

**Dr. N.G.P. ARTS AND SCIENCE COLLEGE (Autonomous)**

**REGULATIONS 2023-24 for Post Graduate Programme  
(Outcome Based Education model with Choice Based Credit System)**

**M.Sc. Degree**

(For the students admitted during the academic year 2023-24 and onwards)

**Programme: M.Sc. Chemistry**

**Eligibility**

A pass in B.Sc. Chemistry as per the norms set by the Government of Tamil Nadu or an Examination accepted as equivalent there to by the Academic Council subject to such conditions as may be prescribed there to are permitted to appear and qualify for the **Master of Science (CHEMISTRY)** Degree Examination of this College after a course study of two academic years.

**Programme Educational Objectives**

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. To build the firm foundation in the fundamentals and correlate the application with the current developments in chemistry.
2. To get sufficient expertise in the operational knowledge and laboratory skills in all major fields of chemistry.
3. To emphasize on integrating various disciplines of Science and encourage for interdisciplinary approach.
4. To acquire problem solving capacity, interpretation of results with the use of sophisticated instruments and devises new preparation techniques.
5. To motivate the students to prepare for competitive examinations, job carriers and get trained for industrial entrepreneurship.



**PROGRAMME OUTCOMES:**

On the successful completion of the program, the following are the expected outcomes.

<b>PO Number</b>	<b>PO Statement</b>
<b>PO1</b>	Make use of knowledge in the major fields of Chemistry which would make them to analyze the significant role played in the field of energy, materials, health sector and environment.
<b>PO2</b>	Select the appropriate modern scientific instruments, to plan and execute in laboratory.
<b>PO3</b>	Interpret the Knowledge and skills to develop independent writing reports and to execute the ideas.
<b>PO4</b>	Take part in research- based knowledge in interdisciplinary approach including design of experiments, analysis and interpretation of data for provide better solution in emerging issues.
<b>PO5</b>	Utilize the knowledge for social, economic, and environmental challenges globally and formulate for life-long learning in the broadest context of technological change.



**PG REGULATION (R5)**  
**(2023-24 and onwards)**  
**(OUTCOME BASED EDUCATION WITH CBCS)**

Effective from the academic year 2023-24 and applicable to the students admitted to the Degree of Master of Arts/Commerce/Management/Science.

**1. NOMENCLATURE**

**1.1 Faculty:** Refers to a group of programmes concerned with a major division of knowledge. Eg. Faculty of Computer Science consists of Programmes like Computer Science, Information Technology, Computer Technology, Computer Applications, Cognitive Systems, Artificial Intelligence and Machine Learning and Cyber Security and Data Analytics etc.

**1.2 Programme:** Refers to the Master of Arts/Management/Commerce/Science Stream that a student has chosen for study.

**1.3 Batch:** Refers to the starting and completion year of a programme of study. Eg. Batch of 2023–2025 refers to students belonging to a 2-year Degree programme admitted in 2023 and completing in 2025.

**1.4 Course:** Refers to component of a programme. A course may be designed to involve lectures / tutorials / laboratory work / seminar / project work/ practical training / report writing / Viva voce, etc or a combination of these, to effectively meet the teaching and learning needs and the credits may be assigned suitably.

**a) Core Courses** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

**b) Extra Departmental Course (EDC):** A course chosen generally from a related discipline/subject, with an intention to seek exposure in the discipline relating to the core domain of the student.



**c) Discipline Specific Elective Course (DSE):** Elective courses are offered under main discipline/ subject of study.

**d) Internship/Industrial Training (IT)**

Students must undertake industrial / institutional training for a minimum of 15 days during the II semester summer vacation. The students will submit the report for evaluation during III semester.

**e) Project Work:** It is considered as a special course involving application of knowledge in problem solving/analyzing/exploring a real-life situation. The Project work will be given in lieu of a Core paper.

**f) Extra credits** Extra credits will be awarded to a student for achievements in co-curricular activities carried out outside the regular class hours. The guidelines for the award of extra credits are given in section two, these credits are not mandatory for completing the programme.

**g) Advanced Learner Course (ALC):** ALC is doing work of a higher standard than usual for students at that stage in their education. Research work / internships carried out in University/ Research Institutions/ Industries of repute in India or abroad for a period of 15 to 30 days.

## 2. STRUCTURE OF PROGRAMME

- Core Course
- Extra Departmental Course (EDC)
- Discipline Specific Elective (DSE)
- Industrial Training (IT)
- Project

## 3. DURATION OF THE PROGRAMME

M.Sc. /M.Com. / M.A. Programme must be completed within 2 Years (4 semesters) and maximum of 4 Years (8 semesters) from the date of acceptance to the programme. If not, the candidate must enroll in the course determined to be an equivalent by BoS in the most recent curriculum recommended for the Programme.



#### 4. REQUIREMENTS FOR COMPLETION OF A SEMESTER

Every student shall ordinarily be allowed to keep terms for the given semester in a program of his/ her enrolment, only if he/ she fulfills at least seventy five percent (75%) of the attendance taken as an average of the total number of lectures, practicals, tutorials, etc. wherein short and/or long excursions/field visits/study tours organised by the college and supervised by the faculty as envisaged in the syllabus shall be credited to his attendance. Every student shall have a minimum of 75% as an overall attendance.

#### 5. EXAMINATIONS

The end semester examinations shall normally be conducted after completing 90 working days for each semester. The maximum marks for each theory and practical course as follows,

##### Mark distribution for Theory Courses

Continuous Internal Assessment (CIA) : 40 Marks

End Semester Exams (ESE) : 60 Marks

Total : 100 Marks

##### i) Distribution of Internal Marks

S.No.	Particulars	Distribution of Marks
1	CIA I (2.5 Units) (On completion of 45 <sup>th</sup> working day)	5
2	Model ( All 5 Units) (On completion of 85 <sup>th</sup> working day)	5
3	Attendance	05
4	Library Usage	05
5	Skill Enhancement *	05
<b>Total</b>		<b>25</b>

##### Breakup for Attendance Marks:

S.No	Attendance Range	Marks Awarded
1	95% and Above	5
2	90% - 94%	4
3	85% - 89%	3
4	80% - 84%	2
5	75% - 79%	1



**Note:**

Special Cases such as NCC, NSS, Sports, Advanced Learner Course, Summer Fellowship and Medical Conditions etc. the attendance exemption may be given by principal and Mark may be awarded.

**Break up for Library Marks:**

S.No	Attendance Range	Marks Awarded
1	10h and above	5
2	9h- less than 10h	4
3	8h - less than 9h	3
4	7h - less than 8h	2
5	6h - less than 7h	1

**Note:**

In exception, the utilization of e-resources of library will be considered.

**\*Components for “Skill Enhancement” may include the following:**

Class Participation, Case Studies Presentation/Term paper, Field Study, Field Survey, Group Discussion, Term Paper, Presentation of Papers in Conferences, Industry Visit, Book Review, Journal Review, e-content Creation, Model Preparation, Seminar and Assignment.

**Components for Skill Enhancement**

Any one of the following should be selected by the course coordinator

S.No.	Skill Enhancement	Description
1	Class Participation	<ul style="list-style-type: none"> <li>Engagement in class</li> <li>Listening Skills</li> <li>Behaviour</li> </ul>
2	Case Study Presentation/ Term Paper	<ul style="list-style-type: none"> <li>Identification of the problem</li> <li>Case Analysis</li> <li>Effective Solution using creativity/imagination</li> </ul>
3	Field Study	<ul style="list-style-type: none"> <li>Selection of Topic</li> <li>Demonstration of Topic</li> <li>Analysis &amp; Conclusion</li> </ul>
4	Field Survey	<ul style="list-style-type: none"> <li>Chosen Problem</li> <li>Design and quality of survey</li> <li>Analysis of survey</li> </ul>

5	Group Discussion	<ul style="list-style-type: none"> <li>• Communication skills</li> <li>• Subject knowledge</li> <li>• Attitude and way of presentation</li> <li>• Confidence</li> <li>• Listening Skill</li> </ul>
6	Presentation of Papers in Conferences	<ul style="list-style-type: none"> <li>• Sponsored</li> <li>• International/National</li> <li>• Presentation</li> <li>• Report Submission</li> </ul>
7	Industry Visit	<ul style="list-style-type: none"> <li>• Chosen Domain</li> <li>• Quality of the work</li> <li>• Analysis of the Report</li> <li>• Presentation</li> </ul>
8	Book Review	<ul style="list-style-type: none"> <li>• Content</li> <li>• Interpretation and Inferences of the text</li> <li>• Supporting Details</li> <li>• Presentation</li> </ul>
9	Journal Review	<ul style="list-style-type: none"> <li>• Analytical Thinking</li> <li>• Interpretation and Inferences</li> <li>• Exploring the perception if chosen genre</li> <li>• Presentation</li> </ul>
10	e-content Creation	<ul style="list-style-type: none"> <li>• Logo/ Tagline</li> <li>• Purpose</li> <li>• Content (Writing, designing and posting in Social Media)</li> <li>• Presentation</li> </ul>
11	Model Preparation	<ul style="list-style-type: none"> <li>• Theme/ Topic</li> <li>• Depth of background Knowledge</li> <li>• Creativity</li> <li>• Presentation</li> </ul>
12	Seminar	<ul style="list-style-type: none"> <li>• Knowledge and Content</li> <li>• Organization</li> <li>• Understanding</li> <li>• Presentation</li> </ul>
13	Assignment	<ul style="list-style-type: none"> <li>• Content and Style</li> <li>• Spelling and Grammar</li> <li>• References</li> </ul>

## ii) Distribution of External Marks

**Total** : 75  
**Written Exam** : 75

## Marks Distribution for Practical course

**Total** : 100  
**Internal** : 40  
**External** : 60

### i) Distribution of Internals Marks

S. No.	Particulars	Distribution of Marks
1	Experiments/Exercises	15
2	Test 1	10
3	Test 2	10
4	Observation Notebook	05
<b>Total</b>		<b>40</b>

### ii) Distribution of Externals Marks

S.No.	Particulars	External Marks
1	Practical	40
2	Record	10
3	Viva- voce	10
<b>Total</b>		<b>60</b>

Practical examination shall be evaluated jointly by Internal and External Examiners.

## A) Mark Distribution for Project

**Total** : 200  
**Internal** : 80  
**External** : 120

### i) Distribution of Internal Marks

S.No.	Particulars	Internal Marks
1	Review I	30
2	Review II	40
3	Attendance	10
<b>Total</b>		<b>80</b>

## ii) Distribution of External Marks

S.No	Particulars	External Marks
1	Project Work & Presentation	100
2	Viva -voce	20
<b>Total</b>		<b>120</b>

Evaluation of Project Work shall be done jointly by Internal and External Examiners.

## 6 . Credit Transfer

a. Upon successful completion of 1 NPTEL Course (4 Credit Course) recommended by the department, during Semester I to II, a student shall be eligible to get exemption of **one 4 credit course** during the 3<sup>rd</sup> semester. The proposed NPTEL course should cover content/syllabus of exempted core paper in 3<sup>rd</sup> semester.

S. No.	Course Code	Course Name	Proposed NPTEL Course	Credit
1			Option - 1 Paper title	4
			Option - 2 Paper title	
			Option - 3 Paper title	

b. Upon successful completion of **2 NPTEL Courses** (2 Credit each) recommended by the department, during Semester I to II, a student shall be eligible to get exemption of **one 4 credit course** during the 3<sup>rd</sup> semester. Out of 2 NPTEL proposed courses, **at least 1 course** should cover content/syllabus of exempted core paper in 3<sup>rd</sup> semester.

### Mandatory

The exempted core paper in the 3<sup>rd</sup> semester should be submitted by the students for approval before the end of 2<sup>nd</sup> semester

Credit transfer will be decided by equivalence committee

S. No.	Course Code	Course Name	Proposed NPTEL Course	Credit
1			Option – 1 Paper title	2
			Option – 2 Paper title	
			Option – 3 Paper title	
2			Option – 1 Paper title	2
			Option – 2 Paper title	
			Option – 3 Paper title	

NPTEL Courses to be carried out during semester I – II.					
S. No.	Student Name	Class	Proposed NPTEL Course		Proposed Course for Exemption
			Course I	Option 1- Paper Title Option 2- Paper Title Option 3- Paper Title	Any one Core Paper in 3 <sup>rd</sup> Semester
			Course II	Option 1- Paper Title Option 2- Paper Title Option 3- Paper Title	
Class Advisor		HoD		Dean	

## 7. Internship/Industrial Training

### Mark Distribution for Internship/ Industrial Training

Total	:	100
Internal	:	40
External	:	60

#### i) Distribution of Internal Marks

S.No.	Particulars	Internal Marks
1	Review I	15
2	Review II	20
3	Attendance	5
Total		40



## ii) Distribution of External Marks

S.No	Particulars	External Marks
1	Internship /Industrial training Presentation	40
2	Viva -voce	20
<b>Total</b>		<b>60</b>

Internship/ Industrial training shall be evaluated jointly by Internal and External Examiners.

## 9. Extra Credits: 10

Earning extra credit is not essential for programme completion. Student is entitled to earn extra credit for achievement in Curricular/Co-Curricular/ Extracurricular activities carried out other than the regular class hours.

A student is permitted to earn a maximum of 10 extra Credits during the programme period.  
A maximum of 1 credit under each category is permissible.

Category	Credit
Self study Course	1
CA/ICSI/CMA (Foundations)	1
CA/ICSI/CMA (Inter)	1
Sports and Games	1
Publications / Conference Presentations (Oral/Poster)/ Awards	1
Innovation / Incubation / Patent / Sponsored Projects / Consultancy	1
Representation in State / National level celebrations	1
Awards/Recognitions/Fellowships	1
<b>Advanced Learner Course (ALC)*</b>	<b>2</b>

Credit shall be awarded for achievements of the student during the period of study only.

## GUIDELINES

### Self study Course

A pass in the self study courses offered by the department.

The candidate should register the self study course offered by the department only in the III semester.

**CA/ICSI/CMA(Foundations)**

Qualifying foundation in CA/ICSI/CMA / etc.

**CA/ICSI/CMA(Inter)**

Qualifying Inter in CA/ICSI/CMA / etc.

**Sports and Games**

The Student can earn extra credit based on their Achievement in sports in University/  
State / National/ International.

**Publications / Conference Presentations (Oral/Poster)**

Research Publications in Journals

Oral/Poster presentation in Conference

**Innovation / Incubation / Patent / Sponsored Projects / Consultancy**

Development of model/ Products /Prototype /Process/App/Registration of Patents/  
Copyrights/Trademarks/Sponsored Projects /Consultancy

**Representation in State/ National level celebrations**

State / National level celebrations such as Independence day, Republic day Parade,  
National Integration camp etc.

**Awards/Recognitions/Fellowships**

Regional/ State / National level awards/ Recognitions/Fellowships

**\*Advanced Learner Course (ALC):**

ALC is doing work of a higher standard than usual for students at that stage in their education.

Research work/internships carried out in University/ Research Institutions/ Industries of repute in India or abroad for a period of 15 to 30 days will be considered as Advanced Learners Course.

### QUESTION PAPER PATTERN

#### CIA Test I : [1½ Hours-2.5 Units] - 25 Marks

SECTION	MARKS	DESCRIPTION	TOTAL	Remarks
Section - A	8 x 0.5= 04 Marks	MCQ	25 Marks	Marks secured will be converted To 5 mark
Section - B	3 x 2 = 06 Marks	Answer ALL Questions Either or Type ALL Questions Carry Equal Marks		
Section - C	3 x 05 = 15 Marks			

#### CIA Test II/ Model [3 Hours-5 Units] - 75 Marks

SECTION	MARKS	DESCRIPTION	TOTAL	Remarks
Section - A	10 x 1 = 10 Marks	MCQ		
Section - B	5 x 3 = 15 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks	75 Marks	Marks secured will be converted To 5 mark
Section - C	5 x 8 = 40 Marks			
Section - D	1 x 10 = 10 Marks	Compulsory Question		

#### End Semester Examination [3 Hours-5 Units] - 75 Marks

SECTION	MARKS	DESCRIPTION	TOTAL
Section - A	10 x 1 = 10 Marks	MCQ	75 Marks
Section - B	5 x 3 = 15 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks	
Section - C	5 x 8 = 40 Marks		
Section - D	1 x 10 = 10 Marks	Compulsory Question	


**Guidelines for Programmes offering for Semesters:**


<b>Subjects</b>	<b>No. of Papers</b>	<b>Credit</b>	<b>Semester No.</b>
Core (Credits 2, 3, 4, 5 )	17	70	I to IV
Extra Disciplinary Course (EDC)	1	4	II
Discipline Specific Elective (DSE)	4	4 x 4 = 16	I to IV
Internship (IT)	1	2	III
<b>TOTAL CREDITS</b>		<b>92</b>	



**PG CURRICULUM**  
**PROGRAMME NAME - M.Sc Chemistry**  
**AY 2023-24**

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
First Semester										
232CE2A1CA	Core -I	Organic Reaction Mechanism	4	1	-	3	25	75	100	4
232CE2A1CB	Core - II	Coordination Chemistry	4	1	-	3	25	75	100	4
232CE2A1CC	Core - III	Thermodynamics and Kinetics	4	1	-	3	25	75	100	4
232CE2A1CD	Core - IV	Analytical Chemistry	4	1	-	3	25	75	100	4
232CE2A1CP	Core Practical - I	Organic Chemistry	-	-	6	6	40	60	100	3
232CE2A1DA	DSE - I	Polymer Chemistry	4	-	-	3	25	75	100	4
232CE2A1DB		Industrial Chemistry								
232CE2A1DC		Green Chemistry								
Total			20	4	6	-	-	-	600	23

  
 BoS Chairman/HoD  
 Department of Chemistry  
 Dr. N. G. P. Arts and Science College  
 Coimbatore - 641 048

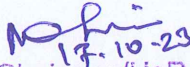
 <b>Dr.N.G.P Arts and Science College</b>		
<b>APPROVED</b>		
BoS- 13 <sup>th</sup> 08/06/23	AC - 15 <sup>th</sup> 14/07/23	GB - 20 <sup>th</sup> 05/08/23




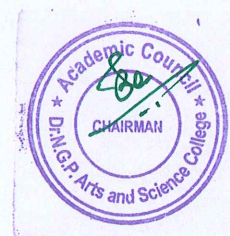
Dr. NGPASC  
 COIMBATORE | INDIA

*M.Sc. Chemistry (Students admitted during the AY 2023-24)*

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Second Semester										
232CE2A2CA	Core – V	Stereochemistry and Pericyclic Reactions	4	1	-	3	25	75	100	4
232CE2A2CB	Core – VI	Bio-Inorganic Chemistry	4	-	-	3	25	75	100	4
232CE2A2CC	Core – VII	Molecular Spectroscopy	4	1	-	3	25	75	100	4
232CE2A2CP	Core Practical – II	Inorganic Chemistry	-	-	8	6	40	60	100	4
233BC2A2EA	EDC	Drug Biochemistry	4	-	-	3	25	75	100	4
232CE2A2DA	DSE - II	Cosmetic Chemistry	4	-	-	3	25	75	100	4
232CE2A2DB		Electrochemistry								
232CE2A2DC		Organic Reactions and Reagents								
Total			20	2	8	-	-	-	600	24


  
 17.10.23  
 BoS Chairman/HoD  
 Department of Chemistry  
 Dr. N. G. P. Arts and Science College  
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<b>APPROVED</b>		
BoS - 14 <sup>th</sup>	AC - 16 <sup>th</sup>	GB - 21 <sup>st</sup>
17.10.23	13.12.23	05.01.24



Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
232CE2A3CA	Core – VIII	Chemistry of Natural Products	4	1	-	3	25	75	100	4
232CE2A3CB	Core – IX	Inorganic Chemistry	4	1	-	3	25	75	100	4
232CE2A3CC	Core – X	Quantum Chemistry and Group Theory	4	1	-	3	25	75	100	4
232CE2A3CD	Core – XI	Analytical Spectroscopy	4	1	-	3	25	75	100	4
232CE2A3CP	Core Practical–III	Physical Chemistry	-	-	6	6	40	60	100	3
232CE2A3CT	IT	Internship					40	60	100	2
232CE2A3DA	DSE - III	Dye and Textile Chemistry	4	-	-	3	25	75	100	4
232CE2A3DB		Nanomaterials and Nanotechnology								
232CE2A3DC		Bio-Organic Chemistry								
Total			20	4	6	-	-	-	700	25

*M. R. V.*  
 BoS Chairman/HoD  
 Department of Chemistry  
 Dr. N. G. P. Arts and Science College  
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BoS- 06-04-24	AC - 17-04-24	GB -




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*M.Sc. Chemistry (Students admitted during the AY 2023-24)*

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits	
							CIA	ESE	Total		
Fourth Semester											
232CE2A4CA	Core – XII	Synthetic Organic Chemistry	4	1	-	3	25	75	100	4	
232CE2A4CB	Core – XIII	Statistical Thermodynamics and Computational Chemistry	4	1	-	3	25	75	100	4	
232CE2A4CV	Core – XIV	Project and Viva voce	-	-	16	-	80	120	200	8	
232CE2A4DA	DSE - IV	Environmental Chemistry	4	-	-	3	25	75	100	4	
232CE2A4DB		Catalysis									
232CE2A4DC		Medicinal Chemistry									
Total			12	2	16	-	-	-	500	20	
*Grand Total									2400	92	

  
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 Department of Chemistry  
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<b>APPROVED</b>		
BoS- 16 <sup>th</sup> 07-11-24	AC- 18 <sup>th</sup> 26-11-24	GB-



## DISCIPLINE SPECIFIC ELECTIVE

Students shall select the desired course of their choice in the listed elective course during Semesters I-IV

### Semester I (Elective I)

#### List of Elective Courses

S.No.	Course Code	Name of the Course
1	232CE2A1DA	Polymer Chemistry
2	232CE2A1DB	Industrial Chemistry
3	232CE2A1DC	Green Chemistry

### Semester II (Elective II)

#### List of Elective Courses

S.No.	Course Code	Name of the Course
1	232CE2A2DA	Cosmetic Chemistry
2	232CE2A2DB	Electrochemistry
3	232CE2A2DC	Organic Reactions and Reagents

### Semester III (Elective III)

#### List of Elective Courses

S.No.	Course Code	Name of the Course
1	232CE2A3DA	Dye and Textile Chemistry
2	232CE2A3DB	Nanomaterials and Nanotechnology
3	232CE2A3DC	Bio-Organic Chemistry

### Semester IV (Elective IV)

#### List of Elective Courses

S.No.	Course Code	Name of the Course
1	232CE2A4DA	Environmental Chemistry
2	232CE2A4DB	Catalysis
3	232CE2A4DC	Medicinal Chemistry



**EXTRA CREDIT COURSES**

The following are the courses offered under self study to earn extra credits:

**Semester III**

S .No.	Course Code	Course Name
1	232CE2ASSA	Research Methodology
2	232CE2ASSB	Forensic Chemistry and Crime Investigation



Course Code	Course Name	Category	L	T	P	Credit
232CE2A1CA	ORGANIC REACTION MECHANISM	CORE	4	1	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The basic principles of acids and bases, electronic effects and aromaticity of organic compounds
- The mechanism involving in the various aliphatic, aromatic electrophilic and nucleophilic substitution reactions
- The basic knowledge about addition, elimination reactions involved in multiple bonds

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Apply the electronic effects in organic chemistry, stability of organic compounds	K3
CO2	Utilize various methods to determine the reaction mechanisms	K4
CO3	Summarize reaction mechanisms of nucleophilic substitution reactions	K3
CO4	Illustrate the reaction mechanisms of electrophilic substitution reactions	K3
CO5	Compare the addition and elimination reactions	K3

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓			✓	✓
CO2		✓	✓	✓	
CO3	✓	✓		✓	
CO4			✓		
CO5	✓	✓			✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/>	Skill Development	<input type="checkbox"/>	Entrepreneurial Development
<input checked="" type="checkbox"/>	Employability	<input type="checkbox"/>	Innovations
<input type="checkbox"/>	Intellectual Property Rights	<input type="checkbox"/>	Gender Sensitization
<input type="checkbox"/>	Social Awareness/ Environment	<input type="checkbox"/>	Constitutional Rights/ Human Values/ Ethics



232CE2A1CA	ORGANIC REACTION MECHANISM	SEMESTER I
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Total Credits: 4

Total Instruction Hours: 60 h

### Syllabus

#### Unit I      Electronic Effects and Aromaticity      12 h

Electron displacement – Inductive and field effect – Delocalised bonds – Rules of resonance – Steric inhibition of resonance – Steric enhancement of resonance – Hyperconjugation – Hydrogen bonding. Aromaticity: Aromatic systems with 2, 6 and 10 electrons – Alternant and non-alternant hydrocarbons, systems of more than 10 electrons – Annulenes – Azulenes – Ferrocene and Syndones – Concept of homoaromaticity

#### Unit II      Methods of Determining Reaction Mechanism      12 h

Thermodynamic and kinetic requirements of reactions: Types of mechanism – Thermodynamic and kinetic control – Methods of determination of reaction mechanism – Product analysis – Determination of the presence of intermediate – Isolation – Detection – Trapping – Cross over experiments – Isotopic labeling – Isotopic effect – Kinetic evidence. Kinetic methods of determination of reaction mechanism- Curtin-Hammett principle – Hammett equation – Significance of substitution and reaction constant – Hammond postulates – Limitations and deviations – Taft equation

#### Unit III      Aliphatic & Aromatic Nucleophilic Substitution Reactions      12 h

SN1, SN2, SNi and neighbouring group participation – Kinetics – Effect of structure, solvent, leaving and entering group and Stereochemistry. Claisen and Dieckmann condensation – Williamson reactions. Mechanism of aromatic nucleophilic substitution – SNAr and Benzyne mechanism – Chichibabin reaction – Cine substitution – Diazonium group as leaving group

#### Unit IV      Aliphatic & Aromatic Electrophilic Substitution Reactions      12 h

SE1 and SE2 reactions – Mechanisms and reactivity – Keto-enol tautomerism – Halogenation of carbonyl compounds – Stork enamine reaction – Aromatic electrophilic substitution – Orientation and mechanism – Nitration – Halogenation and sulphonation – Friedel-Crafts alkylation – Friedel Crafts acylation and Scholl reaction – Vilsmeier-Haack reaction – Gattermann reaction – Bischler Napieralski reaction



**Unit V      Addition and Elimination Reaction**

12 h

Addition to C-C and C-O multiple bonds - Electrophilic - Nucleophilic and free-radical additions - Birch reduction - Michael addition - Diels-Alder reaction - Meerwein-Ponndorf reduction - Stobbe condensation. Elimination reactions - E1 and E2 mechanism - Orientation - Hofmann and Saytzeff rules - Elimination versus substitution - Chugaev reaction - Hofmann degradation and Cope elimination - Mechanism and orientation in pyrolytic elimination

**Text Books**

- 1 Michael B. Smith, 2015, "March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure", 7th Edition, Wiley & USA.
- 2 Morrison R.N. Boyd R.N. and Bhattacharjee, 2010, "Organic Chemistry", 7th Edition, Pearson Education & UK.

**References**

- 1 Bansal R.K., 2012, "Organic Chemistry Reaction mechanisms." 7<sup>th</sup> Edition, New Age International Private Ltd & New Delhi
- 2 Lowry and Richardson, 1997, "Mechanism and theory in organic chemistry", 3<sup>rd</sup> Edition. Pearson Publishers & UK
- 3 Mukherji and Singh S. P, 1984, "Reactions mechanisms in organic chemistry", 3<sup>rd</sup> Edition, Macmillan Publishers & USA
- 4 Clayden J, Greeves N and Warren S, 2014, "Organic Chemistry" 2<sup>nd</sup> Edition, Oxford University Press & UK
- 5 Ahluwalia. V.H and Parashar. R.K, 2010, "Organic Reactions and Mechanisms", 4<sup>th</sup> Edition, Narosa Publishing House & New Delhi
- 6 <https://archive.nptel.ac.in/courses/104/101/104101115/>
- 7 <https://archive.nptel.ac.in/courses/104/106/104106119/>



Course Code	Course Name	Category	L	T	P	Credit
232CE2A1CB	COORDINATION CHEMISTRY	CORE	4	1	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- Theories, reaction mechanism and geometries of coordination complexes
- The structure and bonding of coordination compounds
- The basics of electronic spectroscopy and magnetism of transition metal complexes

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Interpret the various theories of coordination compounds, MO diagrams of complexes	K3
CO2	Outline the various types of reaction mechanism of coordination complexes	K3
CO3	Compare the various symmetries/geometries of coordination complexes	K3
CO4	Examine the structure and bonding of metal carbonyls	K4
CO5	Analyze the importance of electronic spectroscopy using energy level diagram	K4

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	✓
CO2		✓	✓		
CO3	✓	✓		✓	✓
CO4			✓	✓	
CO5	✓	✓			✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A1CB	COORDINATION CHEMISTRY	SEMESTER I
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Total Credits: 4

Total Instruction Hours: 60 h

### Syllabus

#### Unit I Theories of coordination compounds 12 h

VB and CFT theory- Splitting of d orbitals in ligand field and different symmetries - CFSE - Factors affecting the magnitude of  $10 Dq$  - Evidence for crystal field stabilization - Spectrochemical series - Site selection in spinels - Tetragonal distortion from octahedral symmetry - Jahn-Teller distortion - Nephelauxetic effect - MO theory - Octahedral - Tetrahedral and square planar complexes -  $\pi$  bonding and molecular orbital theory

#### Unit II Reaction mechanism in coordination complexes 12 h

Theories of trans effect - The rate law for nucleophilic substitution reaction and mechanism of square planar complexes - Kinetics and substitution reaction mechanism of octahedral complexes. Ligand field effects and reaction rates - Reaction rates influenced by acid and bases - Racemization and isomerization - Mechanism of redox reaction - Outer sphere mechanism - Excited state outer sphere electron transfer reactions - Inner sphere mechanism

#### Unit III Structure of coordination complexes 12 h

Complexes with coordination number two, three, four, five six, seven and eight - Site preference in trigonal bipyramidal and square pyramidal complexes - Isomerism in five coordinate complexes - Distortion from perfect octahedral symmetry - Trigonal prism - Geometrical isomerism in octahedral complexes

#### Unit IV Structure and bonding in metal carbonyls 12 h

Metal carbonyl complexes -Classification- synthesis - Structure and properties - 18 electron and EAN rule - Nature of M-CO bonding - Binding mode of CO and IR spectra of metal carbonyls - Metal carbonyl hydrides -Metal nitrosyl complexes

#### Unit V Electronic spectra and magnetism 12 h

Microstates, terms and energy levels for  $d1 - d9$  ions in cubic and square fields - Selection rules - Band intensities and band widths - Energy level diagrams of Orgel and Tanabe - Sugano - spectra of  $V^{3+}$ ,  $Ni^{2+}$ ,  $Cr^{3+}$ ,  $Co^{2+}$  and  $Fe^{2+}$  - Calculation of  $10Dq$  and magnetic moment for  $V^{3+}$  (oct) and  $Ni^{2+}$  (oct) complexes - Charge transfer spectra - Change in magnetic properties of complexes in terms of spin orbit coupling - Temperature independent paramagnetism



## Text Books

- 1 Huheey. J.E, Keiter. E.A and Keiter. R.L, 2006, "Inorganic Chemistry, Principles of Structure and Reactivity", 4th Edition, Pearson Education & UK
- 2 Cotton. F.A, Wilkinson. G, Murillo. C.A and Bochmann. M, 1999, "Advanced Inorganic Chemistry", 6th Edition, A Wiley - Interscience Publications, John Wiley and Sons & USA

## References

- 1 Gopalan. R, Ramalingam. V, 2001, "Concise Coordination Chemistry", 3rd Edition, Vikas Publishing house pvt. Ltd & New Dehli
- 2 Shriver. D. F, Weller. M.T, Overton. T, Rourke. J and Armstrong. F.A, 2014, "Inorganic Chemistry", 6th Edition, New York, W.H. Freeman and Company & USA
- 3 Gurdeep Raj, 2014, "Advanced Inorganic Chemistry", 12th Edition, Geol Publishing House & New Delhi
- 4 Lewis. J and Wilkins. R.G, 1967, "Modern Coordination Chemistry", Inter Science Publisher & New Delhi
- 5 <https://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-Inorganic-Chemistry-Volume-1/ATOICV1-8-3-Orgel-and-Tanabe-Sugano-Diagrams-for-Transition-Metal-Complexes-d1-d9-States.pdf>
- 6 <https://chem.yonsei.ac.kr/chem/upload/CHE3103-01/125652642990718.pdf>



Course Code	Course Name	Category	L	T	P	Credit
232CE2A1CC	THERMODYNAMICS AND KINETICS	CORE	4	1	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The Fundamentals of equilibrium and non- equilibrium thermodynamics
- The chemical equilibrium and catalysis
- The application oriented knowledge about electrochemistry

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Analyze the concepts of equilibrium thermodynamics	K4
CO2	Understand the concepts of non-equilibrium thermodynamics	K3
CO3	Analyze the concepts and functions of electrochemical reactions	K4
CO4	Interpret the knowledge about chemical kinetics in molecular reactions	K5
CO5	Apply concept involved in catalysis and adsorption	K3

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	✓
CO2		✓			✓
CO3	✓	✓		✓	
CO4			✓		
CO5	✓	✓			✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A1CC	THERMODYNAMICS AND KINETICS	SEMESTER I
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Total Credits: 4

Total Instruction Hours: 60 h

### Syllabus

#### Unit I      Equilibrium thermodynamics      12 h

Gibbs - Helmholtz equation-Maxwell relations - Genesis of third law and its limitations - Thermodynamics of systems of variable compositions - Partial molar quantities and their determination - Chemical potential - Gibbs-Duhem equation - Gibbs-Duhem-Margules equation - Fugacity - Determination of fugacity of gases by graphical method and from equations of state - Variation of fugacity with temperature - Fugacity (or activity) coefficient

#### Unit II      Non-equilibrium thermodynamics      12 h

Phenomenological laws and Onsager Reciprocal relations - Conservation of mass and energy in closed and open system- Entropy production in heat flow and chemical reactions - Entropy production and entropy flow in open systems - Principles of microscopic reversibility - Onsager's theory - Validity and its verification.

#### Unit III      Electrochemistry      12 h

Activity - Mean ion activity and mean activity coefficient of electrolytes in solution - Debye-Hückel theory and limiting law - Debye-Hückel-Onsager equation verification and limitations. The electrical double layer - Structure and models (Helmholtz, Guoy-Chapman and Stern) - Kinetics of electrode processes - Current-potential curve - Butler Volmer relation and its approximations - Tafel equation - Charge transfer resistance

#### Unit IV      Chemical Kinetics-I      12 h

Theories of reaction rates - Collision - transition State - Lindemann - Hinshelwood - Rice - Ramsperger-Kassel theory (RRK), Rice-Ramsperger-Kassel-Marcus (RRKM) theory - Slater treatments - Fast reaction kinetics - Stopped flow method - Chemical relaxation method.

#### Unit V      Chemical Kinetics-II      12 h

Homogenous catalysis - Hammett acid-base catalysis - Acidity function - Enzyme catalysis - Michaelis - Menton kinetics - Lineweaver Burk plot - Influence of PH and temperature on enzyme catalysis



Heterogeneous catalysts - Adsorption and free energy relation at interfaces - Gibbs adsorption isotherm - Adsorption isotherms (Langmuir and BET) - Measurement of surface area - Kinetics of heterogeneous catalysis (Langmuir Hinshelwood mechanism and Eley-Rideal mechanism)

### Text Books

- 1 Glasstone. S, 2008, "Thermodynamics for Chemists", 11<sup>th</sup> Edition, Ewp Publishers & USA.
- 2 Atkins. P and Julio de Paula, 2014, "Physical Chemistry" 10<sup>th</sup> Edition, Oxford University Press & UK.

### References

- 1 Grow. D.R, 1994, "Principles and applications of electrochemistry", 4<sup>th</sup> Edition, CRC Press publishers & UK.
- 2 Laidler. K.J, 2003, "Chemical Kinetics", 3<sup>rd</sup> Edition. Pearson Education Publishers & India.
- 3 Adamson. A.W, 1982, "Physical chemistry Surfaces", 4<sup>th</sup> Edition, Wiley-Blackwell Publishers & USA.
- 4 Bockris. J.O.M and Reddy A. K. N, 1998, "Modern Electrochemistry", 4<sup>th</sup> Edition, Plenum Press & USA.
- 5 <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=13G8VouhmrFfuhs6rkiyTA==>
- 6 <https://archive.nptel.ac.in/courses/104/101/104101128/>



Course Code	Course Name	Category	L	T	P	Credit
232CE2A1CD	ANALYTICAL CHEMISTRY	CORE	4	1	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The nature of errors and their types
- Various techniques involved in chromatography
- The thermoanalytical, Radiochemical, Fluorescence and electroanalytical techniques

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Identify the nature of errors and their analysis	K3
CO2	Apply the various methods of chromatographic techniques	K3
CO3	Examine the Spectrophotometry, XRD and Fluorescence Spectroscopy	K3
CO4	Explain the basic analysis of Thermal methods of analysis	K4
CO5	Analyze the various electroanalytical techniques	K4

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2		✓	✓		✓
CO3	✓			✓	✓
CO4		✓			
CO5	✓		✓	✓	✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A1CD	ANALYTICAL CHEMISTRY	SEMESTER I
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Total Credits: 4

Total Instruction Hours: 60 h

### Syllabus

#### Unit I Data and error analysis 12 h

Types of errors (accuracy, precision, significant figures) - Frequency distributions (Binomial, Poisson and normal). Describing data - Population and sample - Mean - Variance and standard deviation. Way of quoting uncertainty - Robust estimators - Repeatability and reproducibility of measurements. Hypothesis testing - Levels of confidence and significance - Analysis of residuals

#### Unit II Chromatography 12 h

Principles, instrumentation and uses of ion exchange - Paper - Thin-layer and column chromatography - HPTLC (High Performance Thin Layer Chromatography) - HPLC (High Performance Liquid Chromatography) - GC-MS (Gas Chromatography and Mass Spectroscopy) - GC-FID (Gas Chromatography and Field Ionization Detector), GC-ECD (Gas Chromatography and Electron Capture Detector) and GC-PFPD (Gas Chromatography and Pulsed Flame Photometric Detector)

#### Unit III Spectrophotometry, XRD and fluorescence spectroscopy 12 h

Principles, instrumentation and applications of Atomic Absorption Spectrophotometry (AAS) - Flame Emission Spectroscopy (FES) and Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) - Single crystal and powder XRD (X-ray diffraction) - Fluorescence spectroscopy

#### Unit IV Thermal methods of analysis 12 h

Principles - Instrumentations and applications of thermogravimetry analysis (TGA) - Differential Thermal Analysis (DTA) - TGA and DTA of  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  (Calcium oxalate monohydrate),  $\text{CaCO}_3$  (Calcium carbonate) - Differential Scanning Calorimetry (DSC) - PLA (poly lactic acid)

#### Unit V Electroanalytical techniques 12 h

Electrochemical sensors - Ion-sensitive electrodes - Glass membrane - Solid - liquid membrane - Gas sensor. Principles and instrumentations of polarography - Cyclic voltammetry - Amperometric titrations



### Text Books

- 1 Skoog and West, 2014, "Instrumental methods of analysis" 6<sup>th</sup> Edition, Cengage Publishers & USA.
- 2 Sharma B.K, 2011, "Instrumental methods of chemical analysis", 1<sup>st</sup> Edition, Krishna Prakashan Media pvt. Ltd & New Delhi.

### References

- 1 Willard H.W, Merritt. L.I, Dean. J.J.A and Settle. F.A, 2004, "Instrumental methods of analysis". 7<sup>th</sup> edition, CBS Publishers & New Delhi.
- 2 Srivastava.V.K and Srivastava. K.K, 1985, "Introduction to Chromatography," 2<sup>nd</sup> Edition, Holden Day & New York.
- 3 Hibbert. D.B and Gooding. J.J, 2006, "Data Analysis for Chemistry", 1<sup>st</sup> Edition, Oxford University Press & UK.
- 4 Bard. A. J and Faulkner. L. R, 2001, "Electrochemical Methods-Fundamentals and Applications", 2<sup>nd</sup> Edition, John Wiley & Sons & USA.
- 5 [https://www.whitman.edu/chemistry/edusolns\\_software/GC\\_LC\\_CE\\_MS\\_2017/CH%201%202017.pdf](https://www.whitman.edu/chemistry/edusolns_software/GC_LC_CE_MS_2017/CH%201%202017.pdf)
- 6 [http://www.issp.ac.ru/ebooks/books/open/X-Ray\\_Spectroscopy.pdf](http://www.issp.ac.ru/ebooks/books/open/X-Ray_Spectroscopy.pdf)
- 7 [https://web.stanford.edu/class/engr1n/Precision\\_E1.pdf](https://web.stanford.edu/class/engr1n/Precision_E1.pdf)



232CE2A1CP	ORGANIC CHEMISTRY	SEMESTER I
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Total Credits: 3

Total Instructions Hours: 72 h

S.No	Contents
1	Analysis of two component mixtures-separation and characterization of the components-I
2	Analysis of two component mixtures-separation and characterization of the components-II
3	Analysis of two component mixtures-separation and characterization of the components-III
4	Analysis of two component mixtures-separation and characterization of the components-IV
5	Analysis of two component mixtures-separation and characterization of the components-V
6	Estimation of Phenol
7	Estimation of Aniline
8	Estimation of Glucose
9	Preparation of Acetylsalicylic acid from methyl salicylate
10	Preparation of Benzilic acid from benzoin (rearrangement)
11	Preparation of Benzanilide from benzophenone (rearrangement)
12	Preparation of p-Bromoacetanilide from aniline

**Note: Any 10 Experiment****References**

- 1 N.S.Gnanaprakasam and Ramamurthy.G, 1998, "Organic Chemistry-Lab Manual", S.Viswanathan Co.Pvt.Ltd & Chennai
- 2 B.S.Furniss, Brain.S, Hannaford A.J, and Antony.J, 2016, "Vogel's Text book of Practical Organic Chemistry", 5th Edition, ELBS/Longman & UK
- 3 F.G.Mann, Saunders, 2011, "Practical Organic Chemistry", 4th Edition, Pearson & India
- 4 V.K.Aluwalia, Bhagat.P and Agarwal.R, 2005, " Laboratory Techniques in Organic Chemistry", 4th Edition I.K .International Publishing House Pvt .Ltd & New Delhi



Course Code	Course Name	Category	L	T	P	Credit
232CE2A1DA	POLYMER CHEMISTRY	DSE	4	-	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The significance of Polymers
- Polymer structure, properties and characteristics
- Polymer processing techniques and its applications

#### COURSE OUTCOMES

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

CO Number	CC Statement	Knowledge Level
CO1	Summarize the Mechanism of polymerization process	K3
CO2	Categorize the different polymerization techniques	K4
CO3	Analyze the various characteristics of polymers	K4
CO4	Examine the structure, properties and fabrication techniques	K4
CO5	Summarize the functionalities of commercial polymers	K3

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓	✓	✓	✓
CO2		✓			
CO3	✓	✓		✓	
CO4			✓		
CO5	✓	✓		✓	✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics

232CE2A1DA	POLYMER CHEMISTRY	SEMESTER I
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Total Credits: 4

Total Instruction Hours: 48 h

### Syllabus

#### Unit I Chemistry of polymers 10 h

Addition and Condensation polymers - Mechanism (free radical, ionic, Zeigler-Natta polymerization) - Kinetics of polymerization - Kinetic chain length - Factors affecting chain polymerization - Inhibition and retardation - Carother's equation. Difference between polymers and plastics- Compounding of plastics - Fillers, plasticizers, colourants, auto oxidants, fire retardants and thermal stabilizers

#### Unit II Polymerization techniques and types 10 h

Polymerization Techniques (bulk, solution, suspension, emulsion, melt, interfacial solid-gas phase condensation). Types of copolymerization - Free radical - Ionic - Polycondensation - Copolymer equation - Significance - Monomer and radical reactivity - Q-e scheme - Determination of monomer reactivity ratio - Mayo-Lewis and Fineman Ross methods - Block and graft copolymerization - Methods of preparation and mechanism

#### Unit III Polymer characteristics and characterization 8 h

Types of degradation - Thermal- Mechanical - Photodegradations - The concept of number average and weight average molecular weight methods. Separation of polymers - Precipitation and analytical methods - Determination of molecular weights - Osmotic pressure - Viscosity - Ultra centrifugation. Analysis and testing of polymers - Spectroscopic methods, x-ray diffraction study

#### Unit IV Polymer properties and fabrication 10 h

Morphology and order in crystalline polymers - Configuration of polymer chain - Tacticity (Mono and disubstitute polyethylene, polypropylene, polybutadiene). Significance of stereoregularity - Polymer structure and physical properties - Crystalline melting point ( $T_m$ ) - Melting points of homogeneous series - Effect of chain flexibility and heat of fusion - The glass transition temperature ( $T_g$ ) Relationship between  $T_m$  and  $T_g$  - Fabrications of polymers - Moulding, casting and spinning

**Unit V Commercial polymers and applications**

10 h

Preparation, properties and applications of polyethylene - Polyvinyl chloride - Polyamides - Polyesters - Polymethylmethacrylate - Polystyrene - Polycarbonates - Phenolic resins and epoxy resins. Types and applications of dendrimers and conducting polymers. Liquid crystalline polymers

**Text Books**

- 1 Gowariker. V.R and Viswanathan. N.V, 2019, "Polymer science", 3<sup>rd</sup> Edition, New Age International Publishers & New Delhi.
- 2 Billmeyer. F.W, 2007, "Text book of Polymer science", 3<sup>rd</sup> Edition, Wiley India Pvt. Ltd & New Delhi.

**References**

- 1 Manas Chanda, 2013, "Introduction to Polymer Science and Chemistry", 2<sup>nd</sup> Edition, CRC Press & USA.
- 2 Goel R. Fried, 2003, "Polymer science and technology", 2<sup>nd</sup> Edition, Prentice Hall & New Jersey
- 3 George Odian, 2007, "Principles of polymerization", 4<sup>th</sup> Edition, Wiley India Pvt. Ltd & New Delhi.
- 4 Ghosh. P, 2017, "Polymer Science and Technology: Plastics, Rubber, Blends and Composites", 3 Edition, McGraw Hill Education & New Delhi.
- 5 <https://onlinelibrary.wiley.com/journal/10991581>
- 6 [https://nitsri.ac.in/Department/Chemical%20Engineering/M3\\_\\_Polymer\\_Technology.pdf](https://nitsri.ac.in/Department/Chemical%20Engineering/M3__Polymer_Technology.pdf)

Course Code	Course Name	Category	L	T	P	Credit
232CE2A1DB	INDUSTRIAL CHEMISTRY	DSE	4	-	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The properties and manufacture of glass products
- The coating techniques
- The classification and properties of alloys

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Summarize the properties and preparation of glass products	K3
CO2	Utilize the coating process of paint and pigments	K3
CO3	Illustrate the various types and properties of alloying materials	K3
CO4	Analyze the types and manufacturing process of fertilizer	K4
CO5	Develop the various types and manufacturing process of cement and ceramics	K4

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	✓
CO2		✓			
CO3	✓	✓		✓	✓
CO4			✓		
CO5	✓	✓			✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/>	Skill Development	<input type="checkbox"/>	Entrepreneurial Development
<input checked="" type="checkbox"/>	Employability	<input type="checkbox"/>	Innovations
<input type="checkbox"/>	Intellectual Property Rights	<input type="checkbox"/>	Gender Sensitization
<input type="checkbox"/>	Social Awareness/ Environment	<input type="checkbox"/>	Constitutional Rights/ Human Values/ Ethics



232CE2A1DB	INDUSTRIAL CHEMISTRY	SEMESTER I
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Total Credits: 4

Total Instruction Hours: 48 h

### Syllabus

#### Unit I      Silicon industries      10 h

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass - Composition and properties of the glasses - Soda lime - Lead - Armoured - Safety - Borosilicate - Fluorosilicate - Coloured - Photosensitive. Chemistry of refractories and Abrasives

#### Unit II      Surface coatings      10 h

Objective of coating surfaces - Preliminary treatment of surface - Classification of surface coatings - Paints and pigments - Formulation and composition of Oil paint, Vehicle, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents - Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint). Wax polishing-Water and Oil paints - Metallic coatings (electrolytic and electroless). Metal spraying and anodizing

#### Unit III      Alloys      8 h

Classification of alloys (ferrous and non-ferrous) - Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization and dephosphorisation, Surface treatment, argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels

#### Unit IV      Fertilizer      10 h

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates, polyphosphate, superphosphate, and triple super phosphate. Compound and mixed fertilizers - Potassium chloride - Potassium sulphate.

#### Unit V      Ceramics and cements      10 h

Ceramics: clays and feldspar-Manufacture of ceramics and their types - High technology ceramics and their applications - Superconducting and semiconducting oxides - Fullerenes - Carbon nanotubes and carbon fibre. Cements: Classification of cement - Ingredients and their role - Manufacture of cement and the setting process - Quick setting cements



### Text Books

- 1 Jain and Jain , 2017," Engineering Chemistry", 17<sup>th</sup> Edition , Dhanpat Rai & Sons & New Delhi.
- 2 Sharma. B .K , 2003 , "Industrial Chemistry", 22<sup>nd</sup> Edition , Goel Publishing House & Meerut.

### References

- 1 White. H.L, 1986, "Introduction to Industrial Chemistry", 1<sup>st</sup> Edition, A Wiley Interscience Publication & USA.
- 2 Pawar. R.A, Gugale. G.S, Nagawade. A.V, Gadave. K.M, 2017, "A Book of Industrial Chemistry", 1<sup>st</sup> Edition, Nirali Prakashan Publishers & Pune.
- 3 Alan Heaton, 1996, "An Introduction to Industrial chemistry", 3<sup>rd</sup> Edition, Chapman & Hall Publishers & UK.
- 4 Uppal. M.M, 2001, "Textbook of Engineering Chemistry", 6<sup>th</sup> Edition, Khanna Publishers & New Delhi.
- 5 [https://sist.sathyabama.ac.in/sist\\_coursematerial/uploads/SCH1604.pdf](https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCH1604.pdf)
- 6 <https://www.scribd.com/document/491788610/Metal-and-Metal-Alloys-Notes#>



Course Code	Course Name	Category	L	T	P	Credit
232CE2A1DC	GREEN CHEMISTRY	DSE	4	-	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The basics of Green chemistry
- The advantages of green synthetic methods of organic compounds
- The reactions and applications of green chemistry

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Gain knowledge on green chemistry principles	K3
CO2	Understand various methods of Green synthetic routes	K 3
CO3	Develop the basic knowledge of the various green reactions	K 3
CO4	Compare Aqueous phase, Solid state and PTC reactions	K 3
CO5	Analyze the Photochemical, Microwave, Sonication and Ionic liquid reactions	K 4

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓			✓	✓
CO2		✓	✓		
CO3	✓	✓		✓	✓
CO4	✓		✓		✓
CO5	✓	✓			✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A1DC	GREEN CHEMISTRY	SEMESTER I
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Total Credits: 4

Total Instruction Hours: 48 h

### Syllabus

#### Unit I Principles of green chemistry 10 h

Twelve principles of green chemistry - Explanation. Planning a green synthesis - Percentage atom utilization - Evaluating type of reaction involved - Selection of appropriate solvent - Reagent - Protecting groups - Use of catalyst - Energy requirement

#### Unit II Green synthesis 10 h

Adipic acid - Catechol - Disodiumiminodiacetate - Hoffmann elimination - Benzoic acid from methyl benzoate - Toluene - Diels-Alder reaction- Decarboxylation - Safe marine antifoulant

#### Unit III Green reactions 8 h

Mechanism and application of Acyloin condensation - Aldol condensation - Arndt - Eistert - synthesis - Baeyer - Villiger oxidation - Baker Venkatraman Rearrangement - Barbier reaction - Barton reaction - Baylis-Hillman Reaction - Backmann rearrangement - Benzil-Benzilic rearrangement - Biginelli reaction

#### Unit IV Aqueous phase, solid state and PTC reactions 10 h

Aqueous phase reaction - Hydrolysis of methyl salicylate - Chalcone - p-ethoxy acetanilide- p-acetamido phenol - Vanillidene acetone. SFE (Super Critical Fluid Extraction) - Liquid CO<sub>2</sub> in green synthesis. Solid state - Diphenyl carbinol - Phenyl benzoate - Azomethines. PTC(Phase Transfer Catalyst) reaction - Phenylisocyanide - Diphenyl-7-Hydroxy-coumarin

#### Unit V Photochemical, microwave, sonication and ionic liquid reactions 10 h

Photochemical reactions - Benzopinacol, trans Azobenzene to cis-azobenzene, trans stilbene to cis-stilbene. Microwave reactions-3-methyl-1-phenyl-5-pyrazolone, copper phthalocyanine. Sonication reaction - Butyraldehyde, 2-chloro-N-Aryl anthranilic acid. Ionic liquid reactions-1-Acetyl naphthalene-Ethyl-4-methyl 3 Cyclohexene carboxylate




## Text Books

- 1 Ahluwalia. V. K. 2011, "Green Chemistry-Greener Alternatives to synthetic alternatives to synthetic organic transformations" , 1<sup>st</sup> Edition, Narora Publishing House & New Delhi.
- 2 Ahluwalia V. K, 2019, "Green Chemistry", 3<sup>rd</sup> Edition, Ane Books India & New Delhi.

## References

- 1 Asim. K. Das and Madhua. Das, 2012, "Environmental Chemistry with Green Chemistry" , Books and Allied Pvt. Ltd & New Delhi.
- 2 Rashmi S, Srivastava M.M, 2009. "Green Chemistry" 4<sup>th</sup> Edition, Narosa Publishing House & New Delhi.
- 3 Indu Tucker Sidhwani, Rakesh K. Sharma, 2020, " An Introductory Text on Green Chemistry: For Undergraduate Students", 1<sup>st</sup> Edition, Wiley & Sons & Germany
- 4 Kumar V, 2010, "An Introduction to Green Chemistry", 2<sup>nd</sup> Edition , Vishal Publishing Co & New Delhi.
- 5 [https://simons.hec.utah.edu/papers/BOOK2\\_C7.PDF](https://simons.hec.utah.edu/papers/BOOK2_C7.PDF)
- 6 <https://www.uou.ac.in/sites/default/files/slm/MSCH-604.pdf>

  
 BoS Chairman/HoD  
 Department of Chemistry  
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 Coimbatore – 641 048

Dr.N.G.P Arts and Science College		
APPROVED		
BoS- 13 <sup>th</sup> 08/06/23	AC- 15 <sup>th</sup> 4/07/23	GB- 20 <sup>th</sup> 05/08/23



Course Code	Course Name	Category	L	T	P	Credit
232CE2A2CA	STEREOCHEMISTRY AND PERICYCLIC REACTIONS	CORE	4	1	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The basic principles of stereochemistry and conformational analysis of organic compounds
- About photochemistry and pericyclic reaction mechanisms
- The basic knowledge about various molecular rearrangement reactions

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the stereochemistry of organic molecules in 3-D arrangements	K3
CO2	Interpret the various methods of conformational analysis of organic molecules	K3
CO3	Categorize the various light induced photo reactions and their rearrangements	K4
CO4	Examine the basic principles involved in the pericyclic reactions	K3
CO5	Analyze the reaction mechanism of various molecular rearrangement reactions	K4

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	
CO2		✓			✓
CO3	✓	✓		✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓		✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A2CA	STEREOCHEMISTRY AND PERICYCLIC REACTIONS	SEMESTER II
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Total Credits: 4

Total Instruction Hours: 60 h

## Syllabus

**Unit I Stereochemistry 12 h**

Stereoisomerism – Symmetry – Enantiomers and diastereomers – R and S / E and Z nomenclature. Topicity – Homotopic, heterotopic, enantiotopic and diastereotopic systems. Stereochemistry of biphenyls, allenes, spiranes, ansa compounds and helical structures. Asymmetry synthesis – Cram's and Prelog's rules

**Unit II Conformational Analysis 12 h**

Conformational analysis of acyclic system: Conformations of ethane, butane and halogenoalkanes - Effect of conformation on reactivity - Addition and elimination reaction of acyclic systems.

Conformational analysis of cyclic compounds: Cyclohexane - Mono and disubstituted cyclohexane. Conformation and reactivity of cyclohexane derivatives. Conformation of decalins

**Unit III Organic Photochemistry 12 h**

Fundamental concepts – Energy transfer – Characteristics of photoreactions – Photoreduction, photooxidation and photosensitization. Photoreactions of ketones and enones – Norrish type I and II reactions – Paterno-Buchi reaction – Photo-Fries rearrangement – Photochemistry of alkenes, dienes and aromatic compounds – di- $\pi$ -methane rearrangement – Barton reaction

**Unit IV Pericyclic Reactions 12 h**

Concerted reactions: Conservation of orbital symmetry – Woodward-Hoffman rules. Electrocyclic reactions – 1,3-dienes and 1,3,5-trienes. Analysis of reaction using orbital correlation diagram and FMO methods. Cycloadditions [2+2] and [4+2] – Analysis using correlation diagram and FMO methods. Sigmatropic rearrangements – Cope and Claisen rearrangements

**Unit V Molecular Rearrangements 12 h**

Classification – Mechanism and applications of Wagner - Meerwein, Neber, Baeyer-Villiger, Dienone phenol, Favorski, Benzidine, Stevens, Schmidt, Lossen and Wallach rearrangements



### Text Books

- 1 Nasipuri D, 2018, "Stereochemistry of Organic Compounds: Principles and Applications", 3<sup>rd</sup> Edition, New Age International Publishers & New Delhi
- 2 Chatwal G. R, 1998, "Organic Photochemistry", 1<sup>st</sup> Edition, Himalaya Publications house & New Delhi

### References

- 1 Sanyal S. N, 2013, "Reactions, Rearrangements and Reagents", 4<sup>th</sup> Edition, Bharati Bhawan Publishers & Distributors & New Delhi
- 2 Michael B Smith B, 2015, "March's Advanced Organic Chemistry: Reactions Mechanisms and Structure", 7<sup>th</sup> Edition, Wiley & New Delhi
- 3 Kalsi P. S, 2015, "Stereochemistry: Conformation and Mechanism", 10<sup>th</sup> Edition, New Age International Private Limited & New Delhi
- 4 Depuy C. H, 1972, "Molecular Reactions and Photochemistry", 1<sup>st</sup> Edition, Prentice Hall & New Delhi
- 5 [https://personal.utdallas.edu/~scortes/ochem/OChem1\\_Lecture/Class\\_Materials/09\\_stereo\\_notes.pdf](https://personal.utdallas.edu/~scortes/ochem/OChem1_Lecture/Class_Materials/09_stereo_notes.pdf)
- 6 <https://www.alchemyst.co.uk/pdf/Organic/pericyclics.pdf>



Course Code	Course Name	Category	L	T	P	Credit
232CE2A2CB	BIO-INORGANIC CHEMISTRY	CORE	4	-	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The structure and bonding of Cobalamines, Heme and Non Proteins Hemoglobin.
- The structure and reactions of Metal, alkylidene, alkene and alkyne complexes
- The importance of trace elements in biological systems and medicinal applications of bioinorganic compounds

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Explore the broad idea about the Cobalamines, Heme and Non Proteins Hemoglobin	K4
CO2	Analyze the synthesis and reactivity of Metal alkylidene, alkene and alkyne complexes	K4
CO3	Examine the synthesis and applications of metallocene compounds	K3
CO4	Interpret toxic and non-toxic metal ions to the biological systems	K4
CO5	Survey the role of inorganic complexes in medicinal applications	K4

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	✓
CO2	✓	✓			✓
CO3	✓	✓		✓	
CO4		✓	✓		
CO5	✓	✓		✓	✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A2CB	BIO-INORGANIC CHEMISTRY	SEMESTER II
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Total Credits: 4

Total Instruction Hours: 48 h

### Syllabus

#### Unit I Cobalamines, Heme and Non Proteins Hemoglobin 10 h

Reactions of the alkyl cobalamins – One-electron Reduction and Oxidation – Co-C Bond Cleavage – Coenzyme B12 – Alkylation reactions of methyl cobalamin. Hemoglobin and Myoglobin – Oxygen transport and storage – Electron transfer and Oxygen activation. Cytochromes, Ferredoxins and Rubredoxins – Model systems, mononuclear non-heme iron enzymes

#### Unit II Metal-alkylidene/alkene/alkyne complexes 9 h

Synthesis of alkylidene complexes in low oxidation states and in high oxidation states. Alkene complexes - Synthesis – Bonding - Reactivity - Ligand substitution – Reactions with nucleophiles. Alkyne complexes – Synthesis by reduction method. Insertion reactions - Cobalt catalyzed alkyne cycloaddition with nitrile, alkene and alkyne

#### Unit III Metallocenes 10 h

Cyclopentadienyl complexes - Metallocenes - Synthesis of metallocenes - Reactions of metallocenes – Bonding, redox and substitution reactions of ferrocene - Application of ferrocenes - Blood glucose sensors - Synthesis of bent metallocene complexes – Reactivity of bent metallocenes - Substitution, bonding and structure of arene complexes

#### Unit IV Metal ions in biological system 10 h

Classification of elements according to their action in biological systems, Na & K ion transport, Na / K pump. Consequences of excess and deficiency of trace metals. Toxicity of metal ions (Hg, Pb, Cd and As) - Reasons for toxicity. Use of chelating agents in medicine - Cis platin mode of action

#### Unit V Nitrogen Fixation and Photosynthesis 9 h

Nitrogenase enzyme: Introduction, types of nitrogen fixing microorganisms, metal clusters in nitrogenase. Nitrogen fixation pathway. Biological redox reactions. Chlorophyll - Light and dark phase reactions of photosynthesis



**Text Books**

- 1 Asim K Das, 2013, "Bioinorganic chemistry", 5<sup>th</sup> Edition, Books & Allied Pvt Ltd & Kolkatta
- 2 Hussain Reddy K, 2007, "Bioinorganic Chemistry", 1<sup>st</sup> Edition, New Age International (P) limited & New Delhi

**References**

- 1 Stephen J Lippard, 2005, "Principles of Bioinorganic Chemistry", 2<sup>nd</sup> Edition, Panima publishing corporation & New Delhi
- 2 Rosette M Roat-Malone, 2007, "Bioinorganic chemistry" - A short course, 2<sup>nd</sup> Edition, A John Wiley & Sons Inc. Publication & US
- 3 Dieter Rehder, 2014, "Bioinorganic chemistry ", 1<sup>st</sup> Edition, Oxford University Press & New Delhi
- 4 Dharam Prakash, 2018, "Bioinorganic chemistry", 1<sup>st</sup> Edition, Arjun Publishing House & New Delhi
- 5 [https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp\\_content/S000005CH/P000670/M013991/ET/1455878224CHE\\_P15\\_M5\\_e-Text.pdf](https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000005CH/P000670/M013991/ET/1455878224CHE_P15_M5_e-Text.pdf)
- 6 [https://books.google.co.in/books/about/Metallocenes\\_An\\_Introduction\\_to\\_Sandwich.html?id=pwppQgAACAAJ&redir\\_esc=y](https://books.google.co.in/books/about/Metallocenes_An_Introduction_to_Sandwich.html?id=pwppQgAACAAJ&redir_esc=y)



Course Code	Course Name	Category	L	T	P	Credit
232CE2A2CC	MOLECULAR SPECTROSCOPY	CORE	4	1	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The principle and mechanism of different types of molecular spectroscopy
- The basic knowledge on influence of electromagnetic radiation and associated physical events
- The details on the use of spectroscopic techniques for structural investigation

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the fundamental concepts of microwave spectroscopy	K3
CO2	Apply intense knowledge on the principles and instrumentation of IR and electronic spectroscopy	K4
CO3	Develop the basic principles of NMR spectroscopy	K3
CO4	Analyze the 2D techniques involved in NMR spectroscopy	K4
CO5	Utilize the basic principles involved in ESR spectroscopy to understand the structural features of complexes	K4

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	
CO2	✓	✓	✓		✓
CO3	✓	✓		✓	✓
CO4	✓		✓		✓
CO5	✓	✓	✓	✓	✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A2CC	MOLECULAR SPECTROSCOPY	SEMESTER II
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Total Credits: 4

Total Instruction Hours: 60 h

### Syllabus

#### Unit I      Microwave Spectroscopy      12 h

Electromagnetic radiation - Interaction of electromagnetic radiation with molecules - Types of molecular spectroscopy - Factors affecting line width and intensity - Signal to noise ratio and resolving power.

Microwave Spectroscopy - Rotation of molecules - Rotational spectra of rigid rotator - Intensities of rotational lines - Effect of isotopic substitution - Rotational spectrum of non-rigid rotator - Linear & symmetric top molecules - Stark effect. Applications of microwave spectroscopy - Determination of bond length, bond angle dipole moment and atomic mass from microwave spectra

#### Unit II      Infrared and Electronic spectroscopy      12 h

Electronic Spectra of diatomic molecules - Frank Condon principle - Vertical transitions - Selection rules - Parity, symmetry and spin selection rules - Polarization of transitions - Russell Sanders coupling - Different types of electronic transitions - UV-Vis instrumentation.

Infrared Spectroscopy: Vibration of diatomic molecule - Harmonic and anharmonic oscillators - Fermi resonance - Selection rules - Vibrations of polyatomic molecules - Molecular vibrations - Types of molecular vibrations - Rotational vibrational spectra of linear and symmetric top molecules - Factors influencing vibrational frequencies - Fourier transformation in IR spectroscopy - Instrumentation

#### Unit III      Nuclear Magnetic Resonance (NMR) Spectroscopy-I      12 h

Chemical shift - Factors affecting chemical shift - Nuclear spin states and NMR active nuclei - Nuclear magnetic moments - Mechanism of resonance absorption - Population of nuclear spin states. Multiplicity - Coupling constant - First order and second order proton - Dependence of J on dihedral angle - Vicinal and geminal coupling constants - Karplus equation - Long range coupling constants - Factors influencing coupling constant - Splitting of NMR signals - AB, AX and AMX types - Influence of stereochemical factors on chemical shift of protons



## Unit IV      Nuclear Magnetic Resonance (NMR) Spectroscopy-II      12 h

$^{13}\text{C}$  nucleus - Chemical shifts - Spin-spin splitting - Double resonance techniques - Homonuclear and hetero nuclear decoupling - Broad band decoupling - Off resonance decoupling -  $^{13}\text{C}$  relaxation mechanism - Overhauser effect

FT and 2D NMR spectroscopy: FID, DEPT, J-resolved, H-H-COSY, C-H-COSY and NOESY spectra

## Unit V      Electron Spin Resonance (ESR) Spectroscopy      12 h

Theory - Electron spin - Zeeman effect - Presentation of the spectrum - EPR spectrum of hydrogen and methyl radicals (first order treatment) - g factors - Hyperfine splitting - Nuclear spin interaction with electron spin - Hyperfine coupling constants - EPR spectra of organic radicals (AA and AB type). Theory of EPR spectroscopy - Spin densities and McConnell relationship - Factors affecting the magnitude of g and A tensors in metal species - Zero-field splitting and Kramers degeneracy - Applications of EPR

### Text Books

- 1 Pavia. D. L, 2011, "Spectroscopy", 5<sup>th</sup> Edition, Brooks/Cole Publications & UK
- 2 Yadav M. S, 2011, "Molecular Spectroscopy", 1<sup>st</sup> Edition, Arise Publishers and Distributors & New Delhi

### References

- 1 Banwell, C. N, 2017, "Fundamentals of molecular spectroscopy", 4<sup>th</sup> Edition, Mc Graw Hill Book Company & London
- 2 Kalsi P. S, 2014, "Spectroscopy of Organic Compounds", 6<sup>th</sup> Edition, New Age International (P) Ltd & New Delhi
- 3 Silverstein R. M, 2009, "Spectrometric Identification of Organic compounds", 6<sup>th</sup> Edition, John Wiley Publications & Germany
- 4 William Kemp, 2008, "Organic Spectroscopy", 3<sup>rd</sup> Edition, Palgrave Publications & US
- 5 Sharma Y. R, 2013, "Elementary Organic Spectroscopy", 5<sup>th</sup> Edition, S. Chand and Company Pvt Ltd & New Delhi
- 6 <https://ccsuniversity.ac.in/bridge-library/pdf/Msc-chemistry-psct-unit-3.pdf>



232CE2A2CP	INORGANIC CHEMISTRY	SEMESTER II
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Total Credits: 4  
Total Instructions Hours: 72 h

### List of Experiments

Semi micro qualitative Analysis of mixtures containing two common and two less common cations.

S.No Ions of common metals: Pb, Cu, Mn, Cr, Al, Ni, Co, Ba, Sr, Ca, Mg  
Ions of less common metals: W, Se, Te, Mo, Ce, Th, Zr, Ti, V, U, Be, Li

- 1 Analysis of Inorganic Mixture - I
- 2 Analysis of Inorganic Mixture - II
- 3 Analysis of Inorganic Mixture - III
- 4 Analysis of Inorganic Mixture - IV

### Analysis involving Volumetric and Gravimetric estimations of Mixtures of Cations

- 5 Volumetric and gravimetric estimations of Cu and Ni
- 6 Volumetric and gravimetric estimations of Zn and Cu
- 7 Volumetric and gravimetric estimations of Fe and Zn

### Complexometric Titrations

- 8 Estimation of calcium
- 9 Estimation of magnesium
- 10 Estimation of zinc

### Colorimetric Estimation of Metals using Photoelectric Colorimeter

- 11 Estimation of iron
- 12 Estimation of copper

**Note:** Any 10 Experiments



- 1 Venkateswaran V, Veeraswamy R and Kulandaivelu A. R, 2017, "Principles of Practical Chemistry", 1<sup>st</sup> Edition, Sultan Chand & Sons & New Delhi
- 2 Giri S, Bajpai D. N and Panday O. P, 2013, "Practical Chemistry Vol. I & II", 30<sup>th</sup> Edition, S. Chand & Company & New Delhi
- 3 Bassart J, Dennay R. C, Jeffery G. H and Mendham, 1989, "Vogels text book of Qualitative Inorganic Analysis", 5<sup>th</sup> Edition, The ELBS & Longman & UK.
- 4 Ramanujam V. V, 1988, "Inorganic Semimicro Qualitative Analysis", 3<sup>rd</sup> Edition, National Pubs & London



Course Code	Course Name	Category	L	T	P	Credit
233BC2A2EA	DRUG BIOCHEMISTRY	EDC	4	-	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The drug types, characteristics, and action of drugs on the body.
- The basic knowledge on mechanism of action, therapeutic uses, kinetics and adverse effects of drugs used for various clinical conditions
- The principles of chemotherapy, treatment strategies for cancer

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Illustrate the concepts of pharmacokinetics	K3
CO2	Explain the key principles of pharmacodynamics	K3
CO3	Analyze the mechanism of drugs acting on Central Nervous system	K4
CO4	Examine the mechanism of action of drugs for peptic ulcer, inflammation, thyroid disorders and Diabetes	K4
CO5	Illustrate the mechanism of anticancer drugs and basic concepts in patenting of drugs	K3

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	✓
CO2		✓	✓	✓	
CO3	✓	✓	✓	✓	✓
CO4		✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input checked="" type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input checked="" type="checkbox"/> Innovations
<input checked="" type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



233BC2A2EA	DRUG BIOCHEMISTRY	SEMESTER II
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Total Credits: 4

Total Instruction Hours: 48 h

### Syllabus

#### Unit I Pharmacology and Pharmacokinetics 10 h

Pharmacology: Classification of drugs, sources, Routes of drug administration: sublingual, buccal, oral, rectal, intravenous, intramuscular, subcutaneous, transdermal, inhalational and topical administration. Pharmacokinetics: drug absorption, drug distribution, drug biotransformation (role, formation and phases), drug excretion: quantitative pharmacokinetics, bioavailability, drug clearance.

#### Unit II Pharmacodynamics 8 h

Drug receptors: Types, classification, drug-receptor interaction, Agonist, antagonist, Inverse agonist, partial agonist. Dose-response relationships (graded and quantal). Adverse effects of drugs. Factors affecting drug safety and efficacy.

#### Unit III Antidepressant drugs and neurodegenerative diseases 10 h

Antidepressant drugs: Mechanism of action and therapeutic uses of tricyclic antidepressants and monoamine oxidase inhibitors.

Treatment of neurodegenerative diseases: Parkinson's Diseases - Introduction, Monoamine oxidase inhibitors. Alzheimer diseases- Mode of action Galantamine, rivastigmine. Hypnotic drug - zolpidem or zaleplon.

#### Unit IV Drugs for peptic ulcer, inflammation, thyroid disorders and Diabetes 10 h

Anti-peptic ulcer drugs: H<sub>2</sub> receptor antagonists and inhibitors of H<sup>+</sup>K<sup>+</sup> ATP-ase pump.

Anti-inflammatory drugs: Mechanism of action, therapeutic uses, pharmacokinetics and adverse effects of Anti-inflammatory drugs -aspirin and colchicine. Antimicrobial drugs - Sulfonamides, trimethoprim, penicillin, aminoglycosides and bacterial resistance.

Thyroid and anti- thyroid drugs, Insulin and oral anti- diabetic drugs.

#### Unit V Anticancer drugs 10 h

Anticancer drugs: Mode of action and its mechanism - Cyclophosphamide & methotrexate. Antibiotics (Dactinomycin & Bleomycin), microtubule inhibitor



(Vincristine & Vinblastine). Patenting of Drug, Marketing, and Computer aided drug design.

### Text Books

- 1 Richard D. Howland, Mary. J. Mycek, Willaim L. Wilkins, 2006, "Lippincott's illustrated reviews: pharmacology", 3rd Edition, Wolters Kluwer health (India) Pvt. Ltd., Delhi.
- 2 George M. Brunner, Craig W. Stevans. 2011, "Pharmacology", 3rd Edition, Saunders, an imprint of Elsevier Inc, United States.

### References

- 1 Sharma H.L, Sharma, K. K., 2011, "Principles of Pharmacology", 2 Edition, Paras Medical Publisher, India.
- 2 Satoskar, R. S, Nirmala N, Reje, Bhandarkar S. D, 2011, "Pharmacology and Pharmacotherapeutics", 22nd Edition, Popular Prakashan Pvt. Ltd, India
- 3 Aronson J.K., Smith D GG ,2008, Oxford textbook of clinical pharmacology and drug therapy, Oxford University Press, India
- 4 Tripathi, K.D. 2013, Essentials of Medical Pharmacology, 7th Edition, Jaypee Brothers, India.



Course Code	Course Name	Category	L	T	P	Credit
232CE2A2DA	COSMETIC CHEMISTRY	DSE	4	-	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The basic principles of Skin creams and Humectants
- About the methods of Mask and Aroma therapy
- The knowledge about the various methods of Oils extraction

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Understand basics of Skin Creams and Humectants	K3
CO2	Analyze the Bath and Oils	K3
CO3	Summarize the methods of Mask and aroma therapy	K3
CO4	Illustrate the separation of Essential and Flower oils	K3
CO5	Analyze the various methods of oils	K4

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	
CO2					✓
CO3	✓		✓	✓	✓
CO4	✓	✓	✓		✓
CO5	✓	✓	✓	✓	✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A2DA	COSMETIC CHEMISTRY	SEMESTER II
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Total Credits: 4

Total Instruction Hours: 48 h

### Syllabus

#### Unit I Skin Creams and Humectants 10 h

Skin Creams - Introduction, classification of skin creams, cleansing creams, night and massage creams, moisturizing, vanishing and foundation creams, pigmented foundation creams, hand creams, hand and body cream. Humectants - Introduction, drying out, types, hygroscopicity, stability, safety and applications. Antioxidants and application of antioxidants

#### Unit II Bath and Oils 10 h

Bath Preparation: Foam baths, Introduction, formulation and foam baths, types of products, product assessment, bath salts, ingredient and formulations. Bath Oils: Introduction floating and spreading oils, dispersible or blooming oils soluble oils, foaming oils

#### Unit III Mask and Aroma therapy 8 h

Setting masks - Peel off masks - Thermal types - Paraffin wax masks - Non-setting masks - Hot oil masks. Aroma therapy - Methods of extraction of essential oils. Blending & precautions, properties of essential oils and carrier oils. Patch testing, safety & precautions - Different aroma therapy formulations for skin and hair care

#### Unit IV Essential and Flower oils 10 h

Essential oils - Methodology of production, steam and water distillation. Treatment of condensate water after distillation - Flower oils - Extraction with cold fat and hot fat, alcoholic extracts, absolute of enfleurages and chassiss. Extraction with volatile solvents, selection of solvent and extraction apparatus

#### Unit V Isolation of Oils 10 h

Isolates - Methods of Isolation, properties and uses of following- Eugenol, pinene, linalool, citral and geraniol. Flavours - Sources and properties of vanilla, rose, pineapple, peppermint, mango, raspberry, orange and lemon



### Text Books

- 1 Poucher W. A. 2012, "Perfumes, Cosmetics and Soaps: Volume II The Production, Manufacture and Application of Perfumes", 9<sup>th</sup> Edition, Springer, USA & New York
- 2 Vimaladevi M, 2019, "Text book of herbal cosmetics", 10<sup>th</sup> Edition, Satguru Publications, India & New Delhi

### References

- 1 Deore S. V, Gaikwad, S. D, Gaikwad D. D and Gugale G. S. 2022, "Chemistry of Cosmetics and Perfumes", 1<sup>st</sup> Edition Nirali Prakashan, India & New Delhi
- 2 Butler H. 2010, Poucher's "Perfumes, Cosmetics and Soaps", 10<sup>th</sup> Edition Springer, USA & New York
- 3 Asha Ram, 1997, "Herbal Indian Perfumes and Cosmetics", 4<sup>th</sup> Edition Sri Satguru Publications, India & New Delhi
- 4 Susan Stewart, 2007, "Cosmetics and Perfumes in the Roman World", 5<sup>th</sup> Edition, The History Press Ltd, UK & London
- 5 [https://agritech.tnau.ac.in/horticulture/extraction\\_methods\\_natural\\_essential\\_oil.pdf](https://agritech.tnau.ac.in/horticulture/extraction_methods_natural_essential_oil.pdf)
- 6 <https://www.hsrd.research.va.gov/publications/esp/aromatherapy.pdf>



Course Code	Course Name	Category	L	T	P	Credit
232CE2A2DB	ELECTROCHEMISTRY	DSE	4	-	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The efficiency of battery and discharge cycle
- The different types of fuel cells and other storage devices
- The technology behind battery electric and hybrid vehicles

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic concept of electrochemistry related to battery	K3
CO2	Explain the concept of primary and secondary batteries and to explore their operations	K4
CO3	Compare the different batteries used in electric and hybrid vehicles	K3
CO4	Analyze the operations of batteries in hydrogen and other types of fuel cells	K4
CO5	Identify the other energy storage devices such as ultra-capacitors, flywheels, compressed air	K4

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2		✓		✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓				
CO5	✓	✓	✓		✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A2DB	ELECTROCHEMISTRY	SEMESTER II
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Total Credits: 4

Total Instruction Hours: 48 h

## Syllabus

**Unit I Electrochemistry 10 h**

The reaction quotient (Q), for a chemical reaction - The potential (E), for non-standard conditions using the Nernst Equation - Rate of reaction and types of over-voltages in galvanic and electrolytic cells and the Tafel Equation - Efficiency of chemical energy conversion: batteries versus heat engines

**Unit II Batteries 10 h**

Primary batteries - Secondary batteries - Battery charging and discharging curves for secondary batteries - Specific power and specific energy, Ragone plot - Energy efficiency of batteries, energy out during discharge - Energy in during charge - Energy efficiency of batteries versus heat engines for converting chemical energy into work

**Unit III Batteries for Electric and Hybrid Vehicles 10 h**

Battery packs, voltage and state of charge, coulomb counting - Energy in a battery (kW h) and charge in a battery (A h); C-rate of charging and discharging, Peukert equation - Coulombic efficiency of batteries and battery lifetime - Button type battery - Difference between cells and batteries

**Unit IV Fuel Cells 10 h**

Fuel cells - Description - Working principle - Anodic, cathodic and cell reactions. Fabrication of electrodes and other components. Applications, advantages, disadvantages and environmental aspects of the following types of fuel cells: Proton Exchange Membrane Fuel Cells - Alkaline fuel cells - Phosphoric acid - Solid oxide, Molten carbonate and Direct methanol fuel cells

**Unit V Additional Energy Storage Devices and Renewable Energy 8 h**

Hydrogen fueling system and hydrogen storage aboard vehicles - Comparison of fuel cells and batteries for powering electric vehicles. Capacitors - Super capacitor storing charge - Flywheels: storing kinetic energy - Compressed air: storing potential energy - Renewable energy and synergy with electric vehicles.



### Text Books

- 1 Aubrecht G, 2005, "Energy: Physical, Environmental, and Social Impact" 3<sup>rd</sup> Edition, CA: Pearson Addison-Wesley & San Francisco
- 2 Aulice Scibioh M and Viswanathan B, 2006, "Fuel Cells – Principles and Applications", University Press & New Delhi

### References

- 1 Barbir F, 2012, "PEM Fuel Cells: Theory and Practice", Elsevier & USA
- 2 Sharma, B. K, 2014, "Industrial Chemistry", 17<sup>th</sup> Edition, Krishna Prakashan Media P. Ltd & Meerut
- 3 Stochi E, 1990, "Industrial chemistry", 1<sup>st</sup> Edition, Ellis Horwood Ltd & UK
- 4 Jain P.C, Jain M, 2015, "Engineering chemistry", 17<sup>th</sup> Edition, Dhanpat Rai & sons & New Delhi
- 5 <https://www.govinfo.gov/content/pkg/GOVPUB-C13-5b831467adb48f2bfe6aa8895c1f05b5/pdf/GOVPUB-C13-5b831467adb48f2bfe6aa8895c1f05b5.pdf>
- 6 [https://webstor.srmist.edu.in/web\\_assets/srm\\_mainsite/files/files/NS%20316%20UNIT%20III%20and%20IV%20Supporting%20PPT.pdf](https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/NS%20316%20UNIT%20III%20and%20IV%20Supporting%20PPT.pdf)



Course Code	Course Name	Category	L	T	P	Credit
232CE2A2DC	ORGANIC REACTIONS AND REAGENTS	DSE	4	-	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The basic principle and applications of oxidative and reductive reagents involved in organic synthesis
- About mechanism and applications of various important organic name reactions.
- The Reaction and reagents involved in functional group transformations

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the mechanism and applications of various oxidation reagents	K3
CO2	Interpret the mechanism and applications of reducing reagents involved in organic synthesis	K3
CO3	Analyze the various metal mediated and multicomponent name reactions and their applications	K3
CO4	Examine the basic principles and applications involved in name reaction on substitution	K3
CO5	Analyze the reaction and reagents functional group transformations	K3

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓	✓	✓	✓
CO2	✓	✓			
CO3	✓		✓		✓
CO4	✓	✓		✓	✓
CO5		✓	✓	✓	✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A2DC	ORGANIC REACTIONS AND REAGENTS	SEMESTER II
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Total Credits: 4

Total Instruction Hours: 48 h

## Syllabus

**Unit I Reagents in Oxidation Reactions 10 h**

Chromium oxidant - Pyridinium chlorochromate (PCC), pyridinium dichromate (PDC), Chromium trioxide ( $\text{CrO}_3$ ), Chromic acid, Jones reagent, Manganese oxidant -  $\text{KMnO}_4$ ,  $\text{MnO}_2$  - Peracids - Alkenes, ketones and heterocycles, singlet oxygen, ozone,  $\text{OsO}_4$ ,  $\text{HIO}_4$ ,  $\text{Ag}_2\text{O}$ , Bio-oxidations - Bacterium acetic, invertase, putida, Micrococcus sp, gibberella, treptomyces

**Unit II Reagents in Reduction Reactions 10 h**

Palladium/Platinum/Nickel based heterogeneous catalysts for hydrogenation, Wilkinson's catalyst, Noyori asymmetric hydrogenation - Reductions using Lithium / Sodium / Calcium in liquid ammonia. Metal hydrides -  $\text{LiAlH}_4$ ,  $\text{NaBH}_4$ ,  $\text{NaBH}_3\text{CN}$  - Hydrazine, tin hydrochloride,  $\text{NaHSO}_3$ ,  $\text{NaSH}$ , Luche reduction

**Unit III Name Reactions and their Applications - I 10 h**

Jacobsen epoxidation, Shi epoxidation, Suzuki coupling, Heck reaction, Sonogashira reaction, Wacker process, Stille Coupling. Multicomponent reactions: Strecker synthesis, Hantzsch pyridine synthesis, Biginelli synthesis. Multicomponent reactions using alkyl isocyanides: Passerini and Ugi-4-component synthesis

**Unit IV Name Reactions and their Applications - II 8 h**

Mechanism and applications of Robinson annulation, Ene reaction, Hofmann isonitrile synthesis, Doebner-Miller synthesis, Nef reaction, Eschweiler Clark reaction, Bucherer reaction, Leukart reaction, Willegerodt - Kindler reaction

**Unit V Reagents and their Applications 10 h**

Preparation and synthetic application of Lipoteichoic acid (LTA), Lithium diisopropylamide (LDA), dicyclohexyl carbodiimide (DCC), 2,3-Dichloro-5,6-dicyano-1,4-benzoquinone (DDQ), TMS-iodide, TMS-cyanide, TBDMS Chloride, 1,3-Dithiane (reactivity and umpolung), Merrifield resin, Baker's yeast




## Text Books

- 1 Ahluwalia V. H and Parashar R. K, 2009, "Organic Reactions and Mechanisms", 4<sup>th</sup> Edition, Narosa Publishing House & New Delhi
- 2 Fieser L. S, Fieser M and Tse-Lok Ho, 2006, "Fieser and Fieser's Reagents for Organic Synthesis", 1<sup>st</sup> Edition, Wiley-Balckwell & USA

## References

- 1 Chatwal G. R, 2015, "Reaction Mechanism and Reagents in Organic Chemistry", 4<sup>th</sup> Edition, Himalaya Publisher House & Delhi
- 2 Sanyal S. N, 2019, "Reactions, Rearrangements and reagents" 4<sup>th</sup> Edition, Bharati Bhawan Publishers & Bengaluru
- 3 Mundy B. P, Eller M. G and Favarolo F. G, 2015, "Name Reactions and Reagents in Organic Synthesis", 2<sup>nd</sup> Edition. Wiley-Blackwell & USA
- 4 Clayden J, Greeves N and Warren S, 2014, "Organic Chemistry", 2<sup>nd</sup> Edition, Oxford University Press & UK
- 5 Norman R. O. C, 2017, "Principles of organic Synthesis", 2<sup>nd</sup> Edition, Taylor and Francis & UK
- 6 Kalsi P. S, 2010, "Organic Reactions and their Mechanisms", 2<sup>nd</sup> Edition, New Age International Publishers & New Delhi

*M. P. S.*  
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<b>APPROVED</b>		
BoS- 14 <sup>th</sup> 17.10.23	AC - 16 <sup>th</sup> 13.12.23	GB - 21 <sup>st</sup> 05.01.24



Course Code	Course Name	Category	L	T	P	Credit
232CE2A3CA	CHEMISTRY OF NATURAL PRODUCTS	CORE	4	1	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- The isolation and structural elucidation and synthesis of various terpenoids, steroids and alkaloids
- The chemistry of proteins and nucleic acids
- The synthesis and reactions of heterocyclic compounds

### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Classify the isolation and synthesis of terpenoids	K4
CO2	Interpret the various methods involved in the structure determination of steroids	K5
CO3	Analyze the various pathways to synthesize the alkaloids	K4
CO4	Examine preparation, properties and structure of proteins and nucleic acids.	K4
CO5	Distinguish the chemistry of heterocyclic compounds and their synthesis	K4

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	✓
CO2	✓	✓		✓	✓
CO3	✓	✓	✓	✓	✓
CO4		✓	✓		
CO5	✓		✓	✓	✓

### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A3CA	CHEMISTRY OF NATURAL PRODUCTS	SEMESTER III
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Total Credits: 4

Total Instruction Hours: 60 h

### Syllabus

#### Unit I      Terpenoids      12 h

Isolation and classification of terpenoids - Structural elucidation and synthesis of zingiberene, eudesmol, juvenile hormone, abeitic acid and caryophyllene

#### Unit II      Steroids      12 h

Introduction - Structural elucidation and synthesis of cholesterol, ergosterol, equilenin, estrone, testosterone and progesterone

#### Unit III      Alkaloids      12 h

Introduction - Isolation of alkaloids - Structural elucidation and synthesis of morphine, reserpine, quinine, atropine and glaucine

#### Unit IV      Proteins and Nucleic acids      12 h

Proteins - Classification and properties (denaturation, isoelectric point and electrophoresis), primary, secondary, tertiary and quaternary structures of proteins - Synthesis of peptides and polypeptides - N-terminal and C-terminal residue analysis

Nucleic acids - Structure and synthesis of nucleosides and nucleotides - Genetic code - Structure of RNA and DNA and their biological importance

#### Unit V      Heterocyclic compounds      12 h

Heterocyclic compounds - Structure and synthesis natural oxygenated heterocyclics - Flavones, isoflavones - Purines (adenine and guanine) - Anthocyanins (cyanin and pelargonin) and Uric acid. Synthesis and reactivity of nitrogen heterocycles - Oxazoles - Isooxazoles - Imidazoles - Pyrazole - Thiazoles - Isooxazoles - Aziridines - Oxiranes - Azetidines - Pyrazines - Pyridazines - 1,2,3-triazoles - 1,2,4-triazoles - Carbazole- Naphthyridines



## Text Books

- 1 Finar. I.L, 2009,"Organic Chemistry", 7<sup>th</sup> Edition, Pearson education Ltd & NewDelhi
- 2 Bhat. S.V, Nagasampagi. B.A and Sivakumar. M, 2005, "Chemistry of Natural Products", 2<sup>nd</sup> Edition, Springer Science & Business Media & Germany

## References

- 1 Michael B Smith, 2015, "March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure", 7<sup>th</sup> Edition, Wiley and Sons Inc & USA
- 2 Stanforth. S.P, 2006,"Natural Product Chemistry at a Glance", 1<sup>st</sup> Edition, Wiley-Blackwell, USA
- 3 Nicolaou. K.C and Sorensen. E.J. 1996, "Classics in Total Synthesis, Targets, Strategies", 1<sup>st</sup> Edition, Wiley VCH & Germany
- 4 Gurdeep Chatwal, 2019, "Organic Chemistry of Natural Products, Vol II", 5<sup>th</sup> Edition, Himalaya Publishing House & New Delhi
- 5 <https://www.britannica.com/science/heterocyclic-compound/Melting-and-boiling-points>
- 6 [https://www.wlww.k12.or.us/cms/lib/OR01001812/Centricity/Domain/1338/NOTES%20-%20PPT\\_Ch%205%20Proteins-Nuc%20Acids\\_NEW.pdf](https://www.wlww.k12.or.us/cms/lib/OR01001812/Centricity/Domain/1338/NOTES%20-%20PPT_Ch%205%20Proteins-Nuc%20Acids_NEW.pdf)



Course Code	Course Name	Category	L	T	P	Credit
232CE2A3CB	INORGANIC CHEMISTRY	CORE	4	1	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- To gain knowledge on solid state chemistry
- The general characteristics of f-block elements
- The basics of nuclear chemistry, types of nuclear reactions and its applications

### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Relate the basics of solid state chemistry to crystal structure	K3
CO2	Examine crystal structure and defects in crystals.	K4
CO3	Analyze the general characteristics of f- block elements and the electronic and magnetic properties	K4
CO4	Infer the basic concepts of nuclear chemistry and types of nuclear reactions	K4
CO5	Identify the applications of nuclear chemistry in various fields	K5

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓		
CO5	✓	✓	✓		✓

### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A3CB	INORGANIC CHEMISTRY	SEMESTER III
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Total Credits: 4

Total Instruction Hours: 60 h

### Syllabus

#### Unit I Solid State Chemistry I 12 h

Cells and description of crystal structure - Close packing of spheres - Packing efficiency - Hexagonal close packed (hcp) and cubic close packed structures (ccp) - Coordination number - Relative density of packing in simple cubic - Tetrahedral and octahedral holes - Limiting radius ratio rule. Radius ratio for trigonal, tetrahedral, octahedral and cubic sites

#### Unit II Solid State Chemistry II 12 h

Structure of spinels - Stoichiometric defects - Schottky and Frenkel defects - Non-stoichiometric defects - Metal excess and metal deficiency defects - Extended defects - Line and plane defects. Band theory - Semiconductors - Intrinsic and extrinsic type - Fermi level - Flow of current in semiconductors - Hopping mechanism - Band structure - p and n type semiconductors - p-n junction - Superconductivity - 1,2,3-superconductor - Photovoltaic effect

#### Unit III Lanthanides 12 h

General characteristics of lanthanides - Electronic configuration - Oxidation state Lanthanide contraction - Term symbols for Lanthanide ions - Factors that mitigate against the formation of lanthanide complexes - Electronic spectra and magnetic properties of lanthanide complexes - Lanthanide complexes as shift reagents - Difference between 4f and 5f orbital elements

#### Unit IV Nuclear Chemistry I 12 h

Nuclear structure - Stability of nuclei - Packing fraction - Even and Odd nature of nucleons - n/p ratio - Nuclear potential - Binding energy and exchange forces - Shell model and Liquid drop model. Decay of radio nuclei - Rate of decay - Determination of half-life period. Nuclear reactions - Modes of decay - Alpha, beta, gamma and orbital electron capture - Nuclear isomerism - Internal conversions - Q value - Nuclear cross section - Threshold energy and excitation functions. Particle acceleration and counting techniques - Linear accelerator - Cyclotron - Synchrotron - Betatron - Bevatron



**Unit V      Nuclear Chemistry II**

12 h

Applications of isotopes – Esterification – Friedal Craft's reaction – Structural determination of  $PCl_5$  - Solubility of sparingly soluble substance – Isotope dilution analysis – Carbon dating – Thyroiditis - Assessing the volume of blood in a patient - Brain tumor location and bone fracture healing - Cntrol of predatory insects

**Text Books**

- 1 J.D.Lee, 2023, "Concise Inorganic Chemistry", 5<sup>th</sup> Edition, Wiley Publication & India
- 2 M. G. Arora, M. Singh, 1994, "Nuclear Chemistry", 2<sup>nd</sup> Edition, Anmol Publications & India

**References**

- 1 Chakrabarthy D.K. 2005,"Solid State Chemistry", 2<sup>nd</sup> Edition, New Age International Publishers & New Delhi
- 2 Arnikaar H.J. 2001,"Essential of Nuclear Chemistry", 2<sup>nd</sup> Edition, Wiley-Eastern Ltd. & NewDelhi.
- 3 Freindlander G., Kennedy J. W., Macias E.S and Miller J.M John, 1991, "Nuclear and Radiochemistry", 1<sup>st</sup> Edition, Wiley and Sons & US
- 4 Gurdeep Raj. 2014, "Advanced Inorganic Chemistry", 12<sup>th</sup> Edition, Geol Publishing House & India
- 5 <https://wou.edu/chemistry/courses/online-chemistry-textbooks/ch103-allied-health-chemistry/ch103-chapter-3-radioactivity/>
- 6 [https://chem.libretexts.org/Bookshelves/Inorganic\\_Chemistry/Supplemental\\_Modules\\_and\\_Websites\\_\(Inorganic\\_Chemistry\)/Descriptive\\_Chemistry/Elements\\_Organized\\_by\\_Block/4](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_(Inorganic_Chemistry)/Descriptive_Chemistry/Elements_Organized_by_Block/4)



Course Code	Course Name	Category	L	T	P	Credit
232CE2A3CC	QUANTUM CHEMISTRY AND GROUP THEORY	CORE	4	1	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- The basic concepts and applications of quantum chemistry
- The operators and Eigen functions and formulate the approximation methods to construct molecular orbitals.
- The point groups of molecules and apply the concepts of group theory to predict the spectroscopic properties

### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Make use of basic concepts and categorize the operators and Eigen functions	K3
CO2	Explain the concepts involved in the basics and theories of quantum chemical approach	K3
CO3	Analyze the approximation methods to construct molecular orbitals	K4
CO4	Summarize the basic concepts of group theory.	K3
CO5	Identify the point groups of molecules and construct the character table for point groups	K3

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓		✓
CO2		✓		✓	✓
CO3	✓	✓		✓	✓
CO4		✓	✓		
CO5	✓		✓	✓	✓

### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A3CC	QUANTUM CHEMISTRY AND GROUP THEORY	SEMESTER III
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Total Credits: 4

Total Instruction Hours: 60 h

### Syllabus

#### Unit I Quantum Chemistry I 12 h

Failure of classical mechanics and the success of quantum theory in explaining black body radiation - Photoelectric effect and the H-atom spectrum - De Broglie's matter waves - Heisenberg's uncertainty principle - Schrodinger equation - Born's interpretation of the wave function - Requirements of acceptable wave function

Algebra of operators - Sums and products of operators - Commutator - Linear operators - Eigen functions and Eigen values - Correspondence between physical quantities in classical mechanics and Operators in quantum mechanics - Hamiltonian operator - Quantisation of angular momentum and its spatial orientation - Average (expectation) values - Postulates of quantum mechanics

#### Unit II Quantum Chemistry II 12 h

Particle in a one dimensional box - Quantization of energy - Normalisation of wave function - Orthogonality of the particle in a one-dimensional box wave functions - Average position and average momentum of a particle in a one-dimensional box - Illustration of the uncertainty principle and correspondence principle with reference to the particle in a one-dimensional box - Particle in a three-dimensional box - Separation of variables - Degeneracy

Schrodinger equation for simple harmonic oscillator of a diatomic molecule - Illustration of the uncertainty principle and correspondence principle with reference to harmonic oscillator. Schrodinger equation for a rigid rotor of a diatomic molecule. Schrodinger equation for the H-atom (or H - like species) - Separation of variables - Energy levels - Radial factors of the H-atom wave functions

#### Unit III Quantum Chemistry - III 12 h

Need for approximation methods - The perturbation theory (first order only) application of the perturbation method to He-atom - The variation method - Applications of variation method to He-atom - Electron spin and the Pauli's principles - Symmetric and anti-symmetric nature of the wave functions - Slater determinants - Approximate wave function of many electron atoms - Maxwell-Boltzman, Bose-Einstein, Fermi-Dirac, Born Oppenheimer approximation - Stirling's approximation

#### Unit IV Group Theory I 12 h

Symmetry elements and symmetry operations. Inverse operations - Definition of a group - Properties of a group, definition of abelian group, cyclic group, finite group, infinite



group, sub-group and isomorphic group - Group multiplication tables - Symmetry classification of molecules into point groups (Schoenflies symbols only) - Matrices - Definition of matrix - Diagonal matrix - Null matrix - Unit matrix - Symmetric matrix - Skew matrix - Conjugate matrix - Matrix multiplication - Determination of inverse matrix - Block multiplication of matrices. Matrix notations of symmetry operations of  $C_{2v}$  and  $C_{3v}$  point groups. Definition of reducible and irreducible representations - Irreducible representation as orthogonal vectors - Direct product rule - The Great Orthogonality Theorem and its consequences (statement only, proof not needed)

## Unit V      Group Theory II

12 h

Construction of character table of  $C_{2v}$  and  $C_{3v}$  point groups - Calculation of binary coordinates in the character tables for  $C_{2v}$  and  $C_{3v}$  point groups - Calculation of character values of reducible representations per unshifted atom for each type of symmetry operation - Determination of total Cartesian representation - Determination of direct sum from total Cartesian representation. Type of hybridization of atomic orbitals in acetylene,  $CH_4$  and  $[PtCl_4]^{2-}$  - Group theory and Vibrational spectroscopy - Vibrational modes as basis for group representation - Symmetry selection rules for IR and Raman spectra - Mutual Exclusion Principle - Classification of vibrational modes.

### Text Books

- 1 Chandra, A.K, 2017, "Introductory Quantum Chemistry", 4th Edition, McGraw Hill Education & New Delhi
- 2 Veera Reddy, K, 2009, "Symmetry and Spectroscopy of Molecules", 2nd Edition, New age publishers & New Delhi.

### References

- 1 Levine, 2016, "Quantum Chemistry", 7th Edition, Pearson Education & New Delhi
- 2 Mcquarrie, D.A, 2016, "Quantum Chemistry", 1st Edition, Viva Books & New Delhi
- 3 Atkins, P, 2006, "Physical Chemistry", 8th Edition, Oxford University Press & London
- 4 Cotton, F.A, 2008, "Chemical Applications of Group Theory", 3rd Edition, Wiley & London
- 5 [https://chem.libretexts.org/Courses/Mount\\_Royal\\_University/Chem\\_1201/Unit\\_1%3A\\_Quantum\\_Chemistry](https://chem.libretexts.org/Courses/Mount_Royal_University/Chem_1201/Unit_1%3A_Quantum_Chemistry)
- 6 <https://www.cantorsparadise.com/an-invitation-to-group-theory-c81e21ab739a>



Course Code	Course Name	Category	L	T	P	Credit
232CE2A3CD	ANALYTICAL SPECTROSCOPY	CORE	4	1	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- The principles and theory of spectroscopic techniques and the application to structure determination
- The interpretation of organic molecules using spectral data
- The applications of spectroscopy in interpreting unknown molecules and basics of photochemistry

### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Infer the fundamentals of inorganic photochemistry	K3
CO2	Examine the basic principle of mass spectroscopy and to apply the concept in finding the structure of organic compounds	K4
CO3	Apply the concepts of IR spectroscopy and raman spectroscopy to elucidate the structure of compounds	K3
CO4	Explain the knowledge of spectroscopy to examine the structure of compounds based on 1D and 2D NMR techniques	K4
CO5	Analyze and evaluate the conjoint knowledge of the spectroscopic techniques in solving the structure of unknown compounds	K4

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓		✓
CO2		✓	✓	✓	✓
CO3	✓	✓		✓	✓
CO4	✓	✓			
CO5	✓	✓	✓		✓

### COURSE FOCUSES ON

<input checked="" type="checkbox"/>	Skill Development	<input type="checkbox"/>	Entrepreneurial Development
<input checked="" type="checkbox"/>	Employability	<input type="checkbox"/>	Innovations
<input type="checkbox"/>	Intellectual Property Rights	<input type="checkbox"/>	Gender Sensitization
<input type="checkbox"/>	Social Awareness/ Environment	<input type="checkbox"/>	Constitutional Rights/ Human Values/ Ethics



232CE2A3CD	ANALYTICAL SPECTROSCOPY	SEMESTER III
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Total Credits: 4

Total Instruction Hours: 60 h

### Syllabus

#### Unit I IR and Raman Spectroscopy 12 h

Application of IR in Organic chemistry - Characteristic group frequencies - Finger print region. Combined application of Infrared and Raman spectra for structural elucidation of  $\text{N}_2\text{O}$ ,  $\text{ClF}_3$ ,  $\text{ClO}_4^-$  and  $\text{NO}_3^-$  Group theoretical approach to find the IR and Raman active vibrations of simple compounds - Effect of coordination upon ligand vibrations of  $\text{H}_2\text{O}$ ,  $\text{CNS}^-$ ,  $\text{NO}_3^-$ ,  $\text{CN}^-$  and  $\text{SO}_2$

#### Unit II Applications of NMR Spectroscopy 12 h

NMR active nuclei - Equivalent and non-equivalent protons and number of signals - Chemical shifts - Spin spin coupling and coupling constant - Nuclear overhauser effect - Nuclear Quadrupolar resonance - J-resolved -  $\text{H}_2\text{H-COSY}$  -  $\text{C}_2\text{H-COSY}$  - NOESY spectra. Application of NMR in the structural elucidation of inorganic compounds -  $^{31}\text{P}$  NMR spectra of  $\text{P}_4\text{S}_3$ ,  $\text{H}_3\text{PO}_3$ , and  $\text{HPF}_2$  -  $^{19}\text{F}$  NMR spectra of  $\text{ClF}_3$ ,  $\text{BrF}_5$  and equimolar mixture of  $\text{TiF}_6^{2-}$  and  $\text{TiF}_4$  in ethanol - Applications of NMR spectroscopy in the structural analysis of organic compounds

#### Unit III $^{13}\text{C}$ NMR Spectroscopy 12 h

Difficulties and solution for recording  $^{13}\text{C}$  NMR spectra-  $^{13}\text{C}$  NMR spectra scale - Signals and their positions - Multiplicity - Proton coupled and Decoupled  $^{13}\text{C}$  spectra - Off resonance technique - Chemical shifts in  $^{13}\text{C}$  spectra - Use of  $^{13}\text{C}$  spectra in differentiating primary, secondary and tertiary carbons by DEPT technique. Theory and Principles of 2D NMR Spectroscopy, Interpretation of  $^1\text{H}$   $^1\text{H-COSY}$ ,  $^1\text{H}$   $^{13}\text{C}$  HETCOR, HMQC, HMBC

#### Unit IV Mass Spectroscopy 12 h

Mass Spectrometry - Instrumentation - Resolution - ESI, EI, CI, MALDI and FAB method - Presentation of spectral data - Molecular ions - Meta stable ions - Molecular ion peak - Nitrogen rule - Isotopic abundance - Fragmentation process - Scission with rearrangement - Retro Diels Alder rearrangement - Mc Lafferty rearrangement. Fragmentation associated with functional groups - Aliphatic compounds, aldehydes, ketones, carboxylic acids, esters, amides, alcohols, thiols, amines, ethers, sulphides and halides, aromatic compounds - Elimination due to ortho groups



**Unit V Spectroscopic Problems**

12 h

Woodward rule for calculating absorption maximum in conjugated dienes, polyenes,  $\alpha$ ,  $\beta$  - unsaturated carbonyl compounds and benzenoid systems. Conjoint spectroscopic problems - Structure determination of organic compounds using UV-Vis, IR,  $^1\text{H}$ ,  $^{13}\text{C}$ -NMR and Mass spectroscopic techniques - Simple molecules - Restricted to 12 carbon systems with/ without one hetero system

**Text Books**

- 1 Pavia, D.L, 2011, "Spectroscopy", 5<sup>th</sup> edition, Brooks/Cole Publications & UK
- 2 Yadav, M.S, 2011, "Molecular Spectroscopy", 1<sup>st</sup> edition, Arise Publishers and Distributors & New Delhi

**References**

- 1 Kalsi, P.S, 2014, "Spectroscopy of organic compounds", 6<sup>th</sup> edition, New Age International (P) Ltd & New Delhi
- 2 Abraham, R. J, 1988, "Introduction to NMR Spectroscopy" 6<sup>th</sup> edition, Chichester, Wiley & New York
- 3 William Kemp, 2008, "Organic Spectroscopy", 3<sup>rd</sup> edition, Palgrave Publications & USA.
- 4 Banwell C.N, 1983, "Fundamentals of molecular spectroscopy", 3<sup>rd</sup> edition, McGraw Hill Book Company & Europe
- 5 <http://chemistry.emory.edu/msc/tutorial/mass-spectrometry-ionization.html>
- 6 <https://archive.nptel.ac.in/courses/104/108/104108078/>



232CE2A3CP	PHYSICAL CHEMISTRY	SEMESTER III
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Total Credits: 3

Total Instructions Hours: 72 h

S.No	Contents
1	Determination of molecular weight by Rast Method
2	Determination of rate constant of acid catalyzed hydrolysis of ester Chemical kinetics-First order reaction
3	Determination of temperature coefficient and Arrhenius parameter- Phase Rule
4	Two component systems - Simple eutectic form-Phase Rule
5	Determination of CST of Phenol-water system
6	Surface Chemistry: Verification of Freundlich and Langmuir adsorption Isotherm of oxalic acid on activated charcoal
7	Conductometric titration: Acid-base titration-Determination of the strength of strong acid and weak acid.
8	Conductometric titration: Precipitation titration-Determination of the strength of KCl, KI, KCl and KI in the mixture
9	Potentiometric titration: Titration of HCl Vs NaOH
10	Potentiometric titration: Titration of Mixture of acids Vs strong base
11	Potentiometric titration: Titration of CH <sub>3</sub> COOH Vs NaOH
12	Potentiometric Titration: Redox titration-Titration of Ferrous ammonium sulphate against Potassium dichromate
13	Verification of Ostwald's dilution law and determination of molar Conductance at infinite dilution of strong electrolyte using Kohlraush's law.
14	Verification of Ostwald's dilution law and determination of molar Conductance at infinite dilution of weak electrolyte using Kohlraush's law.

**Note:** Any 10 Experiments



- 1 Peter Mathews. G, 1985, "Experimental Physical Chemistry", 1st Edition, Oxford Science Publications & UK
- 2 Findlay,A.J& Kitchener, 1973, "Practical Physical Chemistry", Longmann Publication
- 3 Khosala. D.D, Khosala. A and Gard.V.C, 1975, "Senior Practical Physical Chemistry", 1st Edition, R.Chand& Co & New Delhi
- 4 Viswanathan. B and Raghavan. P.S, 2008, "Practical Physical Chemistry", 2ndEdition, Viva Books Pvt.Ltd& New Delhi



Course Code	Course Name	Category	L	T	P	Credit
232CE2A3DA	DYE AND TEXTILE CHEMISTRY	DSE	4	-	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- The chemistry of dyes and intermediates
- The dyeing methods and printing process
- The problems caused by dye and dyeing process

### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Analyze and classify dyes based on their chemical structure and applications	K3
CO2	Apply the chemistry of dyes and intermediates	K4
CO3	Examine the skills on dye processing on fibres	K3
CO4	Explore the broad idea on methods of printing.	K3
CO5	Illustrate the importance of pollution control eco-friendly processing	K3

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	✓
CO2		✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4			✓	✓	✓
CO5	✓	✓		✓	✓

### COURSE FOCUSES ON

<input checked="" type="checkbox"/>	Skill Development	<input type="checkbox"/>	Entrepreneurial Development
<input checked="" type="checkbox"/>	Employability	<input type="checkbox"/>	Innovations
<input type="checkbox"/>	Intellectual Property Rights	<input type="checkbox"/>	Gender Sensitization
<input type="checkbox"/>	Social Awareness/ Environment	<input type="checkbox"/>	Constitutional Rights/ Human Values/ Ethics



232CE2A3DA	DYE AND TEXTILE CHEMISTRY	SEMESTER III
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**Total Credits: 4**

**Total Instruction Hours: 48 h**

### Syllabus

#### Unit I      Dyes 10 h

Quinonoid dyes - Anthroquinone and Mordant dyes - Synthesis and applications of Alizarin - Phthalocyanin dyes - Copper phthalocyanin - Diphenylmethane dyes - Auramine - Triphenylmethane dyes - Malachite green - Crystal violet - Phthalein dyes - Phenolphthalein

#### Unit II      Dyestuff Intermediates 10 h

Synthesis of important dye intermediates - Alcohols - Aliphatic and aromatic carboxylic acids - Esters - Acid chlorides - Aldehydes and ketones - Aliphatic amines- Commercial processes of Azo dyes, reactive dyes, thermal sensitive dyes, disperse dyes

#### Unit III      Processing of Dyes 10 h

Singeing - Process of singeing - Plate singeing - Roller singeing - Gas flame singeing - Desizing - Acid and enzyme desizing - Scouring - Process of scouring- Lime-soda and enzyme scouring - Bleaching agents - Oxidizing and reducing agents- Optical brightening agents

#### Unit IV      Printing 10 h

Comparison between dyeing and printing - Styles and methods of printing- Ingredients in printing paste- Screen and Rotary screen design preparation -Table screen printing - Flat bed screen printing machine- Rotary screen printing machine - Study of curing machine and steamer - Batik style on cotton with reactive dyes

#### Unit V      Quality control 8 h

Aim of ISO standard in quality control- ISO 9000:2000 and ISO 9001:2000 - Fastness properties - Importance of eco-friendly processing - List of banned dyes and chemicals, Eco labels



### Text Books

- 1 Shenai V. A, 1991, "Textile Fibres" (Vol. I), Mahajan Publishers, Ahmedabad & India.
- 2 K. Venkataraman, 1952, "Chemistry of Synthetic Dyes", Vol-1, Academic Press & London.

### References

- 1 Gurdeep R. Chatwal, 2016, "Synthetic Dyes" 4<sup>th</sup> edition, Himalaya publishing house & New Delhi.
- 2 Robert R Mather and Roger H Wardman , 2015, "The Chemistry of Textile fibres", 2<sup>nd</sup> edition, RSC Publishing, London.
- 3 Arora M.G, 2002, "Text Book of Dyes", 3rd Edition, Anmol Publications Private Ltd & New Delhi
- 4 Nierstrasz. V. A, 2010, "Advances in textile technology" Elsevier.
- 5 <https://www.yourarticlelibrary.com/production-management/12-importance-or-benefits-of-quality-control-production-management/26173>
- 6 <https://www.textileblog.com/various-classification-of-dyes/>



Course Code	Course Name	Category	L	T	P	Credit
232CE2A3DB	NANOMATERIALS AND NANOTECHNOLOGY	DSE	4	-	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The fundamentals and current state of the art of nanotechnology
- The synthesis, characterization of nanostructured materials
- The utilization of nanomaterials in diverse applications

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Analyze the nano materials and nanotechnology	K3
CO2	Identify the properties of nanotubes and nanoparticles	K3
CO3	Examine the synthesis of nanomaterials	K3
CO4	Explain the various characterization techniques for nano materials	K3
CO5	Evaluate the applications of nano structured materials in different fields	K3

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓	✓	✓	✓
CO2		✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4			✓	✓	
CO5		✓	✓	✓	✓

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics

Dr. NGPASC

M.Sc. Chemistry (Students admitted during the AY 2023-24)

COIMBATORE | INDIA



232CE2A3DB	NANOMATERIALS AND NANOTECHNOLOGY	SEMESTER III
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Total Credits: 4

Total Instruction Hours: 48 h

### Syllabus

#### Unit I Introduction to Nano science 10 h

Nano science, nanomaterials - Scale of materials natural and manmade - Properties - Classification of nanomaterials - Origin, phase composition, constituents, dimensions - Energy at bulk and nano scale - Size effect of Nanomaterials - Shape, density, melting point, specific surface area, band gap variation - Quantum confinement

#### Unit II Carbon Nanostructures 10 h

Introduction - Carbon molecules - Nature of the carbon bond - New carbon structures; carbon clusters - Carbon nanotubes, Graphene, Graphene oxide, Reduced Graphene Oxide (RGO) - Fabrication - Structure - Electrical properties - Mechanical properties; applications of carbon nanotubes - Field emission and shielding - Computers - Fuel cells - Chemical sensors - Catalysis - Mechanical reinforcement

#### Unit III Synthesis of Nanomaterials 8 h

Chemical methods - Chemical precipitation and co-precipitation, sol-gel synthesis, solvothermal synthesis, microwave heating synthesis, sonochemical synthesis, electrochemical synthesis and photochemical synthesis. Physical Methods - Inert gas condensation, ion sputtering, laser ablation, laser pyrolysis, chemical vapour deposition and electro deposition

#### Unit IV Characterization Techniques 10 h

Structural characterization - Electron microscopy techniques - Scanning electron microscopy, transmission electron microscopy - X-ray diffraction. Surface characterization - XPS, atomic force microscopy

#### Unit V Applications of Nanomaterials 10 h

Nanomaterials for Solar cells - Smart materials - Biosensors - Drug delivery and therapy - Food packaging - Detection of cancerous cells, nano polymer composite in defense and aerospace. Nanoscale catalysts for energy and automobile industries - Nanomaterials for electrodes and wearable electronics - Nanobased coating and paints



### Text Books

- 1 B.S. Murty et.al., 2013, "Textbook of Nanoscience and Nanotechnology", 1<sup>st</sup> edition, Springer-Verlag Berlin Heidelberg, Universities Press (India) Private Limited & New Delhi
- 2 T. Pradeep., 2018, "Nano: The Essentials: Understanding Nanoscience and Nanotechnology", McGraw-Hill Professional Publishing & New Delhi

### References

- 1 G. Cao., 2014, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", 10<sup>th</sup> edition, Imperial College Press & New Delhi
- 2 J. Dutta, H.F. Tibbals and G.L. Hornyak., 2018, "Introduction to Nanoscience", 2<sup>nd</sup> edition, CRC press, Boca Raton & New Delhi
- 3 CNR Rao et.al., 2016, "Chemistry of Nanomaterials: Synthesis, properties and applications" 5<sup>rd</sup> edition, Royal Society of Chemistry, Cambridge & UK
- 4 R.W. Kelsall, W.H.M. Geoghegan., 2005, "Nanoscale Science and Technology", 4<sup>th</sup> edition, John Wiley & Sons, Ltd. & UK
- 5 <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=+4mIqRALksfwQH9v8YSMrw==>
- 6 [https://drive.google.com/file/d/1ug4enjbbj1x3PRDzFFxJ7vqkaIVoKv2\\_/view](https://drive.google.com/file/d/1ug4enjbbj1x3PRDzFFxJ7vqkaIVoKv2_/view)



Course Code	Course Name	Category	L	T	P	Credit
232CE2A3DC	BIO-ORGANIC CHEMISTRY	DSE	4	-	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- The basics of carbohydrates and lipids
- The structure and biological functions of enzymes and cofactors
- The concept of bioenergetics and biosynthesis of lipids

### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Explain the classification of carbohydrate and carbohydrate metabolism	K3
CO2	Summarize chemical nature and biological functions of enzymes and cofactors	K4
CO3	Analyze the structure and properties of lipids	K3
CO4	Apply concept of energy in living organisms and relate free energy to the chemical equilibria	K4
CO5	Examine nature and biosynthesis of long chain fatty acids	K3

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	✓
CO2		✓	✓	✓	
CO3	✓	✓			✓
CO4			✓		
CO5	✓	✓		✓	✓

### COURSE FOCUSES ON

<input checked="" type="checkbox"/>	Skill Development	<input type="checkbox"/>	Entrepreneurial Development
<input checked="" type="checkbox"/>	Employability	<input type="checkbox"/>	Innovations
<input type="checkbox"/>	Intellectual Property Rights	<input type="checkbox"/>	Gender Sensitization
<input type="checkbox"/>	Social Awareness/ Environment	<input type="checkbox"/>	Constitutional Rights/ Human Values/ Ethics



232CE2A3DC	BIO-ORGANIC CHEMISTRY	SEMESTER III
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Total Credits: 4

Total Instruction Hours: 48 h

### Syllabus

#### Unit I Carbohydrates 10 h

Classification of carbohydrates. Occurrence, structure, properties and uses - Sucrose, lactose - Starch - Cellulose. Carbohydrate metabolism: glycolysis, gluconeogenesis, glycogen metabolism (overview only, structures not required). Diabetes mellitus (elementary details)

#### Unit II Enzymes and Cofactors 10 h

Chemical nature of enzymes - Characteristics of enzymes - Colloidal nature, catalytic nature. Mechanism of enzymes - Michaelis - Menten hypothesis - Fischer's lock and key model, induced fit model. Structure and biological functions of coenzyme A, NAD and FAD

#### Unit III Lipids 8 h

Lipids - Definition - Simple lipids - Fats and oils - Compound lipids - Phospholipids - Phosphoglyceride - Derived lipids - C24 steroids - Low density lipids and High density lipids - Physical properties - Solubility, melting point, surface tension, emulsification and geometric isomerism - Chemical properties - reaction involving -COOH group -OH group and double bonds

#### Unit IV Bioenergetics 10 h

Concept of energy - Law of Thermodynamics - Conservation of energy, - Transformation of energy - Free energy - Exergonic and Endergonic reactions - Relationship between standard free energy change and Equilibrium constant.

Standard free energy values of chemical reactions - Adenosine triphosphate (ATP) hydrolysis and Equilibria of coupled reactions - Inter conversion of adenine nucleotides

#### Unit V Biosynthesis of lipids 10 h

Nature and distribution of fat - Biosynthesis of fatty acid - Palmitic acid - Carbon source for fatty acid synthesis - Formation malonyl-CoA - Reaction of fatty acid synthetase system - Acyl carrier protein - Priming reaction - Malonyl transfer step - Biosynthesis of cholesterol - Biosynthesis of steroid hormones - Aldosterone



## Text Books

- 1 Jain, J. L ,2016,"Fundamentals of Biochemistry",7<sup>th</sup> edition., S. Chand and Co & New Delhi
- 2 Finar, I. L. , 2002, "Organic Chemistry" Vol.II. 5<sup>th</sup> edition., India: Pearson Education&New Delhi

## References

- 1 Kagan, H. B., 2009, "Asymmetric Synthesis",1<sup>st</sup> edition., Thieme Medical Publishers & Germany
- 2 Carey, F.A., 2008, "Advanced Organic Chemistry: Part-A and Part-B", 5<sup>th</sup> edition., Springer & Germany.
- 3 Harish. K., 2013,"Bio-Organic Chemistry", 1<sup>st</sup> edition., Alpha Science International Limited & UK
- 4 Price, N.C.,1999, "Fundamental of Enzymology", 1<sup>st</sup> edition., Oxford University Press & UK.
- 5 [https://www.angelo.edu/faculty/kboudrea/index\\_2353/Chapter\\_07.pdf](https://www.angelo.edu/faculty/kboudrea/index_2353/Chapter_07.pdf)
- 6 <http://www.jiwaji.edu/pdf/ecourse/pharmaceutical/Enzymes%20pdf.pdf>



232CE2ASSA	RESEARCH METHODOLOGY	SEMESTER III
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Total Credit: 1

## Syllabus

### Unit I      Research Concepts & Literature Survey

Importance of research in Science - Criteria of good research - Qualities of a good researcher - Sources of a research problem - Types of research - Sources of information - Primary, Secondary, Tertiary sources - Journals - Journal abbreviations - Current titles - Abstracts - Reviews - Acquisition of information - Web resources - E-journals - Journal access - Building up of own literature collection - Hot articles - Citation index - Impact factor - H-index - I10 index - UGC info net- Search engines - Google Scholar - Chem Industry - Databases - Chem Spider - Science Direct - Sci Finder - Web of science - SCI - Scopus

### Unit II      Scientific Writing and Computer aided packages

Components of a good research report - Tabulation and computation of data- illustration of graphical data - Compilation of results - Characterization of research - Presentation - Synopsis preparation and thesis writing - Writing scientific papers - Justification for scientific contributions - Bibliography - Description of methods - conclusions -The need for illustration - Style - Publications of scientific work - Writing ethics - Avoiding plagiarism

Computer packages - Data presentations using formulas and functions - Generating graphs/charts - Applications and uses of common softwares in chemistry, MS- Excel - SPSS - Origin -Chems sketch - Chemdraw. Basic ideas on the use of Internet in Chemistry education

### Unit III      X-ray Crystallography

Diffraction of X-rays by crystal lattice - Laue's formulation of X-ray diffraction - Diffraction methods - Laue Diffraction - Rotating crystal method - Oscillation method - Powder method - X-ray diffractometer - Data collection

### Unit IV      Structure Determination and Thin Film Technology

Scattering factor - Structure factor - Phase problem - Structure determination - Structure refinement - Structure analysis. Thermal evaporation-General consideration-Evaporation methods- Chemical methods-Electro deposition-Chemical vapour deposition-Miscellaneous methods

### Unit V      Sputtering

Cathodic sputtering-Sputtering process-Glow discharge methods-Sputtering variants-Low pressure sputtering -Reactive sputtering-Sputtering of multi component materials -



Vacuum-Deposition apparatus-Vacuum systems- Substrate deposition Technology- Thickness measurement-Microbalance monitors-Optical Interference methods-Analytical methods-Chemical methods. Structural Analysis. Structure growth process- General Description-Liquid like coalescence

### Text Books

- 1 D.Velmurugan, 2008, "Elementary Crystallography", 1<sup>st</sup> edition, MJP publishers & New Delhi
- 2 Kasturi L. Choprah, 1969, "Thin Film Phenomena", 2<sup>nd</sup> edition, McGraw Hill Company & UK

### References

- 1 Kothari. C.R, 2004, "Research Methodology Methods and Techniques", 3<sup>rd</sup> edition, New age international publishers & New Delhi
- 2 GH. Stout and LH. Jensen, 1989, "X-ray structure determination", A practical guide, 2<sup>nd</sup> edition wiley publications & UK
- 3 Drago. R.S, 1978, "Physical methods in Inorganic Chemistry", 1<sup>st</sup> edition, East west Pvt. Ltd & New Delhi
- 4 Gurdeep Raj. 2014,"Advanced Inorganic Chemistry", 12<sup>th</sup> edition, Geol Publishing House & India
- 5 [https://uomustansiriyah.edu.iq/media/lectures/6/6\\_2020\\_08\\_27!09\\_52\\_58\\_PM.pdf](https://uomustansiriyah.edu.iq/media/lectures/6/6_2020_08_27!09_52_58_PM.pdf)
- 6 [https://webstor.srmist.edu.in/web\\_assets/srm\\_mainsite/files/files/X%20RAY%20CRYSTALLOGRAPHY.pdf](https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/X%20RAY%20CRYSTALLOGRAPHY.pdf)



232CE2ASSB	<b>FORENSIC CHEMISTRY AND CRIME INVESTIGATION</b>	<b>SEMESTER III</b>
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**Total Credit: 1**

### **Syllabus**

#### **Unit I Forensic Chemistry Introduction**

History - Definition - Role of a forensic chemist - Scope and significance in forensic Science - Techniques employed in forensic chemistry - Cases encountered in forensic chemistry

Sample Collection - Sample Integrity - Theory of forensic analysis, Identification, Presumptive analysis, Confirmatory analysis - Comparative analysis, Class characteristics-Individual characteristics - Instrumental techniques employed in forensic chemistry

#### **Unit II Drug Abuse**

Introduction-Drug abuse - Classification of Drugs of abuse - Stimulants - Depressants - Hallucinogens - Narcotics - Cannabis - Volatile solvents - Other common drugs of abuse - Psychoactive drugs - Classification of psychoactive drugs - Narcotics - Stimulants - Depressants - Hallucinogens - Mode of action-Forensic analysis of drugs - Colour - Spot tests - Microcrystal tests - Confirmatory tests.

#### **Unit III Forensic Toxicology**

Introduction to toxicology - History of toxicology - Classification of toxicology - Analytical toxicology - Mechanistic toxicology - Forensic toxicology - Concept of forensic toxicology and its significance - Development and advances of forensic Toxicology- Plant Poisons, Organic Poisons, Microbial Poisons, Inorganic Poisons.

#### **Unit IV Chemical Analysis of Explosives**

Forensic examination of explosives - Chemical composition explosives- Chemical analysis of explosives- Ignition susceptibility test, Colorimetric tests - diphenylamine test, anthrone spot test, barium chloride and silver nitrate spot tests. Microcrystalline tests for explosives - Copen microcrystalline test

#### **Unit V Identification of Fingerprints**

Sources of latent fingermark residue - Aqueous components, Lipid components, Amino acid sensitive reagents - Detection of Latent Fingerprints - Iodine Method, silver nitrate method, Ninhydrin method, Powder techniques, Cyanoacrylate fuming method, Vacuum metal deposition method- Amino acid sensitive reagents- Lipid-Sensitive reagents.

Dr.NGPASC




## Text Books

- 1 Dikshit P.C. 2013, "Textbook of Forensic Medicine and Toxicology", 2<sup>nd</sup> edition, Peepee Publishers and Distributors (P) Ltd & New Delhi
- 2 Narayan Reddy K.S, 2017, "The Essentials of Forensic Medicine and Toxicology", 4<sup>th</sup> edition, JayPee Brothers & New Delhi..

## References

- 1 Jay Seigal, 2020, "Forensic Chemistry: Fundamentals and Applications", John Wiley & Sons & UK
- 2 Richard Saferstein, 2017, "Criminalistics and introduction to forensic science", Prentice Hall of India & New Delhi.
- 3 James, S.H and Nordby, J.J. 2003, "Forensic Science: An introduction to scientific and investigative techniques". CRC Press & New Delhi.
- 4 Kelly M. E, 2019 "Introduction to Forensic Chemistry" CRC Press & USA
- 5 <http://www.remondini.net/newsite/?q=system/files/forensic%20chemistry.pdf>
- 6 [https://sites.ffclrp.usp.br/enqfor/arquivos/Conferencia%2010%20-%20Forensic%20Chemistry\\_\\_\\_\\_.pdf](https://sites.ffclrp.usp.br/enqfor/arquivos/Conferencia%2010%20-%20Forensic%20Chemistry____.pdf)

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<b>APPROVED</b>		
BoS-	AC -	GB -
06-04-24	17-04-24	



Course Code	Course Name	Category	L	T	P	Credit
232CE2A4CA	SYNTHETIC ORGANIC CHEMISTRY	CORE	4	1	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The basics involved in the disconnection approaches
- About the importance of protection and deprotection methods
- The importance of named reaction and asymmetric synthesis in organic chemistry

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline the methods involved in retero synthetic approaches	K3
CO2	Interpret methods of two group C-C and C-O disconnections	K3
CO3	Analyze the various protective and deprotecting groups in organic synthesis	K4
CO4	Examine the various named reactions and their synthetic applications	K4
CO5	Explain the various asymmetric synthetic methods and their selectivity	K4

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	✓
CO2	✓	✓	✓	✓	
CO3	✓		✓	✓	
CO4	✓	✓		✓	✓
CO5	✓	✓	✓		✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A4CA	SYNTHETIC ORGANIC CHEMISTRY	SEMESTER IV
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Total Credits: 4

Total Instruction Hours: 60 h

### Syllabus

#### Unit I Introduction to Retrosynthesis 12 h

Synthon- Synthetic equivalent-Target molecule-Electron donors (nucleophiles)-Electron acceptors (electrophiles)-Functional group interconversion-Disconnection approach-Importance of the order of events in organic synthesis. Chemo selectivity-One group C-C and C-O disconnection (disconnection of alcohols and carbonyl compounds)

#### Unit II Two group C-C & C-N Disconnections 12 h

1,3 and 1,5 difunctionalized compounds,  $\alpha$ ,  $\beta$ -Unsaturated carbonyl compounds, control in carbonyl condensation, synthesis of 3, 5 and 6 membered rings in organic synthesis. Diels- Alder reaction. Retrosynthesis of 5 and 6 membered heterocycles containing two nitrogens. Designing synthesis: Disconnection approach in Ibuprofen, Rosiglitazone and captopril

#### Unit III Protection and Deprotection Chemistry 12 h

Need for protection and deprotection of functional groups during chemical reactions. Protection and cleavage of hydroxyl groups (by ethers) - Methoxymethyl ether (MOM)- Tetrahydropyranyl (THP) - Protection and cleavage of hydroxyl groups by esters - Trichloroacetate - 2,4,6-trimethylbenzoate. Protection and cleavage of 1,2 and 1,3-diols - Methylene dioxy derivative - Methoxy methyleneacetal- Ethyldieneacetal. Protection and cleavage of Amino groups - Butoxy Carbonylation (BOC), Fluorenyl Methoxy Carbonyl (Fmoc), N-Acylation

#### Unit IV Name Reactions in Organic Synthesis 12 h

Bamford- Stevens reaction- McCombie reaction (Barton Deoxygenation)- Corey-Chaykovsky reaction- Hosomi-Sakurai reaction- Suzuki coupling- Nazarov cyclization - Weinreb ketone synthesis - Yamaguchi macrolactonization - McMurry reaction - Palladium based reactions: Negishi-Kumada - Fukuyama coupling - Tsuji-Trost reaction

#### Unit V Asymmetric Synthesis 12 h

Introduction to asymmetric synthesis and control of stereochemistry. Resolution -



Enzymatic resolution and chiral chromatography, chiral pool. Methods of asymmetric induction – Substrate, reagent and catalyst-controlled reactions. Determination of enantiomeric and diastereomeric excess, enantio-discrimination

### Text Books

- 1 Warren S, 2008, "Organic Synthesis: The disconnection Approach". 2<sup>nd</sup> Edition, Wiley and sons & UK
- 2 Carruthers W and Coldham I, 2015, "Modern Methods of Organic Synthesis", 4<sup>th</sup> Edition, Cambridge University Press & UK

### References

- 1 Michael B Smith, 2015, "March's Advanced Organic Chemistry: Reactions Mechanisms and Structure", 7<sup>th</sup> Edition, Wiley & US
- 2 Wuts G. M. P, and Theodora W. G. 2011, "Greene's Protective Groups in Organic Synthesis", 4<sup>th</sup> Edition, Wiley India Pvt Ltd & New Delhi
- 3 Warren S, 2009, "Designing Organic Syntheses: A programmed introduction to the synthon Approach", 2<sup>nd</sup> Edition. Wiley and sons & US
- 4 Clayden J, Greeves N and Warren S, 2014, "Organic Chemistry", 2<sup>nd</sup> Edition, Oxford University Press & UK
- 5 <https://tmv.ac.in/ematerial/chemistry/sat/SEM%20IV%20Two-Group%20Disconnection.pdf>
- 6 <https://www.vanderbilt.edu/AnS/Chemistry/Rizzo/chem223/protect.pdf>



Course Code	Course Name	Category	L	T	P	Credit
232CE2A4CB	STATISTICAL THERMODYNAMICS AND COMPUTATIONAL CHEMISTRY	CORE	4	1	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The basic of statistical thermodynamics and its applications
- The concept in solid and liquid phase kinetics
- The basic of computational chemistry and its applications

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the concept of statistical thermodynamics	K4
CO2	Examine statistical thermodynamics to the properties of identical indistinguishable particles like electrons	K5
CO3	Analyze the reaction paths and concepts in solid and liquid phase kinetics	K4
CO4	Interpret the principles of computational chemistry	K3
CO5	Inspect the compounds using the computational applications	K4

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓			✓	✓
CO3		✓	✓		
CO4	✓	✓		✓	
CO5	✓	✓	✓	✓	✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A4CB	STATISTICAL THERMODYNAMICS AND COMPUTATIONAL CHEMISTRY	SEMESTER IV
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Total Credits: 4

Total Instruction Hours: 60 h

## Syllabus

**Unit I Statistical Thermodynamics-I 12 h**

Mathematical introduction - Theories of permutations and combinations - Laws of probability. Maxwell-Boltzmann statistics - Thermodynamic probability - Thermodynamic probabilities of system in equilibrium - Boltzmann expression for entropy - Stirling's approximation - State of maximum thermodynamic probability - Lagrangian multipliers - Thermodynamics probabilities of systems involving energy levels - Gaussian distribution- Maxwell-Boltzmann distribution law and evaluation of alpha and beta

**Unit II Statistical Thermodynamics - II 12 h**

Bose-Einstein and Fermi-Dirac Statistics: Bose-Einstein distribution law - Entropy of Bose-Einstein gas - Planck distribution law for black body radiation - Fermi-Dirac distribution law - Entropy of a Fermi-Dirac gas - Heat capacity of electron gas and the heat capacity of metals - Helium at low temperature - Negative absolute temperature

**Unit III Chemical and Phase Equilibria 12 h**

Reaction free energy/ reaction potential - Reaction isotherm and direction of spontaneity - Standard reaction free energy - Calculation from thermochemical, electrochemical and equilibrium data - Temperature coefficient of reaction free energy and equilibrium constant. Gibbs phase rule - Thermodynamic derivation - Application of phase rule to three component systems - Formation of one pair and two pairs of partially miscible liquids - Common ion effect - Salting out

**Unit IV Introduction to Computational Chemistry 12 h**

Introduction to computational chemistry - History and evolution of cheminformatics - Use of cheminformatics, prospects of cheminformatics - Database management, cheminformatics database - Introduction to molecular modeling and drug design

**Unit V Application of Computational Chemistry 12 h**

Concepts of computational chemistry - Molecular mechanics: general features, bond stretching, angle bending, improper torsions, out of plane bending, non-bonded interactions, point charges, calculation of atomic charges, polarization, Van der - Waals interactions- Molecular docking studies - Chem draw



## Text Books

- 1 Gupta, M.C, 1990, "Statistical Thermodynamics ", 1<sup>st</sup> Edition, Wiley Eastern Publications & UK
- 2 Rajaram J, Kuriacose J. C, 2013, "Chemical Thermodynamics: Classical, Statistical and Irreversible", 1<sup>st</sup> Edition, Pearson Education & New Delhi

## References

- 1 Sears F. W and Salinger G. L, 2013, " Thermodynamics, Kinetic & Statistical Thermodynamics", 3<sup>rd</sup> Edition, Narosa Publishing House & New Delhi
- 2 Laidler Keith J, 2023, "Chemical Kinetics", 1<sup>st</sup> Edition, Visionias, Inc, & US
- 3 Andrew R, Leach and Valerie J. Gillet, 2007, "An Introduction to Cheminformatics", Springer & US
- 4 Drago R.S, 2016," Physical Methods for Chemists", 2<sup>nd</sup> Edition, Affiliated East West Press Pvt. Ltd. & New Delhi
- 5 <https://shop.elsevier.com/books/theory-and-applications-of-computational-chemistry/dykstra/978-0-444-51719-7>
- 6 <https://www.amazon.in/Computational-Chemistry-Methods-Ponnadurai-Ramasami-ebook/dp/B08FZCN417>



Course Code	Course Name	Category	L	T	P	Credit
232CE2A4DA	ENVIRONMENTAL CHEMISTRY	DSE	4	-	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- The basic knowledge about the structure of atmosphere and various energy resources and environment
- The different types of pollution, health effects and control measures
- Identify the various toxic chemicals and analysis methods of polluted samples

### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Analyze the composition, structure of atmosphere and various energy resources in the environment	K4
CO2	Identify the aquatic pollution and their monitoring techniques	K3
CO3	Explain the sources, effects and control measures of air pollution	K3
CO4	Summarize the toxic chemicals and their health effects, sources of nuclear pollution and nuclear disaster management	K4
CO5	Examine various methods of analysis of pollutants	K3

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1		✓		✓	✓
CO2	✓	✓	✓		✓
CO3	✓		✓	✓	
CO4		✓	✓		✓
CO5	✓	✓		✓	✓

### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A4DA	ENVIRONMENTAL CHEMISTRY	SEMESTER IV
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Total Credits: 4

Total Instruction Hours: 48 h

### Syllabus

#### Unit I Atmosphere, Energy and Environment 10 h

Composition of Atmosphere- Atmosphere structure, Earth radiation balance, particles, ions and radicals in the atmosphere. Chemical and photochemical reactions in the atmosphere - Oxygen and ozone chemistry - EL Nino phenomenon Asian Brown cloud. Mineral resources - Metals and non-metals - Major renewable and non-renewable resources for energy - Consumption and conservation

Case study

#### Unit II Aquatic Pollution and Monitoring Techniques 10 h

Aquatic environment - Polluting agents - Pesticides, insecticides - Cyclodiene organo phosphates - Carbamates - Detergents - Naphtheno aromatics - Radioactive materials - Coral-Reef crisis - Eutrophication. Mineral pollution - Copper, lead, mercury, selenium and chromium - Minamatta disease. General methods of monitoring pollution - Polarographic, neocuproine, dithizone, persulphate and phenanthroline. Tests for identifying phenols, pesticides, surfactants, tanin and lignin

Case study

#### Unit III Air Pollution 8 h

Sources of air pollution - Natural and manmade - Classification and effects of air pollutants - CO, CO<sub>2</sub>, SO<sub>2</sub>, SO<sub>3</sub>, NO and NO<sub>2</sub> - Hydrocarbon as pollutant - Reactions of hydrocarbons and effects - Particulate pollutants sources and effects of organic and Inorganic particulates - Greenhouse effect - Impact on global climate - Control measures - Role of CFC's - Ozone holes - Effects of ozone depletion - Smog components of photochemical smog - Effects of photochemical smog

Case study

#### Unit IV Chemical Toxicology and Nuclear Pollution 10 h

Toxic chemicals in Environment - Impact of toxic chemicals on enzymes - Effects of metals and metallic compounds - Sources, toxicology and health risks of iron, arsenic, cadmium, chromium, lead, mercury and nickel. Nuclear pollution - Sources - Effects of ionizing and non-ionizing radiation - Genetic and somatic effects - Effects of Cesium-137, Krypton-85, Iodine-131 and Strontium-90 - Storage of



nuclear wastes and disposal of nuclear wastes - Nuclear disasters and their management

Case study

## Unit V Analysis and Control

10 h

Analysis of pollutants -CO, NO, SO<sub>2</sub>, H<sub>2</sub>S, hydrocarbons and particulate matter. Analysis of ammonia, nitrate and nitrites, chlorides, fluorides, cyanides, sulphide, sulphate and phosphates, boron, silica and arsenic. Controlling techniques - Scrubbing - Cold trapping - Filtration - Cyclone separator - Gravity settling - Electrostatic precipitators and thermal precipitators

Case study

## Text Books

- 1 De A. K, 2016, "Environmental Chemistry", 8<sup>th</sup> Edition. New Age International Publishers & New Delhi
- 2 Narayanan P, 2018, " Environmental Pollution Principles Analysis and Control ", 1<sup>st</sup> Edition CBS Publishers & New Delhi

## References

- 1 Sharma B. K, 2019, " Environmental Chemistry ", 1<sup>st</sup> Edition, Goel Publishing House & New Delhi
- 2 Dr. Sanjay Kumar Batra, Dr. Kanchan Batra and Dr. Harpreet Kaur, 2023, " Environmental Science ", 6<sup>th</sup> Edition, Taxmann & New Delhi
- 3 Manahan S, 2017, "Environmental chemistry", 10<sup>th</sup> Edition, CRC Press & US
- 4 Kaur H, 2023, "Environmental Chemistry ", 1<sup>st</sup> Edition, Pragati Prakashan & Meerut
- 5 <https://www.dcp-3.org/sites/default/files/dcp2/DCP43.pdf>
- 6 <https://www.lkouniv.ac.in/site/writereaddata/siteContent/202005012116016435Ranvijay-Pratap-Singh-Environmental-Pollution.pdf>



Course Code	Course Name	Category	L	T	P	Credit
232CE2A4DB	CATALYSIS	DSE	4	-	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- The basic principles of homogeneous and heterogeneous catalysis reactions and their types
- The mechanism involving in the various C-C, C-X coupling reactions and C-H activation reactions
- The basic knowledge about photocatalysis reactions involved in multiple bonds

### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Apply the knowledge of catalysis in green, enzyme, nano and phase transfer catalytic reactions	K3
CO2	Utilize the different reactions to conduct C-C, C-X and C- H type of reactions.	K3
CO3	Determine various surface parameters using different spectral techniques	K3
CO4	Illustrate the reaction mechanism of heterogeneous catalytic reactions.	K3
CO5	Outline the different photocatalysis reactions and it's applications	K3

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓			✓	✓
CO2	✓	✓	✓		
CO3			✓	✓	✓
CO4	✓	✓			
CO5		✓	✓	✓	✓

### COURSE FOCUSES ON

<input checked="" type="checkbox"/> Skill Development	<input type="checkbox"/> Entrepreneurial Development
<input checked="" type="checkbox"/> Employability	<input type="checkbox"/> Innovations
<input type="checkbox"/> Intellectual Property Rights	<input type="checkbox"/> Gender Sensitization
<input type="checkbox"/> Social Awareness/ Environment	<input type="checkbox"/> Constitutional Rights/ Human Values/ Ethics



232CE2A4DB	CATALYSIS	SEMESTER IV
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Total Credits: 4

Total Instruction Hours: 48 h

### Syllabus

#### Unit I Introduction to Catalysis 10 h

Fundamental aspects of catalysis - Homogeneous and Heterogeneous catalysis - Enzyme catalysis - Green catalysis - Nano catalysis. The role of catalytic processes in modern chemical manufacturing - Organometallic catalysts - Catalysis in organic polymer chemistry - Catalysis in petroleum industry - Catalysis in environmental control - Catalytic poison and Phase transfer catalysis

#### Unit II Homogeneous Catalysis 10 h

Metal mediated C-C and C-X coupling reactions - Negishi and Nozaki-Hiyama, Buchwald-Hartwig, Ullmann coupling reactions. Ruthenium, Osmium, Rhodium and Iridium catalyzed C-H activation reactions and their synthetic utility. Molybdenum, Tungsten and Rhodium based carbene and nitrene complexes, cyclopropanation. Introduction to N-heterocyclic carbene metal complexes

#### Unit III Characterization of Solid Catalysts 10 h

Surface area - Structure, surface morphology, porosity, pore volume, diameter, particle size. Instrumentation and applications of Scanning Electron Microscope (SEM), Transmission Electron Microscopy (TEM) and Atomic Force Microscope (AFM). Temperature Programmed Desorption (TPD), Temperature - Programmed Reaction (TPR) for acidity and basicity of the catalysts. Boundary layer theory - Wolkenstein theory - Balanding's approach

#### Unit IV Heterogeneous Catalysis 10 h

Adsorption isotherms - Catalysis by metals - Semiconductors and solid acids - Supported metal catalysts - Catalyst preparation - Deactivation and regeneration - Ammonia synthesis - Hydrogenation of carbon monoxide - Hydrocarbon conversion - Selective catalytic reduction - Polymerization

#### Unit V Photocatalysis 8 h

Introduction to photocatalysis - Semiconductor as photocatalysts - Porphyrins - Phthalocyanines. Generation of hydrogen by photocatalysts, photocatalytic break down of water and harnessing solar energy, photocatalytic degradation of dyes, environmental applications.



## Text Books

- 1 Chakrabarty D. K and Viswanathan B, 2008, "Heterogeneous catalysis", 1<sup>st</sup> Edition, New Age International (P) Ltd & New Delhi
- 2 Hegedus L. S, 1999, "Transition metals in the synthesis of complex organic molecules" 3<sup>rd</sup> Edition, University Science Books & USA

## References

- 1 Emmet P. H, 1954, "Catalysis (Vol I & II)", 1<sup>st</sup> Edition, Reinhold & USA
- 2 Kaneko M and Okura, I, 2003, "Photocatalysis: Science and Technology", Springer & Germany
- 3 Schlosser M, 1996, "Organometallics in Synthesis, A manual", 1<sup>st</sup> Edition, John Wiley & USA
- 4 Viswanathan B, Kannan S and Deka R. C, 2010, "Catalysis and Surfaces: Characterization Techniques", 1<sup>st</sup> Edition, Alpha Science International Ltd & UK
- 5 [http://www.nanoer.net/d/img/fundamental%20concepts%20in%20heterogeneous%20catalysis-Jens\\_K.\\_Nrskov,\\_Felix\\_Studt,\\_Frank\\_Abild-Pedersen.pdf](http://www.nanoer.net/d/img/fundamental%20concepts%20in%20heterogeneous%20catalysis-Jens_K._Nrskov,_Felix_Studt,_Frank_Abild-Pedersen.pdf)
- 6 [https://www.researchgate.net/publication/324164107\\_Photocatalysis\\_Present\\_past\\_and\\_future/link/5e439fb7299bf1cdb92107a4/download](https://www.researchgate.net/publication/324164107_Photocatalysis_Present_past_and_future/link/5e439fb7299bf1cdb92107a4/download)



Course Code	Course Name	Category	L	T	P	Credit
232CE2A4DC	MEDICINAL CHEMISTRY	DSE	4	-	-	4

#### PREAMBLE

This course has been designed for students to learn and understand

- The types of drugs, synthesis and their pharmacological action
- The synthesis and mode of action of nonsteroidal anti-inflammatory drugs
- The natural and synthetic sources of drugs in chemotherapy

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Interpret the synthesis and pharmacological application of sulpha drugs in various infectious diseases	K3
CO2	Identify and appraise the synthesis and mode of action of mycobacterial and thyroid drugs	K4
CO3	Analyze the anesthetics and anesthetics and analgesics	K4
CO4	Appraise the application and synthesis of an analgesics and anesthetics	K4
CO5	Examine the mode of action and synthetic route of anti- malarial drugs	K3

#### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	✓			✓	✓
CO2	✓	✓	✓		
CO3			✓	✓	✓
CO4	✓	✓			
CO5		✓	✓	✓	✓

#### COURSE FOCUSES ON

<input checked="" type="checkbox"/>	Skill Development	<input type="checkbox"/>	Entrepreneurial Development
<input checked="" type="checkbox"/>	Employability	<input type="checkbox"/>	Innovations
<input type="checkbox"/>	Intellectual Property Rights	<input type="checkbox"/>	Gender Sensitization
<input type="checkbox"/>	Social Awareness/ Environment	<input type="checkbox"/>	Constitutional Rights/ Human Values/ Ethics



232CE2A4DC	MEDICINAL CHEMISTRY	SEMESTER IV
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Total Credits: 4

Total Instruction Hours: 48 h

## Syllabus

**Unit I      Antibacterial Sulpha Drugs      10 h**

Introduction, Synthesis and mode of action of sulphonamides for general infections – Sulphanilamide – Sulphapyridine – Sulphadiazine. Urinary infections – Sulphacetamide – Sulphafurazole – Sulphisoxazoleacetyl. Intestinal infections – Sulphaguanidine – Phthalylsulphathiazole. Local infection – Sulphacetamide sodium – Mafedine – Dapsone

**Unit II      Anti-Mycobacterial, Thyroid and Antithyroid Drugs      10 h**

Introduction - Synthesis and mode of action of pyrazinamide, fluoroquinolones and ofloxacin. Structure and mode of action of cycloserine, amino glycosides, clofazimine, ciproflaxacin hydrochloride and capreomycin. Synthesis and uses of Thyroxine, carbimazole, methimazole, propylthiouracil. Structure and uses of levothyroxine sodium and liothyronine sodium

**Unit III      Anesthetics and Analgesics      10 h**

Introduction to anesthetics – Preparation of inhalation anesthetics – Ether – Ethyl chloride – Fluroxene – Halothane. Structure of intravenous anesthetics – Ketamine hydrochloride – Methohexital sodium – Thiamylal sodium. Introduction to analgesics, characteristic features of opioids, morphine analogues – Morphine sulphate – Diamorphine hydrochloride (structure only). Morphinan analogues – Levorphanol tartrate – Dextromethorphan hydrobromide (structure only). Synthesis and advantages of phenylpiperidine analogues – Pethidine hydrochloride – Diphenoxylate hydrochloride. Phenyl propylamine analogues – methadone hydrochloride – Dextropropoxyphene hydrochloride

**Unit IV      Non-Steroidal Anti-Inflammatory Drugs      10 h**

Introduction, classification, synthesis and mode of action of indomethacine, sulindac, tolmetin sodium, ibuprophen, ibuphenac, dichlorophenal sodium, flubiprofen, naproxen, auranofin and allopurinol

**Unit V      Antimalarial Drugs      8 h**

Introduction, synthesis and mode of action of chloroquine phosphate, pamaquine, primaquine phosphate, proguanil hydrochloride, pyrimethamine, trimethoprim




## Text Books

- 1 Razdan B, 2010, " Medicinal Chemistry", 1<sup>st</sup> Edition, CBS Publishers and Distributors & New Delhi
- 2 Ahluwalia V.K and Madhu Chopra, 2008, "Medicinal Chemistry", 4<sup>th</sup> Edition, AneBooks & New Delhi

## References

- 1 Ashutosh Kar, 2015, "Medicinal Chemistry", 6<sup>th</sup> Edition, New Age International Ltd & New Delhi
- 2 Jayashree G, 2014, "A Text Book of Pharmaceutical Chemistry", 5<sup>th</sup> Edition, S. Chand and Company Ltd & New Delhi
- 3 Graham L. P, 2005, "An Introduction to Medicinal Chemistry", 3<sup>rd</sup> Edition, Oxford university press & UK
- 4 Malleshappa N, Anurekha Jain and Harun M, 2014, "Textbook of Medicinal Chemistry Volume I", 1<sup>st</sup> Edition, CBS publishers and distributors Pvt Ltd & New Delhi
- 5 <https://www.ramauniversity.ac.in/online-study-material/pharmacy/dpharma/2year/pharmaceuticalchemistry-ii/lecture4.pdf>
- 6 [https://www.researchgate.net/publication/344177762\\_Anesthetic\\_Drugs/link/5f591c61a6fdcc1164046b54/download](https://www.researchgate.net/publication/344177762_Anesthetic_Drugs/link/5f591c61a6fdcc1164046b54/download)

  
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