-depth knowledge and understanding of major concepts:** Understanding of theoretical principles and experimental findings in different sub-areas available in respective disciplines.
- **Creative and Critical thinking:** The capability of using creative and critical thinking in respective areas.
- **Analytical ability:** The ability to analyze issues and problems in all the disciplines.
- **Problem-solving skills:** The capability towards solving problems.
- **Entrepreneur skills:** The inclusion of leadership, business management, time management skills.
- **Communication skills:** The ability to transfer complicated/technical information in a precise manner.
- **Mutual and multidisciplinary competence:** The ability of teamwork in interdisciplinary fields.

- **Digital literacy:** The capability of utilizing modern digital tools to carry out the simulation process.
- **Moral and ethical awareness:** Ability to adopt moral ethics.
- **Social responsibility:** Creating socially responsible citizens.

### III. PROGRAMME EDUCATIONAL OBJECTIVES

- ❖ To learn the applications of chemical agents to provide goods and services for human community by materials processing.
- ❖ To pursue higher education and research in reputed institute at National and International level.
- ❖ To understand the impact of chemistry on basic human needs such as Agriculture, Industry, Medicine, Environment etc.
- ❖ To enrich the knowledge of students on current scenario in chemistry.
- ❖ To work as entrepreneurs and technologist with strong ethics and practical skills.

### IV. PROGRAM OUTCOMES

- ❖ **PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study.
- ❖ **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
- ❖ **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.
- ❖ **PO4: Problem solving Capacity:** To extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.
- ❖ **PO5: Analytical reasoning:** Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.
- ❖ **PO6: Research-related skills:** A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse,

interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.

- ❖ **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.
- ❖ **PO8: Scientific reasoning:** Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.
- ❖ **PO9: Reflective thinking:** Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.
- ❖ **PO10: Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.

## V. PROGRAMME SPECIFIC OUTCOMES

On successful completion of Bachelor of Chemistry with Computer Applications programme, the student should be able to:

- ❖ **PSO1: Disciplinary Knowledge:** Understand the fundamental principles, concepts, and theories related to physics and computer science. Also, exhibit proficiency in performing experiments in the laboratory.
- ❖ **PSO2: Critical Thinking:** Analyze complex problems, evaluate information, synthesize information, apply theoretical concepts to practical situations, identify assumptions and biases, make informed decisions and communicate effectively.
- ❖ **PSO3: Problem Solving:** Employ theoretical concepts and critical reasoning ability with physical, mathematical and technical skills to solve problems, acquire data, analyze their physical significance and explore new design possibilities.
- ❖ **PSO4: Analytical & Scientific Reasoning:** Apply scientific methods, collect and analyse data, test hypotheses, evaluate evidence, apply statistical techniques and use computational models.
- ❖ **PSO5: Research related skills:** Formulate research questions, conduct literature reviews, design and execute research studies, communicate research findings and collaborate in research projects.

## VI. REGULATIONS

These regulations shall take effect from the academic year 2023-2024, i.e., for students who are to be admitted to the first year of the course during the academic year 2023-24 and thereafter.

## **1. Eligibility for Admission**

A candidate who has passed the Higher Secondary Examination of Tamilnadu Higher secondary board or an examination of some other board accepted by the syndicate as equivalent there to with Chemistry and Physics and any one of the following subjects namely Maths, Botany, Zoology or Biology shall be eligible for admission into B.Sc. programme in Chemistry.

## **2. Duration of the Programme**

The candidates shall complete all the courses of the programme in Three years from the date of admission. The programme of study shall consist of six semesters and a total period of three years with a minimum of 140 credits. The programme of study will comprise the course according to the syllabus.

## **3. Programme of Study**

The programme of study for the B.Sc. Chemistry has been divided into the following five categories:

**Part-I** : Tamil / Other Languages.

**Part-II** : English Language.

**Part-III** : Core Courses, Generic & Discipline Specific Elective Courses, and Project with viva-voce.

**Part-IV** : Foundation Course, Skill Enhancement Courses (Non-Major Elective Course), Skill Enhancement Courses (Discipline Specific), Enhancement Compulsory Courses, Professional Competency course and Internship.

**Part-V** : Value added Courses, Extension Activity, etc.

## **4. Extension Activity:**

Every student shall participate compulsorily for period of not less than two years (5 semesters) in any one of the following programmes. NSS/Sports/YRC/Other Extra-curricular and Co-curricular activities (Club/IIC/EDC). The student's performance shall be examined by the staff in-charge of extension activities along with the Head of the respective department and a senior member of the Department on the following parameters.

The marks shall be sent to the Controller of Examinations before the commencement of the final semester examinations.

20% of marks for Regularity of attendance.

60% of marks for Active Participation in classes/camps/games/special Camps/programmes in the college/District/State/University activities.

10% of marks for Exemplary awards/Certificates/Prizes.

10% of marks for other social components such as Blood donations, Fine arts, etc.

The above activities shall be conducted outside the regular working hours of the college. The mark sheet shall carry the gradation relevant to the marks awarded to the candidates.

A - Exemplary - 80 and above

B - Very good - 70-79

C - Good - 60-69

D - Fair - 50-59

E - Satisfactory - 40 – 49

This grading shall be incorporated in the mark sheet to be issued at the end of the semester. (Handicapped students who are unable to participate in any of the above activities shall be required to take a test in the theoretical aspects of any one of the above fields and be graded and certified accordingly).

### **5. Examinations:**

The programme of study shall be based on semester pattern with Internal Assessment under Choice Based Credit System.

The examinations for all the papers consist of both Internal (Continuous Internal Assessment - CIA) and External (End Semester) theory examinations. The theory examinations shall be conducted for three hours duration at the end of each semester. The candidates failing in any subjects(s) will be permitted to reappear for the same in the subsequent semester examinations.

## VII. STRUCTURE OF THE PROGRAMME

### SEMESTER: I

Part	Course Category	Title of the Course	Course Code	Hrs/Week		No. of Credits	Max. Mark		
				L	P		Int.	Ext.	Total
I	LANGUAGE-I	Tamil-I	M23UFTA01	6	-	3	25	75	100
		Hindi-I							
		French-I							
II	LANGUAGE-II	English-I	M23UFEN01	6	-	3	25	75	100
III	CORE-I	General Chemistry-I	M23UCH01	5	-	5	25	75	100
III	GENERIC ELECTIVE-I	Elective -I- Generic Elective - Mathematics-I	M23UMAGE1	3	-	3	25	75	100
		Elective -I- Generic Elective - Biochemistry-I	M23UBCGE1						
III	CORE PRACTICAL-I	Practical-I- Quantitative Inorganic Estimation (titrimetry) and Inorganic Preparation	M23UCHP01	-	3	3	40	60	100
III	GENERIC ELECTIVE PRACTICAL -I	Generic Elective - Practical - I - Mathematics *	M23UMAGEP1	-	3	-	-	-	-
		Generic Elective - Practical - I - Biochemistry*	M23UBCGEP1						
IV	SKILL ENHANCEMENT COURSE	SEC-I-(NME-I)	M23USTN01	2	-	2	25	75	100
IV	FOUNDATION COURSE	Foundation Course in Chemistry	M23UCHFC1	2		2	25	75	100
<b>Total</b>				<b>24</b>	<b>6</b>	<b>21</b>	<b>190</b>	<b>510</b>	<b>700</b>

\* Examination will be held at the end of academic year

**SEMESTER: II**

Part	Course Category	Title of the Course	Course Code	Hrs/Week		No. of Credits	Max. Mark		
				L	P		Int.	Ext.	Total
I	LANGUAGE-I	Tamil-II	M23UFTA02	6	-	3	25	75	100
		French-II Hindi-II							
		French-II							
II	LANGUAGE-II	English-II	M23UFEN02	6	-	3	25	75	100
III	CORE-II	General Chemistry-II	M23UCH02	5	-	5	25	75	100
III	GENERIC ELECTIVE -II	Elective-II – Generic Elective- Mathematics-II	M23UMAGE3	3	-	3	25	75	100
		Elective -II – Generic Elective – Biochemistry- II	M23UBCGE2						
III	CORE PRACTICAL-II	Practical-II – Qualitative Organic Analysis and Preparation of Organic Compounds	M23UCHP02	-	3	3	40	60	100
III	GENERIC ELECTIVE PRACTICAL-I	Generic Elective Practical -I- Mathematics	M23UMAGEP1	-	3	3	40	60	100
		Generic Elective Practical -I- Biochemistry	M23UBCGEP1						
IV	SKILL ENHANCEMENT COURSE	SEC-II (NME-II)	M23USTN03	2	-	2	25	75	100
IV	SKILL ENHANCEMENT COURSE	SEC-III – Cosmetics and Personal Care Products	M23UCHS01	2		2	25	75	100
<b>Total</b>				<b>24</b>	<b>6</b>	<b>24</b>	<b>230</b>	<b>570</b>	<b>800</b>

**SEMESTER: III**

Part	Course Category	Title of the Course	Course Code	Hrs/Week		No. of Credits	Max. Mark		
				L	P		Int.	Ext.	Total
I	LANGUAGE-I	Tamil-III	M23UFTA03	6	-	3	25	75	100
		Hindi-III							
		French-III							
II	LANGUAGE-II	English-III	M23UFEN03	6	-	3	25	75	100
III	CORE-III	General Chemistry-III	M23UCH03	5	-	4	25	75	100
III	GENERIC ELECTIVE-III	Elective-III – Generic Elective - Physics-I	M23UPHGE1	3	-	3	25	75	100
III	CORE PRACTICAL-III	Practical-III - Qualitative Inorganic Analysis	M23UCHP03	-	3	3	40	60	100
III	GENERIC ELECTIVE PRACTICAL-II	Generic Elective - Practical-II- Physics*	M23UPHGEP1	-	3	-	-	-	-
IV	SKILL ENHANCEMENT COURSE	SEC-IV- Entrepreneurial Skills In Chemistry	M23UCHS02	2	-	2	25	75	100
IV	SKILL ENHANCEMENT COURSE	SEC-V-Pesticide Chemistry	M23UCHS03	2		2	25	75	100
<b>Total</b>				<b>24</b>	<b>6</b>	<b>20</b>	<b>190</b>	<b>510</b>	<b>700</b>

\* Examination will be held at the end of academic year.

**SEMESTER: IV**

Part	Course Category	Title of the Course	Course Code	Hrs/Week		No. of Credits	Max. Mark		
				L	P		Int.	Ext.	Total
I	LANGUAGE-I	Tamil-IV	M23UFTA04	6	-	3	25	75	100
		Hindi-IV							
		French-IV							
II	LANGUAGE-II	English-IV	M23UFEN04	6	-	3	25	75	100
III	CORE-IV	General Chemistry-IV	M23UCH04	5	-	4	25	75	100
III	GENERIC ELECTIVE-IV	Elective-IV – Generic Elective - Physics-II	M23UPHGE2	3	-	3	25	75	100
III	CORE PRACTICAL-IV	Practical-IV – Physical Chemistry-I	M23UCHP04	-	3	3	40	60	100
III	GENERIC ELECTIVE PRACTICAL-II	Generic Elective - Practical-II- Physics	M23UPHGEP1	-	3	3	40	60	100
IV	SKILL ENHANCEMENT COURSE	SEC-VI- Instrumental Methods of Chemical Analysis	M23UCHS04	2	-	2	25	75	100
IV	ENHANCEMENT COMPULSORY COURSE	Environmental studies	M23UES01	2	-	2	25	75	100
<b>Total</b>				<b>24</b>	<b>6</b>	<b>23</b>	<b>230</b>	<b>570</b>	<b>800</b>

**SEMESTER: V**

Part	Course Category	Title of the Course	Course Code	Hrs/Week		No. of Credits	Max. Mark		
				L	P		Int.	Ext.	Total
III	CORE-V	Organic Chemistry-I	M23UCH05	5	-	4	25	75	100
III	CORE-VI	Inorganic Chemistry-I	M23UCH06	5	-	4	25	75	100
III	CORE-VII	Physical Chemistry-I	M23UCH07	5		4	25	75	100
III	DISCIPLINE SPECIFIC ELECTIVE-I	Discipline Specific Elective-I - Biochemistry	M23UCHDSE1	5	-	3	25	75	100
		Discipline Specific Elective-I - Nanochemistry	M23UCHDSE2						
		Discipline Specific Elective-I - Corrosion Science	M23UCHDSE3						
	DISCIPLINE SPECIFIC ELECTIVE-II	Discipline Specific Elective-II - Industrial Chemistry	M23UCHDSE4	5		3	25	75	100
		Discipline Specific Elective-II - Material Science	M23UCHDSE5						
		Discipline Specific Elective-II - Water chemistry	M23UCHDSE6						
III	CORE PRACTICAL-V	Practical-V-Physical Chemistry-II	M23UCHP05	-	3	3	40	60	100
IV	ENHANCEMENT COMPULSORY COURSE	Value Education - Yoga	M23UVE01	2	-	2	25	75	100
IV	INTERNSHIP	Internship/Industrial Visit/Field**	M23UCHIS01	-	-	2	40	60	100
<b>Total</b>				<b>27</b>	<b>3</b>	<b>25</b>	<b>230</b>	<b>570</b>	<b>800</b>

\*\* The students should undergo compulsory two weeks internship programs during the IV Semester vacation. The students should submit the report at the end of the V semester.

**SEMESTER: VI**

Part	Course Category	Title of the Course	Course Code	Hrs/Week		No. of Credit	Max. Mark		
				L	P		Int.	Ext.	Total
III	CORE-VIII	Organic Chemistry-II	M23UCH08	5	-	4	25	75	100
III	CORE-IX	Inorganic Chemistry-II	M23UCH09	4	-	4	25	75	100
III	CORE-X	Physical Chemistry-II	M23UCH10	4		4	25	75	100
III	DISCIPLINE SPECIFIC ELECTIVE-III	Discipline Specific Elective-III - Fundamentals of Spectroscopy	M23UCHDSE7						
		Discipline Specific Elective-III – Green Chemistry	M23UCHDSE8	3	-	3	25	75	100
		Discipline Specific Elective-III - Dye and Textile Chemistry	M23UCHDSE9						
	DISCIPLINE SPECIFIC ELECTIVE-IV	Discipline Specific Elective-IV - Pharmaceutical Chemistry	M23UCHDSE10						
		Discipline Specific Elective-IV - Polymer Chemistry	M23UCHDSE11	3		3	25	75	100
		Discipline Specific Elective-IV - Forensic Chemistry	M23UCHDSE12						
III	CORE PRACTICAL-VI	Practical-VI- Gravimetric Estimation	M23UCHP06		5	3	40	60	100
III	PROJECT	Project With Viva-Voce	M23UCHPR1	4		3	40	60	100
IV	PROFESSIONAL COMPETENCY COURSE	Competency Skill in Chemistry	M23UCHPCS1	2	-	2	25	75	100
V	EXTENSION ACTIVITY	Extension Activity	M23UEX01	-	-	1	-	-	-
		<b>Total</b>		<b>25</b>	<b>5</b>	<b>27</b>	<b>230</b>	<b>570</b>	<b>800</b>
		<b>Total</b>		<b>148</b>	<b>32</b>	<b>140</b>	<b>1300</b>	<b>3300</b>	<b>4600</b>

\*The students will gain extra credits for successful completion of online courses from SWAYAM / MOOC/ Approved Online Certification Course.

### Summary of Credits, Hours and Mark Distribution

Part	Course Name	No. of Credits						Total Credits	Total Hours	No. of Courses	Max. Marks
		I	II	III	IV	V	VI				
I	Language-I	3	3	3	3	-	-	12	24	4	400
II	Language-II	3	3	3	3	-	-	12	24	4	400
III	Core	5	5	4	4	12	12	42	48	10	1000
	Core Practical	3	3	3	3	3	3	18	20	6	600
	Discipline Elective	-	-	-	-	6	6	12	16	4	400
	Generic Elective	3	3	3	3	-	-	12	12	4	400
	Generic Elective Practical	-	3	-	3	-	-	6	12	2	200
	Project	-	-	-	-	-	3	3	4	1	100
IV	SEC	2	4	4	2	-	-	12	12	6	600
	Professional Competency Skill	-	-	-	-	-	2	2	2	1	100
	Internship	-	-	-	-	2	-	2	-	1	100
	ECC	-	-	-	2	2	-	4	4	2	200
	Foundation course	2	-	-	-	-	-	2	2	1	100
V	Extension Activities	-	-	-	-	-	1	1	-	-	-
	Additional Credit for Online Courses*		-	-	-	-	-	-	-	-	-
<b>TOTAL</b>		<b>21</b>	<b>24</b>	<b>20</b>	<b>23</b>	<b>25</b>	<b>27</b>	<b>140</b>	<b>180</b>	<b>46</b>	<b>4600</b>

\*The students will gain one extra credit for successful completion of online courses from SWAYAM / MOOC / Approved Online Certification Course.

**GENERIC ELECTIVE SUBJECTS FOR B.Sc. CHEMISTRY STUDENTS**

<b>Semester</b>	<b>Course Title</b>	<b>Course Code</b>
I	Elective-I-Generic Elective-Mathematics-I	M23UMAGE1
	Elective-I-Generic Elective-Biochemistry-I *	M23UBCGE1
II	Elective-II-Generic Elective-Mathematics-II	M23UMAGE3
	Elective-II-Generic Elective-Biochemistry-II *	M23UBCGE2
	Generic Elective-Practical-I-Mathematics	M23UMAGEP1
	Generic Elective-Practical-I-Biochemistry*	M23UBCGEP1
III	Elective-III-Generic Elective-Physics-I	M23UPHGE1
IV	Elective-IV-Generic Elective-Physics-II	M23UPHGE2
	Generic Elective-Practical-II-Physics	M23UPHGEP1

\* For the student not studied mathematics in the qualified examination.

**DISCIPLINE SPECIFIC ELECTIVE SUBJECTS FOR B.Sc. CHEMISTRY STUDENTS**

<b>Semester</b>	<b>Course Title</b>	<b>Course Code</b>
V	Discipline Specific Elective-I - Biochemistry	M23UCHDSE1
	Discipline Specific Elective-I - Nanochemistry	M23UCHDSE2
	Discipline Specific Elective-I - Corrosion Science	M23UCHDSE3
V	Discipline Specific Elective-II - Industrial Chemistry	M23UCHDSE4
	Discipline Specific Elective-II - Material Science	M23UCHDSE5
	Discipline Specific Elective-II - Water chemistry	M23UCHDSE6
VI	Discipline Specific Elective-III - Fundamentals of Spectroscopy	M23UCHDSE7
	Discipline Specific Elective-III - Green Chemistry	M23UCHDSE8
	Discipline Specific Elective-III - Dye and Textile Chemistry	M23UCHDSE9
VI	Discipline Specific Elective-IV - Pharmaceutical Chemistry	M23UCHDSE10
	Discipline Specific Elective-IV - Polymer Chemistry	M23UCHDSE11
	Discipline Specific Elective-IV - Forensic Chemistry	M23UCHDSE12

**SKILL ENHANCEMENT COURSES FOR B.Sc. CHEMISTRY STUDENTS**

<b>Semester</b>	<b>Course Title</b>	<b>Course Code</b>
II	SEC-III-Cosmetics and Personal Care Products	M23UCHS01
III	SEC-IV-Entrepreneurial Skills In Chemistry	M23UCHS02
III	SEC-V-Pesticide Chemistry	M23UCHS03
IV	SEC-VI-Instrumental Methods of Chemical Analysis	M23UCHS04

**ENHANCEMENT COMPULSORY COURSES FOR B.Sc. CHEMISTRY STUDENTS**

<b>Semester</b>	<b>Course Title</b>	<b>Course Code</b>
IV	ECC-I-Environmental studies	M23UES01
V	ECC-II-Value Education – Yoga	M23UVE01

**GENERIC ELECTIVE SUBJECTS OFFERED FOR OTHER MAJOR STUDENTS**

<b>Semester</b>	<b>Course Title</b>	<b>Course Code</b>
III	Elective – III - Generic Elective - Chemistry For Physical Sciences-I	M23UCHGE1
IV	Elective – IV - Generic Elective - Chemistry For Physical Sciences-II	M23UCHGE2
	Generic Elective - Practical-II – Chemistry Practical For Physical and Biological Sciences	M23UCHGEP1

**SEC (NON - MAJOR ELECTIVE COURSES FOR OTHER MAJOR STUDENTS)**

<b>Semester</b>	<b>Course Title</b>	<b>Course Code</b>
I	NME-I-Role Of Chemistry In Daily Life	M23UCHN01
II	NME-II-Dairy Chemistry	M23UCHN02

## VIII. SCHEME OF EXAMINATION

### 1. Question Paper Pattern for Theory Examination

Time: Three Hours

Maximum Marks: 75

Knowledge Level	Sections	Marks	Total Marks	Meaning of K's
<b>K1</b>	<b>Part – A</b> 10 Questions - Objectives type *1 Marks (No Choice)	Two Questions from each unit <b>10</b>	<b>75</b>	K1- Memory Level K2 - Understanding Level K3 - Application Level K4 - Analytical Level
<b>K1, K2</b>	<b>Part – B</b> 5 Questions *2 Marks (No Choice)	One Question from each unit <b>10</b>		
<b>K2, K3</b>	<b>Part – C</b> 5 Questions (either or type) *5 Marks	Two Question from each unit <b>25</b>		
<b>K2, K3, K4</b>	<b>Part – D</b> 3 out of 5 Questions *10 Marks	One Question from each unit <b>30</b>		

### 2. Question Paper Pattern for Practical Examination

Time: Three Hours

Maximum Marks: 60

#### Open Elective with following Scheme

Practical : 55 Marks

Record : 05 Marks

Total : 60 Marks

### 3. Distribution of Marks:

The following are the distribution of marks for external and internal for End Semester Examinations and continuous internal assessment and passing minimum marks for Theory / Practical / Project / Internship courses of B.Sc. Chemistry programme.

ESE	CIA Total	EA Total	Total Marks Allotted	Passing Minimum for EA	Passing Minimum (ESE)
<b>Theory</b>	25	75	100	30	40
<b>Practical</b>	40	60	100	24	40
<b>Project / Internship</b>	40	60	100	24	40

The following are the distribution of marks for the Continuous Internal Assessment in Theory/Practical/Project courses of B.Sc. Chemistry programme.

### **THEORY**

#### EVALUATION OF INTERNAL ASSESSMENT

Test	: 15 Marks
Assignment	: 05 Marks
Attendance	: 05 Marks
	-----
Total	: 25 Marks
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### **PRACTICAL**

#### EVALUATION OF INTERNAL ASSESSMENT

Test	: 20 Marks
Attendance	: 10 Marks
Observation	: 10 Marks
	-----
Total	: 40 Marks
	-----

### **INTERNSHIP/PROJECT**

#### EVALUATION OF INTERNAL ASSESSMENT

Review 1	: 10 Marks
Review 2	: 10 Marks
Review 3	: 10 Marks
Pre-Viva	: 10 Marks
	-----
Total	: 40 Marks
	-----

#### **4. Passing Minimum:**

The Candidates shall be declared to have passed the examination if he/she secures not less than 40 marks in total (CIA mark + Theory Exam mark) with minimum of 30 marks (out of 75 marks) in the End Semester Theory Examinations.

The Candidates shall be declared to have passed the examination if he/she secures not less than 40 marks in total (CIA mark + Practical Exam mark) with minimum of 24 marks (out of 60 marks) in the End Semester Practical Examinations.

## **5. Submission of Record Note Books for Practical Examinations**

Candidates appearing for practical examinations should submit a bonafide record note books prescribed for practical examinations. The candidates failed to submit the record book shall not be permitted to appear for the practical examinations.

## **6. Internship/Project**

### **Internship**

Internship training (Minimum two weeks period) is mandatory for B.Sc. Chemistry programmes during the IV semester vacation period. The Internship training should be valued by an internal examiner; however the Viva-Voce examination should be conducted by the Internal and External examiner/Guide/Teacher concerned.

1. The Internship training Report may consist of minimum of 30 pages.
2. The candidate has to submit the Internship training Report 20 days before the commencement of the V Semester Examinations.

### **Project:**

The following guidelines to be followed for the Project with Viva-voce:

1. The project should be valued for 60 marks by an external examiner; however the Viva-Voce examination should be conducted by both the external examiner appointed by the College and the internal examiner/supervisor/teacher concerned.
2. The Project Report may consist of minimum of 60 pages.
3. The candidate has to submit the Project Report 10 days before the commencement of the VI Semester Examinations.
4. A candidate who fails in the Project/Dissertation or is absent may resubmit the report, on the same topic, with necessary modification/correction/improvements in the subsequent Even Semester Examinations for evaluation and shall undergo viva-voce Examination.

## **IX. NOTE**

### **a) SWAYAM / MOOC – Free Online Course**

SWAYAM/MOOC is an instrument for self-actualization providing opportunities for a life-long learning. Here the student can choose from hundreds of courses, virtually every course taught at the college level, offered by the best teachers in India and elsewhere.

The students can choose an online SWAYAM/MOOC course during their period of study which will earn an extra credit and it will be transferred to the academic records of the students.

### **b) Value Added Courses**

Students are provided with additional courses during their course of study right from the First year. Students are free to choose the courses. On successful completion of each course, the students will gain one extra credit.

## SEMESTER - I

<b>CORE - I</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 5</b>
<b>Course Code: M23UCH01</b>	<b>GENERAL CHEMISTRY-I</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course aims at giving an overall view of the various atomic models and atomic structure, wave particle duality of matter, periodic table, periodicity in properties and its application in explaining the chemical behavior, nature of chemical bonding, and fundamental concepts of organic chemistry.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	State the atomic structure, wave particle duality of matter, periodic properties, bonding, and properties of compounds.	K1
CO2	Classify the elements in the periodic table, types of bonds, reaction intermediates electronic effects in organic compounds and types of reagents.	K2
CO3	Apply the theories of atomic structure, bonding, to calculate energy of a spectral transition, $\Delta x$ , $\Delta p$ electronegativity, percentage ionic character and bond order.	K3
CO4	Examine the relationship existing between electronic configuration, bonding, geometry of molecules and reactions; structure reactivity and electronic effects.	K4
CO5	Sketch the MO diagrams, predict trends in periodic properties, the properties of elements, hybridization in molecules, nature of H - bonding and organic reaction mechanisms.	K3

### UNIT-I: Atomic structure and Periodic Trends

[15 Hours]

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's exclusion principle and Aufbau principle; Numerical problems involving the core concepts.

**UNIT-II: Introduction to Quantum mechanics [15 Hours]**

Classical mechanics, Wave mechanical model of atom, distinction between a Bohr orbit and orbital; Postulates of quantum mechanics; probability interpretation of wave functions, Formulation of Schrodinger wave equation - Probability and electron density - visualizing the orbitals - Probability density and significance of  $\Psi$  and  $\Psi^2$ .

Modern Periodic Table: Cause of periodicity, Features of the periodic table; classification of elements - Periodic trends for atomic size - Atomic radii, Ionic, crystal and Covalent radii; ionization energy, electron affinity, electronegativity - electronegativity scales, applications of electronegativity.

Problems involving the core concepts.

**UNIT-II: Structure and bonding - I [15 Hours]**

Ionic bond: Lewis dot structure of ionic compounds; properties of ionic compounds; Energy involved in ionic compounds; Born Haber cycle - lattice energies, Madelung constant; relative effect of lattice energy and solvation energy; Ion polarization - 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 -  $\sigma$  and  $\pi$  bonds; directed valency - hybridization; VSEPR theory - shapes of molecules of the type  $AB_2$ ,  $AB_3$  and  $AB_4$ . Partial ionic character of covalent bond - dipole moment, application to molecules of the type  $A_2$ ,  $AB$  and  $AB_2$ . Percentage ionic character - numerical problems based on calculation of percentage ionic character.

**UNIT-IV: Structure and bonding - II [15 Hours]**

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 nonbonding orbitals, bond order; MO diagrams of  $H_2$ ,  $O_2$ ,  $O_2^+$ ,  $O_2^-$ ,  $N_2$ ,  $HF$ ,  $CO$ . Magnetic characteristics, comparison of VB and MO theories.

Coordinate bond: Definition, Formation of  $BF_3$ ,  $NH_3$ ,  $NH_4^+$ ,  $H_3O^+$  properties.

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 and its types.

**UNIT-V: Basic concepts in Organic Chemistry and Electronic effects****[15 Hours]**

Types of bond cleavage – heterolytic and homolytic; 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; inductomeric and electromeric effects.

Resonance – resonance energy, conditions for resonance - acidity of phenols, basicity of aromatic amines, stability of carbonium ions, carbanions and free radicals.

Hyperconjugation - stability of alkenes, bond length, orienting effect of methyl group, dipole moment of aldehydes and nitromethane.

**TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Modern Inorganic Chemistry	R.D. Madan and Sathya Prakash	S. Chand and Company, New Delhi	2003
2.	University General Chemistry	C.N.R. Rao	Macmillan Publication, New Delhi	2000
3.	Principles of Physical Chemistry	B.R. Puri and L.R. Sharma	Vishal Publishing Company, Jalandhar	2002
4.	Essential Organic Chemistry	P.Y. Bruce and K.J.R. Prasad	Pearson Education, New Delhi	2008
5.	Textbook of Physical Chemistry	U.N. Dash, O.P. Dharmarha, P.L. Soni	Sultan Chand & Sons, New Delhi	2016

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Principles of Physical Chemistry	S.H. Maron and C.P. Prutton	The Macmillan Company: New York	1972
2.	Concise Inorganic Chemistry	J.D. Lee	ELBS William Heinemann: London	1991

3.	Advanced Inorganic Chemistry	Gurudeep Raj	Goel Publishing House: Meerut	2001
4.	Physical Chemistry	P.W. Atkins & Paula	Oxford University Press: New York	2014
5.	Inorganic Chemistry: Principles of Structure and Reactivity	J.E. Huheey	Addison, Wesley Publishing Company India	1993

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium.

## SEMESTER – I

<b>CORE PRACTICAL - I</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHP01</b>	<b>PRACTICAL - I - QUANTITATIVE INORGANIC ESTIMATION (TITRIMETRY) AND INORGANIC PREPARATIONS</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course aims at providing knowledge on laboratory safety, handling glasswares, quantitative estimation and preparation of inorganic compounds.

### COURSE OUTCOMES

On the successful completion of the course, student will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Identify the basic principles involved in titrimetric analysis and inorganic preparations.	K4
CO2	Compare the methodologies of different titrimetric analysis.	K3
CO3	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

### UNIT-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.

#### **UNIT-II:**

##### **Quantitative Estimation (Volumetric)**

1. Estimation of hydrochloric acid using standard oxalic acid
2. Estimation of sodium hydroxide using standard sodium carbonate

##### **Permanganometry**

1. Estimation of oxalic acid using standard ferrous ammonium sulphate
2. Estimation of ferrous ion using standard oxalic acid

##### **Dichrometry**

1. Estimation of ferric alum using standard dichromate (External indicator)
2. Estimation of ferrous ion using standard ferrous sulphate (Internal indicator- diphenylamine)

##### **Iodometry**

1. Estimation of copper in copper sulphate using standard dichromate

#### **UNIT-III:**

##### **Complexometry**

1. Estimation of Zn and Mg using EDTA
2. Estimation of hardness of water

##### **Estimations**

1. Estimation of iron in iron tablets
2. Estimation of ascorbic acid

##### **Preparation of Inorganic compounds**

1. Potash alum
2. Tetraammine copper(II)sulphate
3. Microcosmic salt
4. Mohr's Salt

#### **TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu	Sultan Chand & Sons, New Delhi	1997
2.	Inorganic Semimicro Qualitative Analysis.	V.V. Ramanujam	National Publishing Co	1971
3.	Practical Chemistry	O.P. Pandey, D.N. Bajpai and S. Giri	S. Chand	2010
4.	Practical Chemistry	Sonia Ratnani, Swati Agarwal and sujeet mishra	Mc Grew Hills	2020

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Vogel's Text Book of Quantitative Inorganic Analysis	J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham	ELBS/Longman, England	1986
2.	Experimental Inorganic Chemistry	W.G. Palmer	Van Nostril and Reinhold Co., London	1972
3.	Vogel's Text Book of Macro and Semimicro Qualitative Inorganic Analysis	G. Svehla	6 <sup>th</sup> edn, Orient Longman	1987
4.	General Practical Chemistry	M.M. Ajaily. A.A. Maihub and R.K. Mohapatra	Central West Publishing	2020
5.	General Chemistry Experiments	Anil J Elias	Universities Press	2008

## SEMESTER - I

<b>FOUNDATION COURSE</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 2</b>
<b>Course Code: M23UCHFC1</b>	<b>FOUNDATION COURSE IN CHEMISTRY</b>	<b>Contact Hours per Week: 2</b>

### OBJECTIVES

To this course aims to make the students to understand the lab safety measures, outline the basic concepts of organic chemistry, the importance of periodic table, the fundamentals of physical properties and the importance of redox chemistry.

### COURSE OUTCOMES

On the successful completion of the course, student will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Identify the safety in chemistry lab.	K1
CO2	Illustrate the molecular formula and IUPAC nomenclature of organic molecule.	K2
CO3	Explain the basic concept of atomic orbitals, shapes of orbitals and electronic configuration of elements.	K3
CO4	Bring out the fundamentals of physical chemistry.	K4
CO5	Calculate the equivalent weight of acids, bases and salts.	K3

### UNIT-I: Chemistry Lab - General Awareness and First Aid Techniques

[6 Hours]

Safety in chemistry lab - introduction to laboratory glass wares - storage and handling of chemicals - carcinogenic chemicals - handling of ethers - toxic and poisonous chemicals.

Burns and damages due to organic substances - acids, alkalies - burns in the eye - inhalation of toxic vapours - hazardous chemicals - dealing with bromine, phenol and hot objects.

### UNIT-II: Introduction to Organic Chemistry

[6 Hours]

Catenation - Classification - Homologous Series - General Molecular Formula - Functional Groups - General and IUPAC Nomenclature - Modern concept of bonding in organic molecules,  $sp^3$ ,  $sp^2$  and  $sp$  hybridization in carbon by taking methane, ethane and benzene as examples.

**UNIT-III: Introduction to Inorganic Chemistry [6 Hours]**

Atomic orbitals and concept of atomic orbitals - shape of s, p and d orbitals - periodic table and the classification of elements - Electronic configuration of elements up to atomic number 30, Types of Chemical bonds - Schematic Illustration of bonds.

**UNIT-IV: Introduction to Physical Chemistry [6 Hours]**

Units - fundamental units - derived units and SI Units - Significant Figures - States of matter - types - properties of solids, liquids and gases - solid state - types of solids - amorphous and crystalline solids - properties of liquids and gases.

**UNIT-V: Basic concepts of redox chemistry [6 Hours]**

Definition - oxidation and reduction reactions - calculation of oxidation numbers - Equivalent weight - definition-calculation of equivalent weight of acids, bases and salts. Reduction potential and electrochemical series.

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Principles of Inorganic Chemistry	B.R. Puri, L.R. Sharma, K.C. Kalia	Milestone Publishers and Distributors, New Delhi, India	2020
2.	A Text Book of Organic Chemistry	Arun Bahl, B.S. Bahl	S. Chand & Co	2019
3.	Principles of Physical Chemistry	B.R. Puri, L.R. Sharma & M.S. Pathania	Vishal Publishing Co	2020
4.	Modern Inorganic Chemistry	R.D. Madan and Sathya Prakash	S. Chand and Company: New Delhi	2003

**REFERENCE BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Organic Chemistry	T.W. Graham Solomons	John Wiley	1992
2.	Concise Inorganic Chemistry	J.D. Lee	ELBS William Heinemann: London	1991

3.	Advanced Inorganic Chemistry	Gurudeep Raj	Goel Publishing House: Meerut	2001
4.	Physical Chemistry	P.W. Atkins & Paula	Oxford University Press: New York	2014

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – II

<b>CORE – II</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 5</b>
<b>Course Code: M23UCH02</b>	<b>GENERAL CHEMISTRY – II</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course aims at providing an overall view of the chemistry of acids, bases and ionic equilibrium, properties of s and p-block elements, chemistry of hydrocarbons, applications of acids and bases, compounds of main block elements and hydrocarbons.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	State the concept of acids, bases and ionic equilibria, periodic properties of s and p block elements, preparation and properties of aliphatic and aromatic hydrocarbons.	K1
CO2	Interpret the periodic properties of s and p-block elements, reactions of aliphatic and aromatic hydrocarbons and strength of acids.	K2
CO3	Classify the hydrocarbons, types of reactions, acids and bases, examine the properties s and p-block elements, reaction mechanisms of aliphatic and aromatic hydrocarbons.	K3
CO4	Elaborate the theories of acids, bases and indicators, buffer action and important compounds of s-block elements.	K4
CO5	Simplify the application of hard and soft acids indicators, buffers, compounds of s and p block elements and hydrocarbons.	K3

### UNIT-I: Acids, bases and Ionic equilibria

[15 Hours]

Concepts of Acids and Bases - Arrhenius concept, Bronsted-Lowry concept, Lewis concept; Relative strengths of acids, bases and dissociation constant; dissociation of poly basic acids, ionic product of water, pH scale, pH of solutions; Degree of dissociation, common ion effect, factors affecting degree of dissociation.

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, weak acids and weak bases - hydrolysis constant, degree of hydrolysis and relation between hydrolysis constant and degree of hydrolysis; Solubility product - determination and applications; numerical problems involving the core concepts.

**UNIT-II: Chemistry of s - Block Elements [15 Hours]**

Hydrogen: Position of hydrogen in the periodic table. Alkali metals: Comparative study of the elements with respect to oxides, hydroxides, halides, carbonates and bicarbonates. Diagonal relationship of Li with Mg. Preparation, properties and uses of NaOH, Na<sub>2</sub>CO<sub>3</sub>, KBr, KClO<sub>3</sub> alkaline earth metals. Anomalous behaviour of Be.

Chemistry of p - Block Elements (Group 13 & 14): Preparation and structure of diborane and borazine. Chemistry of borax. Extraction of Al and its uses. Alloys of Al.

Comparison of carbon with silicon – Carbon-di-sulphide – Preparation, properties, structure and uses - Percarbonates, permonocarbonates and perdicarbonates.

**UNIT-III: Chemistry of p - Block Elements (Group 15-18) [15 Hours]**

General characteristics of elements of Group 15; chemistry of H<sub>2</sub>N-NH<sub>2</sub> and NH<sub>2</sub>OH. Chemistry of PH<sub>3</sub>, PCl<sub>3</sub> and PCl<sub>5</sub> - oxy acids of phosphorous (H<sub>3</sub>PO<sub>3</sub> and H<sub>3</sub>PO<sub>4</sub>).

General properties of elements of group -16 - Structure and allotropy of elements - 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, oxidation states and oxidizing power. Peculiarities of fluorine. Halogen acids (HF, HCl, HBr and HI), oxides and oxy acids (HClO<sub>4</sub>). Inter-halogen compounds (ICl, ClF<sub>3</sub>, BrF<sub>5</sub> and IF<sub>7</sub>).

Noble gases: Position in the periodic table. Preparation, properties and structure of XeF<sub>2</sub>, XeF<sub>4</sub>, XeF<sub>6</sub> and XeOF<sub>4</sub> - uses of noble gases.

**UNIT-IV: Hydrocarbon Chemistry-I [15 Hours]**

Alkenes: Nomenclature, general methods of preparation – Mechanism of β- elimination reactions – E<sub>1</sub> and E<sub>2</sub> mechanism - Hofmann and Saytzeff rules. Reactions of alkenes – addition reactions – mechanisms – Markownikoff's rule, Kharasch effect, oxidation reactions – hydroxylation, epoxidation, ozonolysis.

Alkadienes: Nomenclature - classification – isolated, conjugated and cumulated dienes; stability of conjugated dienes; mechanism of electrophilic addition to conjugated dienes - 1, 2 and 1, 4 additions; free radical addition to conjugated dienes – Diels Alder reactions.

Alkynes: Nomenclature; general methods of preparation, properties

and reactions; acidic nature of terminal alkynes and acetylene, polymerisation and isomerisation.

Cycloalkanes: Nomenclature, Relative stability of cycloalkanes, Bayer's strain theory and its limitations. Conformational analysis of cyclohexane. Geometrical isomerism in cyclohexanes.

#### **UNIT-V: Hydrocarbon Chemistry – II**

**[15 Hours]**

Benzene: Source, structure of benzene, stability of benzene ring, molecular orbital picture of benzene, aromaticity, Huckel's (4n+2) rule and its applications. Electrophilic substitution reactions - General mechanism of aromatic electrophilic substitution - nitration, sulphonation, halogenation, Friedel-Craft's alkylation and acylation.

Polynuclear Aromatic Hydrocarbons: Naphthalene – nomenclature, Haworth synthesis; physical properties, reactions – electrophilic substitution reaction, nitration, sulphonation, halogenation, Friedel – Crafts acylation & alkylation.

Anthracene – synthesis by Elbs reaction, Diels – Alder reaction and Haworth synthesis; physical properties; reactions - Diels-Alder reaction, preferential substitution at C-9 and C-10; uses.

#### **TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Modern Inorganic Chemistry	R.D. Madan and Sathya Prakash	S. Chand and Company, New Delhi	2003
2.	Advanced Inorganic Chemistry	Sathya Prakash, G.D. Tuli, S.K. Basu and R.D. Madan	S. Chand and Company, New Delhi	2003
3.	Advanced Organic Chemistry	B.S. Bahl, Arul Bhal	S. Chand and Company, New Delhi	2003
4.	Text book of Organic Chemistry	K.S. Tewari, S.N. Mehrothra and N.K. Vishnoi	Vikas Publishing House, New Delhi	1998
5.	Principles of Physical Chemistry	B.R. Puri and L.R. Sharma	Vishal Publishing Company, Jalandhar	2002

## REFERENCE BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Principles of Physical Chemistry	S.H. Maron and C.P. Prutton	The Macmillan Company, New York	1972
2.	Physical Chemistry	G.M. Barrow	Tata McGraw Hill, New Delhi	1992
3.	Concise Inorganic Chemistry	J.D. Lee	ELBS William Heinemann, London	1991
4.	Inorganic Chemistry: Principles of Structure and Reactivity	J.E. Huheey	Addison Wesley Publishing Company, India	1993
5.	Advanced Inorganic Chemistry	Gurudeep Raj	Goel Publishing House, Meerut	2003

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	S
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – II

<b>CORE PRACTICAL - II</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHP02</b>	<b>PRACTICAL – II - QUALITATIVE ORGANIC ANALYSIS AND PREPARATION OF ORGANIC COMPOUNDS</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course aims at providing knowledge on laboratory safety, handling glasswares, analysis of organic compounds and preparation of organic compounds.

### COURSE OUTCOMES

On the successful completion of the course, student will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Find the physical state, odour, colour and solubility of the given organic compound.	K3
CO2	Identify the presence of special elements and functional group in an unknown organic compound performing a systematic analysis.	K4
CO3	Analyze the mono and dicarboxylic acids, primary, secondary and tertiary amines, mono and diamides, mono and dihydric phenols, aldehyde and ketone, reducing and non-reducing sugars.	K3

### UNIT-I: (Not for Examination)

Safety rules, symbols and first - aid in chemistry laboratory. Basic ideas about Bunsen burner, its operation and parts of the flame. Chemistry laboratory glassware - basis information and uses.

### UNIT-II: Qualitative Organic Analysis

Preliminary examination, detection of special elements - nitrogen, sulphur and halogens.

Aromatic and aliphatic nature, Test for saturation and unsaturation, identification of functional groups using solubility tests.

Confirmation of functional groups

1. Monocarboxylic acid, Dicarboxylic acid
2. Monohydric phenol, Dihydric phenol
3. Aldehyde, Ketone, Ester
4. Carbohydrate (Reducing and Non-reducing sugars)

5. Primary, Secondary, Tertiary amine
6. Monoamide, Diamide, Thioamide
7. Anilide, Nitro compound
8. Preparation of derivatives for functional groups

### **UNIT-III: Preparation of Organic Compounds**

1. Nitration - Picric acid from Phenol
2. Halogenation - p-Bromo acetanilide from Acetanilide
3. Oxidation - Benzoic acid from Benzaldehyde
4. Methyl benzoate to Benzoic acid
5. Salicylic acid from Methyl Salicylate
6. Hydrolysis of Benzamide to Benzoic Acid

### **Separation and Purification Techniques (Not for Examination)**

1. Purification of organic compounds by crystallization (from water/ alcohol) and distillation.
2. Determination of melting and boiling points of organic compounds.
3. Steam distillation - Extraction of essential oil from citrus fruits/eucalyptus leaves.

### **Chromatography (any one) (Group experiment-Not for Examination)**

1. Separation of amino acids by Paper Chromatography.
2. Thin Layer Chromatography - Mixture of sugars/plant pigments/permanganate dichromate.
3. Column Chromatography - Extraction of Carotene, Chlorophyll and Xanthophyll from leaves /separation of Anthracene - Anthracene picrate.

### **TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Basic Principles of Practical Chemistry	V. Venkateswaran, V. Veeraswamy, R. Kulandaivelu	Sultan Chand: New Delhi	2012
2.	Practical Organic Chemistry	A.K. Manna	Books and Allied: India	2018
3.	Advanced Experimental Chemistry (Organic)	Gurtu J.N. Kapoor	Sultan Chand & sons, New Delhi	1987
4.	Vogel's Textbook of Practical Organic Chemistry	B.S. Furniss, A.J. Hannaford, P.W. Smith and A.R. Tatchell	Pearson: India	1989

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Vogel's Textbook of Quantitative Inorganic Analysis	J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham	ELBS/Longman, England	1986
2.	Experimental Inorganic Chemistry	W.G. Palmer	Van Nostril and Reinhold Co., London	1972
3.	An advanced Course in Practical Inorganic Chemistry	D.N. Grindley	Butterworths	1964
4.	Practical Organic Chemistry	F.G. Mann and B.C. Saunder	Pearson Education India	2009
5.	Vogel's Qualitative Inorganic Analysis	G. Svehla and B. Siva Sankar	Pearson Education India	2012

## SEMESTER - II

<b>SEC - III</b>	<b>B.SC. CHEMISTRY</b>	<b>Credits: 2</b>
<b>Course Code: M23UCHS01</b>	<b>SEC - III - COSMETICS AND PERSONAL CARE PRODUCTS</b>	<b>Contact Hours per Week: 2</b>

### OBJECTIVES

To this course aims at familiarizing the students with formulations of various types of cosmetics like hair, skin, dental care, makeup preparations and personal grooming.

### COURSE OUTCOMES

On the successful completion of the course, student will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Find the composition of various cosmetic products.	K1
CO2	Express the chemical aspects and applications of hair care, dental care and skin care products.	K2
CO3	Examine the chemical aspects and applications of perfumes and skin care products.	K3
CO4	Identify the methods of beauty treatments their advantages and disadvantages.	K4
CO5	Summarize the hazards of cosmetic products.	K2

#### UNIT-I: Skin care

[6 Hours]

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.

#### UNIT-II: Hair care and Dental care

[6 Hours]

Shampoos - types - powder, cream, liquid, gel - ingredients; conditioner - types - ingredients.

Dental care: Tooth pastes - ingredients - mouth wash.

#### UNIT-III: Make up

[6 Hours]

Base - foundation - types - ingredients; lipstick, eyeliner, mascara, eyeshadow, concealers, rouges.

#### UNIT-IV: Perfumes

[6 Hours]

Classification - Natural - plant origin - parts of the plant used, chief constituents; animal origin - amber gries from whale, civetone from civet

cat, musk from musk deer; synthetic - classification emphasizing characteristics - esters - alcohols - aldehydes - ketones.

**UNIT-V: Beauty treatments**

**[6 Hours]**

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.

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	The textbook of Cosmetic Sciences	N.G. Raghavendra Rao	JEC Publication	2023
2.	Text Book on Cosmetology	Arlene Alpert	Milady Publishing	2001
3.	Discovering Cosmetic Science	Stephen Barton	Royal Society Publisher	2020

**REFERENCE BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Harry's Cosmeticology	J.B.E. Wilkinson and R.J Moore	Chemical Publishers	1997
2.	Principles and Practice of Perfumes and Cosmetics	George Howard	Stanley Therones	1987
3.	Modern Technology of Cosmetics	Niir Board	Asia Pacific Business Press Inc	2005

**Mapping with Programme Specific Outcomes**

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

### SEMESTER - III

<b>CORE - III</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 4</b>
<b>Course Code: M23UCH03</b>	<b>GENERAL CHEMISTRY - III</b>	<b>Contact Hours per Week: 5</b>

#### OBJECTIVES

To provide a comprehensive knowledge on the physical properties of gases, liquids, solids and X-ray diffraction of solids, fundamentals of nuclear chemistry and nuclear waste management, applications of nuclear energy, basic chemistry of halo-organic compounds, phenol and other aromatic alcohols, preparation and properties of phenols and alcohols.

#### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Recall the kinetic properties of gases by using mathematical concepts.	K1
CO2	Outline the physical properties of liquid and solids, various types of crystals with respect to its packing, XRD method for crystal structure determinations.	K2
CO3	Analyze the radioactivity, nuclear energy its production and also the nuclear waste management.	K3
CO4	Examine the nomenclature, physical & chemical properties, basic mechanisms of halo organic compounds and alcohols.	K4
CO5	Sketch the named organic reactions related to phenol, preparation and properties of aromatic alcohol including thiol.	K3

#### UNIT I: Gaseous state

[15 Hours]

Kinetic molecular model of a gas: 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, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities. Collision frequency; collision diameter; mean free path.

Real gases: Deviations from ideal gas behaviour, (Andrew's and Amagat's plots); compressibility factor,  $Z$  and its variation with pressure for different gases. Equations of states for real gases - Vander Waal's equation; Virial equation; Boyle temperature; law of corresponding states - liquefaction of gases; numerical problems involving the core concepts.

**Unit-II: Liquid and Solid State****[15 Hours]**

Properties of Liquids - Surface tension, viscosity and their applications. Crystalline and amorphous - differences - geometry, isotropy and anisotropy, melting point; isomorphism, polymorphism.

Symmetry elements - plane, centre and axis; Miller indices, unit cells and space lattices; classification of crystal systems; Bravais lattices; X - ray diffraction - Bragg's equation Packing in atomic solids - simple cubic, body centered cubic, face centered and hexagonal close packing; Co-ordination number in typical structures - NaCl, CsCl, ZnS, TiO<sub>2</sub>; comparison of structure and properties of diamond and graphite; numerical problems involving core concepts.

Defects in solids - stoichiometric and nonstoichiometric defects.

Liquid crystals - classification and applications.

**UNIT-III: Nuclear Chemistry****[15 Hours]**

Natural radioactivity -  $\alpha$ ,  $\beta$  and  $\gamma$  rays; half-life period; Fajan-Soddy group displacement law; Geiger-Nattal rule; isotopes, isobars, isotones, mirror nuclei, iso diaphers; nuclear isomerism; radioactive decay series; magic numbers; units - Curie, Rutherford, Roentgen; nuclear stability - neutron-proton ratio; binding energy; packing fraction; mass defect. Simple calculations involving mass defect and B.E., decay constant and  $t_{1/2}$  and radioactive series.

Isotopes - uses - tracers - determination of age of rocks by radiocarbon dating. (Problems to be worked out). Nuclear energy; nuclear fission and fusion - major nuclear reactors in India; radiation hazards, disposal of radioactive waste and safety measures.

**UNIT-IV: Halogen derivatives****[15 Hours]**

Aliphatic halogen derivatives: Nomenclature and classes of alkyl halides - isomerism, physical properties, Chemical reactions. Nucleophilic substitution reactions - S<sub>N</sub>1, S<sub>N</sub>2 and S<sub>N</sub>i mechanisms. Di, Tri & Tetra Halogen derivatives: Nomenclature, classification, preparation, properties and applications.

Aromatic halogen compounds: Nomenclature, preparation, properties and uses. Mechanism of nucleophilic aromatic substitution - benzyne intermediate. Aryl alkyl halides: Nomenclature, benzyl chloride - preparation - preparation properties and uses.

**UNIT-V: Phenols, Alcohols and Thiols****[15 Hours]**

Phenols: Nomenclature, classification, Preparation from diazonium salts, cumene, Dow's process, Raching process; properties - acidic character and effect of substitution on acidity. Reactions - Fries, claisen rearrangement, Electrophilic substitution reactions, Reimer - Teimen, Kolbe, Schmidt, Gattermann synthesis, Libermann reaction. Resorcinol, quinol,

picric acid – preparation, properties and uses.

Alcohols: Nomenclature, classification, preparation, properties, use; conversions – ascent and descent of series; test for hydroxyl groups. Oxidation of diols by periodic acid and lead tetraacetate.

Aromatic alcohols: Nomenclature, benzyl alcohol – methods of preparation – hydrolysis, reduction of benzaldehyde, Cannizzaro reaction, Grignard synthesis, physical properties, reactions – reaction with sodium, phosphorus pentachloride, thionyl chloride, acetic anhydride, hydrogen iodide.

Thiols: Nomenclature, structure, preparation and properties.

### TEXT BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Principles of Physical Chemistry	B.R. Puri, L.R. Sharma, M.S. Pathania	Vishal Publishing	2020
2.	Principles of Inorganic Chemistry	B.R. Puri, L.R. Sharma and K.C. Kalia	Milestone Publishers and Distributors, New Delhi	2009
3.	Textbook of Inorganic Chemistry	P.L. Soni and Mohan Katyal	Sultan Chand & amp; Sons	2006
4.	Modern Organic Chemistry	M. K. Jain, S. C. Sharma	Vishal Publishing	2003
5.	Reaction Mechanism in Organic Chemistry	S.M. Mukherji and S.P. Singh	Macmillan India Ltd	1994

### REFERENCE BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Organic Chemistry	T.W. Graham Solomons	John Wiley & Sons	1992
2.	Organic Chemistry	A. Carey Francis	Tata McGraw-Hill Education Pvt. Ltd., New Delhi	2009
3.	Organic Chemistry	I.L. Finar	Wesley Longman Ltd, England	1996
4.	Text Book of Organic Chemistry	P.L. Soni, H.M. Chawla	Sultan Chand & Sons, New Delhi	2007
5.	Concise Inorganic Chemistry	J.D. Lee	Blackwell Science	2005

### Mapping with Programme Specific Outcomes

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

### SEMESTER - III

<b>CORE PRACTICAL - III</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHP03</b>	<b>PRACTICAL - III - QUALITATIVE INORGANIC ANALYSIS</b>	<b>Contact Hours per Week: 3</b>

#### OBJECTIVES

To this course develop the skill on systematic analysis of simple inorganic salts and mixture of salts.

#### COURSE OUTCOMES

On the successful completion of the course, student will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Bring out knowledge on the systematic analysis of Mixture of salts.	K4
CO2	Identify the cations and anions in the unknown substance.	K4
CO3	Discover the cations and anions in the soil and water and to test the quality of water.	K3

#### Semi - Micro Qualitative Analysis

1. Analysis of simple acid radicals: Carbonate, Sulphide, Sulphate, Thiosulphite, Chloride, Bromide, Iodide, Nitrate.
2. Analysis of interfering acid radicals: Fluoride, Oxalate, Borate, Phosphate, Arsenate, Arsenite.
3. Elimination of interfering acid radicals and identifying the group of basic radicals.
4. Analysis of basic radicals (group wise): Lead, Copper, Bismuth, Cadmium, Tin, Antimony, Iron, Aluminium, Arsenic, Zinc, Manganese, Nickel, Cobalt, Calcium, Strontium, Barium, Magnesium, Ammonium.
5. Analysis of a mixture - I to VI containing two cations and two anions (of which one is interfering type).

#### TEXT BOOKS

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu	Sultan Chand & Sons, New Delhi	1997
2.	Inorganic Semimicro Qualitative analysis	V.V. Ramanujam	National Publishing Co	1971

3.	Practical Chemistry	O.P. Pandey, D.N. Bajpai and S. Giri	S. Chand	2010
4.	Practical Chemistry	Sonia Ratnani, Swati Agarwal and sujetmishra	Mc Grew Hills	2020

### REFERENCE BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Vogel's Text book of Quantitative Inorganic Analysis	J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham	ELBS/Longman, England	1986
2.	Experimental Inorganic Chemistry	W.G. Palmer	Van Nostril and Reinhold Co., London	1972
3.	Vogel's Text book of Macro and Semimicro Qualitative Inorganic Analysis	G. Svehla	Orient Longman	1987
4.	General Practical Chemistry	M.M. Ajaily, A.A. Maihub and R.K. Mohapatra	Central West Publishing	2020
5.	General Chemistry Experiments	Anil J Elias	Universities Press	2008

**SEMESTER – III**

<b>SEC – IV</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 2</b>
<b>Course Code: M23UCHS02</b>	<b>SEC – IV - ENTREPRENEURIAL SKILLS IN CHEMISTRY</b>	<b>Contact Hours per Week: 2</b>

**OBJECTIVES**

To this course aims at providing training to develop entrepreneur skills in students, provide hands on experience to prepare products and develop start ups.

**COURSE OUTCOMES**

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Identify adulterated food items by doing simple chemical tests.	K1
CO2	Give cleaning products and become entrepreneurs.	K2
CO3	Explain others about adulteration and motivate them to become entrepreneurs.	K3
CO4	Discover the uses and chemical composition of Agro industrial products.	K4
CO5	Illustrate the preparation of food products.	K2

**UNIT-I: Food Chemistry****[6 Hours]**

Food adulteration - contamination of food items with clay stones, water and toxic chemicals - common adulterants. Detection of adulterants in food items like coffee, tea, pepper, chilli powder, turmeric powder, butter, ghee, milk, honey etc., by simple techniques.

Food additives, Natural and synthetic anti-oxidants, glazing agents (hazardous effect), food colourants, preservatives, leavening agents, baking powder and baking soda, yeast, MSG, vinegar.

**UNIT-II: Food Packaging and Food Quality Management****[6 Hours]**

Food packaging: Definitions, objectives and functions of packaging and packaging materials. Different forms of packaging system. Packaging equipment and machinery - Vacuum, CA and MA packaging machine.

Food Quality: Importance and functions of quality control. Methods of quality, assessment of food materials - fruits, vegetables, cereals, dairy products, meat.

**UNIT-III: Textile and Dyes Chemical product****[6 Hours]**

Textile Chemicals: Types of Chemical used in Textile industry.  
 Dyes: Classification – natural, synthetic dyes and their characteristics – basic methods and principles of dyeing. Dyeing – cotton fabrics with natural and synthetic dyes. Textile printing.

**UNIT-IV: Agro Industrial Products****[6 Hours]**

Fertilizers: Classification, Macronutrients and Micronutrients.  
 Manufacture of urea. Pesticides & Insecticides: Definition - Classification based on the use and chemical composition – examples. Plant products - Nicotine, Pyrethrin – Inorganic pesticides – borates. Organic pesticides – DDT and BHC. Fungicides: Sulphur compounds, Copper compounds, Bordeaux mixture. Herbicides: Acaricides – Rodenticides. Attractants – Repellants.

**UNIT-V: Consumer products****[6 Hours]**

Preparation of products like soap, detergents, cleaning powder, shampoos, pain balm, tooth paste/powder, candles and disinfectants in small scale. Preparation of jam, squash and jelly, gulkand, cottage cheese. Extraction of oils from spices and flowers.

**TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Food Chemistry	Seema Yadav	Anmol Publishing Ltd, New Delhi	2002
2.	Textile Chemistry	Vishnu Arora	Abhishek Publications	2011
3.	Handbook on Printing and Dyeing of Textiles	G.P. Appaswamy	Intermediate Technology	2012
4.	Industrial Chemistry	B.K. Sharma	Goel Publishing House	2008
5.	Consumer Product Guarantees	Twiggs-Flesner Christain	Taylor & Francis Ltd	2002

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Food Chemistry	Werner Grosch	Springer	2009
2.	Dyeing and Chemical Technology of Textile Fibres	E.R. Trotman	Charles Griffin & Co Ltd	1985

3.	Rapid Detection of Food Adulterant and Contaminants	Shyam Jha	Elsevier	2015
4.	An Introduction of Agricultural Chemistry	J. Subbiah	JV Publishers	2020
5.	Encyclopedia of Chemical Technology	Kirk Othmer	John Wiley and Sons, New York	1999

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

### SEMESTER - III

<b>SEC - V</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 2</b>
<b>Course Code: M23UCHS03</b>	<b>SEC - V - PESTICIDE CHEMISTRY</b>	<b>Contact Hours per Week: 2</b>

#### OBJECTIVES

To this course aims to providing the students, knowledge about the various types of pesticides and their toxicity, the accumulation of pesticides in the form of residues and its analysis, knowledge on choice of alternate and eco-friendly pesticides.

#### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Recall about the pesticides and their toxicity with respect to structure and category.	K1
CO2	Interpret the preparation and property of pesticides.	K2
CO3	Examine the pesticide residues, prevention and care.	K3
CO4	Elaborate the extraction and analytical methods of pesticide residues.	K4
CO5	Demonstrate the awareness to the public on bio-pesticides.	K2

#### UNIT-I: Introduction

[6 Hours]

History of pesticides. Chemistry of Pesticides: Brief introduction to classes of pesticides (Chemical class, targets), structures, chemical names, physical and chemical properties.

Toxicity of pesticides: Acute and chronic toxicity in mammals, birds, aquatic species etc. Methods of analysis of pesticides.

#### UNIT-II: Insecticides

[6 Hours]

Classification and study of following insecticides with respect to structure, chemical name, physical properties, chemical properties, synthesis, degradation, metabolism, formulations, Mode of action, uses, toxicity.

Organophosphates and Phosphothionates: Acephate, Chlorpyrifos, Monocrotophos, and parathion-methyl. Organochlorine - Endosulfan, heptachlor; Carbamate: Cartap hydrochloride, Methomyl, Propoxur.

#### UNIT- III: Pesticides residues

[6 Hours]

Introduction - application of agrochemicals, dissemination pathways of

pesticides, causes of pesticide residues, remedies. Pesticides residues in atmosphere - entry into atmosphere, action of pesticides, effects on environments. Pesticides residues in water - entry into water systems, action and effect in aquatic environment. Pesticides residues in soil. Entry into soil, absorption, retention and transport in soil, effects on microorganism, soil condition and fertility, decomposition and degradation by climatic factors and microorganism.

**UNIT-IV: Pesticide Residues effect and analysis [6 Hours]**

Effects of pesticides residue on human life, birds and animals - routes for exposure to pesticides, action of pesticides on living system. Analysis of pesticides residues - sample preparation, extraction of pesticides residues (soil, water and vegetables/fruits) simple methods and schemes of analysis, multi-residue analysis.

**UNIT-V: Biopesticides [6 Hours]**

Pheromones, attractants, repellents - Introduction, types and application (8-Dodecen-1-ol, 10-cis-12-hexadecadienoic, Trimedlure, Cue-lure, methyl eugenol, N,N-Diethyl-m-toluamide, Dimethyl phthalate, Icaridin). Baits - Metaldehyde, Iron(II) phosphate, Indoxacarb, Zinc Phosphide, Bromadiolone.

**TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Principles of Pesticide Chemistry	S.K Handa	Agrobios (India)	2012
2.	Pesticide Chemistry	G. Matolcsy, M. Nádasy, V. Andriska	Elsevier	1989
3.	Pesticide Chemistry Human Welfare and the Environment vol. IV Pesticide Residue and Formulation Chemistry	J. Miyamoto and P.C. Kearney	Pergamon press	1985
4.	Pesticides	R. Cremllyn	John Wiley	2008
5.	Natural Pesticides	Dr. Kumkum Rajput	Notion press	2022

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Chemistry of Pesticides	N.K. Roy	CBS Publisher & Distributors Pvt Ltd	2010
2.	Handbook of Pesticides: Methods of Pesticide Residues Analysis	L.M. Nollet, H.S. Rathore	CRC press	2016
3.	Pesticide Residues: Significance, Management and Analysis,	R.H. Ellerbrock	AB Publication Ltd	2005
4.	Biopesticides Handbook	M.L. Leo, Nollet, Hamir Singh Rathore	CRC press	2008
5.	An Introduction to Pesticide Chemistry	Kuldeep Singh, Raman Singh	AJL Publishers	2006

**Mapping with Programme Specific Outcomes**

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – IV

<b>CORE – IV</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 4</b>
<b>Course Code: M23UCH04</b>	<b>GENERAL CHEMISTRY – IV</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course aims to provide a comprehensive knowledge on thermodynamic concepts on chemical processes and applied aspects, thermo chemical calculations, transition elements with reference to periodic properties and group study of transition metals, the organic chemistry of ethers, aldehydes and ketones the organic chemistry of carboxylic acids.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Recall the terms and processes in thermodynamics, various laws of thermodynamics and thermo chemical calculations.	K1
CO2	Summarize the second law of thermodynamics and its application to heat engine, third law and its application on heat capacity measurement.	K2
CO3	Explain the chemistry of transition elements with respect to various periodic properties and group wise discussions.	K3
CO4	Analyze the fundamental organic chemistry of ethers, epoxides and carbonyl compounds including named organic reactions.	K4
CO5	Discover the chemistry and named reactions related to carboxylic acids and their derivatives, chemistry of active methylene compounds, halogen substituted acids and hydroxyl acids.	K3

### UNIT-I: Thermodynamics I

[15 Hours]

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 ( $C_p$  &  $C_v$ ); Joule Thomson effect - inversion temperature.

Thermo chemistry - heats of reactions, standard states; effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions; Hess's law and its applications; Measurement of heat of reaction - Zeroth law of thermodynamics-Absolute Temperature scale.

**Unit-II: Thermodynamics II [15 Hours]**

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 with changes in temperature, volume and pressure.

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, thermodynamic equations of state; Thermodynamics of mixing of ideal gases, Ellingham Diagram-application.

Third law of thermodynamics - Nernst heat theorem; Applications of third law - evaluation of absolute entropies from heat capacity measurements, exceptions to third law.

**UNIT-III: General Characteristics of d-block elements [15 Hours]**

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.

**UNIT- IV: Ethers, Epoxides, Aldehydes and Ketones [15 Hours]**

Ethers and Epoxides: Nomenclature, isomerism, general methods of preparations, reactions involving cleavage of C-O linkages, alkyl group and ethereal oxygen. Zeisel's method of estimation of methoxy group. Reactions of epoxides with alcohols, ammonia derivatives and  $\text{LiAlH}_4$ .

Aldehydes and Ketones: Nomenclature, structure and reactivity of aliphatic and aromatic 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.

Reduction: Clemmensen reduction, Wolf - Kishner reduction, Meerwein - Ponder Verley reduction, reduction with  $\text{LiAlH}_4$  and  $\text{NaBH}_4$ . Addition reactions of unsaturated carbonyl compounds: Michael addition.

**UNIT-V: Carboxylic Acids and their derivatives****[15 Hours]**

Carboxylic acids: Nomenclature, structure, preparation and reactions of aliphatic and aromatic monocarboxylic acids. Physical properties, acidic nature, effect of substituent on acidic strength. HVZ reaction, Claisen ester condensation, Bouveault Blanc reduction, decarboxylation, Hunsdiecker reaction. Formic acid-reducing property.

Carboxylic acid Derivatives: Preparations of aliphatic and aromatic acid chlorides, esters, amides and anhydrides. Nucleophilic substitution reaction at the acyl carbon of acyl halide, anhydride. Schotten-Baumann reaction. Claisen condensation, Dieckmann and Reformatsky reactions and Curtius rearrangement.

Active methylene compounds: Keto – enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

Halogen substituted acids: Nomenclature; preparation by direct halogenation, iodination from unsaturated acids, alkyl malonic acids. Hydroxy acids: Nomenclature; preparation from halo, aldehydic and ketonic acids, ethylene glycol – action of heat on  $\alpha$ ,  $\beta$  and  $\gamma$  hydroxy acids.

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Principles of Physical Chemistry	B.R. Puri and L.R. Sharma	Shoban Lal Nagin Chand and Co	1992
2.	A Textbook of Physical chemistry	K.L. Kapoor	Macmillan, India Ltd	2009
3.	Textbook of Inorganic Chemistry	P.L. Soni and Mohan Katyal	Sultan Chand & Sons	2006
4.	Modern Organic Chemistry	M.K. Jain and S.C. Sharma	Vishal Publishing	2003
5.	Reaction Mechanism in Organic Chemistry	S.M. Mukherji, and S.P. Singh	Macmillan India Ltd	1994

**REFERENCE BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Principles of Physical Chemistry	S.H. Maron and C.P. Prutton	The Macmillan Company: New York	1972
2.	Concise Inorganic Chemistry	J.D. Lee	ELBS William Heinemann: London	1991
3.	Advanced Inorganic Chemistry	Gurudeep Raj	Goel Publishing House: Meerut	2001

4.	J. Physical Chemistry	P.W. Atkins & Paula	Oxford University Press: New York	2014
5.	Inorganic Chemistry: Principles of Structure and Reactivity	J.E. Huheey	Addison Wesley Publishing Company: India	1993

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – IV

<b>CORE PRACTICAL – IV</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHP04</b>	<b>PRACTICAL – IV - PHYSICAL CHEMISTRY – I</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course aims at providing an understanding of the laboratory experiments in order, the concepts of physical changes in chemistry, rates of chemical reactions, colligative properties and adsorption isotherm.

### COURSE OUTCOMES

On the successful completion of the course, student will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Apply the principles and methodology for the practical work.	K3
CO2	Analyze the procedure, data and methodology for the practical work.	K4
CO3	Use the principles of electrochemistry, kinetics for carrying out the practical work.	K3

### UNIT-I: Chemical kinetics

1. Determination of rate constant of acid catalysed hydrolysis of an ester (methyl acetate).
2. Determination of order of reaction between iodide and persulphate (initial rate method).
3. Polarimetry: Determination of rate constant of acid catalysed inversion of cane sugar.

### Thermochemistry

4. Determination of heat of neutralisation of a strong acid by a strong base.
5. Determination of heat of hydration of copper sulphate.

### UNIT-II: Electrochemistry

#### Conductance measurements

6. Determination of cell constant.
7. Determination of molar conductance of strong electrolyte.
8. Determination of dissociation constant of acetic acid.

#### Potentiometry

9. Potentiometric titration of HCl against NaOH.

**UNIT-III: Colligative property**

10. Determination of molecular weight of an organic compound by Rast method using naphthalene or diphenyl as solvent.
11. Determination of molar depression constant  $K_f$  of the given solvent.

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu	Sultan Chand & Sons, New Delhi	1997
2.	Inorganic Semimicro Qualitative Analysis	V.V. Ramanujam	National Publishing Co	1971
3.	Practical Chemistry	O.P. Pandey, D.N. Bajpai and S. Giri	S Chand	2010
4.	Practical Chemistry	Sonia Ratnani, Swati Agarwal and sujeet mishra	Mc Grew Hills	2020

**REFERENCE BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Practical in Physical Chemistry	P.S. Sindhu	Macmillan India: New Delhi	2005
2.	Senior Practical Physical Chemistry,	B. Khosla, D. Garg, V.C. Gulati	R. Chand: New Delhi	2011
3.	Practical Physical Chemistry	Gupta, Renu	New Age International: New Delhi	2017
4.	General Practical Chemistry	M.M. Ajaily. A.A. Maihub and R.K. Mohapatra	Central West Publishing	2020
5.	General Chemistry Experiments	Anil J Elias	Universities Press	2008

## SEMESTER - IV

<b>SEC – VI</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 2</b>
<b>Course Code: M23UCHS04</b>	<b>SEC – VI - INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS</b>	<b>Contact Hours per Week: 2</b>

### OBJECTIVES

To this course aims at providing an overall view of the operation and troubleshooting of chemical instruments, fundamentals of analytical techniques and its application in the characterization of compounds, theory of chromatographic separation, theory of thermo / electro analytical techniques, stoichiometry and the related concentration terms.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Identify the error analysis in the calibration, use of analytical instruments, theory, instrumentation, application of flame photometry and atomic absorption spectrometry.	K1
CO2	Express the theory, instrumentation, application of UV visible and Infrared spectroscopy.	K2
CO3	Analyze the instrumentation, theory and applications of thermal and electrochemical techniques.	K3
CO4	Bring out the use of chromatographic techniques in the separation and identification of mixtures.	K4
CO5	Recall the preparation of solutions, stoichiometric calculations.	K1

#### **UNIT-I: Qualitative and Quantitative Aspects of Analysis [6 Hours]**

S.I Units, Distinction between Mass and Weight. Moles, Millimoles, Milli equivalence, Molality, Molarity, Normality, Percentage by Weight and Volume, ppm, ppb. Density and Specific Gravity of Liquids.

Sampling, Evaluation of analytical data, Errors – Types of Errors, Accuracy, Precision, Minimization of Errors. Significant Figures. Methods of Expressing Precision: Mean, Median, Average Deviation, Standard Deviation.

#### **UNIT-II: Atomic Absorption Spectroscopy [6 Hours]**

Basic principles - instrumentation (source, monochromator, detector, flame and Burner designs). Techniques of atomization and sample introduction - Techniques for the quantitative estimation of trace level of

metal ions from water samples.

**UNIT- III: UV-Visible and IR Spectroscopy [6 Hours]**

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

UV-Visible Spectrometry: Basic principles, instrumentation (choice of source, monochromator and detector) for single and double beam instrument.

Infrared Spectroscopy: Basic principles, instrumentation (choice of source, monochromator & detector) for double beam instrument; sampling techniques.

**UNIT-IV: Thermal and Electro-analytical Methods of Analysis [6 Hours]**

TGA and DTA - Principle, Instrumentation, methods of obtaining Thermograms, factors affecting TGA/DTA, Thermal analysis of calcium oxalate.

Electroanalytical methods: Polarography - principle, instrumentation and applications.

**UNIT-V: Separation and purification techniques [6 Hours]**

Principle of solvent extraction and liquid - liquid extraction. Chromatography: Column, TLC, Paper - principle, choice of adsorbents, solvents, preparation of column and elution - development of chromatograms and  $R_f$  value.

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	A Test book of Quantitative Inorganic Analysis	Vogel, John Mendham	Prentice Hall	2000
2.	Elements of Analytical Chemistry	R. Gopalan, P.S. Subramanian and K. Rengarajan	Sultan Chand, New Delhi	2007
3.	Principles of Instrumental Analysis	Skoog, Holler and Crouch	Cengage Learning, 6th Indian	2017
4.	Thermal Analysis of Materials	R. Speyer	CRC Press	1993
5.	Quantitative Analysis	R.A. Day and A.L. Underwood	Prentice Hall of India Private Ltd., New Delhi	1993

## REFERENCE BOOKS

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Analytical Chemistry: An Introduction	D.A. Skoog, D.M. West and F.J. Holler	Saunders College Publishing, Philadelphia	1998
2.	Analytical Chemistry: Theory and Practice	U.N. Dash	Sultan Chand and sons Educational Publishers, New Delhi	2011
3.	Analytical Chemistry	Christian, D. Gary	John Wiley & Sons, New York	2004
4.	Laboratory Handbook of Chromatographic & Allied Methods	O. Mikes and R.A. Chalmes	Elles Harwood Ltd. London	1979
5.	Vogel's Textbook of Quantitative Chemical Analysis	G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney	Pearson Education	2000

### Mapping with Programme Specific Outcomes

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – IV

<b>ECC – I</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 2</b>
<b>Course Code: M23UES01</b>	<b>ENVIRONMENTAL STUDIES</b>	<b>Contact Hours per Week: 2</b>

### OBJECTIVES

To this course is provide basic knowledge on the environment, ecosystem, natural resources, biodiversity and conservation, pollution, environmental policy awareness, and management, the population explosions and disaster management.

#### UNIT-I: Environment

[6 Hours]

Environment: definition – scope – structure and function of ecosystems- producers, consumers and decomposers - energy flow in the ecosystem - ecological succession – food chain, food webs and ecological pyramids – concept of sustainable development.

#### UNIT-II: Natural resources

[6 Hours]

Natural resources: renewable - air, water, soil, land and wildlife resources. Non-renewable - mineral coal, oil and gas. Environmental problems related to the extraction and use of natural resources.

#### UNIT-III: Biodiversity

[6 Hours]

Biodiversity: definition – values – consumption use, productive social, ethical, aesthetic and option values threats to biodiversity - hotspots of biodiversity – conservation of biodiversity: *in - situ*, *ex - situ*. Bio - wealth - National and global level.

#### UNIT-IV: Environmental Pollution

[6 Hours]

Environmental Pollution: definition – causes, effects and mitigation measures – air pollution, water pollution, soil pollution noise pollution, thermal pollution – nuclear hazards – solid wastes, acid rain – climate change and global warming. Environmental laws and regulations in India.

#### UNIT-V: Social Issues and the Environment

[6 Hours]

Social Issues and the Environment: urban problems related to energy. Water conservation, rainwater harvesting, watershed management, wasteland reclamation, Environment Protection Act - Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act, wildlife Protection Act, Forest Conservation Act.

**TEXT BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Textbook for Environmental Studies for Undergraduate Courses of all branches of higher education	Erach Bharucha	UGC and bharati vidyapeeth Institute of Environment Education and Research, Pune.	2004
2.	Environmental Studies	Anubha Kaushik	New Age International Publishers, New Delhi.	2012
3.	Environmental Studies for Undergraduate Courses - As Per UGC Notified Syllabus	Sushmita Baskar and R. Baskar	Unicorn Books Publishers.	2007
4.	Textbook of Environmental Studies for Undergraduate Courses	Erach Bharucha	Second edition Orient Black Swan Publishers.	2013

**REFERENCE BOOKS:**

<b>S. No.</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Environmental Pollution: Causes, Effects and Control	K.C. Agarwal	Nidhi Publishers (India), Bikanir.	2001
2.	Essentials of Ecology and Environmental Sciences	S.V.S. Rana	Prentice Hall of India Private Limited, New Delhi, India.	2005
3.	Modern Concepts of Ecology	H.D. Kumar	Vikas Publishing House Private Ltd.	1982
4.	Environmental Studies	Sanjay Kumar Batra, Kanchan Batra, Harpreet Kaur and Parul Pant	Taxmans Publication.	2018
5.	Ecology: From Individuals to Ecosystems	Michael Begon, Colin R. Townsend and John L. Harper	Blackwell Publishing Company.	2006

## SEMESTER - V

<b>CORE – V</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 4</b>
<b>Course Code: M23UCH05</b>	<b>ORGANIC CHEMISTRY – I</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course aims to provide an understanding of stereoisomerism in chirals and geometric isomerism in olefins, conformations of ethane and butane, preparation and properties of aromatic and aliphatic nitro compounds and amines, preparation of different dyes, food colour and additives, preparation and properties of five membered heterocycles like pyrrole, furan and thiophene, preparation and properties of six membered heterocycles like pyridine, quinoline and isoquinoline.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Identify the RS notations to chirals and EZ notations to olefins, conformations of ethane and butane.	K1
CO2	Give the preparation and properties of aromatic, aliphatic nitro compounds and amines.	K2
CO3	Explain the colour, constitution of dyes and food additives.	K3
CO4	Analyze the preparation and properties of five membered heterocycles like pyrrole, furan and thiophene.	K4
CO5	Sketch the preparation and properties of six membered heterocycles like pyridine, quinoline and isoquinoline.	K3

### UNIT-I: Stereochemistry

**[15 Hours]**

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis-trans, syn-anti isomerism, E/Z notations. Optical Isomerism: Optical activity, specific rotation, asymmetry, enantiomers, distereoisomers, meso structures - molecules with one and two chiral centres, racemisation - methods of racemisation; resolution - methods of resolution. C.I.P rules. R and S notations for one and two chirality (stereogenic) centres. Molecules with no asymmetric carbon atoms – allenes and biphenyls. Conformational analysis of ethane and butane.

**UNIT-II: Chemistry of Nitrogen Compounds – I [15 Hours]**

Nitroalkanes: Nomenclature, isomerism, preparation from alkyl halides, halo acids, alkanes; physical properties; reactions - reduction, halogenations, Grignard reagent, Pseudo acid character. Nitro - aci nitro tautomerism. Aromatic nitro compounds: Nomenclature, preparation - nitration, from diazonium salts, physical properties; reactions - reduction of nitrobenzene in different medium, Electrophilic substitution reactions, TNT.

Amines: Aliphatic amines: Nomenclature, isomerism, preparation - Hofmann's degradation reaction, Gabriel's phthalimide synthesis, Curtius Schmidt rearrangement. Physical properties, reactions - alkylation, acylation, carbylamine reaction, Mannich reaction, oxidation, basicity of amines.

**UNIT- III: Chemistry of Nitrogen Compounds – II [15 Hours]**

Aromatic amines: Nomenclature, preparation - from nitro compounds, Hofmann's method; Schmidt reaction, properties - basic nature, ortho effect; reactions - alkylation, acylation, carbylamine reaction, reaction with nitrous acid, aldehydes, oxidation, Electrophilic substitution reactions, diazotization and coupling reactions; sulphanilic acid - Zwitter ion formation. Distinction between primary, secondary and tertiary amines - aliphatic and aromatic Diazonium compounds. Diazomethane, Benzene diazonium chloride - preparations and synthetic applications.

Dyes: Theory of colour and constitution; classification based on structure and application; preparation - Martius yellow, aniline yellow, methyl orange, alizarin, indigo, malachite green.

**UNIT-IV: Heterocyclic compounds - I [15 Hours]**

Nomenclature and classification. General characteristics - aromatic character and reactivity. Five membered heterocyclic compounds. Pyrrole - preparation - from succinimide, Paal Knorr synthesis; reactions - reduction, basic character, acidic character, electrophilic substitution reactions, ring opening. Furan - preparation from mucic acid and pentosan; reactions - hydrogenation, reaction with oxygen, Diels Alder reactions, formation of thiophene and pyrrole; Electrophilic substitution reaction. Thiophene synthesis - from acetylene; reactions - reduction; oxidation; electrophilic substitution reactions.

**UNIT-V: Heterocyclic compounds-II [15 Hours]**

Pyridine - synthesis - from acetylene, Physical properties; reactions - basic character, oxidation, reduction, electrophilic substitution reactions; nucleophilic substitution- uses.

Condensed ring systems: Quinoline - preparation - Skraup synthesis and Friedlander's synthesis; reactions - basic nature, reduction, oxidation; electrophilic substitutions; nucleophilic substitutions - Chichibabin

reaction. Isoquinoline – preparation by the Bischler – Napieralski reaction, reduction, oxidation; electrophilic substitution.

### TEXT BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Modern Organic Chemistry	M.K. Jain, S.C. Sharma	Vishal Publishing	2009
2.	Reaction Mechanism in Organic Chemistry	S.M. Mukherji and S.P. Singh	Macmillan India Ltd	2009
3.	Advanced organic chemistry	Arun Bahl and B.S. Bahl	S. Chand & Company Pvt. Ltd	2012
4.	Text Book of Organic Chemistry	P. L. Soni and H. M. Chawla	Sultan Chand & Sons, New Delhi	2007
5.	Text Book of Organic Chemistry	C.N. Pillai	Universities Press (India) Private Ltd	2009

### REFERENCE BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Organic Chemistry	R.T. Morrison and R.N. Boyd	Pearson Education, Asia	2012
2.	Organic Chemistry	T.W. Graham Solomons	John Wiley & Sons	2012
3.	Organic Chemistry	A. Carey Francis	Tata McGraw-Hill Education Pvt. Ltd., New Delhi	2009
4.	Organic Chemistry	I.L. Finar	England, Wesley Longman Ltd	2006
5.	Heterocyclic Chemistry	J.A. Joule, and G.F. Smith	John Wiley & Sons	2010

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – V

<b>CORE – VI</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 4</b>
<b>Course Code: M23UCH06</b>	<b>INORGANIC CHEMISTRY – I</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course aims to provide knowledge on nomenclature, isomerism and theory of coordination compounds, and chelate complexes, crystal field theory, magnetic properties, stability of complexes and Jahn Teller effect, preparation and properties of metal carbonyls, Lanthanoids and actinoids, preparation and properties of inorganic polymers.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Recognize the isomerism, Werner's Theory and stability of chelate complexes.	K1
CO2	Illustrate the crystal field theory, magnetic properties and spectral properties of complexes.	K2
CO3	Explain the preparation and properties of metal carbonyls.	K3
CO4	Compare the characteristics of lanthanoids and actinoids.	K4
CO5	Represent the properties and uses of inorganic polymers of silicon, sulphur, boron and phosphorous.	K2

### UNIT-I: Co-ordination Chemistry – I

[15 Hours]

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 – geometry of co-ordination compounds with co-ordination number 4 & 6.

Chelates – types of ligands forming chelates – stability of chelates, applications of chelates in qualitative and quantitative analysis – application of DMG and oxime in gravimetric analysis – estimation of hardness of water using EDTA, metal ion indicators. Role of metal chelates in living systems – haemoglobin and chlorophyll.

### Unit-II: Co-ordination Chemistry – II

[15 Hours]

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, heats of ligation with water as a ligand (heat of hydration), interpretation of magnetic properties, spectra of  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  - Jahn - Teller effect. Stability of complexes in aqueous solution, stability constants - factors affecting the stability of a complex ion, thermodynamic and kinetic stability (elementary idea). Comparison of VBT and CFT.

**UNIT-III: Organometallic compounds [15 Hours]**

Metal Carbonyls: Mono and polynuclear carbonyls, General methods of preparation of carbonyls - general properties of binary carbonyls - bonding in carbonyls - structure and bonding in carbonyls of Ni, Fe, Cr, Co, Mn, Ru and Os. EAN rule as applied to metal carbonyls. Ferrocene - Methods of preparation, physical and chemical properties.

**UNIT-IV: Lanthanoids and Actinoids [15 Hours]**

General characteristics of f-block elements - Comparative account of lanthanoids and actinoids - Occurrence, Oxidation states, Magnetic properties, Colour and spectra - Lanthanoids and Actinoids, Separation by ion - Exchange and Solvent extraction methods - Lanthanoids contraction - Chemistry of thorium and Uranium - Occurrence, Ores, Extraction, properties and uses - Preparation, Properties and uses of ceric ammonium sulphate, thorium dioxide and uranyl acetate.

**UNIT-V: Inorganic polymers [15 Hours]**

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 polyphosphonitrilic chloride), sulphur based polymer (polysulfide and polymeric sulphur nitride), boron based polymers (borazine polymers) - industrial applications of inorganic polymers.

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Principles of Inorganic Chemistry	B. R. Puri, L. R. Sharma, K. C. Kalia	Milestone Publishers & Distributors	2011
2.	Advanced Inorganic Chemistry	Satya Prakash, G.D. Tuli, S.K. Basu, R.D. Madan	S. Chand & Co., New Delhi	2009

3.	Concise Inorganic Chemistry	J.D. Lee	ELBS William Heinemann, London	1991
4.	Selected Topics in Inorganic Chemistry	W.V. Malik, G.D. Tuli, R.D. Madan	S. Chand and Company Ltd	2000
5.	Text book of Inorganic Chemistry	A.K. De	Wiley East Ltd	1992

### REFERENCE BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Modern Inorganic Chemistry	R.D. Madan, Sathya Prakash	S. Chand and Company, New Delhi	2003
2.	Inorganic Chemistry for Undergraduates	R. Gopalan	University Press (India) Private Limited, Hyderabad	2009
3.	Inorganic Chemistry	B. Sivasankar	Pearson, Chennai	2013
4.	Inorganic Chemistry	Alan G. Sharp	Addition-Wesley, England	1992
5.	Inorganic Chemistry	Peter Atkins, Tina Overton, Jonathan Rourke and Mark Weller	Oxford University Press	2014

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – V

<b>CORE – VII</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 4</b>
<b>Course Code: M23UCH07</b>	<b>PHYSICAL CHEMISTRY – I</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course aims at providing an overall view of Gibbs free energy, Helmholtz free energy, Ellingham's diagram and partial molar properties, chemical kinetics and different types of chemical reactions, adsorption, homogeneous and heterogeneous catalysis, colloids and macromolecules, photochemistry, fluorescence and phosphorescence.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Define Gibbs and Helmholtz free energy functions, partial molar quantities and Ellingham's diagram.	K1
CO2	Indicate the concepts of chemical kinetics to predict the rate of the reaction and order of the reaction, effect of temperature on reaction rate, significance of free energy and entropy of activation.	K2
CO3	Compare chemical and physical adsorption, Freundlich and Langmuir adsorption isotherms, differentiate between homogenous and heterogeneous catalysis.	K3
CO4	Brief out the types and characteristics of colloids, preparation of sols and emulsions, and to determine the molecular weights of macromolecules.	K4
CO5	Bring out the concepts of photochemistry in fluorescence, phosphorescence, chemi-luminescence and color perception of vision.	K2

### UNIT-I: Thermodynamics – III

[15 Hours]

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, thermodynamic equations of state; Thermodynamics of mixing of ideal gases, Ellingham Diagram - application.

Partial molar properties – chemical potential, Gibbs Duhem equation,

variation of chemical potential with temperature and pressure, chemical potential of a system of ideal gases, Gibbs-Duhem-Margules equation.

### **UNIT-II: Chemical Kinetics**

**[15 Hours]**

Rate of reaction: Average and instantaneous rates, factors influencing rate of reaction - molecularity of a reaction - rate equation - order of reaction. order and molecularity of simple and complex reactions, Rate laws - Rate constants - derivation of rate constants and characteristics for zero, first order, second and third order (equal initial concentration)-Derivation of time for half change with examples. Methods of determination of order of Volumetry, manometry and polarimetry.

Effect of temperature on reaction rate - temperature coefficient - concept of activation energy - Arrhenius equation. Theories of reaction rates - Collision theory - derivation of rate constant of bimolecular gaseous reaction - Failure of collision theory. Lindemann's theory of unimolecular reaction. Theory of absolute reaction rates - Derivation of rate constant for a bimolecular reaction - significance of entropy and free energy of activation. Comparison of collision theory and ARRT.

Complex reactions - reversible and parallel reactions (no derivation and only examples). Kinetics of consecutive reactions - steady state approximation.

### **UNIT-III: Adsorption**

**[15 Hours]**

Chemical and physical adsorption and their general characteristics - distinction between them Different types of isotherms - Freundlich and Langmuir. Adsorption isotherms and their limitations - BET theory, kinetics of enzyme catalysed reaction - Michaelis-Menten and Briggs-Haldene equation - Lineweaver-Burk plot - inhibition - reversible - competitive, noncompetitive and uncompetitive (no derivation of rate equations).

Catalysis - general characteristics of catalytic reactions, auto catalysis, promoters, negative catalysis, poisoning of a catalyst - theories of homogenous and heterogeneous catalysis - Kinetics of Acid - base and enzyme catalysis.

### **UNIT-IV: Colloids and Surface Chemistry**

**[15 Hours]**

Colloids: Types of Colloids, Characteristics Colloids (Lyophilic and Lyophobic sols), preparation of Sols - Dispersion methods, aggregation methods, Properties of Sols - Optical properties, Electrical properties - Electrical double layer, Electro Kinetic properties - Electro-osmosis, Electrophoresis, Coagulation or precipitation, Stability of sols, associated colloids, Emulsions, Gels-preparation of Gels, Applications of colloids.

Macromolecules: Molecular weight of Macromolecules - Number average molecular weight-average molecular weight.

**UNIT-V: Photochemistry****[15 Hours]**

Laws of photo chemistry – Lambert-Beer, Grotthus-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 – cis retinal – vitamin A as a precursor - colour perception of vision.

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Principles of Physical Chemistry	B.R. Puri and L.R. Sharma	Shoban Lal Nagin Chand and Co	2021
2.	Physical Chemistry	Peter Atkins, Julio de Paula and James Keeler	Oxford University press	2018
3.	Essentials of Physical Chemistry	Arun Bahl, B.S. Bahl, G.D. Tuli	S. Chand & Co	2019
4.	Physical Chemistry Through Problems	S.K. Dogra and S. Dogra	New Age International	1996
5.	Thermodynamics	J. Rajaram and J.C. Kuriacose	Shoban Lal Nagin Chand and CO	1986

**REFERENCE BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Chemical Thermodynamics	J. Rajaram and J.C. Kuriacose	Pearson	2013
2.	Chemical Kinetics	Keith J. Laidler	Pearson	2003
3.	Physical Chemistry	P.W. Atkins and Julio de Paula	Oxford University Press	2002
4.	A Textbook of Physical Chemistry	K.L. Kapoor	Macmillan, India Ltd	2009
5.	Principles of Physical Chemistry	B.R. Puri, L.R. Sharma and M.S. Pathania	Shobanlal Nagin Chand and Co, Jalendhar	2001

### Mapping with Programme Specific Outcomes

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER - V

<b>ELECTIVE – I</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHDSE1</b>	<b>DISCIPLINE SPECIFIC ELECTIVE – I BIOCHEMISTRY</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course aims at providing knowledge on relationship between biochemistry and medicine, composition of blood, structure and properties of amino acids, peptides, enzyme, vitamins and proteins, biological functions of proteins, enzymes, vitamins and hormones, biochemistry of nucleic acids and lipids, metabolism of lipids.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Find the molecular logic of living organisms, composition of blood and blood coagulation.	K1
CO2	Interpret the synthesis and properties of amino acids, determination of structure of peptides and proteins.	K2
CO3	Explain factors influencing enzyme activity and vitamins as coenzymes.	K3
CO4	Brief out RNA and DNA structure and functions.	K4
CO5	Conclude the biological significance of simple and compound lipids.	K4

### UNIT-I: Logic of Living Organisms [15 Hours]

Relationship of Biochemistry and Medicine. Blood - Composition of Blood, Blood Coagulation – Mechanism. Hemophilia and Sickle Cell Anaemia - Definition. Maintenance of pH of Blood – Bicarbonate Buffer, Acidosis, Alkalosis.

### UNIT-II: Amino acids, Peptides and Proteins [15 Hours]

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 & Edmann method; C terminal analysis - Enzymic 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.

**UNIT-III: Enzymes and Vitamins [15 Hours]**

Enzymes: Nomenclature and classification, characteristics, factors influencing enzyme activity – mechanism of enzyme action – Lock and key hypothesis, Koshland's induced fit model.

Vitamins as coenzymes – functions of TPP, lipoic acid, NAD, NADP, FMN, FAD, folic acid, biotin, cyanocobalamin.

**UNIT-IV: Nucleic acids and Hormones [15 Hours]**

Nucleic acids: Components of nucleic acids - nitrogenous bases and pentose sugars, structure of nucleosides and nucleotides, DNA - structure & functions; RNA - types – structure - functions; biosynthesis of proteins.

Hormones: Adrenalin and thyroxine - chemistry, structure and functions (No structure elucidation).

**UNIT-V: Lipids [15 Hours]**

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.

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Advanced Organic Chemistry	B.S. Bahl, A. Bhal	S. Chand: New Delhi	2003
2.	Modern Organic Chemistry	M.K. Jain, S.C. Sharma	Vishal Publications: New Delhi	2017
3.	Fundamentals of Biochemistry for Medical Students	A. Shanmugam	Published by the author	1999
4.	Biochemistry	L. Veerakumari	MJP Publications: Chennai	2004
5.	Fundamentals of Biochemistry	J.L. Jain	S. Chand: New Delhi	1983

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Outline of Biochemistry	E.E. Conn, P.K. Stumpf	Wiley Eastern: New Delhi	2002
2.	Text Book of Biochemistry	E.S. West, W.R. Todd, H.S. Mason, J.T. Van Bruggen	Macmillan: New York	1970
3.	Principles of Biochemistry	A.L. Lehninger	CBS Publisher: Delhi	1993
4.	Biochemistry	S.C. Rastogi	Tata McGraw-Hill: New Delhi	2003
5.	Textbook of Medical Biochemistry	M.N. Chatterjea, R. Shinde	Jaypee Brothers: New Delhi	2002

**Mapping with Programme Specific Outcomes**

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – V

<b>ELECTIVE – I</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHDSE2</b>	<b>DISCIPLINE SPECIFIC ELECTIVE – I NANOCHEMISTRY</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course aims at providing knowledge on introduction to nanoparticles/clusters and nanocomposites, properties of nanomaterials, characterization of nanomaterials by different methods, synthesis of carbon nanotubes, graphene, quantum dots, self-assembled nanomaterials applications of nanomaterials as sensors.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	State the general concepts and physical phenomena of relevance within the field of nanoscience.	K1
CO2	Outline the properties, synthesis, characteristics of nanomaterials, special nanomaterials and applications.	K2
CO3	Sketch the structure, properties, applicability and characterization of nanomaterials.	K3
CO4	Analyze the various synthesis procedures, characterizations and uses of carbon nanotubes, fullerene and graphene.	K4
CO5	Tell the applications of nanomaterials of sensors and in optics and electronics.	K2

### UNIT-I: Introduction

**[15 Hours]**

Definition of terms – 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, methods based on evaporation of a precursor-inert gas condensation, ion sputtering, spray pyrolysis, aerosol synthesis - nanolithography. Bottom-up approach (chemical methods) - solvothermal synthesis, photochemical method, gamma radiolysis, sonochemical synthesis, electro deposition, sol-gel method, nanomaterials via chemical routes- solvents reducing agents, capping agents-stabilization of nanoparticles - electrostatic and steric stabilization, common stabilizers, nanoparticle growth in solution,

templated growth, Langmuir – Blodgett (L-B) method, reverse micelles-emulsion method.

**UNIT-II: Properties of materials on a nanoscale [15 Hours]**

Optical properties of metal and semiconductor nanomaterials- surface Plasmon resonance (SPR), surface enhanced Raman spectra (SERS), quantum confinement effect, tuning of optical spectrum. Magnetic properties -  $\text{Fe}_3\text{O}_4$  particle, supra magnetic properties, electronic properties, Chemical properties - chemical process on the surface of nanoparticles, catalysis, mechanical properties.

**UNIT-III: Characterization of nanomaterials [15 Hours]**

Spectroscopy – UV-visible, 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) [Principle and Block diagram only].

**UNIT-IV: Special nanomaterials [15 Hours]**

Carbon Nano Structures Carbon nanotubes: Introduction - types - zigzag, armchair, helical, synthesis by CVD, Functionalization of Carbon Nanotubes, Reactivity of Carbon Nanotubes, Field emission, Fuel Cells, Display devices .Other important Carbon based materials: Preparation and Characterization Fullerene, Graphene, properties, DLC and nanodiamonds and Applications.

Semiconductor nanoparticles: Quantum dots, synthesis – chemical synthesis using clusters, properties, porous silicon – electrochemical etching, aerogel – types – silica aerogel, resorcinol formaldehyde (RF) aerogels, zeolites – applications Self Assembled Nanomaterials: Self Assembled Monolayers (SAMS) – inorganic, organic molecules.

**UNIT-V: Application of nanomaterials [15 Hours]**

Biomedical Applications- drug, drug delivery, biolabelling, artificial implants, cancer treatment. Sensors – Natural nanoscale sensors, chemical sensors, biosensors, electronic noses. Optics & Electronics – Nanomaterials in the next generation computer technology, high definition TV, flat panel displays, quantum dot laser and single electron transistors [SET].

Nanotechnology in agriculture – Fertilizer and pesticides nanomaterials for water purification, nanomaterials in food and packaging materials, fabric industry. Impacts of Nanotechnology – human & environmental safety risks.

**TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Nanotechnology: Principles and Practices	Sulabha K. Kulkarni	Capital Publishing Co., New Delhi.	2013
2.	The Essentials, Understanding Nanoscience and Nanotechnology	T. Pradeep	Tata McGraw-Hill Publishing Company Limited, New Delhi,	2007
3.	Principles of Nanoscience and Nanotechnology	M.A. Shah, Tokeer Ahmad	Narosa Publishing House, New Delhi	2010
4.	Textbook of Nanoscience and Nanotechnology	B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath, James Murday	India Ltd, Hyderabad	2012

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Understanding Nanotechnology	P.K. Sharma	Vista International Publishing House, Delhi.	2008
2.	Introduction to Nanotechnology;	P. Charles, Jr. Poole, Frank J. Owens.	John Wiley & Sons, INC., Publication	2003
3.	Nano Materials	B. Viswanathan	Narosa Publishing House, NewDelhi.	2009
4.	Nanomaterials Chemistry Recent Developments and New Directions	C.N.R. Rao, A. Muller, A.K. Cheetham	WILEY-VCHVerlag GMBH & Co., KGaA, Darmstad.	2007
5.	Optical properties and spectroscopy of Nanomaterials	Jing Zhong Zhang	World Scientific Publishing Pvt. Ltd., Singapore	2006

### Mapping with Programme Specific Outcomes

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – V

<b>ELECTIVE – I</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHDSE3</b>	<b>DISCIPLINE SPECIFIC ELECTIVE – I CORROSION SCIENCE</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course presents an idea about corrosion types and its reaction mechanism and corrosion prevention techniques.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand basic principles of corrosion science.	K1
CO2	Describe various types corrosion including crevice Corrosion, Pitting, intergranular Corrosion.	K2
CO3	Apply the knowledge of a materials composition and its corrosion performance.	K3
CO4	Analyze methodologies for predicting, measuring and analyzing corrosion performance of materials.	K4
CO5	Identify materials that will exhibit adequate corrosion resistance of metals.	K4

#### UNIT-I: Corrosion

**[15 hours]**

Introduction - Definition – Mechanism – Electrochemical Reactions – Polarization – Passivity – Effect of Oxygen and Oxidizers, velocity, temperature, Corrosion concentration and Galvanic coupling

#### UNIT-II: Types of Corrosion

**[15 hours]**

Metal corrosion – types (crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion, stress corrosion) - hydrogen damage.

#### UNIT-III: Corrosion Testing

**[15 hours]**

Introduction – Classification – Purpose – Materials and Specimens – Surface Preparation – Measuring and Weighing – Exposure Techniques – Duration – Interval Tests – Aeration – Cleaning Specimens after Exposure – Temperature – Standard Expression for Corrosion Rate – Test for Stainless Steels (Huey, Streicher) – Warren Test – NACE.

#### UNIT-IV: Corrosion Test Methods

**[15 hours]**

Slow – Stain – Rate Tests – Linear Polarization – AC Impedance – Small – Amplitude Cyclic Voltammetry – Paint Tests – Sea Water Test.

Miscellaneous Tests of Metals.

**UNIT-V: Corrosion Prevention**

**[15 hours]**

Metals and Alloys – Metal Purification – Alteration of Environment – Changing Mediums – Inhibitors – Design – Wall Thickness – Design Rules – Cathodic Protection – Anodic Protection – Comparison of Anodic and Cathodic Protection - Coatings – Metallic and Inorganic Coatings – Organic Coatings – Corrosion Control Standards.

**TEXT BOOKS**

S. No	Title of the Book	Author	Publishing Company	Year
1.	Corrosion Engineering	Mars G. Fontana	McGraw- Hill International Editions	1987
2.	Corrosion Hand Book	Herbert H. Uhlig	John Wiley and Sons, New York	1948
3.	Corrosion Inhibitors, Principle and Applications	V.S. Sastri	John Wiley and Sons, Newyork	1998

**REFERENCE BOOKS**

S. No	Title of the Book	Author	Publishing Company	Year
1.	Corrosion Inhibitors	C.C. Nathan	National Association of Corrosion Engineers Houston	1974
2.	Introduction to corrosion science	Mccafferety	Springer	2010
3.	Corrosion Chemistry	Volkan Cicek, Bayan Al-Numan	Scrivener Publishing	2011

**Mapping with Programme Outcomes**

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	M	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	M	S	M	S
<b>CO4</b>	M	M	S	M	M
<b>CO5</b>	M	S	M	S	M

**S-** Strong; **M-**Medium.

## SEMESTER – V

<b>ELECTIVE – II</b>	<b>B.Sc. Chemistry</b>	<b>Credits:3</b>
<b>Course Code: M23UCHDSE4</b>	<b>DISCIPLINE SPECIFIC ELECTIVE – II INDUSTRIAL CHEMISTRY</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course is designed to provide knowledge on classifications and characteristics of fuels, preparation of cosmetics, manufacture of sugar, paper, cement and leather and food processing, applications of abrasives, lubricants and other industrial products intellectual property rights.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Recite the properties of fuels which include petroleum, water gas, natural gas and propellants.	K1
CO2	Represent the cosmetic products, soaps and detergents.	K2
CO3	Explain the manufacture of sugar, food spoilages and food additives.	K3
CO4	Elaborate the properties of abrasives, manufacture of leather and paper.	K4
CO5	Elaborate the properties and manufacture of lubricants, cement and intellectual property of rights.	K4

### UNIT-I: Survey of Indian Industries and mineral resources in India

**[15 Hours]**

Fuels: Classification, characteristics of fuels. Solid fuels: coal - classification; analysis of coal - proximate analysis and ultimate analysis; calorific value-determination, carbonisation of coal.

Liquid fuels: Petroleum - characteristics; Gasoline aviation petrol - knocking in internal combustion engines, antiknock agents; unleaded petrol-octane number, octane number.

Gaseous fuel: Advantages over solid and liquid fuels; water gas, producer gas, carburetted water gas - preparations - uses.

Natural gas: LPG - composition, advantages, application; Gobar gas - production, composition, advantages, application. Propellants – rocket fuels (basic idea).

### UNIT-II: Cosmetics

**[15 Hours]**

Skin care: Powders, ingredients; creams and lotion - cleansing,

moisturizing, all purpose shaving cream, sunscreen; make up preparations.

Dental care: Tooth pastes – ingredients.

Hair care: Shampoos - types, ingredients; conditioners - types, ingredients.

Perfumes: Natural-plant origin - parts of the plant used, chief constituents; animal origin - ambergris and musk; synthetic – classification – esters - amylsalicylate alcohols - citronellol; terpenoids - geraniol and nerol; ketones - muskone, coumarin; aldehydes-vanillin.

Soaps and Detergents: Soaps - properties, manufacture of soap - batch process; types -transparent soap, toilet soap, powder soap and liquid soap – ingredients. Detergents - definition, properties - cleansing action; soapless detergents - anionic, cationic and non-ionic (general idea only); uses of detergents as surfactants. Biodegradability of soaps and detergents.

### **UNIT-III: Sugar Industry & Food Preservation and processing [15 Hours]**

Sugar Industry: Manufacture from sugar cane; recovery of sugar from molasses; testing and estimation of sugar.

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.

### **UNIT-IV: Abrasives, Leather Industry & Paper Industry [15 Hours]**

Abrasives: Definition, characteristics, types - natural and synthetic; natural abrasives – diamond, corundum, emery, garnet, quartz – composition, uses; synthetic abrasives – carborundum, aluminium carbide, boron carbide, boron nitride, synthetic graphite – composition and uses.

Leather Industry: Structure and composition of skin, hide; Manufacture of leather – pre-tanning process – curing, liming, beating, pickling; methods of tanning - vegetable, chrome – one bath, two bath process; finishing.

Paper Industry: Manufacture of pulp - mechanical, chemical processes; sulphate pulp, rag pulp; manufacture of paper - beating, refining, filling, sizing, colouring, calendaring; cardboard.

### **UNIT-V: Lubricants, Cement Industry & Intellectual Property Rights [15 Hours]**

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; cutting fluids.

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.

Intellectual Property Rights: Introduction to Intellectual Property Rights – Patents - Factors for patentability - Novelty, Non-obviousness, Industrial applications - Patent offices in India: Trademark - Types of trademarks - Certification marks, logos, brand names, signatures, symbols and service marks.

### TEXT BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Industrial Chemistry	B.K. Sharma	Goel Publishing House: Meerut	1998
2.	Harry's Cosmeticology	J.B.E. Wilkinson R.J. Moore	Chemical Publishers: New York	1982
3.	Food Chemistry	Alex V. Ramani	MJP publishers: Chennai	2009
4.	Applied Chemistry	Jayashree Ghosh	S. Chand: New Delhi	2006
5.	Food Science	B. Srilakshmi	New Age International Publication	2005

### REFERENCE BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Engineering Chemistry	P.C. Jain, M. Jain	Dhanapet Rai: Delhi	1992
2.	Principles and Practice of Perfumes and Cosmetics	George Howard	Stanley Theron, Cheltenham, UK	1987
3.	Foods, Drugs and Cosmetics - A Consumer Guide	Thankamma Jacob	Macmillan: London	1997
4.	Food Facts and Principles	N. Shankuntala Manay, M. Shadaksharaswamy	New Age Publication	2008
5.	Intellectual Property Rights	Neeraj Pandey, Khushdeep Dharni	PHI Learning	2014

### Mapping with Programme Specific Outcomes

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – V

<b>ELECTIVE – II</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHDSE5</b>	<b>DISCIPLINE SPECIFIC ELECTIVE – II MATERIAL SCIENCE</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course gives an insight into the fascinating area of advanced material tools and characterization techniques for smart materials.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Acquire knowledge about smart materials and nano materials.	K1
CO2	Discuss different techniques for characterization of materials.	K2
CO3	Demonstrate the mechanical and thermal properties of metallic, ceramic and polymeric materials.	K3
CO4	Understand the concept of energy band diagram for materials.	K2
CO5	Illustrate the optical and magnetic properties of metallic and ceramic materials.	K4

### **UNIT-I: Advanced Materials and Tools [15 Hours]**

Smart materials, exhibiting ferroelectric, piezoelectric, optoelectric, semiconducting behavior, lasers and optical fibers, photoconductivity and superconductivity, nanomaterials, synthesis, properties and applications, biomaterials, super alloys, shape memory alloys.

### **UNIT-II: Magnetic Materials [15 Hours]**

Introduction – types of magnetic materials – diamagnetism – paramagnetism, ferromagnetism. Ferrites: preparation and their application in microwave- floppy disc – magnetic bubble memory and applications. Insulating materials: classification – on the basis of temperature – Polymer insulating materials and ceramic insulating materials Ferro electric materials; examples, application of ferroelectrics.

### **UNIT-III: Modern Engineering Materials [15 Hours]**

Metallic glasses – introduction – composition, properties and applications. Shape memory alloys: introduction – examples- application of SMA- advantages and disadvantages. Biomaterials: Introduction – metals

and alloy in biomaterials- Ceramic biomaterial, composite biomaterials – polymer biomaterials.

**UNIT-IV: Thermal and electronic Properties [15 Hours]**

Thermal Properties: Heat capacity, thermal conductivity, thermal expansion of materials. Electronic Properties: Concept of energy band diagram for materials - conductors, semiconductors and insulators, electrical conductivity effect of temperature on conductivity, intrinsic and extrinsic semiconductors, dielectric properties.

**UNIT-V: Optical and magnetic Properties [15 Hours]**

Optical properties: Reflection, refraction, absorption and transmission of electromagnetic radiation in solids. Magnetic Properties: Origin of magnetism in metallic and ceramic materials, paramagnetism, diamagnetism, anti-ferromagnetism, ferromagnetism, ferrimagnetism, magnetic hysteresis.

**TEXT BOOKS**

S. No	Title of the Book	Author	Publishing Company	Year
1.	Material Science	S.L. Kakani Amit Kakani	New Age International (P) Limited, Publishers	2004
2.	Material Science	Abdul Mubeen	Khanna Publishers	1999
3.	Fundamentals of Material Science	Anup Kumar Amit Prakash Sen	Notion Publishers	2015
4.	Material Science	M. Arumugam	Anuradha Agencies	2002

**REFERENCE BOOKS**

S. No	Title of the Book	Author	Publishing Company	Year
1.	Fundamentals of Materials Science and Engineering An Integrated Approach	William D. Callister, David G. Rethwisch	Wiley - Interscience, New York	2008
2.	Materials Science: Future Aspects	Kalpna Awasthi Arti Srivastava Mridula Tripathi	Nova Science Publishers, New Delhi	2007
3.	Recent Topics in Advanced Materials Science: Element by Element	Akio Makishima	Cambridge Publishers	2020
4.	Materials Science	G.K. Narula, K.S. Narula, V.K. Gupta	Mc Grew Hill Education	1990

### Mapping with Programme Specific Outcomes

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – V

<b>ELECTIVE – II</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHDSE6</b>	<b>DISCIPLINE SPECIFIC ELECTIVE – II WATER CHEMISTRY</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course enable the students to have knowledge on physico-chemical properties and the evaluation technique for sewage.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand Physical and chemical characteristics of water.	K1
CO2	Discuss drinking water specification with physical and chemical parameters.	K2
CO3	Identify physical and chemical treatment of waste water.	K3
CO4	Devise industrial waste water treatment process.	K4
CO5	Develop water treatment plant layouts.	K3

### UNIT-I: Water Treatment [15 Hours]

Sources of Water; Physical and chemical characteristics of water; Water analysis; Potable water – WTO standard: uses of water.

### UNIT-II: Drinking Water Specification [15 Hours]

Physical parameters: Color, taste - odour, Turbidity, suspended solids, Temperature; Chemical parameters: TDS Alkalinity, Hardness, salts, acids and alkalis, chlorides, fluorides, proteins, carbohydrates, organics, fats oil & grease, Hazen units, BOD, COD, DO, TDS, Trace metals, Heavy metals, tests on quality parameters.

### UNIT-III: Waste Water Treatment [15 Hours]

Physico - Chemical treatments: Sedimentation, Coagulation-Flocculation, Settling Tanks, Disinfection Systems: Chemicals - Chlorination and other Disinfection methods, UV, Ozonation, Aeration and Gas transfer; Precipitation; Softening; Adsorption and Ion exchange; Reverse Osmosis Technologies Membrane processes, Ultra Filtration.

### UNIT-IV: Industrial waste water treatment [15 Hours]

Activated sludge treatment plants – mass balances, with and without recycle plants; Types of plants – single tank, contact stabilization, biosorption plants. Biofilters: Hydraulic film diffusion, two component

diffusion; Types of plants – trickling filters, submerged filters and rotating disc; removal of particulate organic matter

### UNIT-V: Treatment Plants

[15 Hours]

Plants for nitrification – mass balances, nitrifying plants and types of plants. Treatment plant for denitrification - mass balances, denitrifying plants and types of plants; redox zones in the biomass. Aerobic treatment; Suspended growth aerobic treatment processes; Activated sludge process and its modifications; Attached growth aerobic processes; Tricking filters and Rotating biological contactors; Anaerobic treatment; suspended growth, attached growth, fluidized bed and sludge blanket systems; nitrification, denitrification; Phosphorus removal.

### TEXT BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Industrial Chemistry (Including Chemical Engineering)	B.K. Sharma	Goel Publishing House, Meerut	1999
2.	Outlines of Chemical Technology	M. Gopala Rao Marshall Sittig	East-West Press Pvt Ltd	1997
3.	Environmental Chemistry	A.K. De	Wiley Eastern	1989
4.	A Textbook on Water Chemistry: Sampling, Data Analysis and Interpretation	A.G. S Reddy	Nova Publishers	2020

### REFERENCE BOOKS

S. No	Title of the Book	Author	Publishing Company	Year
1.	Waste Water Engineering	L. Winther	Polyteknisk Forlag, Lyngby	1978
2.	Water Chemistry	P. Harremoes	Polyteknisk Forlag, Lyngby	1989
3.	Principles of Water treatment	Kerry J. Howe	Wiley	2012
4.	Water Chemistry	Patrick Brezonik, William Arnold	OUP USA	2012
5.	Water Quality Engineering: Physical / Chemical Treatment Processes	Mark M. Benjamin, Desmond F. Lawler	Wiley Publication	2013

### Mapping with Programme Specific Outcomes

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – V

<b>CORE PRACTICAL – V</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHP05</b>	<b>PRACTICAL – V - PHYSICAL CHEMISTRY – II</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course aims at providing, basic principles of physical chemistry experiments and hands on experience in carrying out the experiments.

### COURSE OUTCOMES

On the successful completion of the course, student will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Examine the principles and methodology for the practical work.	K4
CO2	Explain the procedure, data and methodology for the practical work.	K3
CO3	Apply the principles of phase rule and electrochemistry for carrying out the practical work.	K3

### UNIT-I: Phase Diagrams

1. Simple eutectic - determination of eutectic temperature and composition of naphthalene - diphenyl amine or naphthalene - diphenyl system.
2. Determination of transition temperature of a salt hydrate.
3. Determination of upper critical solution temperature of phenol - water system.
4. Effect of an electrolyte on miscibility temperature of phenol - water system.
5. Determination of concentration of sodium chloride using phenol - sodium chloride system.

### UNIT-II: Distribution law

6. Determination of the distribution coefficient of iodine between carbon tetrachloride (or) benzene and water.
7. Determination of equilibrium constant of the reaction  
$$I_2 + I^- \rightarrow I_3^-$$
8. Determination of concentration of the given potassium iodide solution using the above equilibrium constant.

**UNIT-III: Electrochemistry**

9. Conductometric titration of hydrochloric acid against sodium Hydroxide.
10. Conductometric titration of mixture of acids against sodium Hydroxide.
11. Potentiometric titration of ferrous ion against potassium dichromate using quinhydrone electrode.

**TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu	Sultan Chand & Sons, New Delhi	1997
2.	Inorganic Semimicro Qualitative analysis	V.V. Ramanujam	National Publishing Co	1971
3.	Practical Chemistry	O.P. Pandey, D.N. Bajpai and S. Giri	S. Chand	2010
4.	Practical Chemistry	Sonia Ratnani, Swati Agarwal and sujeet mishra	Mc Grew Hills	2020

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Practical in Physical Chemistry	P.S. Sindhu	Macmillan India: New Delhi	2005
2.	Senior Practical Physical Chemistry	B.D. Khosla, V.C. Garg, A. Gulati	R. Chand: New Delhi	2011
3.	Practical Physical Chemistry	Gupta, Renu	New Age International: New Delhi	2017
4.	General Practical Chemistry	M.M. Ajaily A.A. Maihub and R.K. Mohapatra	Central West Publishing	2020
5.	General Chemistry Experiments	Anil J Elias	Universities Press	2008

## SEMESTER – V

<b>ECC – II</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 2</b>
<b>Course Code: M23UVE01</b>	<b>VALUE EDUCATION – YOGA</b>	<b>Contact Hours per Week: 2</b>

### OBJECTIVES

- To understand physical body and Health concepts.
- To have the basic Knowledge on Simplified Physical Exercises and Asanas and Meditation.
- To Introspect and improve the behaviors.
- To inculcate cultural behavioral patterns.

பாட நோக்கம் :

- உடல் நலம் பற்றித் தெளிதல்
- உடற்பயிற்சி, யோகாசனங்கள் கற்றுக் கொள்ளல்
- அகத்தாய்வுப் பயிற்சிகளைக் கற்றுக்கொள்ளுதல்
- நல்லொழுக்க பண்பாட்டு முறைகளை கற்பித்தல்

### UNIT-I: Yoga and Physical Health

[6 Hours]

Health - Meaning and Definition - Physical Structure - Three bodies - Five limitations - Simplified Physical Exercises - Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana 1,2, Massage, Acu pressure, Relaxation exercises - Yogasanas - Surya namaskar - Padmasana - Vajrasana - Ardha katti Chakrasana - Viruchasana - Yogamudra - Patchimothasana - Ustrasana - Vakkarasana - Salabasana.

#### அலகு-I: யோகமும் உடல்நலமும்

6 மணிகள்

வாழ்க்கை நலம் - உடலமைப்பு - மூன்று உடல்கள் - ஐந்தில் அளவுமுறை - எளியமுறை உடற்பயிற்சி - கை, கால், மூச்சு, கண் பயிற்சிகள் - கபாலபதி, மகராசனம், உடல் வருடுதல், அக்கு பிரஷர், உடல் தளர்த்தல் பயிற்சி முறை, ஆசனம் - சூரிய வணக்கம் - பத்மாசனம் - வஜ்ராசனம் - அர்த்தகட்டி சக்கராசனம் - விருச்சாசனம் (ஏகபாதாசனம்) - யோகமுத்ரா - பச்சி மோத்தாசனம் - உஸ்ட்ராசனம் - வக்கராசனம் - சலபாசனம்.

### UNIT-II: Greatness of Life Force and Mind

[6 Hours]

Maintaining youthfulness - Postponing the ageing process - Sex and spirituality - Significance of sexual vital fluid - Married life - Chastity - Development of mind in stages - Mental Frequencies - Methods for Concentration - Meditation and its Benefits.

#### அலகு-II: உயிர்வளமும் மனவளமும்

6 மணிகள்

இளமை காத்தல் - முதுமையைத் தள்ளிப்போடுதல் - பாலுணர்வும் ஆன்மீகமும் - வித்தின் மகிமை - இல்லற வாழ்வு - கற்புநெறி - மனம் அறிவாக இயங்கும் மனதின் பத்துப் படிநிலைகள் - மன அலைச்சூழல் - தவநிலைகள் - தவத்தின் பயன்கள்.

**UNIT-III: Personality Development – Sublimation****[6 Hours]**

Purpose and Philosophy of Life - Introspection - Analysis of Thought - Moralization of Desire - Analysis and practice - Neutralization of Anger - Strengthening of will-power.

**அலகு-III: குணநலப்பேறு****6 மணிகள்**

வாழ்வின் நோக்கமும், வாழ்க்கைத் தத்துவமும் - அகத்தாய்வு - எண்ணம் ஆராய்தல் - ஆசை சீரமைத்தல் - பயிற்சி - சினம் தவிர்த்தல் - சினத்தை வெல்ல ஒரு சீரிய பயிற்சி முறை.

**UNIT-IV: Human Resources Development****[6 Hours]**

Eradication of Worries - Analysis and Eradication practice - Benefits of Blessings - Effect of good vibrations - Greatness of Friendship - Guidance for good Friendship - Individual Peace and world peace - Good cultural behavioral patterns.

**அலகு-IV: மனிதவள மேம்பாடு****6 மணிகள்**

கவலை ஒழித்தல் - கவலை ஒழித்தல் பயிற்சிமுறை - வாழ்த்தும் பயனும் - அலை இயக்கம் - நட்பு நலம் - நல்ல நட்பு - தனிமனித அமைதி - உலக அமைதி - நல்லொழுக்கப் பண்பாட்டு முறைகள்.

**UNIT-V: Law of Nature****[6 Hours]**

Unified force - Cause and effect system - Purity of thought deed and Genetic Centre - Love and Compassion - Gratitude - Cultural Education - Fivefold culture.

**அலகு-V: இயற்கை நியதி****6 மணிகள்**

ஒருங்கிணைப்பு ஆற்றல் - செயல்விளைவுத் தத்துவம் - கருமையத் தூய்மைக்கும், வளத்துக்கும் ஏற்ற செயல்கள் - அன்பும் கருணையும் - நன்றியுணர்வு - பண்பாட்டுக்கல்வி - ஐந்தொழுக்கப் பண்பாடு.

**REFERENCE BOOKS**

1. Vethathiri Maharishi, 2011, Journey of Consciousness, Erode, Vethathiri Publications.
2. Vethathiri Maharishi, 2014, Simplified Physical Exercises, Erode, Vethathiri Publications.
3. Vethathiri Maharishi, 2004, Unified force, Erode, Vethathiri Publications
4. Yoga for Modern age - Thathuvagnani Vethathiri Maharishi
5. Sound Health through yoga – Dr. K. Chandrasekaran, November 1999 Prem Kalyan Publications, Madurai
6. Light on yoga – B.K.S. Iyenger
7. Thathuvagnani Vethathiri Maharishi – Kayakalpa yoga – First Edition 2009 – Vethathiri Publications, Erode.
8. Environmental Studies - Bharathidasan University Publication Division.

**பார்வை நூல்கள்**

வ. எண்	ஆசிரியர்	நூல் பெயர்	பதிப்பகம்	பதிப்பு ஆண்டு
1.	அறிஞர்குழு ஆழியாறு	மனவளக்கலை யோகா	உலக சமுதாய சேவா சங்கம் வேதாத்திரி பதிப்பகம்	2008
2.	அறிஞர்குழு ஆழியாறு	மனவளக்கலை யோகா-I	உலக சமுதாய சேவா சங்கம் வேதாத்திரி பதிப்பகம்	2009
3.	அறிஞர்குழு ஆழியாறு	மனவளக்கலை யோகா-II	உலக சமுதாய சேவா சங்கம் வேதாத்திரி பதிப்பகம்	2012
4.	அறிஞர்குழு ஆழியாறு	மனவளக்கலை யோகா-III	உலக சமுதாய சேவா சங்கம் வேதாத்திரி பதிப்பகம்	2015
5.	அறிஞர்குழு ஆழியாறு	எளிமுறை உடற்பயிற்சி	உலக சமுதாய சேவா சங்கம் வேதாத்திரி பதிப்பகம்	2009

## SEMESTER – VI

<b>CORE – VIII</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 4</b>
<b>Course Code: M23UCH08</b>	<b>ORGANIC CHEMISTRY – II</b>	<b>Contact Hours per Week: 5</b>

### OBJECTIVES

To this course aims at providing knowledge on classification, isolation and discussing the properties of alkaloids and terpenes, preparation and properties of saccharides, biomolecules, different molecular rearrangement, preparation and properties of organometallic compounds.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Memorize the isolation and properties of alkaloids and terpenes.	K1
CO2	Give the preparation and reactions of mono and disachharides.	K2
CO3	Categorize biomolecules and natural products based on their structure, properties, reactions and uses.	K3
CO4	Classify biomolecules and natural products based on their structure, properties, reactions and uses.	K4
CO5	Indicate the preparation and properties of organolithium compounds.	K2

### UNIT-I: Alkaloids & Terpenes

**[15 Hours]**

Alkaloids: Classification, isolation, general properties - Hofmann Exhaustive Methylation; Structure elucidation – Coniine, Piperine, Nicotine.

Terpenes: Classification, Isoprene rule, isolation and structural elucidation of Citral, Alpha terpineol, Menthol, Geraniol and Camphor.

### UNIT-II: Carbohydrates

**[15 Hours]**

Definition and classification of carbohydrates with examples. Relative configuration of sugars. Determination of configuration (Fischer's Proof). Definition of enantiomers, diastereomers, epimers and anomers with suitable examples. Monosaccharides: Configuration – D and L hexoses – aldohexoses and ketohexoses. Glucose, Fructose – Occurrence, preparation, properties, reactions, structural elucidation, uses. Interconversions of sugar series – ascending, descending, aldose to ketose and ketose to aldose.

Disaccharides: Sucrose, lactose, maltose - preparation, properties

and uses (no structural elucidation). Polysaccharides: Source, constituents and biological importance of homo polysaccharides - starch and cellulose, heteropolysaccharides – hyaluronic acid, heparin.

**UNIT-III: Molecular rearrangements [15 Hours]**

Molecular Rearrangement: Type of rearrangements, Mechanism for Benzidine, Favorskii, Claisen, Fries, Hofmann, Curtius, Schmidt and Beckmann, Pinacol-pinacolone rearrangement.

**UNIT-IV: Special reagents & Organometallic compounds [15 Hours]**

Special reagents in organic synthesis: AIBN, 9BBN, BINAP/BINOL, BOC, DABCO, DCC, DIBAL, DMAP, NBS/NCS, NMP, PCC, TBHP, TEMPO.

Organometallic compounds in Organic Synthesis: Preparation, Properties and application: Grignard Reagents, Organo Lithium Compounds, Ziegler – Natta, Wilkinson, Metal Carbonyl, Zeiss's Salt.

**UNIT-V: Green Chemistry [15 Hours]**

Principles, chemistry behind each principle and applications in chemical synthesis. Green reaction media – green solvents, green reagents and catalysts; tools used like microwave and ultra-sound in chemical synthesis.

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Modern Organic Chemistry	M.K. Jain, S.C. Sharma	Vishal Publishing	2009
2.	Reaction Mechanism in Organic Chemistry	S.M. Mukherji, S.P. Singh	India Ltd, New Delhi	2009
3.	Advanced organic chemistry	Arun Bahl and B.S. Bahl	S. Chand & Company Pvt. Ltd	2012
4.	Text Book of Organic Chemistry	P.L. Soni and H.M. Chawla	Sultan Chand & Sons, New Delhi	2007
5.	An Insight into Green Chemistry	C. Bandyopadhyaya	S. Chand & Company Pvt. Ltd	2020

**REFERENCE BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Organic Chemistry	R.T. Morrison and R.N. Boyd	Pearson Education, Asia	2012
2.	Organic Chemistry	T.W. Graham Solomons	John Wiley & Sons	2012

3.	Organic Chemistry	A. Carey Francis	Tata McGraw-Hill Education Pvt. Ltd., New Delhi	2009
4.	Organic Chemistry	I.L. Finar	England, Wesley Longman Ltd	2006
5.	Heterocyclic Chemistry	J.A. Joule and G.F. Smith	John Wiley & Sons	2010

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER - VI

<b>CORE - X</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 4</b>
<b>Course Code: M23UCH09</b>	<b>INORGANIC CHEMISTRY - II</b>	<b>Contact Hours per Week: 4</b>

### OBJECTIVES

To this course aims to provide knowledge on tracer elements and their role in the biological system, iron transport and storage, metallo enzymes, oxygen transport, silicates and their applications, industrial applications of refractories, alloys, paints and pigments.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Relate to explain the importance of tracer elements on biological system.	K1
CO2	Express the metal ion transport, Bohr effect, Na, K, Ca pump.	K2
CO3	Analyze the function of Vitamin B12, Zn-Cu enzyme, ferredoxin, cluster enzymes.	K3
CO4	Sketch out classification and structure of silicates.	K4
CO5	Elaborate the manufacture of refractories, explosives, paints and pigments.	K4

### UNIT-I: Bioinorganic Chemistry [12 Hours]

Essential and trace elements: Role of  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Cu}^{2+}$  and  $\text{Zn}^{2+}$  in biological systems. Effect of excess intake (Toxicity) of Metal ions – trace elements - As, Cd, Pb, Hg.

### UNIT-II: Metal ion transport and storage [12 Hours]

Iron – storage, transport - Transferrin and Ferritin; Iron-porphyrins – myoglobin, haemoglobin – oxygen transport - Bohr effect; Sodium/potassium pump, calcium pump; transport and storage – copper and zinc.

### UNIT-III: Metallo enzymes [12 Hours]

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 -  $2\text{Fe}-2\text{S}$  – rubredoxin,  $4\text{Fe}-2\text{S}$  –

ferridoxin, Iron sulphur cluster enzymes. Invivo and Invitro nitrogen fixation – biological functions of nitrogenase and molybdo enzymes.

#### **UNIT-IV: Silicates**

**[12 Hours]**

Introduction – 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 dimensional structure (feldspars, zeolites, ultramarines).

#### **UNIT-V: Industrial Applications of Inorganic Compounds [12 Hours]**

Refractories, pyrochemical, explosives. Alloys, paints and pigments - requirements of a good paint; classification, constituents of paints – pigments, vehicles, thinners, driers, extenders, anti-knocking agents, anti-skinning agents, plasticizers, binders - application; varnishes - oils, spirit; enamels. Nano composite Hydrogels: synthesis, characterization and uses.

#### **TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Principles of Inorganic Chemistry	B.R. Puri, L. R. Sharma, K.C. Kalia	Milestone Publishers & Distributors, New Delhi	2011
2.	Advanced Inorganic Chemistry	Satya Prakash, G.D. Tuli, S.K. Basu, R.D. Madan	S. Chand & Co., New Delhi	2009
3.	Concise Inorganic Chemistry	J.D. Lee	Concise Inorganic Chemistry	1991
4.	Selected Topics in Inorganic Chemistry	W.V. Malik, G.D. Tuli, R.D. Madan	S. Chand and Company Ltd	2000
5.	Text book of Inorganic Chemistry	A.K. De	Wiley East Ltd	1992

#### **REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Modern Inorganic Chemistry	R.D. Madan, Sathya Prakash	S. Chand and Company, New Delhi	2003

2.	Inorganic Chemistry for Undergraduates	R. Gopalan	University Press (India) Private Ltd, Hyderabad	2009
3.	Inorganic Chemistry	B. Sivasankar	Pearson, Chennai	2013
4.	Inorganic chemistry	Alan G. Sharp	Addition-Wesley, England	1992
5.	Inorganic Chemistry	Peter Atkins, Tina Overton, Jonathan Rourke and Mark Weller	Oxford University Press	2014

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

**SEMESTER - VI**

<b>CORE - XI</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 4</b>
<b>Course Code: M23UCH10</b>	<b>PHYSICAL CHEMISTRY - II</b>	<b>Contact Hours per Week: 4</b>

**OBJECTIVES**

To this course aims at providing an overall view of the phase diagram of one and two component systems, chemical equilibrium, separation techniques for binary liquid mixtures, electrical conductance and transport number, galvanic cells, EMF and significance of electrochemical series.

**COURSE OUTCOMES**

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Recognize the phase diagram for one component and two component systems, properties of freezing mixture, component with congruent melting points and solid solutions.	K1
CO2	Express the concepts of chemical equilibrium in dissociation of $\text{PCl}_5$ , $\text{N}_2\text{O}_4$ and formation of HI, $\text{NH}_3$ , $\text{SO}_3$ and decomposition of calcium carbonate, important principles such as Lechatelier principle, van't Hoff reaction isotherm and Clausius-Clayperon equation.	K2
CO3	Analyze an appropriate distillation method for the separation of binary liquid mixtures such as azeotropic mixtures, partially miscible mixtures and immiscible liquids.	K3
CO4	Enumerate the significance of Arrhenius theory, Debye-Huckel theory, Onsager equation and Kohlrausch's law in conductance.	K4
CO5	Sketch the electrochemical cell with the help of electrochemical series and calculate cell EMF, applications of EMF and significance of potentiometric titrations.	K3

**UNIT-I: Phase rule****[12 Hours]**

Definition of terms; derivation of phase rule; application to one component systems - water and sulphur - super cooling, sublimation; two component systems - solid liquid equilibria - simple eutectic (lead - silver), freezing mixtures (potassium iodide-water), compound formation with - congruent melting points (magnesium - zinc and ferric chloride - water

system), peritectic change (sodium – potassium), solid solution (gold-silver); copper sulphate – water system.

**UNIT-II: Chemical equilibrium [12 Hours]**

Law of mass action – thermodynamic derivation – relationship between  $K_p$  and  $K_c$  – application to the homogeneous equilibria – dissociation of  $PCl_5$  gas,  $N_2O_4$  gas – equilibrium constant and degree of dissociation – formation of HI,  $NH_3$ , and  $SO_3$  – heterogeneous equilibrium – decomposition of solid calcium carbonate – Lechatelier principle – Van't Hoff reaction isotherm – temperature dependence of equilibrium constant – Van't Hoff reaction isochore – Clayperon equation – Clausius Clayperon equation and its applications.

**UNIT-III: Binary liquid mixtures [12 Hours]**

Ideal liquid mixtures – non ideal solutions – azeotropic mixtures – fractional distillation – partially miscible mixtures – Phenol-water, Triethylamine-water, Nicotine-water – effect of impurities on critical solution temperature; immiscible liquids – steam distillation; Nernst distribution law – applications.

**UNIT-IV: Electrical Conductance and Transference [12 Hours]**

Arrhenius theory of electrolytic dissociation – Ostwald's dilution law, limitations of Arrhenius theory; behavior of strong electrolytes – interionic effects – Debye Huckel theory – Onsager equation (no derivation), significance of Onsager equation, Debye Falkenhagen effect, Wien effect.

Transport number – determination – Hittorf's method, moving boundary method – factors affecting transport number.

Kohlrausch's law – applications; molar ionic conductance and viscosity (Walden's rule); applications of conductance measurements – determination of degree of dissociation of weak electrolyte, dissociation constant of weak acid and weak base, ionic product of water, solubility and solubility product of sparingly soluble salts – conductometric titrations – acid base titrations.

**UNIT-V: Galvanic Cells and Applications [12 Hours]**

Galvanic cell, representation, reversible and irreversible cells, EMF and its measurement – standard cell; sign of EMF and spontaneity of a reaction, thermodynamics and EMF – calculation of  $\Delta G$ ,  $\Delta H$ , and  $\Delta S$  from EMF data.

Electrode potential, standard electrode potential, primary and secondary reference electrodes, Nernst equation for electrode potential and cell EMF; types of electrodes – metal/metal ion, metal amalgam/metal ion, metal, insoluble salt/anion, gas electrode, redox electrode; electrochemical series – applications of electrochemical series.

Applications of EMF measurements – determination of

activity coefficient of electrolytes, transport number, valency of ions, solubility product, pH using hydrogen gas electrode, quinhydrone electrode and glass electrode, potentiometric titrations – acid base titrations, redox titrations, precipitation titrations, ionic product of water and degree of hydrolysis.

Industrial component: Galvanic cells - lead storage, Ni-Cd, batteries. Fuel cells – H<sub>2</sub>-O<sub>2</sub> cell – efficiency of fuel cells.

### TEXT BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Principles of Physical Chemistry	B.R. Puri and L.R. Sharma	Shoban Lal Nagin Chand and Co	2021
2.	Physical Chemistry	Peter Atkins, and Julio de Paula, James Keeler	Oxford University Press	2018
3.	Essentials of Physical Chemistry	Arun Bahl, B.S. Bahl, G.D. Tuli	S. Chand & Co	2019
4.	Physical Chemistry Through Problems	S.K. Dogra and S. Dogra	New Age International	1996
5.	Thermodynamics	J. Rajaram and J.C. Kuriacose	Shoban Lal Nagin Chand and CO	1986

### REFERENCE BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	A Textbook of Physical Chemistry	K.L. Kapoor	Macmillan India Ltd	2009
2.	Physical Chemistry	Gilbert W. Castellen	Narosa Publishing House	1985
3.	Physical Chemistry	P.W. Atkins and Julio de Paula	Oxford University Press	2002
4.	Principles of Physical Chemistry	B.R. Puri, L.R. Sharma and M.S. Pathania	Shoban Lal Nagin Chand and Co Jalendhar	2001
5.	Advanced Physical Chemistry	D.N. Bajpai	S. Chand & Co	2001

### Mapping with Programme Specific Outcomes

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – VI

<b>ELECTIVE – III</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHDSE7</b>	<b>DISCIPLINE SPECIFIC ELECTIVE – III FUNDAMENTALS OF SPECTROSCOPY</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course is designed to provide knowledge on electrical and magnetic properties of organic and inorganic compounds, basic principles of microwave, UV-Visible, infrared, Raman, NMR and Mass spectrometry, instrumentation and applications of various spectral techniques in structural elucidate solving combined spectral problems.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Recognize electrical and magnetic properties of materials and microwave spectroscopy.	K1
CO2	Represent theory, instrumentation and applications of Infrared and Raman spectroscopy.	K2
CO3	Assume selection rules to understand spectral transitions, Woodward – Fieser’s rule for the calculation of wavelength maximum of conjugated dienes.	K3
CO4	Elucidate theory, instrumentation and applications of NMR spectroscopy.	K4
CO5	Outline theory, instrumentation and applications of Mass spectrometry.	K2

### UNIT-I: Electrical and Magnetic properties of molecules [9 Hours]

Dipole moment – polar and nonpolar 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; diamagnetism, paramagnetism – determination of magnetic susceptibility using Guoy balance, ferromagnetism, anti-ferromagnetism.

Microwave spectroscopy: Rotation spectra - diatomic molecules (rigid rotator approximation) selection rules – determination of bond length, effect of isotopic substitution – instrumentation and applications

### UNIT-II: Ultraviolet and Visible spectroscopy [9 Hours]

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 – Pre-dissociation energy – Types of electronic transition -  $\sigma\text{-}\sigma^*$ ,  $\pi\text{-}\pi^*$ ,  $n\text{-}\sigma^*$ ,  $n\text{-}\pi^*$  transitions. Chromophore, Auxochromes, Bathochromic shift and Hypsochromic shift, Applications of UV – Woodward-Fieser rules as applied to conjugated dienes and  $\alpha$ ,  $\beta$  - unsaturated ketones.

**UNIT-III: Infrared and Raman spectroscopy [9 Hours]**

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 – isotopic shift – application of IR spectra to simple organic and inorganic molecules.

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. Difference between IR and Raman spectroscopy.

**UNIT-IV: Nuclear magnetic resonance spectroscopy [9 Hours]**

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; spin-spin splitting of neighbouring protons in vinyl and allyl systems.

**UNIT-V: Mass spectrometry [9 Hours]**

Principle – different kinds of ionisation – instrumentation – the mass spectrum – types of ions – determination of molecular formula-fragmentation and structural elucidation – McLafferty rearrangement Retro Diels Alder reaction - illustrations with simple organic molecules.

Solving structure elucidation problems using multiple spectroscopic data (NMR, MS, IR and UV-Vis).

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Elements of Analytical Chemistry	R. Gopalan P. Subramaniam S. Rengarajan	S. Chand, New Delhi	2003

2.	Analytical Chemistry	S. Usharani	Macmillan, India	2002
3.	Fundamentals of Molecular Spectroscopy	C.N. Banwell, E.M. McCash	Tata McGraw Hill, New Delhi	2017
4.	Analytical Chemistry Theory and Practice	U.N. Dash	Sultan Chand & Sons	2005
5.	Spectroscopy	B.K. Sharma	Goel Publishing House	2011

### REFERENCE BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Chemical Analysis an Instrumental Approach	A.K. Srivastava, P.C. Jain	S. Chand, New Delhi	1997
2.	Introduction to Instrumental Analysis	Robert D Braun	McGraw Hill, New York.	1987
3.	Fundamentals of Analytical Chemistry	D.A. Skoog, S.R. Holler, F.J. West	Harcourt college Publishers, USA	2013
4.	Physical Chemistry	R.L. Madan, G.D. Tuli	S. Chand, New Delhi	2005
5.	Principles of Physical Chemistry	B.R Puri, L.R. Sharma, M.S. Pathania	Vishal Publishing, New Delhi	2008

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – VI

<b>ELECTIVE – III</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHDSE8</b>	<b>DISCIPLINE SPECIFIC ELECTIVE – III GREEN CHEMISTRY</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course can give idea about basic principles and importance of green chemistry and its application.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Acquire basic principles and tools of green chemistry.	K1
CO2	Discuss microwave mediated organic synthesis.	K2
CO3	Relate the synthetic applications of ionic liquids.	K3
CO4	Analyze supported catalysts and bio-catalysts for Green chemistry.	K4
CO5	Distinguish of modified bio catalysts.	K2

### UNIT-I: Green chemistry

[9 Hours]

Need for green chemistry – principles of green chemistry – atom economy – definition with example (ibuprofen synthesis) – green oxidant – hydrogen peroxide. Microwave assisted organic synthesis – apparatus required – examples of MAOS – advantages and disadvantages of MAOS. Organic reactions by Sonication method – apparatus required – examples of sonochemical reactions (Heck, Hundsdiecker and Wittig reactions).

### UNIT-II: Green Reactions

[9 Hours]

Acetylation of primary amine, base catalyzed aldol condensation (synthesis of dibenzalpropanone), halogen addition to C=C bond (bromination of trans-stilbene), [4+2] cyclo addition reaction (Diels-Alder reaction between furan and maleic acid). Electrophilic aromatic substitution reactions (nitration of phenol, bromination of acetanilide), zeolite catalyzed Friedel-Crafts acylation.

### UNIT-III: Green Solvents

[9 Hours]

Ionic liquids: simple preparation – types – properties and application – ionic liquids in organic reactions (Heck reaction, Suzuki reactions, epoxidation) - advantages and disadvantages. Diels-Alder reaction in water – catalysis in water (aerobic oxidation of alcohols catalyzed by Pd(II) / bathophenanthroline).

**UNIT-IV: Green catalysts and Biocatalysts****[9 Hours]**

Supported catalysts and bio-catalysts for Green chemistry  
Introduction – the concept of atom economy – supported metal catalysts – mesoporous silicas – the use of Biocatalysts for green chemistry.

**UNIT-V: Modified bio catalysts****[9 Hours]**

Fermentations and biotransformations – fine chemicals by microbial fermentations – vitamins and amino acids – Baker's yeast mediated biotransformations – Bio-catalyst mediated Baeyer-Villiger reactions – Microbial polyester synthesis.

**TEXT BOOKS**

<b>S. No</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	New Trends in Green Chemistry	V.K. Ahluwalia, M. Kidwai	Anamaya Publishers	2012
2.	Organic Synthesis - Special Techniques	V.K. Ahluwalia, Renu Aggarwal	Techniques Narosa Publishing House	2012
3.	Environmental Chemistry	A.K. De	Wiley Eastern Ltd., New Delhi.	1989
4.	Green Chemistry	A. Gurtu J.N. Gurtu	Pragati Prakashan Publisher	2019

**REFERENCE BOOKS**

<b>S. No</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Green Chemistry – Environmentally benign reactions	V.K. Ahluwalia	Ane Books India	2006
2.	Green Chemistry – Environment friendly alternatives	Rashmi Sanghi & M.M. Srivastava	Narora Publishing House	2003
3.	Green Chemistry – Frontiers in benign chemical synthesis and processes	Paul T. Anastas & Tracy C. Williamson	Oxford University Press	1998
4.	Industrial Application of Green Solvents	Inamuddin, Mohd Imran Ahmed, M. aniri	Materials Research Forum LLC.	2019

### Mapping with Programme Specific Outcomes

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – VI

<b>ELECTIVE – III</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHDSE9</b>	<b>DISCIPLINE SPECIFIC ELECTIVE – III DYE AND TEXTILE CHEMISTRY</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course student could understand differentiate the types of dyes and know the process and mechanism of dyeing process in textiles industry.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Understand basic concepts dye and textile chemistry.	K1
CO2	Classify dyes based on structure and mechanism and Fibres.	K2
CO3	Distinguish Dyes and pigments, impurities of fibres.	K3
CO4	Examine the synthesis and applications to various dyes and dyeing process.	K3
CO5	List out the applications of dyes in different areas.	K4

### UNIT-I: Colour and constitution

[9 Hours]

Colour of substances - Complementary colours - Classification of dyes based on chemical constitution and method of applications; General properties - linearity, coplanarity and fastness - Colour index and its significance.

### UNIT-II: Pigments

[9 Hours]

Requirements of a pigment – Organic / inorganic pigments & their uses in paints. Reactions of dyes with fibre & water. Fluorescent Brightening Agents. Applications of dyes in other areas – Medicine, chemical analysis, cosmetics, colouring agents, foods and beverages.

### UNIT-III: Fibre

[9 Hours]

Fibre – polymers and polymerization - Morphology of fibres – Molecular arrangements in fibres. General classification of fibres - chemical structure, properties and uses of the following natural fibres (a) natural cellulosic fibres (cotton and jute) (b) natural protein fibre (wool and silk) - synthetic fibres (i) Man-made cellulosic fibres (Rayon, modified cellulosic fibres) (ii)

Man-made protein fibres (Azions) (iii) Poly amide fibres (different types of nylons) (iv) Poly ester fibres (v) Acrylic fibres and (vi) Olefin fibres.

#### **UNIT-IV: Impurities of fibre**

**[9 Hours]**

Impurities in raw cotton and grey cloth, wool and silk- general principles of the removal – Scouring – bleaching – Desizing – Kierboiling- Chemicking Chemical and machinery use- Degumming and Bleaching of silk Scouring and Bleaching of wool.

#### **UNIT-V: Dyeing**

**[9 Hours]**

Dyeing – Classification of dyes and their properties - applications – direct, basic, sulphur and azoic dyes on cotton. Application of vegetable and other colour to cotton. Dyeing of wool and silk – Fastnerss properties of dyed materials – dyeing of nylon, terylene and other synthetics. Finishes given to fabrics - Mechanical finishes on cotton, wool and silk, method used process of mercerizing – Anti-crease and Anti-shrink finishes – Water proofing.

#### **TEXT BOOKS**

<b>S. No</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Synthetic Dyes	Gurdeep R Chatwal	Himalaya Publishing House (Pvt)	2016
2.	A Text Book of Synthetic Dyes	O.D. Thyagi, M. Yadav	Anmol Publication (Pvt) Ltd.	2002
3.	The chemistry of synthetic dyes Part I & II	K. Venkataraman	Academic Press, New York	1952
4.	Chemical Technology of fibrous Materials	F. Sadov, M. Horchagin and A. Matetshy	Mir Publishers	1973
5.	The Identification of Textile Fibres	M.M. Houck	Woohead Publishing	2009

#### **REFERENCE BOOKS**

<b>S. No</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Chemistry of Dyes and Principles of Dyeing Vol.- II	V.A. Shenai	Sevak Prakashan, Mumbai	1987

2.	The Dyeing of Synthetic Polymer and Acetate Fibres	D. M. Nunn	Dyers Company, Publication Trust.	1979
3.	Dyes and their Intermediates	E.N. Abrahart	Edward Arnold Publishers	1977
4.	Synthetic Dyes	Pope Sine	Neha Publishers	2016
5.	Textile Chemistry –Vol.II	R.H. Peters	Elserier, Avesterdam	1967

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – VI

<b>ELECTIVE – IV</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHDSE10</b>	<b>DISCIPLINE SPECIFIC ELECTIVE – IV PHARMACEUTICAL CHEMISTRY</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course aims at providing an overall view of drugs design and drug metabolism, important Indian medicinal plants, common diseases and antibiotics, drugs for major diseases like cancer, diabetes and AIDS analgesics and antipyretic agents and significance of clinical tests.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Define the pharmaceutical terminologies, principles in pharmacological activity, clinical chemistry, hematology, therapeutic drugs and treatment of diseases, types of IPR and trademarks.	K1
CO2	Express the development of drugs, structural activity, disease types, physio- chemical properties of therapeutic agents, significance of medicinal plants, clinical tests and factors for patentability.	K2
CO3	Apply the principles involved in structural activity and drug designing, functions of haematological agents, clinical parameters and therapeutic application of drugs for major diseases.	K3
CO4	Classify of analgesics, anesthetics, and physiological functions of plasma proteins.	K4
CO5	Explain the significance of clinical tests like blood urea, serum proteins and coronary risk index.	K3

### UNIT-I: Introduction

**[9 Hours]**

Important terminologies – drug, pharmacognosy, pharmacy, pharmacology, pharmacodynamics, pharmacokinetics, clinical pharmacology, pharmacotherapeutics, chemotherapy, toxicology, pharmacophore, antimetabolites, mutation, bacteria, virus, fungi, actinomycetes, vaccines, pharmacopeia, posology and therapeutic index.

Sources of drugs – dosage forms – bio availability – routes of administration – absorption, distribution and elimination of drugs – drug metabolism – prescription terms. Structure and pharmacological activity: Effect of unsaturation, chain length, isomerism; groups - halogens amino, nitro, nitrite, cyano, acidic, aldehydic, keto, hydroxyl and alkyl groups.

**Unit-II: Indian medicinal plants****[9 Hours]**

Some important Indian medicinal plants – tulsi, neem, kizhanelli, mango, semparuthi, adadodai, turmeric and thoothuvalai – uses. Common diseases and their treatment: Causes, prevention and treatment of the following diseases: Insect borne diseases – malaria, filariasis, plague; Air borne diseases – diphtheria, whooping cough, influenza, common cold, tuberculosis; Water borne diseases – cholera, typhoid, dysentery. Digestive system – jaundice; Respiratory system – asthma; Nervous system – epilepsy.

Antibiotics: Definition – classification – structure and therapeutic uses of chloramphenicol, penicillins, structure activity relationship of chloramphenicol; therapeutic uses of ampicillin, streptomycin, erythromycin.

**UNIT-III: Drugs for major diseases****[9 Hours]**

Cancer – common causes – chemotherapy – anti neoplastic agents – classification – adverse effects of cytotoxic agents ; alkylating agents – chlorambucil; anti-metabolites – methotrexate, fluouracil; Vinca alkaloids – vincristine, vinblastine.

Diabetes – types – management of diabetes – insulin; oral hypoglycemic agents – sulphonyl ureas – chlorpropamide; biguanides – metformin – thiazolidinediones. Cardiovascular drugs – cardio glycosides; anti-arrhythmic agents – quinidine, propranolol hydrochloride; anti-hypertensive drugs - Aldomet, pentoliniumtartarate.

AIDS – causes, symptoms and prevention – anti HIV drugs - AZT, DDC.

**UNIT-IV: Analgesics and antipyretic agents****[9 Hours]**

Analgesics: Classification – action of analgesics – narcotic analgesics – morphine; synthetic analgesics – pethidine, methadone; antipyretic analgesics – salicylic acid derivatives, indolyl derivatives.

Anaesthetics: Definition, characteristics, classification – general anaesthetics – volatile anaesthetics – nitrous oxide, ethers, cyclopropane, chloroform, halothane, trichloro ethylene – storage, advantages and disadvantages; nonvolatile anaesthetics – thiopental sodium; local anaesthetics – requisites – advantages – esters – cocaine, benzocaine; amides – lignocaine, cinchocaine.

Blood and haematological agents: Blood – composition, grouping – physiological functions of plasma proteins – mechanism of clotting; Coagulants – vitamin K, protamine sulphate, dry thrombin; Anti-coagulants – coumarins, citric acid and heparin; antifibrinolytic agents – aminocaproic acid and tranexamic acid.

Anaemia – causes, types and control – anti anaemic drugs.

**UNIT-V: Clinical Chemistry****[9 Hours]**

Blood tests – blood count – complete haemotogram – Hb, RBC, GTT,

TC, DC, platelets, PCV, ESR; bleeding and clotting time – glucose tolerance test.

Significance of Clinical Tests: Serum electrolytes - blood Glucose - orthotoluidine method; Renal functions tests - blood urea, creatinine; liver function tests - serum proteins, albumin globulin ratio, serum bilirubin, enzymes SGOT, SGPT; lipid profile – cholesterol, triglycerides, HDL, LDL, coronary risk index. Urine examination – pH, tests for glucose, albumin and bile pigment.

### TEXT BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	A Textbook of Pharmaceutical Chemistry	Jayashree Ghosh	S. Chand & Company, New Delhi	1999
2.	Pharmaceutical Chemistry	S. Lakshmi	Sultan chand & sons, New Delhi.	2004
3.	Essentials of Medical Pharmacology	K.D. Tripathi	Jaypee brothers medical publishers (P) Ltd, New Delhi.	2018
4.	Medicinal chemistry	Ashutosh Kar	New ageinternational (P) Ltd, Publishers, New Delhi.	2018

### REFERENCE BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Pharmaceutical Chemistry, Inorganic (Vol-I)	G.R. Chatwal	Himalaya Publishing House, Bombay	2013
2.	Pharmaceutical Chemistry, organic (Vol-II )	G.R. Chatwal	Himalaya Publishing House, Bombay	1991
3.	Instant Notes Medicinal Chemistry	G. Patrick	Viva books Private Limited, New Delhi	2002
4.	Intellectual Property Rights	Neeraj Pandey, Khushdeep	Dharni. Publisher: PHI Learning Pvt. Ltd	2014

### Mapping with Programme Specific Outcomes

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – VI

<b>ELECTIVE – IV</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHDSE11</b>	<b>DISCIPLINE SPECIFIC ELECTIVE – IV POLYMER CHEMISTRY</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course aims at providing an overall view of classification of polymers, preparation of polymers, kinetics of polymerization and characterization of polymers, analytical techniques used to characterize polymers, reactions of polymers, speciality polymers like PVC, PMMA.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	List of polymers, elastomers, fibres and liquid resins.	K1
CO2	Illustrate the addition and condensation polymerization, mechanical properties of polymers.	K2
CO3	Explain the molecular weight of polymers, and explain the thermal properties of polymers.	K3
CO4	Elaborate the reactions of polymers and special polymers like PVC, PMMA, rubbers and biodegradable polymers.	K4
CO5	Examine the polymer processing and degradation of polymer.	K3

### UNIT-I: Introduction

[9 Hours]

Difference between polymer and macromolecule – classification – synthetic and natural, organic and inorganic, thermoplastic and thermosetting. Plastics, elastomers, fibres and liquid resins.

Techniques of polymerization: Bulk, solution, emulsion and suspension polymerization.

### UNIT-II: Kinetics of polymerization & Characterization of polymers

[9 Hours]

Kinetics of condensation and addition polymerisation; ionic, free radical, copolymerisation and coordination polymerisation – reactivity ratios – block and graft copolymers.

Characterization of polymers: Appearance, feel and hardness, density, effect of heat, solubility, combustion, tensile strength, shear, stress, impact strength, mechanical, thermomechanical and rheological properties of polymers in viscoelastic state.

**UNIT-III: Molecular weight and properties of polymers [9 Hours]**

Molecular weight of polymers-number average and weight average, molecular weight distribution, determination of molecular weight polydispersity index – membrane and vapour phase osmometry, light scattering - Zimm plot, ultracentrifuge – sedimentation velocity and sedimentation equilibrium – viscometry – gel permeation chromatography.

Thermal properties of polymers – Glass transition temperature - State of aggregation and state of phase transitions, factors influencing glass transition temperature, importance of glass transition temperature, Heat distortion temperature, TGA / DTA, Crystallinity of polymers: Crystalline behaviour, Degree of Crystallinity.

**UNIT-IV: Reactions of Polymers & Special polymers [9 Hours]**

Reactions of Polymers - Hydrolysis, Acidolysis, Aminolysis, Addition and substitution reactions (One Example Each) Cyclisation, Cross-linking and reactions of specific functional groups in the polymer.

Special polymers: Polyelectrolytes, conducting polymers, polymeric supports for solid phase synthesis, biomedical polymers, liquid crystalline polymers, electroluminescent polymers – two examples of each of these polymers. Polyethylene, PVC, PMMA, polyester; rubber – synthetic and natural, vulcanisation of rubber.

**UNIT-V: Polymer technology & Polymer Degradation [9 Hours]**

Polymer technology: Processing of polymers – casting, thermoforming and moulding – extrusion, compression, blow moulding – foaming, lamination, reinforcing – processing of fibres – melt, wet and dry spinning.

Polymer Degradation: Types of Degradation - Thermal, Mechanical, Ultra Sound, Photo Radiation and Chemical Degradation Methods. Rubber - Natural and Synthetic - Structure, Mechanism of Vulcanisation Biodegradable and Non-Biodegradable Polymers.

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Polymer Science	V.R. Gowariker, N.V. Viswanthan and Jayadev Sreedhar	New Age International, New Delhi	2015
2.	Introductory Polymer Chemistry	G.S. Misra	Wiley Eastern, New Delhi	2010
3.	Principles of Polymer Science	P. Bahadur and N.V. Sastry	Narosa Publishing House, New Delhi:	2005
4.	Polymer Science A	V.K. Ahluwalia Anuradha Mishra	Ane Books India: New Delhi	2008

5.	Organic Chemistry	R.R. Morrison R.N. Boyd S.K. Bhattacharjee	Pearson, New Delhi	2011
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### REFERENCE BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Polymer Science	F.W. Billmeyer	India: Wiley-Interscience	2007
2.	Polymer Chemistry: An Introduction	R.B. Seymour C.E. Jr. Carraher	Marcel Dckker Inc, New York	1981
3.	Outlines of Polymer Technology	R. Sinha	Prentice Hall of India, New Delhi	2000
4.	Polymer Science and Technology	Joel R. Fried	Prentice Hall of India, New Delhi	2014

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – VI

<b>ELECTIVE – IV</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHDSE12</b>	<b>DISCIPLINE SPECIFIC ELECTIVE – IV FORENSIC CHEMISTRY</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course presents an idea about basic science of forensic science, finger print in crime investigation, post-mortem appearances, antidots, Cybercrimes and counterfeit of currency and coins.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Learn about the history and introduction of forensic chemistry.	K1
CO2	Understand the concept of Traces at crime scene.	K2
CO3	Interpret the forensic samples.	K3
CO4	Inspect on arsons, explosives and ballistics at crime scene.	K4
CO5	Examine the cybercrime through network Documents.	K3

### UNIT-I: Introduction

**[9 Hours]**

Functions of forensic science- Historical aspects of forensic science - Definitions and concepts in forensic science- Scope of forensic science - Need of forensic science - Basic principles of forensic science - Branches of forensic science - Forensic science in international perspectives, including set up of INTERPOL and FBI - Duties of forensic scientists - Code of conduct for forensic scientists- Qualifications of forensic scientists- Organizational set up of Forensic Science Laboratories in India.

### UNIT-II: Finger prints & Tracks - Traces

**[9 Hours]**

Finger prints - patterns - classification - uses of finger print in crime investigation - direct and latent prints - development by powders - other methods of development - transfer methods of finger prints-Tracks – Traces - Foot prints - casting of foot prints - residue prints - walking pattern - tire marks - miscellaneous traces & tracks - glass fracture - tool marks – paints - fibres.

**UNIT-III: Human Specific Physical Evidences and Analysis [9 Hours]**

Blood – semen – saliva – sweat – urine – hair – skin - DNA analysis- Poisons - types and classification-diagnosis of poisoning in the living and in the dead - clinical symptom - post-mortem appearances - treatment in cases of poisoning – antidotes- Hand writing comparison- genuine and forged writing- collection of samples- detection.

**UNIT-IV: Arsons, Explosives and Ballistics [9 Hours]**

Natural fires and arson - nature of action of fire - drifts and air supply - burning characteristics. Explosives - definition – classification - composition and mechanism of explosion - bombs. Ballistics – classification - internal, external and terminal ballistics - small arms -classification and characteristics - laboratory examination of barrel washing and detection of powder residues by chemical tests.

**UNIT-V: Cybercrimes and documents [9 Hours]**

Cybercrimes - crime through network Documents - Chemistry of paper and ink - writing paper - carbon paper – chalk – adhesives - sealing waxes - different types of forged signatures - simulated and traced forgeries -inherent signs of forgery models - writing of forged models - writing deliberately modified - use of ultraviolet rays - comparison of type written letters - counterfeit of currency and coins.

**TEXT BOOKS**

<b>S. No</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Basic principles of Forensic Chemistry	Javad I. Khan, J. Thomas, Kennedy, R. Dobbell, Jr Christian	Springer Science and Business media	2002
2.	Forensic Chemistry: Fundamentals and applications	Jay Siegel	Wiley – Blackwell	2015
3.	Role of Forensic Science in the New Millennium	M. K Bhasin and S. Nath	University of Delhi	2002

**REFERENCE BOOKS**

<b>S. No</b>	<b>Title of the Book</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Forensic Science in India: A vision for the Twenty First Century	B.B. Nanda and R.K Tiwari	select publishers, New Delhi	2001
2.	Forensic Science: An introduction to scientific and Investigative Techniques	S.H. James and J.J. Nordby	CRC Press, Boca Raton	2005
3.	Forensic Chemistry	K. Kobilinsky	John Wiley	2012
4.	Fisher's Techniques of Crime scene Investigation	R. Saferstein, M.L. Hastrup and C. Hald	CRC Press, Boca Raton	2013

**Mapping with Programme Specific Outcomes**

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – VI

<b>CORE PRACTICAL – VI</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHP06</b>	<b>PRACTICAL – VI - GRAVIMETRIC ESTIMATION</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course aims at providing basic principles of an analytical chemistry experiment and hands on experience in carrying out the experiments.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Apply the principles and methodology for the practical work.	K3
CO2	Analyze the procedure, data and methodology for the practical work.	K4
CO3	Explain the principles for carrying out the practical work.	K3

### UNIT-I: GRAVIMETRIC ESTIMATION

1. Estimation of Barium as Barium sulphate
2. Estimation of Barium as Barium chromate
3. Estimation of Lead as Lead Chromate
4. Estimation of Calcium as Calcium oxalate monohydrate
5. Estimation of Sulphate as Barium sulphate
6. Estimation of Chloride as silver chloride
7. Estimation of Nickel as Nickel dimethyl glyoxime

### TEXT BOOKS

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu	Sultan Chand & Sons, New Delhi	1997
2.	Inorganic Semimicro Qualitative analysis	V.V. Ramanujam	National Publishing Co	1971

3.	Practical Chemistry	O.P. Pandey, D.N. Bajpai and S. Giri	S. Chand	2010
4.	Practical Chemistry	Sonia Ratnani, Swati Agarwal and sujcet mishra	Mc Grew Hills	2020

### REFERENCE BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Vogel's Textbook of Quantitative Inorganic Analysis	J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham	ELBS/Longman, England	1986
2.	Experimental Inorganic Chemistry	W.G. Palmer	Van Nostril and Reinhold Co., London	1972
3.	Vogel's Text book of Macro and Semimicro Qualitative Inorganic analysis	G. Svehla	Orient Longman	1987
4.	General Practical Chemistry	M.M. Ajaily, A.A. Maihub and R.K. Mohapatra	Central West Publishing	2020
5.	General Chemistry Experiments	Anil J Elias	Universities Press	2008

## SEMESTER - VI

<b>PCC</b>	<b>B.Sc. Chemistry</b>	<b>Credits: 2</b>
<b>Course Code: M23UCHPCS1</b>	<b>COMPETENCY SKILLS IN CHEMISTRY</b>	<b>Contact Hours per Week: 2</b>

### OBJECTIVES

To this course aims at providing various Skills in chemistry such as experimental, analytical, problem solving, computer IT and report writing skills.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Identify the skills through synthetic chemistry.	K1
CO2	Extend the skills in various aspects of analytical chemistry.	K2
CO3	Apply the skills in analysis of data.	K3
CO4	Inspect the skills in computer and their Softwares.	K4
CO5	Prepare of scientific report writing.	K3

### UNIT-I: Preparative/synthetic skills [6 Hours]

Synthetic methods – Microwave assisted organic synthesis – examples of MAOS – advantages and disadvantages of MAOS. Reactions by Sonication method – examples of sonochemical reactions. Multi-step syntheses – Nanoparticle and thin film synthesis.

### UNIT-II: Analytical Skills [6 Hours]

Separation and Purification methods – Distillation – Solvent extraction – Chromatographic methods – General aspects of chromatography, classification, mechanism. Gas Chromatography – High Performance Liquid Chromatography – types and application.

### UNIT-III: Data analysis skills [6 Hours]

Stages of analysis - Data Collection – Processing of Data – Data analysis and interpretation – Graph plotting and curve fitting – Least Squares Fitting.

### UNIT-IV: Computer skills [6 Hours]

Introduction to Computer – Hardware and Software - Search/use of Internet resources - Literature searches, including Web of Science, SciFinder - Use of software packages - ChemDraw and Origin.

**UNIT-V: Report writing Skills****[6 Hours]**

Report writing - Significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation, mechanics of writing a research report, precautions for writing research reports, conclusions.

**TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Synthetic Organic Chemistry	G.R. Chatwal	Himalaya Publishing House New Delhi	2001
2.	Principles of Instrumental Analysis	Skoog, Holler & Nieman	5 <sup>th</sup> edn, Saunders College Publishing	2000
3.	Instrumental methods of chemical analysis	Chatwal and Anand	Himalaya publishing House New Delhi	2000
4.	Computers and Their Applications to Chemistry	Ramesh Kumari	Alpha science international Ltd	2002
5.	Research Methodology Methods & Techniques	C.R. Kothari	9 <sup>th</sup> edn, New Age International Publishers	2023

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	New Approaches to Synthetic Organic Chemistry	M. Darabantu A. Rinderspacher G. Proni	MDP, Switzerland	2023
2.	Modern Analytical Chemistry	W.F. Pickering	Maroel Dec	1971
3.	Quantitative Analysis using Chromatographic Techniques	E. Katz	John Wiley & Sons Ltd	1987
4.	Data Analysis for chemistry	D.B. Hibbert J.J. Gooding	Oxford. University Press	2006
5.	Basics and Application of Computer in Chemistry	Semanti Basu Anamitra basu	Books Way	2018
6.	Research Methods: the concise knowledge base	B.L. Wadehra	Universal Law Publishing	2000

### Mapping with Programme Specific Outcomes

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

**GENERIC ELECTIVE SUBJECTS OFFERED FOR  
OTHER MAJOR STUDENTS**

### SEMESTER - III

<b>ELECTIVE – III</b>	<b>OTHER DEPARTMENTS</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHGE1</b>	<b>ELECTIVE-III - GENERIC ELECTIVE – CHEMISTRY FOR PHYSICAL SCIENCES – I</b>	<b>Contact Hours per Week: 3</b>

#### OBJECTIVES

To this course aims to provide knowledge on the basics of atomic orbitals, chemical bonds, hybridization, concepts of thermodynamics and its applications, concepts of nuclear chemistry, importance of chemical industries and qualitative and analytical methods.

#### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Recognize in-depth knowledge about the theories of chemical bonding, nuclear reactions and its applications.	K1
CO2	Represent the efficiencies and uses of various fuels and fertilizers.	K2
CO3	Explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.	K3
CO4	Enumerate the various thermodynamic principles, systems and phase rule.	K4
CO5	Identify an appropriate method for the separation of chemical component.	K4

#### **UNIT-I: Chemical Bonding and Nuclear Chemistry [9 Hours]**

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.

#### **UNIT-II: Industrial Chemistry [9 Hours]**

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.

**UNIT-III: Fundamental Concepts in Organic Chemistry [9 Hours]**

Hybridization: Orbital overlap, hybridization and geometry of CH<sub>4</sub>, C<sub>2</sub>H<sub>4</sub>, C<sub>2</sub>H<sub>2</sub> and C<sub>6</sub>H<sub>6</sub>. Electronic effects: Inductive effect and consequences on K<sub>a</sub> and K<sub>b</sub> of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric - 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.

**UNIT-IV: Thermodynamics and Phase Equilibria [9 Hours]**

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 derivation). Conditions for spontaneity in terms of entropy and Gibbs free energy. Relationship between Gibbs free energy and entropy.

Phase Equilibria: Phase rule - definition of terms in it. Applications of phase rule to water system. Two component system - Reduced phase rule and its application to a simple eutectic system (Pb-Ag).

**UNIT-V: Analytical Chemistry [9 Hours]**

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.

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Text book of Ancillary Chemistry	V. Veeraiyan	High mount Publishing House, Chennai	2009
2.	Text book of Ancillary Chemistry	S. Vaithyanathan	Priya Publications, Karur	2006
3.	Advanced Organic Chemistry	Arun Bahl, B.S. Bahl	S. Chand and Company, New Delhi	2012

4.	Text Book of Organic Chemistry	P.L. Soni, H.M. Chawla	Sultan Chand & sons, New Delhi	2007
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### REFERENCE BOOKS

S. No.	Title	Author	Publishing Company	Year
1.	Textbook of Inorganic chemistry	P.L. Soni, Mohan Katyal	Sultan Chand and Company, New Delhi	2007
2.	Textbook Physical Chemistry	B.R. Puri, L.R. Sharma, M.S. Pathania	Vishal Publishing Co., New Delhi	2014
3.	Industrial Chemistry	B.K. Sharma	GOEL Publishing House, Meerut	2014
4.	Advanced Organic Chemistry	J. March and M. Smith	John-Wiley and Sons	2015

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER - IV

<b>ELECTIVE – IV</b>	<b>OTHER DEPARTMENTS</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHGE2</b>	<b>ELECTIVE-IV - GENERIC ELECTIVE – CHEMISTRY FOR PHYSICAL SCIENCES – II</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course aims at providing knowledge on the coordination chemistry and water technology, carbohydrates and amino acids, basics and applications of electrochemistry, basics and applications of kinetics and catalysis and various photochemical phenomenon.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Memorize the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology.	K1
CO2	Give the preparation and property of carbohydrate, amino acids and nucleic acids.	K2
CO3	Apply the electrochemistry principles in corrosion, electroplating and fuelcells.	K3
CO4	Identify the reaction rate, order for chemical reaction and explain the purpose of a catalyst.	K4
CO5	Outline the various type of photochemical process.	K2

### UNIT-I: Co-ordination Chemistry and Water Technology [9 Hours]

Coordination Chemistry: Definition of terms - IUPAC Nomenclature - Werner's theory - EAN rule - Pauling's theory - Postulates - Applications to  $[\text{Ni}(\text{CO})_4]$ ,  $[\text{Ni}(\text{CN})_4]^{2-}$ ,  $[\text{Co}(\text{CN})_6]^{3-}$ . 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.

### Unit-II: Carbohydrates and Amino acids [9 Hours]

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).

**UNIT-III: Electrochemistry [9 Hours]**

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.

**UNIT-IV: Kinetics and Catalysis [9 Hours]**

Order and molecularity. Integrated rate expression for I and II 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.

**UNIT-V: Photochemistry [9 Hours]**

Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum Yield - Hydrogen-chloride reaction. Phosphorescence, fluorescence, Chemiluminescence, photosensitization and photosynthesis (definition with examples).

**TEXT BOOKS**

S. No.	Title	Author	Publishing Company	Year
1.	Text book of Ancillary Chemistry	V. Veeraiyan	High mount Publishing House, Chennai	2009
2.	Text book of Ancillary Chemistry	S. Vaithyanathan	Priya Publications, Karur	2006
3.	Advanced Organic Chemistry	Arun Bahl, B.S. Bahl	S.Chand and Company, New Delhi	2012
4.	Text Book of Organic Chemistry	P.L. Soni, H.M. Chawla	Sultan Chand & sons, New Delhi	2007

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Textbook of Inorganic chemistry	P.L. Soni, Mohan Katyal	Sultan Chand and Company, New Delhi	2007
2.	Textbook Physical Chemistry	B.R. Puri, L.R. Sharma, M.S. Pathania	Vishal Publishing Co., New Delhi	2014
3.	Industrial Chemistry	B.K. Sharma	GOEL Publishing House, Meerut	2014
4.	Organic Chemistry	I.L. Finar	Wesley Longman Ltd, England	1996

**Mapping with Programme Specific Outcomes**

<b>COs/PSOs</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER – IV

<b>ELECTIVE PRACTICAL – II</b>	<b>OTHER DEPARTMENTS</b>	<b>Credits: 3</b>
<b>Course Code: M23UCHGEP1</b>	<b>GENERIC ELECTIVE-PRACTICAL – II - CHEMISTRY PRACTICAL FOR PHYSICAL AND BIOLOGICAL SCIENCES</b>	<b>Contact Hours per Week: 3</b>

### OBJECTIVES

To this course aims to provide knowledge on the basics of preparation solutions, principles and practical experience of volumetric analysis, identification of organic functional groups, different types of organic compounds with respect to their properties and determination of elements in organic compounds.

### COURSE OUTCOMES

On the successful completion of the course, student will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Indicate the uses of standard flask and volumetric pipettes, burette.	K2
CO2	Analyze the carry out, record and interpret the results of volumetric titration and systematic analysis of organic compounds.	K4
CO3	Apply in their skill in the analysis of water/hardness.	K3

### Unit-I: Volumetric Analysis

1. Estimation of sodium hydroxide using standard sodium carbonate
2. Estimation of hydrochloric 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 potassium permanganate using standard potassium dichromate
6. Estimation hardness of water
7. Estimation of ferrous ion using diphenyl amine as indicator

### Unit-II: Systematic Analysis of Organic Compounds

The analysis must be carried out as follows:

1. Functional group tests [phenol, acids (mono & di) aromatic primary amine, amides (mono & di), aldehyde and glucose]
2. Detection of elements (N, S, Halogens)
3. To distinguish between aliphatic and aromatic compounds.
4. To distinguish – Saturated and unsaturated compounds.

**TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Basic Principles of Practical Chemistry	V. Venkateswaran, R. Veeraswamy, A.R. Kulandaivelu	Sultan Chand & Sons, New Delhi	1997
2.	Inorganic Semimicro Qualitative analysis	V.V. Ramanujam	National Publishing Co	1971
3.	Practical Chemistry	O.P. Pandey, D.N. Bajpai and S. Giri	S. Chand	2010
4.	Practical Chemistry	Sonia Ratnani, Swati Agarwal and Sujeet mishra	Mc Grew Hills	2020

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Vogel's Text Book of Quantitative Inorganic analysis	J. Basset, R.C. Denney, G.H. Jeffery and J. Mendham	ELBS/Longman, England	1986
2.	Experimental Inorganic Chemistry	W.G. Palmer	Van Nostrand Reinhold Co., London	1972
3.	Vogel's Text Book of Macro and Semi Micro Qualitative Inorganic Analysis	G. Svehla	Orient Longman	1987
4.	General Practical Chemistry	M.M. Ajaily, A.A. Maihub, R.K. Mohapatra	Central West Publishing	2020
5.	General Chemistry Experiments	Anil J Elias	Universities Press	2008

**SKILL ENHANCEMENT COURSE**  
**(NON - MAJOR ELECTIVE COURSES FOR**  
**OTHER MAJOR STUDENTS)**

## SEMESTER - I

<b>SEC - I - NME - I</b>	<b>OTHER DEPARTMENT</b>	<b>Credits: 2</b>
<b>Course Code: M23UCHN01</b>	<b>ROLE OF CHEMISTRY IN DAILY LIFE</b>	<b>Contact Hours per Week: 2</b>

### OBJECTIVES

To this course aims at providing an overall view of the importance of Chemistry in everyday life, chemistry of building materials and chemistry of drugs and pharmaceuticals.

### OUTCOMES

On the successful completion of the course, student will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Identify the chemicals used in everyday life as well as air pollution and water pollution.	K1
CO2	Express knowledge on building materials cement, ceramics, glass, plastics, polythene, PVC, Bakelite and polyesters.	K2
CO3	Examine information about food and nutrition, carbohydrates, proteins, fats and also have awareness about cosmetics of tooth pastes, face powder, soaps and detergents.	K3
CO4	Analyze about the fertilizers like urea, NPK fertilizers and super phosphate. Fuel classification solid, liquid and gaseous; nuclear fuel - examples and use.	K4
CO5	Discover an idea about the pharmaceutical drugs analgesics and antipyretics like paracetamol and aspirin and also about pigments and dyes and its application.	K3

### **UNIT-I: General survey of chemicals used in everyday life [6 Hours]**

Air - components and their importance; photosynthetic reaction, air pollution, green - house effect and the impact on our life style. Water - Sources of water, qualities of potable water, soft and hard water, methods of removal of hardness - water pollution.

### **UNIT-II: Building materials [6 Hours]**

Cement, ceramics, glass and refractories - definition, composition and application only. Plastics - polythene, PVC, bakelite, polyesters, melamine - formaldehyde resins - preparation and uses only.

**UNIT-III: Food and Cosmetics Chemistry****[6 Hours]**

Food and Nutrition - Carbohydrates, Proteins, Fats - definition and their importance as food constituents – balanced diet – Calories minerals and vitamins (sources and their physiological importance). Cosmetics – tooth paste, face powder, soaps and detergents, shampoos, nail polish, perfumes - general formulation and preparations - possible hazards of cosmetic use.

**UNIT-IV: Fertilizers and Fuel****[6 Hours]**

Chemicals in food production - fertilizers - need, natural sources; urea, NPK fertilizers and super phosphate. Fuel - classification - solid, liquid and gaseous; nuclear fuel examples and uses.

**UNIT-V: Pharmaceutical chemistry****[6 Hours]**

Pharmaceutical drugs - analgesics and antipyretics - paracetamol and aspirin. Colour chemicals - pigments and dyes - examples and applications. Explosives - classification and examples.

**TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Food Chemistry	H.K. Chopra, P.S. Panesar	Narosa Publishing House	2010
2.	Textbook of Pharmaceutical Chemistry	Jayashree Ghosh	S. Chand Publishing	2012
3.	Text book of Ancillary Chemistry	S. Vaithyanathan	Priya Publications, Karur	2006
4.	Industrial Chemistry	B.K. Sharma	GOEL Publishing House, Meerut	2014
5.	Introduction to Forensic Chemistry	Kelly M. Elkins	CRC Press Taylor & Francis Group	2019

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Chemical Process Industries	Randolph Norris Shreve	McGraw-Hill, Texas	1977
2.	Perfumes, Cosmetics and Soaps	W.A. Poucher, Joseph A Brink	Springer	2000
3.	Environmental Chemistry	A.K. De	New Age International Public Co	1990

4.	Introduction to Forensic Chemistry	Kelly M. Elkins	CRC Press Taylor & Francis Group	2019
5.	Chemistry in Daily Life	Kirpal Singh	PHI Publishers	2010

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium

## SEMESTER-II

<b>SEC – II - NME – II</b>	<b>OTHER DEPARTMENT</b>	<b>Credits: 2</b>
<b>Course Code: M23UCHN02</b>	<b>DAIRY CHEMISTRY</b>	<b>Contact Hours per Week: 2</b>

### OBJECTIVES

To this course aims at providing an overall view of the chemistry of milk and milk products, processing of milk, preservation and formation of milk products.

### COURSE OUTCOMES

On the successful completion of the course, student will be able to

<b>CO Number</b>	<b>CO Statement</b>	<b>Knowledge Level</b>
CO1	Identify the general composition of milk – constituents and its physical properties.	K1
CO2	Illustrate about pasteurization of milk and various types of pasteurization - bottle, batch and HTST ultra high temperature pasteurization.	K2
CO3	Examine the cream and butter their composition and how to estimate fat in cream and ghee.	K3
CO4	Elucidate about Homogenized milk, flavoured milk, vitaminised milk and toned milk.	K4
CO5	Express an idea about how to make milk powder and its drying process - types of drying process.	K2

#### **UNIT-I: Composition of Milk**

**[6 Hours]**

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 - adulterants, preservatives with neutralizer - examples and their detection - estimation of fat, acidity and total solids in milk.

#### **UNIT-II: Processing of Milk**

**[6 Hours]**

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 HTST (High Temperature Short Time) – Vacuum pasteurization – Ultra High Temperature Pasteurization.

**UNIT- III: Major Milk Products****[6 Hours]**

Cream - definition - composition - chemistry of creaming process - gravitational and centrifugal methods of separation of cream - estimation of fat in 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 - rancidity - definition - prevention - antioxidants and synergists - natural and synthetic.

**UNIT-IV: Special Milk****[6 Hours]**

Standardized 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.

**UNIT- V: Fermented and other Milk Products****[6 Hours]**

Fermented milk products – fermentation of milk - definition, conditions, cultured milk - definition of culture - example, conditions - cultured cream, butter milk - acidophilous milk – Ice cream – definition - percentage composition - types - ingredients - manufacture of ice cream, stabilizers - emulsifiers and the role - milk powder – definition - need for making milk powder - drying process - types of drying.

**TEXT BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Applied Chemistry	K. Bagavathi Sundari	MJP Publishers	2006
2.	Indian Dairy Products	K.S. Rangappa and K.T. Acharya	Asia Publishing House New Delhi	1974
3.	Text Book of Dairy Chemistry	M.P. Mathur, D. Datta Roy and P. Dinakar	Indian Council of Agricultural Research	2008
4.	A Text book of dairy chemistry	Saurav Singh	Daya Publishing House	2013
5.	Text book of dairy chemistry	P.L. Choudhary	Bio-Green Book Publishers	2021

**REFERENCE BOOKS**

<b>S. No.</b>	<b>Title</b>	<b>Author</b>	<b>Publishing Company</b>	<b>Year</b>
1.	Principles of Dairy Chemistry	Robert Jenness and S. Patom	S. Wiley, New York	2005

2.	Fundamentals of Dairy Chemistry	F.P. Wond	Springer, Singapore	2006
3.	Outlines of Dairy Technology	Sukumar De	Oxford University Press, New Delhi	1980
4.	Dairy Chemistry and Biochemistry	P.F. Fox and P.L.H. Mcsweeney	2 <sup>nd</sup> edn, Springer.	2016
5.	Dairy chemistry and biochemistry	P.F. Fox, T. Uniacke-Lowe, P.L.H. McSweeney, J.A. OMahony	2 <sup>nd</sup> edn, Springer.	2015

### Mapping with Programme Specific Outcomes

COs/PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	S	S	S	S	S
<b>CO2</b>	M	S	S	S	M
<b>CO3</b>	S	S	S	M	S
<b>CO4</b>	S	S	S	S	S
<b>CO5</b>	S	M	S	S	S

**S**-Strong; **M**-Medium