



# **SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE (AUTONOMOUS)**

*(Affiliated to Bharathidasan University, Tiruchirappalli)*

**Accredited by NAAC-An ISO 9001:2015 Certified Institution**

**SUNDARAKKOTTAI, MANNARGUDI-614016.**

**TAMILNADU, INDIA.**

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## **M.Sc., CHEMISTRY CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK (CBCS - LOCF) (For the candidates admitted in the academic year 2024-2025)**

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### **CHOICE BASED CREDIT SYSTEM**

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. Our College has moved to CBCS and implemented the grading system.

### **OUTCOME-BASED EDUCATION (OBE) LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)**

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications are awarded on the basis of demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and academic standards expected of graduates of a programme of study. Learning outcomes specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study. The expected learning outcomes are used as reference points that would help to formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn will help in curriculum planning and development, and in the design, delivery and review of academic programmes. They provide general guidance for articulating the essential learnings associated with programmes of study and courses within a programme, maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility and provide higher education institutions an important point of reference for designing teaching-learning strategies, assessing student learning levels, and periodic review of programmes and academic standards.

### **Some important aspects of the Outcome Based Education**

**Course:** is defined as a theory, practical or theory cum practical subject studied in a semester.

**Course Outcomes (COs):** are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

**Programme:** is defined as the specialization or discipline of a Degree.

**Programme Outcomes (POs):** Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

**Programme Specific Outcomes (PSOs):** PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.

### **Some important terminologies repeatedly used in LOCF.**

**Core Courses (CC):** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.

**Discipline Specific Elective Courses (DSE):** Elective course may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective (DSE). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature.

**Generic Elective Courses:** An elective course chosen generally from an **unrelated discipline/subject**, with an intention to seek exposure is called a Generic Elective. Generic Elective courses are designed for the students of other disciplines. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.

**Non Major Elective (NME):** A student shall choose at least two Non-major Elective Courses (NME) from outside his/her department.

**Skill Enhancement Courses (SECs):** These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme. These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

**Field Study/Industrial Visit/ Case Study:** It has to be completed during the fifth semester of the degree programme. Credit for this course will be entered in the fifth semester's marks statement.

**Internship:** Students must complete internship during summer holidays after the fourth semester. They have to submit a report of internship training with the necessary documents and have to appear for a viva-voce examination during fifth semester. Credit for internship will be entered in the fifth semester's mark statement.

**Extra Credit Courses:** In order to facilitate the students, gaining knowledge/skills by attending online courses MOOC, credits are awarded as extra credits, the extra credit are at three semesters after verifying the course completion certificates. According to the guidelines of UGC, the students are encouraged to avail this option of enriching their knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL etc.

### **Postgraduate Programme:**

**Programme Pattern:** The Post Graduate degree programme consists of **FIVE** vital components. They are as follows:

- Part –A : Core Course (Theory, Practicals) Core Industry Module, Core Project
- Part-B (i) : Elective courses
- Part-B (ii) : Non Major Elective, Skill Enhancement course, Professional Competency course
- Part-B (iii) : Internship
- Part –C : Extension activity

### **EXAMINATION**

#### **Continuous Internal Assessment (CIA):**

#### **PG - Distribution of CIA Marks**

**Passing Minimum: 50 %**

Assignments – 3 = 30%

Tests- 2 = 50%

Seminar=10 %

Attendance= 10 %

#### **Question Paper Pattern**

**Part A:** includes two subsections

**Part A 1** (10X1=10 marks)

One word question/ Fill in the blanks /True or False/ Multiple Choice Questions  
Two Questions from Each unit

**Part A 2**(5X2=10 marks)

Match the following

Short Answers

One question from Each unit

**Total Marks - 20**

**Part B:** (5X5=25 marks)

Paragraph Answers

Either/ or type, One Question from each unit

**Part C:** (10X3=30)

Essay Type Answers

Answer 3 out of 5 Questions

One Question from each unit

**Part A:** K1 Level

**Part B:** K2, K3 and K4 Level

**Part C:** K5 and K6 Level

### Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S.No.	Level	Parameter	Description
1	K1	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/ Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis/Creating	The learner creates a new product or point of view

### WEIGHTAGE of K –LEVELS IN QUESTION PAPER

(Cognitive Level) K-LEVELS →	Lower Order Thinking			Higher Order Thinking			Total
	K1	K2	K3	K4	K5	K6	
<b>END SEMESTER EXAMINATIONS (ESE)</b>	20		25		30		<b>75</b>
<b>Continuous Internal Assessment (CIA)</b>	20		25		30		<b>75</b>

**QUESTION PATTERN FOR END SEMESTER EXAMINATION/ Continuous  
Internal Assessment**

<b>PART</b>	<b>MARKS</b>
<b>PART –A I.</b> (No choice ,One Mark) <b>TWO</b> questions from each unit (10x1=10)	<b>20</b>
<b>II.</b> (No choice, Two Mark) <b>ONE</b> question from each unit (5x2=10)	
<b>PART –B</b> (Either/ or type,5-Marks) <b>ONE</b> question from each unit (5x5=25)	<b>25</b>
<b>PART –C</b> (3 out of 5) (10Marks) <b>ONE</b> question from each unit (3x10=30)	<b>30</b>
<b>Total</b>	<b>75</b>

**BLUE PRINT OF QUESTION PAPER FOR END SEMESTER EXAMINATION**

<b>DURATION: 3 Hours.</b>		<b>Max Mark :75</b>						
<b>K-LEVELS</b>		<b>K1</b>	<b>K2</b>	<b>K3</b>	<b>K4</b>	<b>K5</b>	<b>K6</b>	<b>Total Marks</b>
<b>PART</b>								
<b>PART –A</b> (One Mark, No choice) (10x1=10)		10						<b>10</b>
(2-Marks,Nochoice) (5x2=10)		10						<b>10</b>
<b>PART –B</b> (5-Marks)(Either/or type) (5x5=25)			5	10	10			<b>25</b>
<b>PART –C</b> (10 Marks)(3 out of 5) (3x10=30)						20	10	<b>30</b>
Courses having only <b>K5,K6</b> levels, K5 level- 3 Questions, K6 level- 2 Questions <b>(One K6 level question is compulsory)</b>								
<b>Total</b>		<b>20</b>	<b>05</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>10</b>	<b>75</b>

## EVALUATION

### GRADING SYSTEM

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added and converted as final mark. The marks thus obtained will then be graded as per the scheme provided in Table-1.

Grade Point Average (GPA) will be calculated from the first semester onwards for all semester. From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by semester Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA), respectively. These two are calculated by the following formulae:

$\text{GPA} = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i}$	$\text{WAM (Weighted Average Marks)} = \frac{\sum_{i=1}^n C_i M_i}{\sum_{i=1}^n C_i}$
Where, $C_i$ is the Credit earned for the Course $i$ $G_i$ is the Grade Point obtained by the student for the Course $i$ $M_i$ is the marks obtained for the course $i$ and $n$ is the number of Courses <b>Passed</b> in that semester.	

**CGPA:** Average GPA of all the Courses starting from the first semester to the current semester.

### CLASSIFICATION OF FINAL RESULTS:

- i. The classification of final results shall be based on the CGPA, as indicated in Table-2.
- ii. For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as 'Outstanding'. Similarly the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99 and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as 'Excellent', 'Very Good', 'Good', and 'Above Average' respectively.
- iii. Absence from an examination shall not be taken an attempt.

**Table- 1: Grading of the Courses**

<b>Marks Range</b>	<b>Grade Point</b>	<b>Corresponding Grade</b>
90 and above	<b>10</b>	<b>O</b>
80 and above and below 90	<b>9</b>	<b>A+</b>
70 and above and below 80	<b>8</b>	<b>A</b>
60 and above and below 70	<b>7</b>	<b>B+</b>
50 and above and below 60	<b>6</b>	<b>B</b>
Below 50	<b>NA</b>	<b>RA</b>

**NA- Not Applicable, RA- Reappearance**

The candidates performance in every current semester is indicated by **Semester Grade Point Average (SGPA)** and from the second semester onwards, the continuous performance including previous semester/s is indicated by **Cumulative Grade Point Average (CGPA)**

**Table-2: Final Result**

<b>CGPA</b>	<b>Corresponding Grade</b>	<b>Classification of Final Result</b>
9.00 and above	<b>O</b>	<b>Outstanding</b>
8.00 to 8.99	<b>A+</b>	<b>Excellent</b>
7.00 to 7.99	<b>A</b>	<b>Very Good</b>
6.00 to 6.99	<b>B+</b>	<b>Good</b>
5.00 to 5.99	<b>B</b>	<b>Above Average</b>

\* The candidates who have passed in the first appearance and within the prescribed duration of the PG Programme are eligible. If the candidate's Grade is O/A+ with more than one attempt, the performance is fixed as "Very Good"

## **Vision**

To Empower the women students by providing excellent theoretical, practical and research skills in Chemistry to meet the global needs.

## **Mission**

- Providing quality education in the principles, theory and practice of Chemistry.
- Making the students to cope up with the requirements of industry and service sectors.
- Excelling in teaching, research, knowledge transfer and to serve the social, cultural and economic needs of the nation.

## PROGRAMME OUTCOMES FOR M.Sc.,DEGREE PROGRAMMES

PO.No	Programme Outcomes <i>(Upon completion of the M.Sc.,Degree Programme, the Post graduate will be able to)</i>
PO-1	<b>Disciplinary Knowledge:</b> demonstrate in-depth knowledge and understanding of theories, policies, and practices in one or more disciplines that form a part of a Post Graduate program of study in Master of Science.
PO-2	<b>Critical Thinking and Problem Solving:</b> apply analytic thought to a body of knowledge, analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence, identify relevant assumptions or implications, formulate coherent arguments, critically evaluate practices, policies and theories by following scientific approach to knowledge development: solve problems and extrapolate the same to real life situation
PO-3	<b>Information/digital literacy and Communication Skills:</b> use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources, and use appropriate software for analysis of data: communicate thoughts and ideas analytically and effectively in writing and orally using appropriate media, and present complex information in a clear and concise manner to different groups.
PO-4	<b>Research-related skills:</b> conduct independent inquiry in a chosen scientific discipline, demonstrate sense of inquiry and capability for asking relevant/appropriate questions, problematising, synthesizing and articulating; recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; plan, execute and report the results of an experiment or investigation.
PO-5	<b>Scientific reasoning and Reflective Thinking:</b> analyse, interpret and draw conclusions from quantitative/qualitative data and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective; critically and sensibly evaluate life experiences, with self awareness and reflexivity of both self and society.
PO-6	<b>Multidisciplinary Approach, Innovation and Entrepreneurship:</b> propose novel ideas of interdisciplinary approach in providing better solutions and new ideas for the sustainable developments; identify opportunities, entrepreneurship vision and use of innovative ideas to create value and wealth for the betterment of the individual and society.
PO-7	<b>Moral and ethical awareness/reasoning:</b> embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work, demonstrate the ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, appreciate environmental and sustainability issues, and adopt objective, unbiased and truthful actions in all aspects of work.
PO-8	<b>Self directed Learning:</b> work independently, identify appropriate resources required for a project, and manage a project till completion.
PO-9	<b>Lifelong Learning:</b> engage in continuous learning for professional growth and development, acquire knowledge and skills, adapt to changing environment and to changing trades and demands of work place through knowledge/skill development/reskilling.
PO-10	<b>Multicultural Competence, Social Interaction and Effective Citizenship:</b> understand the values and beliefs of multiple cultures, global perspectives, engage and interact respectfully with diverse groups and elicit views of others, mediate disagreements and help reach conclusions in group settings, and demonstrate empathetic social concern and equity centred national development



## PROGRAMME SPECIFIC OUTCOME (PSO)

PSO No.	Program Specific Outcomes (M.Sc., Chemistry)
<b>PSO1</b>	<b>Placement:</b> To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions
<b>PSO2</b>	<b>Entrepreneur:</b> To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations
<b>PSO3</b>	<b>Research and Development:</b> Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.
<b>PSO4</b>	<b>Contribution to Business World:</b> To produce employable, ethical and innovative professionals to sustain in the dynamic business world.
<b>PSO5</b>	<b>Contribution to the Society:</b> To contribute to the development of the society by collaborating with stakeholders for mutual benefit



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**M.Sc., CHEMISTRY**

**COURSE STRUCTURE UNDER CHOICE BASED CREDIT SYSTEM - LEARNING OUTCOMES BASED  
CURRICULUM FRAMEWORK (CBCS - LOCF)**

(Applicable to the candidates admitted from the academic year 2024-2025)

**ELIGIBILITY:** Candidates who have passed Bachelor level Examination in Chemistry

Sem	Part	Course	Course Code	Title of the Course	Ins. Hous /Week	Ins. Hours/Week				Credit	Exam Hours	Marks		Total
						L	T	P	S			CIA	ESE	
I	Part A	Core Course –I	P24CH101	Organic Reaction Mechanism-I	6	4	1	-	1	5	3	25	75	100
		Core Course –II	P24CH102	Structure and Bonding in Inorganic Compounds	6	4	1	-	1	5	3	25	75	100
		Core Practical– I	P24CH103P	Organic Chemistry Practical	6	-	-	6	-	3	6	25	75	100
	Part B (i)	Elective Course –I	P24CHE11A/ P24CHE11B/ P24CHE11C	Nanomaterials and Nanotechnology /Pharmaceutical Chemistry / Analytical Chemistry	5	5	-	-	-	3	3	25	75	100
		Elective Course -II	P24CHE12A/ P24CHE12B/ P24CHE12C	Molecular Spectroscopy / Electrochemistry/ Catalysis	5	4	1	-	-	3	3	25	75	100
	Part B (ii)	Non Major Elective-I	-	-	2	2	-	-	-	2	3	25	75	100
<b>TOTAL</b>					<b>30</b>	<b>19</b>	<b>03</b>	<b>06</b>	<b>02</b>	<b>21</b>	-	-	-	<b>600</b>
II	Part A	Core Course –III	P24CH204	Organic Reaction Mechanism-II	6	4	1	-	1	5	3	25	75	100
		Core Course-IV	P24CH205	Physical Chemistry-I	6	4	1	-	1	5	3	25	75	100
		Core Practical– II	P24CH206P	Inorganic Chemistry Practical	6	-	-	6	-	3	6	25	75	100
	Part B (i)	Elective Course – III	P24CHE23A/ P24CHE23B/ P24CHE23C	Green Chemistry / Medicinal Chemistry/ Supramolecular Chemistry	5	5	-	-	-	3	3	25	75	100

		Elective Course - IV	P24CHE24A/ P24CHE24B/ P24CHE24C	Bio Inorganic Chemistry/ Material Science/ Solid State Chemistry	5	4	1	-	-	3	3	25	75	100
	Part B (ii)	Non Major Elective-II	-	-	2	2	-	-	-	2	3	25	75	100
	Part B(iii)	Internship/Industrial Activity			-	-	-	-	-	-	-	-	-	-
		<b>TOTAL</b>			<b>30</b>	<b>19</b>	<b>03</b>	<b>06</b>	<b>02</b>	<b>21</b>	-	-	-	<b>600</b>
Sem	Part	Course	Course Code	Title of the Course	Ins. Hors /Week	Ins. Hours/Week				Credit	Exam Hours	Marks		Total
						L	T	P	S			CIA	ESE	
III	Part A	Core Course –V		Organic Synthesis & Photochemistry	6	4	1	-	1	5	3	25	75	100
		Core Course –VI		Coordination Chemistry	6	4	1	-	1	5	3	25	75	100
		Core Practical-III		Physical Chemistry Practical	6	-	-	6	-	3	6	25	75	100
		Core Industry Module		Industrial Chemistry	5	4	1	-	-	3	3	25	75	100
	Part B (i)	Elective Course –V		Pharmacognosy and Phytochemistry/ Biomolecules and Heterocyclic Compounds/ Computational Chemistry	5	4	1	-	-	3	3	25	75	100
	Part B (ii)	Skill Enhancement Course		Preparation of Consumer Products	2	2	-	-	-	2	3	25	75	100
	Part B (iii)	Internship/Industrial Activity			-	-	-	-	-	2	-	-	-	-
		<b>TOTAL</b>			<b>30</b>	<b>18</b>	<b>04</b>	<b>06</b>	<b>02</b>	<b>23</b>	-	-	-	<b>600</b>
IV	Part A	Core Course –VII		Research Methodology	5	4	1	-	-	5	3	25	75	100
		Core Course-VIII		Physical Chemistry-II	5	4	1	-	-	5	3	25	75	100
		Core Practical– IV		Analytical Instrumentation technique Practicals	6	-	-	6	-	3	6	25	75	100
		Core Project		Project with Viva Voce	8	-	2	6	-	7	3	25	75	100
	Part B (i)	Elective Course – VI (Industry / Entrepreneurship)		Chemistry of Natural Products/ Polymer Chemistry/ Food Chemistry	4	3	1	-	-	3	3	25	75	100
	Part B (ii)	Professional Competency Course		Chemistry for Competitive Examination	2	2	-	-	-	2	3	25	75	100
	Part C	Extension Activity			-	-	-	-	-	1	-	-	-	-
		<b>TOTAL</b>			<b>30</b>	<b>13</b>	<b>05</b>	<b>12</b>	<b>-</b>	<b>26</b>	-	-	-	<b>600</b>
		<b>GRAND TOTAL</b>			<b>120</b>	<b>69</b>	<b>15</b>	<b>30</b>	<b>06</b>	<b>91</b>				<b>2400</b>
	Extra Credit	MOOC/SWAYAM/NPTEL			-	-	-	-	-	2	-	-	-	-
		Value added Courses			-	-	-	-	-	2	-	-	-	-

L-Lecture

T-Tutorial

P-Practical

S-Seminar

## CREDIT DISTRIBUTION FOR M.Sc., CHEMISTRY

S.No	Course Details	Credit
Part A	Core Course [8 Courses X 5 Credits]	40
	Core Practical [4 Courses X 3 Credits]	12
	Project Work with Viva Voce	07
	Core Industry Module	03
Part B (i)	Elective Course [ 6 Courses X 3 Credits]	18
Part B (ii)	Non Major Elective [2 Courses X 2 Credits]	04
	Skill Enhancement Course [1 Courses X 2 Credits]	02
	Professional Competency Course [ 1 Courses X 2 Credits]	02
Part B (iii)	Internship	02
Part C	Extension Activity	01
	<b>Total Credit</b>	<b>91</b>

Part A component and Part B (i) will be taken into account for CGPA calculation for the postgraduate programme and the other components of Part B and Part C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the PG degree.

### NON MAJOR ELECTIVE (NME) OFFERED BY THE DEPARTMENT

Semester	Part	Course	Course Code	Title of the Paper
I	Part B (ii)	NME-I	P24NMECH11	Cosmetic Chemistry
II		NME-II	P24NMECH22	Chemistry in Everyday life

# **SEMESTER -I**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE  
(AUTONOMOUS)



SUNDARAKKOTTAI, MANNARGUDI- 614016  
(For the Candidates admitted in the academic year 2024-2025)

DEPARTMENT OF CHEMISTRY  
M.Sc., CHEMISTRY

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**SEMESTER: I - CC-1: Organic Reaction Mechanism – I**

**Ins. Hrs. /Week: 6**

**Course Credit: 5**

**Course Code:P24CH101**

**UNIT-I: METHODS OF DETERMINATION OF REACTION MECHANISM: (18 Hours)**

Reaction intermediates, The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate. Methods of determining mechanism: non-kinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism. Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants.

**UNIT-II: AROMATIC AND ALIPHATIC ELECTROPHILIC SUBSTITUTION:**

**(18 Hours)**

Aromaticity: Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds and annulenes. Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions. Aliphatic electrophilic substitution Mechanisms:  $SE_2$  and  $SE_i$ ,  $SE_1$ - Mechanism and evidences.

**UNIT-III: AROMATIC AND ALIPHATIC NUCLEOPHILIC SUBSTITUTION:**

**(18 Hours)**

Aromatic nucleophilic substitution: Mechanisms -  $SN_{Ar}$ ,  $SN_1$  and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attacking nucleophile. Reactions: Oxygen and Sulphur-nucleophiles, Bucherer and Rosenmund reactions, von Richter, Sommelet-Hauser and Smiles rearrangements.  $SN_1$ , ion pair,  $SN_2$  mechanisms and evidences. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon.  $SN_1$ ,  $SN_2$ ,  $SN_i$ , and  $SE_1$  mechanism and evidences, Swain- Scott, Grunwald-Winstein relationship - Ambident nucleophiles.

**UNIT-IV: STEREO CHEMISTRY-I:****(18 Hours)**

Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers. Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shape, methods of determining the configuration. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation. D, L system, Cram's and Prelog's rules: R, S- notations, proR, proS, side phase and re phase Cahn-Ingold- Prelog rules, absolute and relative configurations. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds, exo-cyclic alkylidene-cycloalkanes. Topicity and prostereoisomerism, chiral shift reagents and chiral solvating reagents. Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, destruction. Stereoselective and stereospecific synthesis.

**UNIT-V: STEREO CHEMISTRY-II:****(18 Hours)**

Conformation and reactivity of acyclic systems, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium - Curtin-Hammett Principle. Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule. Optical rotation and optical rotatory dispersion, conformational asymmetry, ORD curves, octant rule, configuration and conformation, Cotton effect, axial haloketone rule and determination of configuration.

**TOTAL LECTURE HOURS : 90****COURSE OUTCOMES**

Students will be able

1. To recall the basic principles of organic chemistry.
2. To understand the formation and detection of reaction intermediates of organic reactions.
3. To predict the reaction mechanism of organic reactions and stereochemistry of organic compounds.
4. To apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions.
5. To design and synthesize new organic compounds by correlating the stereochemistry of organic compounds.

## REFERENCE BOOK

1. J. March and M. Smith, Advanced Organic Chemistry, 5<sup>th</sup> edition, John-Wiley and Sons, 2001.
2. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959.
3. P.S.Kalsi, Stereochemistry of carbon compounds, 8<sup>th</sup> edition, NewAge International Publishers, 2015.
4. P. Y. Bruice, Organic Chemistry, 7<sup>th</sup> edn, Prentice Hall, 2013.
5. J. Clayden, N. Greeves, S. Warren, Organic Compounds, 2<sup>nd</sup> edition, Oxford University Press, 2014.
6. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5<sup>th</sup> edition, Kluwer Academic / Plenum Publishers, 2007.
7. D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001.
8. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987.
9. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000.
10. L. Finar, Organic chemistry, Vol-1 & 2, 6<sup>th</sup> edition, Pearson Education Asia, 2004.

## E RESOURCES

1. <https://sites.google.com/site/chemistrybookscollection02/home/organic-chemistry/organic>
2. <https://www.organic-chemistry.org/>
3. [https://www.ccdc.cam.ac.uk/support-and-resources/ccdcresources/aromaticity\\_teaching\\_subset.pdf](https://www.ccdc.cam.ac.uk/support-and-resources/ccdcresources/aromaticity_teaching_subset.pdf)
4. <https://phclub15.files.wordpress.com/2016/03/nomenclature-of-heterocyclic-compounds-copy-copy-1.pdf>
5. [https://stromindia.weebly.com/uploads/1/0/6/9/106902953/organic\\_chemistry\\_reactions.pdf](https://stromindia.weebly.com/uploads/1/0/6/9/106902953/organic_chemistry_reactions.pdf)



## MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO2	2	3	3	3		2	3		3	3	3	3	3	3
CO3	3	3	2	3		3	3		3	3	3	3	3	3
CO4	1	3	3	3		3	3	3	3	3	3	3	3	3
CO5	1	3	2	3		3	3	3	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**



**SEMESTER: I – CC - 2-: Structure and Bonding in Inorganic Compounds**

**Ins. Hrs. /Week: 6**

**Course Credit:5**

**Course code: P24CH102**

**UNIT-I: STRUCTURE OF MAIN GROUP COMPOUNDS AND CLUSTERS: (18 Hours)**

VB theory – Effect of lone pair and electronegativity of atoms (Bent's rule) on the geometry of the molecules; Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates– ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates. Structure of silicones, Structural and bonding features of B-N, S-N and P-N compounds; Poly acids – types, examples and structures; Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes; Wade's rule to predict the structure of borane cluster; main group clusters – zintl ions and mno rule.

**UNIT-II: SOLID STATE CHEMISTRY – I: (18 Hours)**

Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Crystal systems and Bravais lattices, Symmetry operations in crystals, glide planes and screw axis; point group and space group; Solid state energetics: Lattice energy – Born-Landé equation - Kapustinski equation, Madelung constant.

**UNIT-III: SOLID STATE CHEMISTRY – II: (18 Hours)**

Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels - normal and inverse types and perovskite structures. Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.

**UNIT-IV: TECHNIQUES IN SOLID STATE CHEMISTRY: (18 Hours)**

X-ray diffraction technique: Bragg's law, Powder diffraction method – Principle and Instrumentation; Interpretation of XRD data – JCPDS files, Phase purity, Scherrer formula, lattice constants calculation; Systematic absence of reflections; Electron diffraction technique – principle, instrumentation and application. Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM.

## UNIT-V: BAND THEORY AND DEFECTS IN SOLIDS:

(18 Hours)

Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors; Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser and phosphors; Linear defects and its effects due to dislocations.

**TOTAL LECTURE HOURS : 90**

### COURSE OUTCOMES :

Students will be able

1. Predict the geometry of main group compounds and clusters.
2. Explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of cations.
- 3.: Understand the various types of ionic crystal systems and analyze their structural features.
- 4.: Explain the crystal growth methods.
5. To understand the principles of diffraction techniques and microscopic techniques.

### REFERENCE BOOKS

1. A R West, Solid state Chemistry and its applications, 2<sup>nd</sup> Edition (Students Edition), JohnWiley& Sons Ltd., 2014.
2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers,Himalaya Publishing House,2001.
3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4<sup>th</sup>Edition, CRC Press, 2012.
4. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunderscompany: Philadelphia, 1977.
5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry;4th ed.; Harper and Row:NewYork, 1983.
6. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in InorganicChemistry, 3rd Ed, 1994.
7. R J D Tilley, Understanding Solids - The Science of Materials, 2<sup>nd</sup>edition, Wiley Publication,2013.
8. C N R Rao and J Gopalakrishnan, New Directions in Solid StateChemistry, 2<sup>nd</sup> Edition,Cambridge University Press,

### E RESOURCES

1. [http://academic.macewan.ca/gelminil/231\\_1.pdf](http://academic.macewan.ca/gelminil/231_1.pdf)
2. <https://www.osti.gov/biblio/6090744>
3. <http://www.tcm.phy.cam.ac.uk/~cjp20/old/lectures/topic1.pdf>
4. <http://revroum.lew.ro/wp-content/uploads/2014/11/Art%2001.pdf>
5. <http://revroum.lew.ro/wp-content/uploads/2014/11/Art%2001.pdf>

**MAPPING WITH PROGRAM OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3
CO2	2	3	3	3	3		3	3	3	3	3	3	3	3
CO3		3	2	3	3		3	2	3	3	3	3	3	3
CO4		3	3	3	3		3	3	3	3	3	3	3	3
CO5		3	2	3	3		3	2	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE

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DEPARTMENT OF CHEMISTRY

M.Sc., CHEMISTRY



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SEMESTER: I – CP-I-: Organic Chemistry Practical

INS. HRS. /WEEK: 6

COURSE CREDIT: 3

COURSE CODE: P24CH103P

**UNIT-I: SEPARATION AND ANALYSIS: (30 Hours)**

- a. Two Component Mixtures.
- b. Three Component Mixtures

**UNIT-II: ESTIMATIONS: (30 Hours)**

- a. Estimation of Phenol (bromination)
- b. Estimation of Aniline (bromination)
- c. Estimation of Ethyl methyl ketone (iodimetry)
- d. Estimation of Glucose (redox)
- e. Estimation of Ascorbic acid (iodimetry)
- f. Estimation of Aromatic nitro groups (reduction)
- g. Estimation of Glycine (acidimetry)
- h. Estimation of Formalin (iodimetry)
- i. Estimation of Acetyl group in ester (alkalimetry)
- j. Estimation of Hydroxyl group (acetylation)
- k. Estimation of Amino group (acetylation)

**UNIT-III: Two stage preparations: (30 Hours)**

- a. *p*-Bromo acetanilide from aniline
- b. *p*-Nitroaniline from acetanilide
- c. 1,3,5-Tribromobenzene from aniline
- d. Acetyl salicylic acid from methyl salicylate
- e. Benzilic acid from benzoin
- f. *m*-Nitroaniline from nitrobenzene
- g. *m*-Nitrobenzoic acid from methyl benzoate

**TOTAL PRACTICAL HOURS : 90**

**COURSE OUTCOMES**

Students will be able:

1. To recall the basic principles of organic separation, qualitative analysis and preparation.
2. To explain the method of separation and analysis of separated organic mixtures and convert them as derivatives by suitable preparation method.
3. To determine the characteristics of separation of organic compounds by various chemical reactions.
4. To develop strategies to separate, analyze and prepare organic compounds.
5. To formulate a method of separation, analysis of organic mixtures and design suitable procedure for organic preparations.

## REFERENCE BOOKS

1. A R West, Solid state Chemistry and its applications, 2nd Edition (Students Edition), John Wiley & Sons Ltd., 2014.
2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.
3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4<sup>th</sup> Edition, CRC Press, 2012.
4. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3<sup>rd</sup> Ed, 1994.
5. R J D Tilley, Understanding Solids - The Science of Materials, 2<sup>nd</sup> edition, Wiley Publication, 2013.
6. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2<sup>nd</sup> Edition, Cambridge University Press, 199.

## E RESOURCES

1. <https://soe.unipune.ac.in/studymaterial/ashwiniwadegaonkaronline/mixturechartfinalwatermar k.pdf>
2. <https://www.slideshare.net/drssreenivasa/msc-laboratory-manual-organic-chemistry-binary-mixture-separations>
3. <https://soe.unipune.ac.in/studymaterial/ashwiniwadegaonkaronline/mixturechartfinalwatermar k.pdf>
4. <https://www.ncbi.nlm.nih.gov/pubmed/22812571>
5. [https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video\\_galleries/lecture-videos/](https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/)

## MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3
CO2	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO3	3	3		3	3	3	3	2	3	3	3	3	3	3
CO4	2	3		3	3	2	3	3	3	3	3	3	3	3
CO5	2	3	2	3	3	2	3	2	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**



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**DEPARTMENT OF CHEMISTRY**

**M.Sc., CHEMISTRY**

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**SEMESTER: I - EC-I (A): Nanomaterials and Nanotechnology**

**Ins. Hrs. /Week: 5**

**Course Credit: 3**

**Course code: P24CHE11A**

**UNIT-I:INTRODUCTION OF NANOMATERIALS AND NANOTECHNOLOGIES:**

**(15 Hours)**

Introduction-role of size, classification-0D, 1D, 2D, 3D. Synthesis- Bottom –Up, Top–Down, consolidation of Nano powders. Features of nanostructures, Background of nanostructures. Techniques of synthesis of nanomaterials, Tools of the nanoscience. Applications of nanomaterials and technologies.

**UNIT-II:BONDING AND STRUCTURE OF THE NANOMATERIALS: (15 Hours)**

Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance crystal structure. Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties. Synthesis- Physical and chemical methods - inert gas condensation, arc discharge, laser ablation, sol-gel, solvothermal and hydrothermal-CVD-types, metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis.

**UNIT-III: MECHANICAL PROPERTIES OF MATERIALS: (15 Hours)**

Mechanical properties of materials, theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials Nanoparticles: gold and silver, metal oxides: silica, iron oxide and alumina - synthesis and properties.

**UNIT-IV: ELECTRICAL PROPERTIES: (15 Hours)**

Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials. Classification of magnetic phenomena. Semiconductor materials – classification-Ge, Si, GaAs, SiC, GaN, GaP, CdS, PbS. Identification of materials as p and n –type semiconductor-Hall effect - quantum and anomalous, Hall voltage - interpretation of charge carrier density. Applications of semiconductors:p-n junction as transistors and rectifiers, photovoltaic and photo galvanic cell.

**UNIT-V: CHARACTERIZATION AND ITS APPLICATIONS: (15 Hours)**

Nano thin films, nanocomposites. Application of nanoparticles in different fields. Core-shell nanoparticles - types, synthesis, and properties. Nanocomposites - metal-, ceramic- and polymer-matrix composites-applications. Characterization – SEM, TEM and AFM - principle, instrumentation and applications.

**TOTAL LECTURE HOURS: 75**

## COURSE OUTCOMES

Students will be able:

1. To explain methods of fabricating nanostructures.
2. To relate the unique properties of nanomaterials to reduce dimensionality of the material.
3. To describe tools for properties of nanostructures.
4. To discuss applications of nanomaterials.
5. To understand the health and safety related to nanomaterial.

## REFERENCE BOOKS

1. S.Mohan and V. Arjunan, Principles of Materials Science, MJ Publishers, 2016.
2. Arumugam, Materials Science, Anuradha Publications, 2007.
3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010
4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012.
5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6<sup>th</sup> ed., PEARSON Press, 2007.

## E RESOURCES:

1. <http://xrayweb.chem.ou.edu/notes/symmetry.html>.
2. <http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf>
3. [http://oms.bdu.ac.in/ec/admin/contents/1\\_p16che5b\\_2020051904031942.pdf](http://oms.bdu.ac.in/ec/admin/contents/1_p16che5b_2020051904031942.pdf)
4. <https://sal.nanofab.utah.edu/imagi`ng-applications/>
5. [https://www.nano.gov/sites/default/files/pub\\_resource/sensors\\_nsi\\_2012\\_07\\_09\\_final\\_for\\_web.pdf](https://www.nano.gov/sites/default/files/pub_resource/sensors_nsi_2012_07_09_final_for_web.pdf)

## MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3
CO2	2	3	3		3	2	3	3	3		3	3	3	3
CO3	3	3	2		3	3	3	2	3		3	3	3	3
CO4	2	3	3		3	2	3	3	3		3	3	3	3
CO5	2	3		3	3	2	3	2	3		3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**



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**SEMESTER: I – EC – I (B) Pharmaceutical Chemistry**

**Ins. Hrs. /Week:5**

**Course Credit: 3**

**Course code: P24CHE11B**

**UNIT-I: PHYSICAL PROPERTIES IN PHARMACEUTICALS: (15 Hours)**

Physical properties of drug molecule: physical properties. Refractive index- Definition, explanation, formula, importance, determination, specific & molar refraction. Optical activity\rotation- monochromatic & polychromatic light, optical activity, angle of rotation, specific rotation examples, measurement of optical activity. Dielectric constant & Induced Polarization- Dielectric constant explanation & determination. Rheology of pharmaceutical systems: Introduction, Definition, Applications, concept of viscosity, Newton's law of flow, Kinematic, Relative, Specific, Reduced & Intrinsic viscosity. Newtonian system, non- Newtonian system- Plastic flow, Pseudoplastic flow, Dilatent flow. Viscosity measurements- selection of viscometer for Newtonian and non-Newtonian system.

**UNIT-II: ISOTOPIC DILUTION ANALYSIS: (15 Hours)**

Principle and applications, Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning. Introduction to radiopharmaceuticals. Properties of various types of radiopharmaceuticals, Radiopharmaceuticals as diagnostics, as therapeutics, for research and sterilization. Physico Chemical Properties and drug action. Physico chemical properties of drugs (a) Partition coefficient, (b) solubility (c) surface activity, (d) degree of ionization.

**UNIT-III: DRUG DOSAGE AND PRODUCT DEVELOPMENT: (15 Hours)**

Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms. Drug dosage and product development. Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms.

**UNIT-IV: DEVELOPMENT OF NEW DRUGS: (15 Hours)**

Introduction, procedure followed in drug design, the research for lead compounds, molecular modification of lead compounds. Structure-Activity Relationship (SAR): Factors effecting bioactivity, resonance, inductive effect, isoterism, bioisosterism, spatial considerations, biological properties of simple functional groups, theories of drug activity, occupancy theory, rate theory, induced-fit theory, 4.3 Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions, the additivity of group contributions, physico-chemical parameters, lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator-variables.

## **UNIT-V: COMPUTERS IN PHARMACEUTICAL CHEMISTRY: (15 Hours)**

Need of computers for chemistry. Computers for Analytical Chemists- Introduction to computers: Organization of computers, CPU, Computer memory, I/O devices, information storage, software components. Application of computers in chemistry: Programming in high level language (C+) to handle various numerical methods in chemistry – least square fit, solution to simultaneous equations, interpolation, extrapolation, data smoothing, numerical differentiation and integrations.

**TOTAL LECTURE HOURS :75**

### **COURSE OUTCOMES :**

Students will be able:

1. To identify the suitable drugs for various diseases.
2. To apply the principles of various drug action and drug design.
3. To acquire the knowledge on product development based on SAR.
4. To apply the knowledge on applications of computers in chemistry.
5. To synthesize new drugs after understanding the concepts SAR.

### **REFERENCE BOOKS:**

1. Physical Chemistry- Bahl and Tuli.
2. Text Book of Physical Pharmaceutics, II<sup>nd</sup> edition, Vallabh Prakashan-. C.V.S. Subramanyam.
3. Medicinal Chemistry (Organic Pharmaceutical Chemistry), G.RChatwal, Himalaya Publishing house.
4. Instrumental method of Analysis: Hubert H, Willard, 7<sup>th</sup> edition.
5. Textbook of Pharmaceutical Chemistry by, Jayshree Ghosh, S. Chand & company Ltd. Pharmaceutical Chemistry by Dr. S.Lakshmi, Sultan chand & Sons.
6. Computers in chemistry, K.V. Raman, Tata Mc.Graw-Hill, 1993.
7. Computers for Chemists, S.K Pundir, Anshu bansal, A pragate prakashan., 2<sup>nd</sup> edition, New age international (P) limited, New Delhi.
8. Physical Pharmacy and Pharmaceutical Sciences by Martins, Patrick J. Sinko, Lippincott. William and Wilkins.
9. Cooper and Gunn's Tutorial Pharmacy ,6<sup>th</sup> edition by S.J. Carter, CBS Publisher Ltd.
10. Ansel's pharmaceutical Dosage forms and Drug Delivery System by Allen Popvich and Ansel, Indian edition-B.I. Publication Pvt. Ltd.

### **E RESOURCES:**

1. <https://www.nptel.ac.in/content/storage2/courses/104101005/downloads/lecturenotes/cha%20pter%208.pdf>
2. <https://www.eolss.net/sample-chapters/c09/e4-11-02-03.pdf>
3. <https://www.scribd.com/document/366774039/pulp-and-paper-industry-pdf>
4. <https://www.vanbaerle.com/en/silicates/markets-applications/industry>
5. <https://www.apdaparkinson.org>

## MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3		3	3	2	3	3	3	3
CO2	2	3	3	3	3	2		3	3	3	3	3	3	3
CO3	3	3	2	3	3	3		2	3	3	3	3	3	3
CO4	2	3	3	3	3	2		3	3	3	3	3	3	3
CO5	2	3	2	3	3	2		2	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**

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**DEPARTMENT OF CHEMISTRY**

**M.Sc., CHEMISTRY**

**Semester: I - EC- I(C): Analytical Chemistry**

**Ins. Hrs. /Week: 5**

**Course Credit: 3**

**Course Code:P24CHE11C**

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**UNIT -I: INSTRUMENTAL METHODS OF ANALYSIS (15 Hours)**

Principles and applications of extended X-ray absorption fine structure (EXAFS) – surface extended X-ray absorption (SEXAFS) – atomic absorption spectroscopy (AAS) – flame emission spectroscopy (FES) – turbidimetry – theory and applications.

**UNIT -II: DATA AND ERROR ANALYSIS (15 Hours)**

Various types of error – accuracy, precision, significant figures – frequency distributions, the binomial distribution, the Poisson distribution and normal distribution – mean, variance, standard deviation, Hypothesis testing, levels of confidence and significance, – testing variances, means t-Test, paired t-Test – analysis of variance – analysis of variance (ANOVA) – correlation and regression. Curve fitting, fitting of linear equations.

**UNIT -III: CHROMATOGRAPHY (15 Hours)**

Solvent extraction – principles of ion exchange, paper, thin-layer and column chromatography techniques – columns, adsorbents, methods, R<sub>f</sub> values, McReynold's constants and their uses – HPTLC, HPLC techniques – adsorbents, columns, detection methods, estimations, preparative column – GC-MS techniques – methods, principles and uses. Recent trends in chromatography.

**UNIT- IV: THERMO ANALYTICAL METHODS AND FLUORESCENCE SPECTROSCOPY (15 Hours)**

Principles – instrumentations and applications of thermogravimetry analysis (TGA), Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC) – thermometric titrations – types – advantages. Basic aspects of synchronous fluorescence spectroscopy – spectral hole burning – flow cytometry – fluorometers (quantization) – instrumentation – applications.

**UNIT - V: ELECTROANALYTICAL TECHNIQUE (15Hours)**

Electrochemical sensors, ion-sensitive electrodes, glass – membrane electrodes, solid-liquid membrane electrodes – ion-selective field effect transistors (ISFETs) – sensors for the analysis of gases in solution. Polarography – principles and instrumentation – dropping mercury electrode – advantages – Ilkovic equation – applications of polarography – polarographic maxima – oscillographic polarography, AC polarography – amperometric titrations: principles – techniques – applications – estimation of lead.

**Total Lecture Hours :75**

## COURSE OUTCOME

The student will be able to

1. Understand the principles, instrumentation and applications of various instruments.
2. Relate the statistical tools behind analytical chemistry.
3. Explain the principles, instrumentation and applications of chromatographic techniques.
4. Describe the principles, instrumentation and applications of thermo analytical techniques.
5. Apply the principles, instrumentation and applications of electroanalytical techniques.

## TEXT BOOK(S)

1. Banwell. C.N , McCash .E.M 1994. Fundamentals of Molecular Spectroscopy; 4th Ed., Tata McGraw-Hill, New Delhi.
2. Braithwaite ,A, Smith .J.F 1995. Chromatographic Methods, 5th Ed., Springer, Germany.
3. Gary . D ,Christian 2013. Analytical Chemistry, John Wiley & Sons, 7th edition.
4. Gupta. S.C 2018. Fundamentals of Statistics, 6th Ed., Himalaya Publications, Delhi,
5. Harris. D.C 1995. Quantitative Chemical Analysis, 4th Ed., W. H. Freeman Publications, New York.
6. Hibbert, D. Band Gooding . J.J 2006. Data Analysis for Chemistry, Oxford University Press, UK.
7. Sharma. A, Schulman. S.G , 1999. Introduction to Fluorescence Spectroscopy, Wiley Inter Science, New York.
8. Sivasankar. B, 2012. Instrumental methods of analysis, Oxford University Press.
9. Srivastava. V.K and Srivastava .K.K 1985. Introduction to Chromatography, 2<sup>nd</sup>, Ed., Holden Day, New York.
10. Topping . J, 1984. Errors of Observation and Their Treatment, 4th Ed., Chapman Hall, London.
11. Vogel . A.I. 2000 .Text Book of Quantitative Inorganic Analysis, 6th Ed., Longman, New Delhi.
12. Willard. H.H, Merritt. L.L , Dean. J.A and Settle. F.A , 1986. Instrumental Methods of Analysis, 6<sup>th</sup> Ed., CBS Publishers and Distributors, Chennai.

## REFERENCE BOOK(S)

1. Gopalan ,R .2004. Elements of Analytical Chemistry, 3rd edition, Sultan Chand and Co, New Delhi.
2. Heftmann. E .2004. Chromatography, Volume 69A, 6<sup>th</sup> edition, Elsevier.
3. [Sergey .V. yazovkin , Nobuyoshi Koga Christoph Schick](#) 2018, Handbook of Thermal Analysis and Calorimetry, v.6, Recent Advances, Techniques and Applications, Elsevier.
4. Skoog. D.A, West. D.M and Holler. D.J 2004. Fundamentals of Analytical Chemistry, 7th Ed., Harcourt College Publishers, Singapore.
5. Valcarcel Cases Miguel LópezLorente Àngela I López Jiménez M Àngeles Foundations of Analytical Chemistry, A Teaching–Learning Approach, Springer. DOI 10.1007/978-3-642-57157-2

## E- RESOURCES

1. <https://pubs.acs.org/doi/10.1021/ac60112a013>
2. [https://web.pa.msu.edu/courses/2014summer/phy451/lectures/lecture\\_data\\_err\\_or\\_analysis.pdf](https://web.pa.msu.edu/courses/2014summer/phy451/lectures/lecture_data_err_or_analysis.pdf)
3. <https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod5.pdf>
4. <https://www.currenta.com/analytics/methods/thermoanalytical-methods.html>
5. <http://www.umich.edu/~chem241/lecture13final.pdf>

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### MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	3	2	3	3	3	3	2	3	3	3	3
CO2	2		3	3	3		3	3	3	3	3	3	3	3
CO3	3		2	3	3		3	2	3	3	3	3	3	3
CO4	2		3	3	3		3	3	3	3	3	3	3	3
CO5	2		2	3	3	2	3	2	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**

SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE  
(AUTONOMOUS)



**SUNDARAKKOTTAI, MANNARGUDI- 614016**  
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**DEPARTMENT OF CHEMISTRY**  
**M.Sc., CHEMISTRY**

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**SEMESTER: I - EC—II (A) : Molecular Spectroscopy**

**Ins. Hrs./Week: 5**

**Course Credit: 3**

**Course Code: P24CHE12A**

**UNIT-I: ROTATIONAL AND RAMAN SPECTROSCOPY: (15 Hours)**

Rotational spectra of diatomic and polyatomic molecules. Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators. Classical theory of the Raman effect, polarizability as a tensor, polarizability ellipsoids, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines. Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches, Polarization of Raman scattered photons.

**UNIT-II: VIBRATIONAL SPECTROSCOPY: (15 Hours)**

Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution. Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born- Oppenheimer approximation. Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies. Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules.

**UNIT-III: ELECTRONIC SPECTROSCOPY: (15 Hours)**

Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation and predissociation spectra.  $\pi \rightarrow \pi^*$ ,  $n \rightarrow \pi^*$  transitions and their selection rules. Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, X-ray photoelectron spectroscopy (XPS). Lasers: Laser action, population inversion, properties of laser radiation, examples of simple laser systems.

**UNIT-IV: NMR SPECTROSCOPY: (15 Hours)**

Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding. Spin systems: First order and second order coupling of AB systems, Simplification of complex spectra. Spin-spin interactions: Homonuclear coupling interactions - AX, AX<sub>2</sub>, AB types. Vicinal, germinal and long-range coupling-spin decoupling. Nuclear Overhauser effect (NOE), Factors influencing coupling constants and Relative intensities. <sup>13</sup>C NMR and structural correlations, Satellites. Brief

**UNIT-V: MASS SPECTROMETRY AND EPR SPECTROSCOPY: ( 15 Hours)**

Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI), isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution. Effect of isotopes on the appearance of mass spectrum. EPR spectra of anisotropic systems - anisotropy in g- value, causes of anisotropy, anisotropy in hyperfine coupling, hyperfine splitting caused by quadrupole nuclei. Zero-field splitting (ZFS) and Kramer's degeneracy. Applications of EPR to organic and inorganic systems. Structural elucidation of organic compounds by combined spectral techniques. Principle of Mossbauer spectroscopy: Doppler shift, recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications.

**.TOTAL LECTURE HOURS: 75**

**COURSE OUTCOMES**

Students will be able:

1. To understand the importance of rotational and Raman spectroscopy.
2. To apply the vibrational spectroscopic techniques to diatomic and polyatomic molecules.
3. To evaluate different electronic spectra of simple molecules using electronic spectroscopy.
4. To outline the NMR, <sup>13</sup>C NMR, 2D NMR – COSY, NOESY, Introduction to <sup>31</sup>P, <sup>19</sup>F NMR and ESR spectroscopic techniques.
5. To develop the knowledge on principle, instrumentation and structural elucidation of simple molecules using Mass Spectrometry, EPR and Mossbauer Spectroscopy techniques.

**REFERENCE BOOKS:**

1. C. N. Banwell and E. M. McCash, *Fundamentals of Molecular Spectroscopy*, 4<sup>th</sup> Ed., Tata McGraw Hill, New Delhi, 2000.
2. R. M. Silverstein and F. X. Webster, *Spectroscopic Identification of Organic Compounds*, 6<sup>th</sup> Ed., John Wiley & Sons, New York, 2003
3. W. Kemp, *Applications of Spectroscopy*, English Language Book Society, 1987.
4. D. H. Williams and I. Fleming, *Spectroscopic Methods in Organic Chemistry*, 4<sup>th</sup> Ed., Tata McGraw-Hill Publishing Company, New Delhi, 1988.
5. R. S. Drago, *Physical Methods in Chemistry*; Saunders: Philadelphia, 1992.
6. P.W. Atkins and J. de Paula, *Physical Chemistry*, 7<sup>th</sup> Ed., Oxford University Press, Oxford, 2002.
7. N. Levine, *Molecular Spectroscopy*, John Wiley & Sons, New York, 1974.  
Rahman, *Nuclear Magnetic Resonance-Basic Principles*, Springer-Verlag, New York, 1986.
8. K. Nakamoto, *Infrared and Raman Spectra of Inorganic and coordination Compounds*, Part B: 5<sup>th</sup> ed., John Wiley & Sons Inc., New York, 1997.
9. J. A. Weil, J. R. Bolton and J. E. Wertz, *Electron Paramagnetic Resonance*; Wiley Interscience, 1994.



**E RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc20\\_cy08/preview](https://onlinecourses.nptel.ac.in/noc20_cy08/preview)
2. <https://www.digimat.in/nptel/courses/video/104106122/L14.html>
3. <https://courses.lumenlearning.com/suny-mcc-organicchemistry/chapter/the-general-mechanism-for-electrophilic-aromatic-substitution-reactions/>
4. [https://www.academia.edu/38161284/natural\\_product\\_total\\_synthesis](https://www.academia.edu/38161284/natural_product_total_synthesis)

**MAPPING WITH PROGRAM OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3
CO2	2		3	3	3	2		3	3	3	3	3	3	3
CO3	3		2	3	3	3		2	3	3	3	3	3	3
CO4	2		3	3	3	2		3	3	3	3	3	3	3
CO5	2		2	3	3	2		2	3	3	3	3	3	3

**Strong - 3****Medium-2****Low-1**

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SEMESTER: I – EC-II (B) - Electrochemistry

Ins. Hrs. /Week: 5

Course Credit: 3

Course code: P24CHE12B

(15 Hours)

**UNIT-I: IONICS:**

Arrhenius theory -limitations, van't Hoff factor and its relation to colligative properties. Deviation from ideal behavior. Ionic activity, mean ionic activity and mean ionic activity coefficient-concept of ionic strength, Debye Huckel theory of strong electrolytes, activity coefficient of strong electrolytes Determination of activity coefficient ionsolvent and ion-ion interactions. Born equation. Debye-Huckel Bjerrummodel. Derivation of Debye-Huckel limiting law at appreciableconcentration of electrolytes modifications and applications. Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte- qualitative and quantitative verification and limitations. Evidence forionic atmosphere. Ion association and triple ion formations.

**UNIT-II: ELECTRODE-ELECTROLYTE INTERFACE:**

(15 Hours)

Interfacial phenomena - Evidences for electrical double layer, polarizable and non-polarizable interfaces, Electrocapillary phenomena - Lippmann equation electrocapillary curves. Electro-kinetic phenomena electro-osmosis, electrophoresis, streaming and sedimentation potentials, colloidal and poly electrolytes. Structure of double layer: Helmholtz -Perrin, Guoy- Chapman and Stern models of electrical double layer.Zeta potential andpotential at zero charge. Applications and limitations.

**UNIT-III: ELECTRODICS OF ELEMENTARY ELECTRODE REACTIONS: (15 Hours)**

Behavior of electrodes: Standard electrodes and electrodes at equilibrium. Anodicand Cathodic currents,condition for the discharge of ions. Nernst equation, polarizable and non-polarizable electrodes. Model ofthree electrode system, over potential. Rate of electro chemical reactions: Ratesof simple elementary reactions. Butler-Volmer equation-significance of exchange current density, net current density and symmetry factor. Low and high field approximations. symmetry factor and transfer coefficient Tafel equations and Tafel plots.

**UNIT-IV: ELECTRODICS OF MULTISTEP MULTI ELECTRON SYSTEM: (15 Hours)**

Rates of multi-step electrode reactions, Butler - Volmer equation for a multi-step reaction. Rate determining step, electrode polarization and depolarization. Transfer coefficients, its significance and determination,Stoichiometric number. Electro-chemical reaction mechanisms-rate expressions, order, and surface coverage. Reduction of  $I_3^-$ ,  $Fe^{2+}$ , and dissolution of Fe to  $Fe^{2+}$ . Overvoltage - Chemical and electro chemical, Phase, activation and concentration over potentials. Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan's diagrams.

## UNIT-V: CONCENTRATION POLARIZATION, BATTERIES AND FUEL CELLS: (15 Hours)

Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes. Polarography- principle and applications. Principle of square wave polarography. Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. Sodium and lithium-ion batteries and redox flow batteries. Mechanism of charge storage: conversion and alloying. Capacitors- mechanism of energy storage, charging at constant current and constant voltage. Energy production systems: Fuel Cells: classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells.

**TOTAL LECTURE HOURS : 75**

### COURSE OUTCOMES :

Students will be able:

1. To understand the behaviour of electrolytes in solution and compare the structures of electrical double layer of different models.
1. To predict the kinetics of electrode reactions applying Butler-Volmer and Tafel equations
2. To study different thermodynamic mechanism of corrosion,
3. To discuss the theories of electrolytes, electrical double layer, electrostatics and activity coefficient of electrolytes
4. To have knowledge on storage devices and electrochemical reaction mechanism.

### REFERENCE BOOKS:

1. J.O.M. Bockris and A.K.N. Reddy, Modern Electro chemistry, vol. 1 and 2B, Springer, Plenum Press, New York, 2008.
2. J.O.M. Bockris, A.K.N. Reddy and M.G. Aldeco Morden Electrochemistry, vol. 2A, Springer, Plenum Press, New York, 2008.
3. Philip H. Rieger, Electrochemistry, 2<sup>nd</sup> edition, Springer, New York, 2010.
4. L.I. Antropov, Theoretical electrochemistry, Mir Publishers, 1977.
5. K.L. Kapoor, A Text book of Physical chemistry, volume-3, Macmillan, 2001.
6. D. R. Crow, Principles and applications of electrochemistry, 4<sup>th</sup> edition, Chapman & Hall/CRC, 2014.
7. J. Rajaram and J.C. Kuriakose, Kinetics and Mechanism of chemical transformations Macmillan India Ltd., New Delhi, 2011.
8. S. Glasstone, Electro chemistry, Affiliated East-West Press, Pvt., Ltd., New Delhi, 2008.
9. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan, Electrochemistry-Principles and applications, S. Viswanathan Printers, Chennai, 2007.
10. Joseph Wang, Analytical Electrochemistry, 2<sup>nd</sup> edition, Wiley, 2004.

### E RESOURCES:

1. <https://www.chem.uci.edu/~lawm/ch%204%20solutions.pdf>
2. <http://careerendeavour.com/wp-content/uploads/2016/02/quantum-chemistry.pdf>
3. <https://learn.careers360.com/chemistry/chemical-kinetics-chapter/>
4. [http://www.rmki.kfki.hu/~vpet/advthd/adv\\_thermo\\_lnp1.pdf](http://www.rmki.kfki.hu/~vpet/advthd/adv_thermo_lnp1.pdf)
5. <https://www.pdfdrive.com/modern-electrochemistry-e34333229>.

## MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3
CO2	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	2	3	3	3	3	3	3
CO4	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO5	2	3	2	3	3	2	3	2	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**

# SENGAMALA THAYAR EDUCATIONAL TRUST WOMEN'S COLLEGE

(AUTONOMOUS)

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**DEPARTMENT OF CHEMISTRY**

**M.Sc., CHEMISTRY**



**Semester: I-EC- I(C): Catalysis**

**Ins. Hrs. /Week :5**

**Course Credit: 3**

**Course Code:P24CHE12C**

## **Unit -I: INTRODUCTION TO CATALYSIS :**

**(15 Hours)**

Activity, selectivity, promoters, stabilisers and poisons, Catalysts deactivation, Turn over number, inhibitors. Thermodynamic consideration in catalysis: Energy factor, significance of activation parameters and application to kinetic systems. Physical adsorption-Unimolecular adsorption- types of adsorption isotherms, Multimolecular adsorption-BET method, Harkins-Jura equation. Chemisorption of gases on metals and oxides

## **Unit - II :HOMOGENEOUS AND HETEROGENEOUS CATALYSIS:**

**(15 Hours)**

Acid-base catalytic reactions, protolytic and protropic mechanisms, activation energy of the processes, catalytic activity and acid-base strength, acidity functions: Hammett- Zuckertreatments, linear free energy relationships. Homogeneous catalysts for the polymerization of olefins, oxidative dehydrogenation, Ethylbenzene to styrene, Ziegler-Natta polymerization. Catalysts for the production of petrochemicals- production of aromatics, paraxylene, cumene, linear alkylbenzenes and methanol. Phase transfer catalysis – Rhodium water soluble catalyst systems with carboxylated and sulfonated phosphines for hydroformylation reactions.

## **Unit - III :PHOTOCATALYSIS AND ELECTROCATALYSIS :**

**(15 Hours)**

Thermal and photochemical reactions between  $H_2-Cl_2$  and  $H_2-Br_2$  and  $H_2- I_2$  reactions, fluorescence, phosphorescence and quenching-Stern-Volmer equation. Photocatalytic studies using non- stoichiometric oxides such as n-type and p-type semiconductors ( $TiO_2$ ,  $ZnO$ ,  $Cr_2O_3$ , doped and coupled semiconductors for the degradation of dyes) Solar energy conversion, electrochemical cells, photoelectrolysis of water and Photocatalytic reactions. Photocatalytic reduction of dinitrogen, photocatalysis for organic reactions oxidation, reduction, polymerization, substitution and isomerization reaction using  $TiO_2$ .

## **Unit -IV: BIOCATALYSIS: MECHANISM AND APPLICATION:**

**(15 Hours)**

Mechanisms: Covalent catalysis, acid-base and metal-ion catalysis, entropy and geometric effects, structural complementary of the active site to the transition state, prevention of the side reactions, the size of the enzymes Applications of enzymes in organic synthesis: Oxidoreductase: Oxidation - Alcohols, epoxides,

sulfoxides, amino acids, lactones, Oxidoreductase: Reduction- $\alpha$ -hydroxyamino acid, Transferase: Aminoacids, amines.

**Unit -V: TECHNIQUES IN CATALYSIS :**

**(15 Hours)**

Structural characterization-BET surface area method, pore volume, and pore size distribution -BJH method, t-plot method, XRD, SEM, TEM, AFM, STM, TPR and TPD. Special relevance to metal oxides with different structures .

**TOTAL LECTURE HOURS : 75**

**TEXT BOOKS**

1. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy, *Catalysis: Principles and Applications*, Narosa Publishing House, New Delhi, 2004
2. G.C. Bond, *Heterogeneous catalysis: Principles and applications*, Oxford University Press, Ely House, London W.I, 1974.
3. A.K. Chandra, "Introductory Quantum Chemistry", 4 th ed., Tata McGraw Hill (1994)
4. D.A. Mcquarrie, "Quantum Chemistry", University Science Books (1998)
5. F.L.Pillar."Elementary Quantum Chemistry", McGraw Hill (1968)
6. J.P.Lowe, "Quantum Chemistry", Academic Press (1978)

**REFERENCES**

1. V. Murugesan, A. Banumathi and M. Palanichamy, *Recent Trends in Catalysis*, Narosa Publishing House, New Delhi, 1999.
2. K.J. Laidler, *Chemical Kinetics*, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 1973.
3. D.K. Chakrabarty, *Adsorption and Catalysis by solids*, Wiley Eastern Limited, New Delhi, 1991.
4. J.M Thomas, W.J. Thomas, *Principles and practice of Heterogeneous Catalysis*, Wiley VCH, New York, 1996.

**E RESOURCES**

1. <https://www.bing.com/aclick>
2. <https://medical-dictionary.thefreedictionary.com/nutrient>
3. <https://nios.ac.in/media/documents/srsec321newe/321-e-lesson-8.pdf>
4. <http://www.eagri.org/eagri50/ambe101/pdf/lec23.pdf>
5. [http://ijsit.com/admin/ijsit\\_files/food%20adulteration\\_1.2.4.pdf](http://ijsit.com/admin/ijsit_files/food%20adulteration_1.2.4.pdf)

**MAPPING WITH PROGRAM OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3
CO2	2	3	3	3	3	2	3	3	3		3	3	3	3
CO3	3	3	2		3	3	3	2	3		3	3	3	3
CO4	2	3	3		3	2	3	3	3		3	3	3	3
CO5	2	3	2		3	2	3	2	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**



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**M.Sc., CHEMISTRY**

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**SEMESTER: I - NME—I : Cosmetic Chemistry**

**Ins. Hrs. /Week: 2**

**Course Credit: 2**

**Course Code:P24NMECH11**

**UNIT I : HISTORY OF COSMETICS: (6 Hours)**

History of cosmetics, classification of cosmetics, professional image of self grooming, beauty and wellness. Cosmetics emulsions: cream, cleansers, powders, moisturisers, sun screen, acne and anti aging creams. Chemical peels and peeling agents, lasers and light devices, Electro Chemistry, bath salts, gels, soaps, bubble baths and scrubs.

**UNIT II: REQUIREMENT AND CLASSIFICATION OF COSMETICS: (6 Hours)**

Cosmetics- introduction and classification. Face powder- requirements and ingredients of a face powder. Face cream- (cold and vanishing) - ingredients, formulation and uses. Lipstick- requirement of a lipstick and common ingredients of a lipstick. Mascara – requirements and Formulation.

**UNIT-III: PEARLS AND PEARL ESSENCE : (6 Hours)**

Definitions, commercial uses, production methods, synthetic pearly substances. Ion exchange resins and their cosmetic uses in case of purified water, Raw water, standards for water as per IP, BP, USP (with recent amendments).

**UNIT IV: SOLID FORMULATIONS AND SEMISOLID FORMULATIONS: (6 Hours)**

Solid formulations -Bulk powders, incorporation of different varieties of powders viz. dusting, compact, face and talcum. Incompatibility – physical and chemical Properties. Semisolid formulations - Ointments, paste, creams, jellies, sticks, selection of ideal bases, preparation and stability and packing.



## **UNIT-V: PACKAGING AND DISPENSING OF COSMETIC FORMULATIONS: (6 Hours)**

Importance of different materials for containers and closures. Packaging of cosmetic product and labeling. Environmental aspects of packaging materials, appropriate recycling and disposal. Green packaging. Hydrocolloids – definition classification, properties and significance in cosmetics.- Field Project.

**TOTAL LECTURE HOURS: 30**

### **COURSE OUTCOMES :**

#### **Students should be able to**

1. To know about the history of cosmetics.
2. To know the requirements and Classification of Cosmetics.
3. To understand the chemical aspects and applications of Pearl and Pearl Essence.
4. To understand chemical aspects and applications of Solid Formulation and Semisolid Formulations.
5. To understand the methods of packaging and dispensing of Cosmetic formulations. understand the hazards of cosmetic products.

### **REFERENCE BOOKS:**

1. Chemistry & Manufacture of Cosmetics by M. G. DeNavarre.
2. Text Book of Cosmeticology – by Harry's.
3. Wilkinson J B E and Moore R J, (1997) Harry's cosmeticology, 7<sup>th</sup> ed., Chemical Publishers, London.
4. George Howard, (1987) Principles and practice of perfumes and cosmetics.
5. Thankamma Jacob, (1997) Foods, drugs and cosmetics – A consumer guide, Macmillan publication, London.

### **E RESOURCES:**

1. <http://www.khake.com/page75.html>
2. [Net.foxsm/list/284](http://Net.foxsm/list/284)
3. <https://www.ncbi.nlm.nih.gov/books/NBK482447/>
4. <https://training.seer.cancer.gov/treatment/chemotherapy/types.html>
5. [http://oms.bdu.ac.in/ec/admin/contents/1\\_p16che5b\\_2020051904031942.pdf](http://oms.bdu.ac.in/ec/admin/contents/1_p16che5b_2020051904031942.pdf)

**MAPPING WITH PROGRAM OUTCOMES**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>
<b>CO1</b>	3	3	3	3	2	3	3	3	3	2	3	3	3	3
<b>CO2</b>	2	3	3	3	3	2	3	3	3	3	3	3	3	3
<b>CO3</b>	3	3	2	3	3	3	3	2	3	3	3	3	3	3
<b>CO4</b>	2	3	3	3	3	2	3	3	3	3	3	3	3	3
<b>CO5</b>	2	3	2	3	3	2	3	2	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**

**SEMESTER- II**



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**SEMESTER: II – CC3:- Organic Reaction Mechanism – II**

**Ins. Hrs. /Week: 6**

**Course Credit: 5**

**Course code: P24CH204**

**UNIT-I: ELIMINATION AND FREE RADICAL REACTIONS: (18 Hours)**

Mechanisms: E2, E1, and E1cB mechanisms. Syn- and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules. Reactivity: Effect of substrate, attacking bases, leaving group and medium. Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination. Long lived and short-lived radicals – Production of radicals by thermal and photochemical reactions, Detection and stability of radicals, characteristics of free radical reactions and free radical, reactions of radicals; polymerization, addition, halogenations, aromatic substitutions, rearrangements. Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.

**UNIT-II: OXIDATION AND REDUCTION REACTIONS: (18 Hours)**

Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition- elimination, oxidative and reductive coupling reactions. Mechanism of oxidation reactions: Dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate lead tetraacetate, permanganate, manganesedioxide, osmium tetroxide, oxidation of saturated hydrocarbons, alkyl groups, alcohols, halides and amines. Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allylic oxidation, oxidation by chromium trioxide-pyridine, DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation, dimethyl sulphoxide- dicyclohexyl carbodiimide (DMSO-DCCD). Mechanism of reduction reactions: Wolff- Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyltin hydrides, McFadyen-Steven's reduction, Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault-Blanc reduction.

**UNIT-III: REARRANGEMENTS: (18 Hours)**

Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements - applications and stereochemistry, Wagner-Meerwein, Demjanov, Dienone-phenol, Baker- Venkataraman, Benzilic acid and Wolff rearrangements. Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann and abnormal Beckmann rearrangements. Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements. Rearrangements to electron rich atom: Favorskii, Quasi-Favorskii, Stevens, [1,2]-Wittig and [2,3]-Wittig rearrangements. Fries and Photo Fries rearrangement. Intramolecular rearrangements – Claisen, abnormal Claisen, Cope, oxy-Cope Benzidine rearrangements.

**UNIT-IV: ADDITION TO CARBON MULTIPLE BONDS: (18 Hours)**

Mechanisms: (a) Addition to carbon-carbon multiple bonds- Addition reactions involving electrophile, nucleophiles, free radicals, carbenes and cyclic mechanisms-Orientation and reactivity

, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen; (b) Addition to carbon- hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction, Prins reaction. Stereochemical aspects of addition reactions. Addition to Carbon-Hetero atom Multiple bonds: Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates – Stobber reactions. Hydrolysis of esters and amides, ammonolysis of esters.

**UNIT-V: REAGENTS AND MODERN SYNTHETIC REACTIONS: (18 Hours)**

Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride (NaBH<sub>3</sub>CN), *meta*-Chloroperbenzoic acid (m-CPBA), Dimethyl aminopyridine (DMAP), n-Bu<sub>3</sub>SnD, Triethylamine (TEA), Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), *N*-bromosuccinimide (NBS), Trifluoroacetic acid (TFA), Tetramethyl piperidin-1-oxyl (TEMPO), Phenyltrimethylammonium tribromide (PTAB). Diazomethane and Zn-Cu, Diethyl maleate (DEM), Copper diacetylacetonate (Cu(acac)<sub>2</sub>), TiCl<sub>3</sub>, NaIO<sub>4</sub>, Pyridinium chlorochromate (PCC), Pyridinium dichromate (PDC), Meisenheimer complex. Suzuki coupling, Heck reaction, Negishi reaction, Baylis-Hillman reaction.

**TOTAL LECTURE HOURS: 90**

**COURSE OUTCOMES :**

Students will be able:

1. To recall the basic principles of aromaticity of organic and heterocyclic compounds.
2. To understand the mechanism of various types of organic reactions.
3. To predict the suitable reagents for the conversion of selective organic compounds.
4. To correlate the principles of substitution, elimination, and addition reactions.
5. : To design new routes to synthesis organic compounds.

**REFERENCE BOOKS:**

1. J. March and M. Smith, *Advanced Organic Chemistry*, 5<sup>th</sup> ed., John-Wiley and Sons, 2001.
2. E. S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc., 1959.
3. P. S. Kalsi, *Stereochemistry of carbon compounds*, 8<sup>th</sup> edn, New Age International Publishers, 2015.
4. P. Y. Bruice, *Organic Chemistry*, 7<sup>th</sup> edn., Prentice Hall, 2013.
5. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee *Organic Chemistry*, 7<sup>th</sup> edn., Pearson Education, 2010.
6. S.H. Pine, *Organic Chemistry*, 5<sup>th</sup> edn, McGraw Hill International Edition, 1987.
7. L. F. Fieser and M. Fieser, *Organic Chemistry*, Asia Publishing House, Bombay, 2000.
8. E.S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc., 1959.
9. T. L. Gilchrist, *Heterocyclic Chemistry*, Longman Press, 1989.
10. J. A. Joule and K. Mills, *Heterocyclic Chemistry*, 4<sup>th</sup> ed., John-Wiley, 2010.

## E RESOURCES:

1. [http://www1.udel.edu/chem/mpwatson/mpwatson/chem\\_633\\_files/pericyclic\\_reactions\\_handout%20for%20lecture.pdf](http://www1.udel.edu/chem/mpwatson/mpwatson/chem_633_files/pericyclic_reactions_handout%20for%20lecture.pdf)
2. <http://www.eolss.net/sample-chapters/c06/e6-101-10-00.pdf>
3. <https://onlinelibrary.wiley.com/doi/pdf/10.1002/9780470084960.ch15>
4. [https://preparatorychemistry.com/bishop\\_book\\_6\\_ebook.pdf](https://preparatorychemistry.com/bishop_book_6_ebook.pdf)
5. <https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic>  
<https://www.organic-chemistry.org/>

## MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3		2	3	3	3	3		3	3	3	3
CO2	2	3	3		3	2	3	3	3		3	3	3	3
CO3	3	3	2		3	3	3	2	3		3	3	3	3
CO4	2	3	3		3	2	3	3	3		3	3	3	3
CO5	2	3	2		3	2	3	2	3		3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**



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**SEMESTER: II – CC4-: Physical Chemistry-I**

**Ins. Hrs. /Week: 6**

**Course Credit: 5**

**Course code: P24CH205**

**UNIT-I: CLASSICAL THERMODYNAMICS:**

**(18 Hours)**

Partial molar properties - Chemical potential, Gibb's- Duhem equation-binary and ternary systems. Determination of partial molar quantities. Thermodynamics of real gases - Fugacity-determination of fugacity by graphical and equation of state methods-dependence of temperature, pressure and composition. Thermodynamics of ideal and non-ideal binary mixtures, Duhem - Margulus equation applications of ideal and non-ideal mixtures, Activity and activity coefficients-standard states - determination-vapour pressure, EMF and freezing point methods.

**UNIT-II: STATISTICAL THERMODYNAMICS:**

**(18 Hours)**

Introduction of statistical thermodynamics concepts of thermodynamic and mathematical probabilities- distribution of distinguishable and non-distinguishable particles. Assemblies, ensembles, canonical particles. Maxwell -Boltzmann, Fermi Dirac & Bose-Einstein Statistics- comparison and applications. Partition functions-evaluation of translational, vibrational and rotational partition functions for monoatomic, diatomic and polyatomic ideal gases. Thermodynamic functions in terms of partition functions-calculation of equilibrium constants. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function residual entropy, equilibrium constants and equipartition principle. Heat capacity of mono and di atomic gases-ortho and para hydrogen. Heat capacity of solids- Einstein and Debye models.

**UNIT-III: IRREVERSIBLE THERMODYNAMICS:**

**(18 Hours)**

Theories of conservation of mass and energy entropy production in open systems by heat, matter and current flow, force and flux concepts. Onsager theory-validity and verification- Onsager reciprocal relationships. Electro kinetic and thermomechanical effects-Application of irreversible thermodynamics to biological systems.

**UNIT-IV: KINETICS OF REACTIONS:**

**(18 Hours)**

Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions -Lindeman and Christiansen hypothesis- molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces. Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules, time and true order-kinetic parameter evaluation. Factors determine the reaction rates in solution - primary salt effect and secondary salt effect, Homogeneous catalysis-acid- base catalysis- mechanism of acid base catalyzed reactions- Bronsted catalysis law, enzyme catalysis-Michelis-Mento catalysis.

## UNIT-V: KINETICS OF COMPLEX AND FAST REACTIONS: (18 Hours)

Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions. Chain reactions-chain length, kinetics of  $H_2 - Cl_2$  &  $H_2 - Br_2$  reactions (Thermal and Photochemical reactions) - Rice Herzfeld mechanism. Study of fast reactions-relaxation methods-temperature and pressure jump methods electric and magnetic field jump methods - stopped flow flash photolysis methods and pulse radiolysis. Kinetics of polymerization-free radical, cationic, anionic polymerization - Polycondensation.

**TOTAL LECTURE HOURS : 90**

### COURSE OUTCOMES :

Students will be able:

1. To explain the classical and statistical concepts of thermodynamics.
2. To compare and correlate the thermodynamic concepts to study the kinetics of chemical reactions.
3. To discuss the various thermodynamic and kinetic determination.
4. To evaluate the thermodynamic methods for real gases and mixtures.
5. To compare the theories of reaction rates and fast reactions.

### REFERENCE BOOKS:

1. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, 2nd edition, S.L.N. Chand and Co., Jalandhar, 1986.
2. I.M. Klotz and R.M. Rosenberg, Chemical thermodynamics, 6th edition, W.A. Benjamin Publishers, California, 1972.
3. M.C. Gupta, Statistical Thermodynamics, New Age International, Pvt. Ltd., New Delhi, 1995.
4. K.J. Laidler, Chemical Kinetics, 3rd edition, Pearson, Reprint -2013.
5. J. Rajaram and J.C. Kuriacose, Kinetics and Mechanisms of chemical transformation, Macmillan India Ltd, Reprint - 2011.
6. D.A. McQuarrie and J.D. Simon, Physical Chemistry - A Molecular Approach, Viva Books Pvt. Ltd., New Delhi, 1999.
7. R.P. Rastogi and R.R. Misra, Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi, 1990.
8. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Publishers, New York, 1974
9. K.B. Ytsimirski, "Kinetic Methods of Analysis", Pergamon Press, 1996.
10. Gurdeep Raj, Phase rule, Goel Publishing House, 2011.

### E RESOURCES:

1. <https://nptel.ac.in/courses/104/103/104103112/>
2. <https://bit.ly/3tL3GdN>
3. <https://chem.yonsei.ac.kr/chem/upload/che3103-01/119665541089910.pdf>
4. <http://www.educacio.novaciudadania.bcn.cat/cgi-bin/download.php>
5. <https://www.chemicalsafetytacts.org>



### MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3		3	3	3	3	2	3	3	3	3
CO2	2	3	3	3		2	3	3	3	3	3	3	3	3
CO3		3	2	3			3	2	3	3	3	3	3	3
CO4		3	3	3	3	2	3	3	3	3	3	3	3	3
CO5		3	2	3	3	2	3	2	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**



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**SEMESTER: II – CP-II-: Inorganic Chemistry Practical**

**Ins. Hrs. /Week: 6**

**Course Credit: 3**

**Course code: P24CH206P**

**UNIT-I: ANALYSIS OF MIXTURE OF CATIONS: (30 Hours)**

Analysis of a mixture of four cations containing two common cations and two rare cations.

Cations to be tested.

Group-I : W, Tl and Pb.

Group-II : Se, Te, Mo, Cu, Bi and Cd.

Group-III : Tl, Ce, Th, Zr, V, Cr, Fe, Ti and U.

Group-IV : Zn, Ni, Co and Mn.

Group-V : Ca, Ba and Sr.

Group-VI : Li and Mg.

**UNIT-II: Preparation of metal complexes: (30 Hours)**

Preparation of inorganic complexes:

1. Preparation of trithioureacopper(I) sulphate
2. Preparation of potassium trioxalate chromate(III)
3. Preparation of tetramminecopper(II) sulphate
4. Preparation of Reineck's salt
5. Preparation of hexathioureacopper(I) chloridedihydrate
6. Preparation of *cis*-Potassium tri oxalate diaquachromate(III)
7. Preparation of sodium trioxalato ferrate(III)
8. Preparation of hexathiourealead(II) nitrate.

**UNIT-III: Complexometric Titration: (30 Hours)**

1. Estimation of zinc, nickel, magnesium, and calcium.
2. Estimation of mixture of metal ions-pH control, masking and demasking agents.
3. Determination of calcium and lead in a mixture (pH control).
4. Determination of manganese in the presence of iron.
5. Determination of nickel in the presence of iron.

**TOTAL PRACTICAL HOURS - 90**

## COURSE OUTCOMES :

Students will be able:

1. To identify the anions and cations present in a mixture of salts.
2. To apply the principles of semi micro qualitative analysis to categorize acid radicals and basic radicals.
3. To acquire the qualitative analytical skills by selecting suitable confirmatory tests and spot tests.
4. To choose the appropriate chemical reagents for the detection of anions and cations.
5. To synthesize coordination compounds in good quality.

## REFERENCE BOOKS:

1. JeyaRajendran, *Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis*, United global publishers, 2021.
2. V. V. Ramanujam, *Inorganic Semimicro Qualitative Analysis*; 3rd ed., The National Publishing Company, Chennai, 1974.
3. *Vogel's Text book of Inorganic Qualitative Analysis*, 4th ed., ELBS, London.
4. G. Pass, and H. Sutcliffe, *Practical Inorganic Chemistry*; Chapman Hall, 1965.
5. W. G. Palmer, *Experimental Inorganic Chemistry*; Cambridge University Press, 1954.

## E RESOURCES:

1. [https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video\\_galleries/lecture-videos/](https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/)
2. [http://vpultz.sites.truman.edu/files/2016/05/inorganicqualitativeanalysis\\_2016.pdf +A6 01](http://vpultz.sites.truman.edu/files/2016/05/inorganicqualitativeanalysis_2016.pdf+A601)
3. <https://assets.thermofisher.com/tfs-assets/cmd/manuals/pi-d10493-da-ph-colorimetric-pid10493-en.pdf>
4. [https://www.academia.edu/2112381/colorimetric\\_analysis](https://www.academia.edu/2112381/colorimetric_analysis)
5. [http://staff.uny.ac.id/sites/default/files/inorganic\\_2\\_labwork\\_manual.pdf](http://staff.uny.ac.id/sites/default/files/inorganic_2_labwork_manual.pdf)

## MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3
CO2	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	2	3	3	3	3	3	3
CO4	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO5	2	3	2	3	3	2	3	2	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**



**SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE**

(AUTONOMOUS)

**SUNDARAKKOTTAI, MANNARGUDI- 614016**

*(For the Candidates admitted in the academic year 2024-2025)*

**DEPARTMENT OF CHEMISTRY**

**M.Sc., CHEMISTRY**

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**SEMESTER: II – EC-III-(A)-: Green Chemistry**

**Ins. Hrs. /Week: 5**

**Course Credit: 3**

**Course code: P24CHE23A**

**UNIT-I: INTRODUCTION:**

**(15 Hours)**

Introduction- Need for Green Chemistry. Goals of Green Chemistry. Limitations/ of Green Chemistry. Chemical accidents, terminologies, Internationall green chemistry organizations and Twelve principles of Green Chemistry with examples.

**UNIT-II: STARTING MATERIALS:**

**(15 Hours)**

Choice of starting materials, reagents, catalysts and solvents in detail, Green chemistry in day today life. Designing green synthesis- green reagents: dimethyl carbonate. Green solvents: Water, Ionic liquids- criteria, general methods of preparation, effect on organic reaction. Supercritical carbon dioxide- properties, advantages, drawbacks and a few examples of organic reactions in CO<sub>2</sub>. Green synthesis- adipic acid and catechol.

**UNIT-III: ENVIRONMENTAL POLLUTION:**

**(15 Hours)**

Environmental pollution, Green Catalysis- Acid catalysts, Oxidation catalysts, Basic catalysts, Polymer supported catalysts- Poly styrene aluminum chloride, polymeric super acid catalysts, Poly supported photosensitizers.

**UNIT-IV: PHASE TRANSFER CATALYSIS IN GREEN SYNTHESIS:**

**(15 Hours)**

Phase transfer catalysis in green synthesis- oxidation using hydrogen peroxide, crown ethers- esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction. Applications in organic synthesis.

**UNIT-V: MICROWAVE INDUCED GREEN SYNTHESIS:**

**(15 Hours)**

Microwave induced green synthesis- Introduction, Instrumentation, Principle and applications. Sonochemistry - Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and Applications.

**TOTAL LECTURE HOURS : 75**

**COURSE OUTCOMES :**

Students will be able:

1. To recall the basic chemical techniques used in conventional industrial preparations and in green innovations.
2. To understand the various techniques used in chemical industries and in laboratory.
3. To compare the advantages of organic reactions assisted by renewable energy sources and non-renewable energy sources.

- To apply the principles of PTC, ionic liquid, microwave and ultrasonic assisted organic synthesis.
- To design and synthesize new organic compounds by green methods.

#### REFERENCE BOOKS:

- Ahluwalia, V.K. and Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005.
- W. L. McCabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, 7<sup>th</sup> edition, McGraw-Hill, New Delhi, 2005.
- J. M. Swan and D. St. C. Black, Organometallics in Organic Synthesis, Chapman Hall, 1974.
- V. K. Ahluwalia and R. Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, New Delhi, 2001.
- A. K. De, Environmental Chemistry, New Age Publications, 2017.

#### E RESOURCES:

- <https://www.organic-chemistry.org/>
- <https://www.studyorgo.com/summary.php>
- <https://soe.unipune.ac.in/studymaterial/ashwiniwadegaonkaronline/mixturechartfinalwatermark.pdf>
- <https://www.slideshare.net/drssreenivasa/msc-laboratory-manual-organic-chemistry-binary-mixture-separations>
- <https://soe.unipune.ac.in/studymaterial/ashwiniwadegaonkaronline/mixturechartfinalwatermark.pdf>

#### MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3
CO2	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	2	3	3	3	3	3	3
CO4	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO5	2	3	2	3	3	2	3	2	3	3	3	3	3	3

Strong - 3

Medium-2

Low-1

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**SEMESTER: II - EC-III (B) : Medicinal Chemistry**

**Ins. Hrs. /Week: 5**

**Course Credit: 3**

**Course code: P24CHE23B**

**UNIT-I: INTRODUCTION TO RECEPTORS:**

**(15 Hours)**

Introduction, targets, Agonist, antagonist, partial agonist. Receptors, Receptor types, Theories of Drug-receptor interaction, Drug synergism, Drug resistance, physicochemical factors influencing drug action.

**UNIT-II: ANTIBIOTICS:**

**(15 Hours)**

Introduction, Targets of antibiotics action, classification of antibiotics, enzyme-based mechanism of action, SAR of penicillins and tetracyclins, clinical application of penicillins, cephalosporin. Current trends in antibiotic therapy.

**UNIT-III: ANTIHYPERTENSIVE AGENTS AND DIURETICS:**

**(15 Hours)**

Classification of cardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride.

**UNIT-IV: ANTIHYPERTENSIVE AGENTS AND DIURETICS:**

**(15 Hours)**

Classification of cardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride.

**UNIT-V: ANALGESICS, ANTIPYRETICS AND ANTI-INFLAMMATORY DRUGS: (15 Hours)**

Introduction, Mechanism of inflammation, classification and mechanism of action and paracetamol, Ibuprofen, Diclofenac, naproxen, indomethacin, phenylbutazone and meperidine. Medicinal Chemistry of Antidiabetic Agents Introduction, Types of diabetics, Drugs used for the treatment, chemical classification, Mechanism of action, Treatment of diabetic mellitus. Chemistry of insulin, sulfonamide.

**TOTAL LECTURE HOURS:75**

**COURSE OUTCOMES :**

Students will be able:

1. Predict a drug's properties based on its structure.
2. Describe the factors that affect its absorption, distribution, metabolism, and excretion, and

hence the considerations to be made in drug design.

3. Explain the relationship between drug's chemical structure and its therapeutic properties.
4. Designed to give the knowledge of different theories of drug actions at molecular level.
5. To identify different targets for the development of new drugs for the treatment of infectious and GIT.

#### REFERENCE BOOKS:

1. Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry,
2. Wilson, Charles Owens; Beale, John Marlowe; Block, John H, Lipincott William, 12th edition, 2011.
3. Graham L. Patrick, An Introduction to Medicinal Chemistry, 5th edition, Oxford University Press, 2013. Jayashree Ghosh, A text book of Pharmaceutical Chemistry, S. Chand and Co. Ltd, 1999, 1999 edn.
4. O. LeRoy, Natural and synthetic organic medicinal compounds, Ealemi, 1976.
5. S.S. Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, New Delhi, 1993, New edn.
6. Foye's Principles of Medicinal Chemistry, Lipincott Williams, Seventh Edition, 2012
7. Burger's Medicinal Chemistry, Drug Discovery and Development, Donald J. Abraham, David P. Rotella, Alfred Burger, Academic press, 2010.
8. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, John M. Beale Jr and John M. Block, Wolters Kluwer, 2011, 12<sup>th</sup> edn.
9. P. Parimoo, A Textbook of Medical Chemistry, New Delhi: CBS Publishers. 1995.
10. S. Ramakrishnan, K.G. Prasanna and R. Rajan, Textbook of Medical Biochemistry, Hyderabad: Orient Longman. 3<sup>rd</sup> edition, 2001.

#### E RESOURCES:

1. <https://www.ncbi.nlm.nih.gov/pubmed/22812571>
2. [https://ymc.bharativedyapeeth.edu/media/pdf/msc\\_org\\_chem\\_sem\\_iv\\_2018\\_210720.pdf](https://ymc.bharativedyapeeth.edu/media/pdf/msc_org_chem_sem_iv_2018_210720.pdf)
3. <https://www.ncbi.nlm.nih.gov/books/NBK482447/>
4. <https://training.seer.cancer.gov/treatment/chemotherapy/types.html>
5. <https://www.classcentral.com/course/swavam-medicinal-chemistry-12908>



**MAPPING WITH PROGRAM OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3
CO2	2		3	3	2	2	3	3	3	3	3	3	3	3
CO3	3		2	3	3	3	3	2	3	3	3	3	3	3
CO4	2		3	2	3	2	3	3	3	3	3	3	3	3
CO5	2		2	3	2	2	3	2	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**

# SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE



(AUTONOMOUS)

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## Semester: II - EC- III- (C): Supramolecular Chemistry

Ins. Hrs. /Week: 5

Course Credit: 3

Course Code:P24CHE23C

### UNIT- I : Concepts of Supramolecular Chemistry: (15 Hours)

Concepts and languages of supramolecular chemistry. Crystal engineering of organic solids –hydrogen bonded supramolecular patterns involving water / carboxyl / halide motifs – principles of crystal engineering and non-covalent synthesis – polymorphism and pseudopolymorphism –supramolecular isomorphism / polymorphism – crystal engineering of pharmaceutical phases.

### UNIT -II : Classification of Supramolecular Chemistry: (15 Hours)

Metallo Organic Frameworks M.O.F (Metallo Organic Frameworks) – organometallic systems –combinations of different interactions to design molecular rods, triangles, etc. – design of nanoporous solids – interligand hydrogen bonds in metal complexes – implications for drug design – crystal engineering of NLO materials, OLED.

### UNIT -III : Molecular Recognition: (15 Hours)

Co-receptor Molecules and Multiple Recognition Dinuclear and polynuclear metal ion cryptates– linear recognition of molecular length by di topic co-receptors – heterotopic co-receptors – cyclophane receptors, amphiphilic receptors and large molecular cages – multiple recognition in metallo receptors

### UNIT -IV : Supramolecular Reactivity and Catalysis: (15 Hours)

Supramolecular Reactivity and Catalysis Catalysis by reactive macrocyclic cation receptor molecules – catalysis by reactive anion receptor molecules – catalysis with cyclophane type receptors – supramolecular metallo catalysis – co catalysis – catalysis of synthetic reactions –

### UNIT -V : Supramolecular Devices and Sensors (15 Hours)

Supramolecular devices and sensors – various types of supramolecular devices – an overview –supramolecular photochemistry – molecular and supramolecular photonic devices – light conversion and energy transfer devices – molecular and supramolecular electronic devices –electronic conducting devices.

**Total Lecture Hours: 75**

## **COURSE OUTCOME**

Students are able to

1. Understand the Principles , concepts and languages of Supramolecular Chemistry.
2. Learn the framework, combinations of Organometallic Systems, and Crystal Engineering.
3. Understand the Co receptor molecules, multiple recognition and Supramolecular reactivity and Catalysis.
4. Learn the Supramolecular reactivity and catalysis.
5. Learn the Supramolecular devices and Sensors..

## **TEXT BOOK(S)**

1. Ariga. K. Berlin . Supramolecular Chemistry – Fundamentals and applications. Advanced Textbook by T. Kunitake, Springer – Verlag Heidelberg, 2006.208 p. ISBN 978 – 3 -540-01298 – 6
2. Asim. k Das, Mahua Das, 2020. An Introduction to Supramolecular Chemistry. CBS Publishers & Distributor Pvt Ltd.
3. Helena Dodziuk, 2007. Introduction to Supramolecular Chemistry. Springer(SIE).
4. Kalsi. P.S, kalsi. J.P, 2008 . Bioorganic bio inorganic and supramolecular chemistry. New Age International Pvt Ltd Publishers.Kerala.
5. Paul. D. Beer , Philip A. Gale & David K.Smith. 1999. Supramolecular Chemistry: I st Edition. OUP Oxford.

## **REFERENCE BOOK(S)**

1. Desiraju. G.R , Steiner. T.1999. The Weak Hydrogen Bond in Structural Chemistry and Biology. Oxford University Press, Oxford.
2. Desiraju. G.R. 1989. Crystal Engineering. The Design of Organic Solids. Elsevier, United State,.
3. Jeffrey. G. A. 1997. Introduction to Hydrogen Bonding. Oxford University Press. UK.
4. Lehn. J.M. 1999. Transition Metals in Supramolecular Chemistry. John Wiley and Sons: New York.
5. Lehn. J. M.1995. Supramolecular Chemistry. VCH, Weinheim, Germany.

## **E-RESOURCES**

1. <https://ijsr.net/archive/v4i4/29031502.pdf>
2. <https://www.internetchemistry.com/chemistry/supramolecular-chemistry.php>
3. <https://edoc.unibas.ch/55079/>
4. <https://www.tue.nl/en/research/research-groups/macromolecular-and-organic-chemistry/supramolecular-chemistry-catalysis/>

**MAPPING WITH PROGRAM OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3	2	3	3	3	3	2	3	3	3	3
CO2	2	3		3	3	2	3	3	3	3	3	3	3	3
CO3	3	3		3	3	3	3	2	3	3	3	3	3	3
CO4	2	3		3	3	2	3	3	3	3	3	3	3	3
CO5	2	3		3	3	2	3	2	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**



**SENGAMALA THAYAAR EDUCATIONAL TRUST WOMEN'S COLLEGE**  
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**SUNDARAKKOTTAI, MANNARGUDI- 614016**  
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**DEPARTMENT OF CHEMISTRY**  
**M.Sc., CHEMISTRY**

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**SEMESTER: II – EC-IV(A) : Bio Inorganic Chemistry**

**Ins. Hrs. /Week: 5**

**Course Credit: 3**

**Course code: P24CHE24A**

**UNIT-I: ESSENTIAL TRACE ELEMENTS:**

**(15 Hours)**

Selective transport and storage of metal ions: Ferritin, Transferrin and siderophores; Sodium and potassium transport, Calcium signalling proteins. Metalloenzymes: Zinc enzymes—carboxypeptidase and carbonic anhydrase. Iron enzymes—catalase, peroxidase. Copper enzymes – superoxide dismutase, Plastocyanin, Ceruloplasmin, Tyrosinase. Coenzymes - Vitamin-B12 coenzymes.

**UNIT-II: TRANSPORT PROTEINS:**

**(15 Hours)**

Oxygen carriers -Hemoglobin and myoglobin - Structure and oxygenation Bohr Effect. Binding of CO,NO, CN– to Myoglobin and Hemoglobin. Biological redox system: Cytochromes-Classification, cytochrome a, b and c. Cytochrome P-450. Non-heme oxygen carriers-Hemerythrin and hemocyanin. Iron-sulphur proteins- Rubredoxin and Ferredoxin- Structure and classification.

**UNIT-III: NITROGEN FIXATION:**

**(15 Hours)**

Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase- redox property - Dinitrogen complexes transition metal complexes of dinitrogen - nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia. Photosynthesis: photosystem-I and photosystem-II-chlorophylls structure and function.

**UNIT-IV: METALS IN MEDICINE:**

**(15 Hours)**

Metal Toxicity of Hg, Cd, Zn, Pb, As, Sb. Therapeutic Compounds: Vanadium-Based Diabetes Drugs; Platinum-Containing Anticancer Agents. Chelation therapy; Cancer treatment. Diagnostic Agents: Technetium Imaging Agents; Gadolinium MRI Imaging Agents. temperature and critical magnetic Field.

**UNIT-V: ENZYMES :**

**(15 Hours)**

Introduction and properties -nomenclature and classification. Enzyme kinetics, free energy of activation and the effects of catalysis. Michaelis - Menton equation - Effect of pH, temperature on enzyme reactions. Factors contributing to the efficiency of enzyme.

**TOTAL LECTURE HOURS: 75**

## COURSE OUTCOMES :

Students will be able:

1. The students will be able to analyse trace elements.
2. Students will be able to explain the biological redox systems.
3. Students will gain skill in analyzing the toxicity in metals.
4. Students will have experience in diagnosis.
5. Learn about the nitrogen fixation and photosynthetic mechanism.

## REFERENCE BOOKS:

1. Williams, D.R. – Introduction to Bioinorganic chemistry.
2. F.M. Fiabre and D.R. Williams – The Principles of Bioinorganic Chemistry, Royal Society of Chemistry, Monograph for Teachers-31
3. K.F. Purcell and Kutz., Inorganic chemistry, WB Saunders Co., USA.
4. G.N. Mughherjea and Arabinda Das, Elements of Bioinorganic Chemistry - 1993.
5. R. Gopalan, V. Ramalingam, *Concise Coordination Chemistry*, S. Chand, 2001.
6. M. Satake and Y. Mido, Bioinorganic Chemistry- Discovery Publishing House, New Delhi (1996)
7. M.N. Hughes, 1982, The Inorganic Chemistry of Biological Processes, II Edition, Wiley London.
8. R. W. Hay, Bio Inorganic Chemistry, Ellis Horwood, 1987.
9. R. M. Roat-Malone, Bio Inorganic Chemistry, John Wiley, 2002.
10. T. M. Loehr, Iron carriers and Iron proteins, VCH, 1989.

## E RESOURCES:

1. <https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry-the-instant-notes-chemistry-series-d162097454.html>
2. <https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry-5th-edition-d161563417.html>
3. <https://authors.library.caltech.edu/25052/1/BioinCh.pdf>
4. <https://www.sciencedirect.com/book/9780080098364/reaction-kinetics83a9aed8427c/11280d23bf7e8be93781f873f16905f8.kinetics-w3.pdf>
5. <https://onlinelibrary.wiley.com/doi/book/10.1002/9783527678211>

**MAPPING WITH PROGRAM OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3
CO2	2	3	3		3	2	3	3	3	3	3	3	3	3
CO3	3	3	2		3	3	3	2	3	3	3	3	3	3
CO4	2	3	3		3	2	3	3	3	3	3	3	3	3
CO5	2	3	2		3	2	3	2	3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**



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**SEMESTER: II- EC-IV-(B): Material Science**

**Ins. Hrs. /Week: 5**

**Course Credit: 3**

**Course code: P24CHE24B**

**UNIT-I: CRYSTALLOGRAPHY:**

**(15 Hours)**

Symmetry- unit cell and Miller indices -crystal systems - Bravais lattices - point groups and space groups. X- ray diffraction-Laue equations-Bragg's law-reciprocal lattice and its application to geometrical crystallography. Crystal structure-powder and single crystal applications. Electron charge density maps, neutron diffraction-method and applications.

**UNIT-II: CRYSTAL GROWTH METHODS:**

**(15 Hours)**

Nucleation-equilibrium stability and metastable state. Single crystal -Low and high temperature, solution growth- Gel and sol-gel. Crystal growth methods- nucleation- equilibrium stability and metastable state. Single crystal-Low and high temperature, solution growth- Gel and sol-gel. Melt growth - Bridgeman-Stockbarger,Czochralski methods.Flux technique, physical and chemical vapour transport. Lorentz and polarization factor - primary and secondary extinctions.

**UNIT-III: PROPERTIES OF CRYSTALS:**

**(15 Hours)**

Optical studies - Electromagnetic spectrum (qualitative) refractive index - reflectance - transparency, translucency and opacity. Types of luminescence - photo-, electro-, and injection luminescence, LEDs -organic, Inorganic and polymer LED materials - Applications. Dielectric studies- Polarisation - electronic, ionic, orientation, and space charge polarisation. Effect of temperature. dielectric constant, dielectric loss. Types of dielectric breakdown- intrinsic, thermal, discharge, electrochemical and defect breakdown.

**UNIT-IV: SPECIAL MATERIALS:**

**(15 Hours)**

Superconductivity: Meissner effect, Critical temperature and critical magnetic Field, Type I and II superconductors, BCS theory-Cooper pair, Applications. Soft and hard magnets - Domain theory Hysteresis Loop-Applications. Magneto and giant magneto resistance. Ferro, ferri and antiferromagnetic materials- applications, magnetic parameters for recording applications. Ferro-, Piezo-, and pyro electric materials - properties and applications. Shape memory Alloys-characteristics and applications, Non-linear optics- Second Harmonic Generators, mixing of Laser wavelengths by quartz, ruby and LiNbO<sub>3</sub>

**UNIT-V: MATERIALS FOR RENEWABLE ENERGY CONVERSION:**

**(15 Hours)**

Solar Cells: Organic, bilayer, bulk heterojunction, polymer, perovskite based. Solar energy conversion: lamellar solids and thin films, dye-sensitized photo voltaic cells, coordination compounds anchored onto semiconductor surfaces - Ru(II) and Os(II) polypyridyl complexes. Photochemical activation and splitting of water, CO<sub>2</sub> and N<sub>2</sub>. Manganese based photosystems for water-splitting. Complexes of Rh, Ru, Pd and Pt - photochemical generation of hydrogen from alcohol.

**TOTAL LECTURE HOURS :75**



## COURSE OUTCOMES :

Students will be able:

1. To understand and recall the synthesis and characteristics of crystal structures, semiconductors, magnets, nanomaterials and renewable energy materials.
2. To integrate and assess the structure of different materials and their properties.
3. To analyse and identify new materials for energy applications.
4. To explain the importance of crystal structures, piezoelectric and pyroelectric materials, nanomaterials, hard and soft magnets, superconductors, solar cells, electrodes, LED uses, structures and synthesis.
5. To design and develop new materials with improved property for energy applications.

## REFERENCE BOOKS:

1. S. Mohan and V. Arjunan, Principles of Materials Science, MJ Publishers, 2016.
2. Arumugam, Materials Science, Anuradha Publications, 2007.
3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010
4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012.
5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007.
6. M.G. Arora, Solid State Chemistry, Anmol Publications, New Delhi, 2001.
7. R.K. Puri and V.K. Babbar, Solid State Physics, S Chand and Company Ltd, 2001.
8. C. Kittel, Solid State Physics, John-Wiley and sons, NY, 1966.
9. H.P. Meyers, Introductory Solid State Physics, Viva Books Private Limited, 1998.
10. A.R. West, Solid State Chemistry and Applications, John-Wiley and sons, 1987.

## E RESOURCES

1. <http://xrayweb.chem.ou.edu/notes/symmetry.html>.
2. <http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf>.
3. <https://bit.ly/3QyVg2R>
4. [http://oms.bdu.ac.in/ec/admin/contents/1\\_p16che5b\\_2020051904031942.pdf](http://oms.bdu.ac.in/ec/admin/contents/1_p16che5b_2020051904031942.pdf)
5. <https://sal.nanofab.utah.edu/imagi`ng-applications/>

**MAPPING WITH PROGRAM OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3		3	2	3	3	3	3
CO2	2	3	3	3	3	2	3		3	3	3	3	3	3
CO3	3	3	2	3	3	3	3		3	3	3	3	3	3
CO4	2	3	3	3	3	2	3		3	3	3	3	3	3
CO5	2	3	2	3	3	2	3		3	3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**



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**Semester: II-EC-IV (C): Solid State Chemistry**

**Ins. Hrs. /Week: 5**

**Course Credit: 3**

**Course Code:P24CHE24C**

**UNIT I: CRYSTAL STRUCTURE AND CRYSTAL ENGINEERING OF ORGANIC SOLIDS :  
(15 Hours)**

Types of close packing – hcp and ccp – packing efficiency – SC, BCC, and FCC, radius ratio rule – applications – polyhedral description of solids – structure types: Na<sub>2</sub>O, Cs<sub>2</sub>O, rutile, perovskite (ABO<sub>3</sub>), ReO<sub>3</sub>, K<sub>2</sub>NiF<sub>4</sub>, spinels and antispinel. Hydrogen bonded supramolecular patterns involving water / carboxyl / halide motifs – concepts of different types of synthons based on non-covalent interactions – principles of crystal engineering and non-covalent synthesis – polymorphism and pseudopolymorphism – supramolecular isomorphism, polymorphism and crystal engineering of pharmaceutical phases.

**UNIT II: METALLO ORGANIC FRAMEWORKS : (14 Hours)**

M.O.Fs (Metallo Organic Frameworks) – organometallic systems – combinations of different interactions to design molecular rods, triangles, ladders, networks, etc. Design of nanoporous solids. Interligand hydrogen bonds in metal complexes – implications for drug design – crystal engineering of NLO and OLED materials.

**UNIT III: PREPARATIVE METHODS IN SOLID STATE CHEMISTRY : (18 Hours)**

Experimental procedure, coprecipitation as a precursor to solid state reaction, other precursor methods, kinetics of solid state reactions – crystallizations of solutions, melts, glasses and gels, solutions and gels: zeolite synthesis – precipitation from solution or melt: flux method, epitaxial growth of thin layers, verneuil flame fusion method. Graphite intercalation compounds, transition metal dichalcogenide and other intercalation compounds, ion exchange reaction, synthesis of new metastable phases by 'Chimie Douce'. Electrochemical reduction methods – preparation of thin films, chemical and electrochemical methods, physical methods – growth of single crystals, Czochralski method, Bridgman-Stockbarger methods – zone melting. Vapour phase transport, hydrothermal methods, comparison of different methods – high pressure and hydrothermal methods and dry high pressure methods.

**UNIT IV: MAGNETIC MATERIALS AND OPTICAL PROPERTIES : (14 Hours)**

Selected examples of magnetic materials and their properties – metals and alloys, transition metal oxides, spinels, garnets, ilmenite and perovskites. Magnetoplumbites – applications – structure/property relations – transformer, information storage, magnetic bubble memory devices, permanent magnets. Luminescence, Lasers and phosphors – definitions and general comments, configurational coordinate model, some phosphor materials, anti-Stokes phosphors – lasers – the ruby laser, Neodymium lasers

**UNIT V: ORGANIC SOLIDSTATE CHEMISTRY: (14 Hours)**

Topochemical control of solid state organic reactions – intramolecular reactions – conformational effects – intermolecular reactions – molecular packing effects – photodimerization of 2-ethoxycinnamic acid ( $\alpha$  form,  $\beta$  form,  $\gamma$  form) – photopolymerization of 2,5-distyrylpyrazine – photopolymerizations of diacetylenes. Asymmetric syntheses – dimerization of anthracene – control of molecular packing arrangements. Organic reactions within inorganic host structures – electrically conductive organic solids – organic metals, conjugated systems, doped polyacetylene, polyparaphenylene, polypyrrole – organic charge transfer complexes – new superconductors

**Total Lecture Hours: 75**

**COURSE OUTCOME**

**The student should able to**

1. Identify crystal structures of few inorganic solids.
2. Study the chemistry of crystallization and vapour phase transport.
3. Explain the applications of magnetic materials.
4. Understand the chemistry of organic solids.
5. Design the molecular rods, triangles, ladders, networks

**TEXT BOOKS**

1. J. D. Lee, 2011. Concise Inorganic Chemistry, 5th Ed., Blackwell Science, London,
2. D. F. Shriver and P. W. Atkins, 2021 Inorganic Chemistry, 3rd Ed., W. H. Freeman and Co,
3. B. R. Puri, L. R. Sharma, K. C. Kalia, 2019. Principles of Inorganic Chemistry, Shoban Lal Nagin Chand and Co., Delhi,.
4. J. M. Lehn, 2000. Transition Metals in Supramolecular Chemistry; Vol 5, John Wiley and Sons, New York,
5. C. N. R. Rao, 2001. Current Science, Royal Society of Chemistry, UK, .

## REFERENCES

1. A. R. West, 2019. Solid State Chemistry and Its Applications; 2nd Ed., John Wiley and sons, New York,
2. J. M. Lehn, 2011. Supramolecular Chemistry; VCH, Weinheim,.
3. G. R. Desiraju, 2013. Crystal Engineering: The Design of Organic Solids; Elsevier, Amsterdam,
4. G. R. Desiraju, and T. Steiner, 2002 The Weak Hydrogen Bond in Structural Chemistry and Biology; Oxford University Press: Oxford,.
5. G. A. Jeffrey, 1997 Introduction to Hydrogen Bonding; Oxford University Press, New York,.

## E-RESOURCES

1. <https://link.springer.com/chapter>
2. [https://books.google.com/books/about/Crystal\\_Engineering](https://books.google.com/books/about/Crystal_Engineering)
3. <https://www.researchgate.net>
4. <https://engineering.virginia.edu/departments/materials-science-and-engineering/research/electrical-magnetic-optical-properties>
5. <https://www.nanowerk.com/mof-metal-organic-framework.php>

## MAPPING WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3
CO2	2	3		3	3	2	3	3	3	3	3	3	3	3
CO3	3	3		3	3	3	3	2		3	3	3	3	3
CO4	2	3		3	3	2	3	3		3	3	3	3	3
CO5	2	3		3	3	2	3	2		3	3	3	3	3

**Strong - 3**

**Medium-2**

**Low-1**



**SEMESTER: II – NME-II : Chemistry in Every day life**

**Ins. Hrs. /Week: 2      Course Credit: 2      Course Code: P24NMECH22**

**UNIT I: CHEMISTRY IN HEALTH CARE AND BEAUTY: ( 6 Hours)**

Vitamins and Proteins- sources, functions and deficiency diseases  
Cosmetics: Face powder- Face cream- Lipstick- Mascara-Nail polish- Perfumes-Shampoo-  
Tooth paste-Ingredients and uses.

**UNIT II: CHEMISTRY IN MEDICINE: (6 Hours)**

Analgesics, Antimicrobials, Antifertility drugs, Anaesthetics, Antibiotics, Antacids,  
Antihistamines, Tranquilizers, Hypnotics and Antidepressant drugs- definition, examples, uses and  
side effects.

**UNIT III: CHEMISTRY IN HOUSEKEEPING: (6 Hours)**

Soaps- definition, varieties of soap and their uses- cleansing action of soap -detergents,  
deodorants, acid cleaners, laundry aids, alkaline cleaners, metal polishes, solvent cleaners, floor  
seal, abrasive, antiseptics, disinfectants- definition, ingredients and examples.

**UNIT IV: CHEMISTRY IN INDUSTRY: (6 Hours)**

Food industry: Food adulterants and testing, Food colorants, Food preservatives  
and Food additives. Paints and varnishes : Definition, types and composition. Glass :  
Composition, manufacture, types and uses.

**UNIT V : CHEMISTRY OF PHOTOGRAPHY: (6 Hours)**

Role of Chemistry in photography- photographic process- preparation of sensitive plates-  
exposure-developing- fixing- printing- toning- colour photography.

**TOTAL LECTURE HOURS : 30**

**COURSE OUTCOME**

The students are able to

1. The Students are able to understand the preparation , properties and uses of cosmetics.
2. Learn how chemical compounds used as medicines.
3. Learn about how certain chemicals used housekeeping .
4. Understand the manufacturing process of Paints ,Varnishes and glass.
5. Predict the role of chemistry in photography.

**TEXTBOOK(S):**

1. Text book of Applied chemistry
2. A Text of Pharmaceutical Chemistry – Jayashreeghosh, Sultan chand & sons, New Delhi, 1997.
3. Industrial Chemistry Mark Antony Benvenuto
4. Clinical Medicine A.B.M. Abdullah

**REFERENCE BOOK(S):**

1. Chemistry in everyday life – Shandendukislaya Discovery Publishing Pvt. Ltd., (1 January 2001).
2. Chemistry in daily life by Singh K prentice Hall India Learning Private Limited, Third edition (1 January 2012).
3. Cosmetic Applications of laser and light-Based systems by Gurpreet S. Ahluwalia William Andrew, 1<sup>st</sup> edn. (16 Dec. 2008).
4. Aromatherapy and Essential Oils Ultimate Guide, speedy publishing Books 22 July 2014.
5. Essential Oils by Shiva Rose Artisan Division of Workman Publishing (1 Sept. 2019).

**E-RESOURCES:**

1. <http://www.makingcosmetics.com>
2. <http://www.Satersolution.com>
3. [https://www.nano.gov/sites/default/files/pub\\_resource/sensors\\_nsi\\_2012\\_07\\_09\\_final\\_forum\\_web.pdf](https://www.nano.gov/sites/default/files/pub_resource/sensors_nsi_2012_07_09_final_forum_web.pdf)
4. <https://www.electronicshub.org/types-of-biosensors/>
5. [http://ijsit.com/admin/ijsit\\_files/food%20adulteration\\_1.2.4.pdf](http://ijsit.com/admin/ijsit_files/food%20adulteration_1.2.4.pdf)

**MAPPING WITH PROGRAM OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3	3	3
CO2	2	3	3	3		2	3	3	3	3	3	3	3	3
CO3	3	3	2	3		3	3	2	3	3	3	3	3	3
CO4	2	3	3	3		2	3	3	3	3	3	3	3	3
CO5	2	3	2	3		2	3	2	3	3	3	3	3	3

**Strong - 3****Medium-2****Low-1**