V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
(Belonging to Virudhunagar Hindu Nadars)
An Autonomous Institution Affiliated to Madurai Kamaraj University, Madurai
Reaccredited with 'A++' Grade (4th Cycle) by NAAC
VIRUDHUNAGAR
Quality Education with Wisdom and Values

OUTCOME BASED EDUCATION WITH CHOICE BASED CREDIT SYSTEM REGULATIONS AND SYLLABUS
(with effect from Academic Year 2023 - 2024)

V.V.Vanniaperumal College for Women, Virudhunagar, established in 1962, offers 13 UG Programmes (Aided), 15 UG Programmes (SF), 15 PG Programmes and 6 Ph.D. Programmes. The curricula for all these Programmes, except Ph.D. Programmes, have been framed as per the guidelines given by the and University Grants Commission (UGC) & Tamil Nadu State Council for Higher Education (TANSCHE) under Choice Based Credit System (CBCS) and the guidelines for Outcome Based Education (OBE).

The Departments of Commerce, English, History, Mathematics, Biochemistry and Tamil upgraded as Research Centres offer Ph.D. Programmes as per the norms and regulations of Madurai Kamaraj University, Madurai and do not come under the purview of CBCS.

A. CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed Courses. The CBCS is followed as per the guidelines formulated by the UGC. The performance of students is evaluated based on the uniform grading system. Computation of the Cumulative Grade Point Average (CGPA) is made to ensure uniformity in evaluation system.

List of Programmes in which CBCS/Elective Course System is implemented

UG PROGRAMMES

Arts & Humanities	:	History (E.M. & T.M.), English, Tamil
Physical & Life Sciences	:	Mathematics, Zoology, Chemistry, Physics, Biochemistry, Home Science - Nutrition and Dietetics, Costume Design and Fashion, Microbiology, Biotechnology, Computer Science, Information Technology, Data Science, Computer Applications and Computer Applications - Graphic Design
Commerce & Management	:	Commerce, Commerce (Computer Applications), Commerce (Professional Accounting), Business Administration

PG PROGRAMMES

Arts & Humanities	:	History, English, Tamil
Physical & Life Sciences	:	Mathematics, Physics, Chemistry, Zoology, Biochemistry, Home Science - Nutrition and Dietetics, Biotechnology, Computer Science, Computer Science (Data Science) and Computer Applications (MCA) *
Commerce & Management	:	Commerce, Business Administration (MBA) *

* AICTE approved Programmes

OUTLINE OF CHOICE BASED CREDIT SYSTEM- PG

1. Core Courses
2. Elective Courses
    - Discipline Specific Elective Courses (DSEC)
    - Generic Elective Courses
    - Non-Major Elective Course (NMEC)
3. Skill Enhancement Courses
4. Self Study Course (Online)
5. Extension Activity
6. Extra Credit Courses (Optional)

List of Non Major Elective Courses (NME)
(2023-2024 onwards)

PG PROGRAMMES

Name of the Course	Course Code	Department
Tourism in Tamilnadu	23PHIN31	History
Functional English	23PENN31	English
தமிழும் பிற துறைகளும்	23PTAN31	Tamil
Taxation Concepts and Assessment	23PCON31	Commerce
Entrepreneurship	23PBAN31	Business Administration
Statistics for Life and Social Sciences	23PMTN31	Mathematics
Advanced Chemistry for Competitive Examinations	23PCHN31	Chemistry
Nutrition and Health	23PHSN31	Home Science - Nutrition and Dietetics
Molecular Basis of Diseases and Therapeutic Strategies	23PBCN31	Biochemistry
Web Programming	23PCSN31	Computer Science
Fundamentals of Web Design	23PCAN31	Computer Applications

B. OUTCOME BASED EDUCATION (OBE) FRAMEWORK

The core philosophy of Outcome Based Education rests in employing a student - centric learning approach to measure the performance of students based on a set of pre-determined outcomes. The significant advantage of OBE is that it enables a revamp of the

curriculum based on the learning outcomes, upgrade of academic resources, quality enhancement in research and integration of technology in the teaching-learning process. It also helps in bringing clarity among students as to what is expected of them after completion of the Programme in general and the Course in particular. The OBE directs the teachers to channelise their teaching methodologies and evaluation strategies to attain the Programme Educational Objectives (PEOs) and fulfill the Vision and Mission of the Institution.

Vision of the Institution

The founding vision of the Institution is to impart Quality Education to the rural women folk and to empower them with knowledge and leadership quality.

Mission of the Institution

The mission of the Institution is to impart liberal education committed to quality and excellence. Its quest is to mould learners into globally competent individuals instilling in them life-oriented skills, personal integrity, leadership qualities and service mindedness.

B.1 Programme Educational Objectives, Programme Outcomes and Programme Specific Outcomes

It is imperative for the Institution to set the Programme Educational Objectives (PEOs), Programme Outcomes (POs) and Course Outcomes (COs), consistent with its Vision and Mission statements. The PEOs and the POs should be driven by the Mission of the Institution and should provide distinctive paths to achieve the stated goals. The PEOs for each Programme have to fulfill the Vision and Mission of the Department offering the Programme.

Vision of the Department of M.Sc. CHEMISTRY

To train our students as scientifically literate professionals with a sense of social responsibilities.

Mission of the Department of M.Sc. CHEMISTRY

- To provide advanced knowledge in chemistry.
- To develop in students employable skills for job opportunities in the field of education, R&D institutions and industries.
- Acquire knowledge, abilities and insight in well-defined area of research within Chemistry.
- Acquire the skills of planning and conducting advanced chemical experiments and applying structural-chemical characterization techniques.
- To impart moral, ethical and social responsibilities to students

B.1.1 Programme Educational Objectives (PEOs)

PEOs are broad statements that describe the career and professional achievements that the Programme is preparing the graduates to achieve within the first few years after graduation. PEOs are framed for each Programme and should be consistent with the Mission of the Institution.

Programme Educational Objectives (PEOs) of M.Sc. CHEMISTRY Programme

The Students will be able to

- To educate and guide the students in attaining significant opportunities in various service domains at national and international level, and can work as scientist, analyst, quality controller, academics, research organizations and set testing labs.
- To mould the overall personality of the students by providing training and opportunities to enhance their communication skills, team management, co- ordination skills and leadership qualities.
- To guide and create awareness among the students to learn and adopt new skills and techniques to overcome the problem related with new technologies and to formulate, investigate and analyze scientifically real life problems along with ethical attitude which works in multidisciplinary team.

Key Components of the Mission Statement	PEO1	PEO2	PEO3
advanced knowledge and practical experience	√	-	√
development of research activities among students	√	√	√
employable skills for job opportunities	√	√	√
Contributing innovation of new applications of research in chemistry.	√	-	√

B.1.2 Programme Outcomes (POs)

POs shall be based on Graduate Attributes (GAs) of the Programme. The GAs are the attributes expected of a graduate from a Programme in terms of knowledge, skills, attitude and values. The Graduate Attributes include Disciplinary Knowledge, Communication Skills, Critical Thinking, Problem Solving, Analytical Reasoning, Research Related Skills, Co-operation/Team Work, Scientific Reasoning, Reflective Thinking,

Information/Digital Literacy, Multicultural Competence, Moral and Ethical Awareness/Reasoning, Leadership Qualities and Lifelong Learning.

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

1 apply their in-depth domain knowledge and practical skills in interdisciplinary fields for research-based endeavours, employment and entrepreneurship development. (*Disciplinary Knowledge)*

2 communicate proficiently and confidently with the ability to present complex ideas both in spoken and written forms in a concise manner to assorted groups. (*Communication Skills*)

3 identify, formulate and solve problems in a consistent and systematic way with updated skills using modern tools and techniques. (*Scientific Reasoning and Problem Solving*)

4 analyze the data, synthesis the findings and provide valid conclusion by critical evaluation of theories, policies and practices for the fulfillment of the local, national, regional and global developmental needs. (*Critical Thinking and Analytical Reasoning*)

5 explore and evaluate globally competent research methodologies to apply appropriately in interdisciplinary research; Develop and sustain the research capabilities to meet the emerging needs for the welfare of the society. (*Research Related Skills*)

6 use ICT to mould themselves for lifelong learning activities to face career challenges in the changing environment. (*Digital Literacy, Self - directed and Lifelong Learning*)

7 self-manage and function efficiently as a member or a leader in diverse teams in a multicultural society for nation building. (*Co-operation/Team Work and Multicultural Competence*)

8 uphold the imbibed ethical and moral values in personal, professional and social life for sustainable environment. (*Moral and Ethical Awareness*)

B.1.3 Programme Specific Outcomes (PSOs)

Based on the Programme Outcomes, Programme Specific Outcomes are framed for each PG Programme**.** Programme Specific Outcomes denote what the students would be able to do at the time of graduation. They are Programme-specific and it is mandatory that each PO should be mapped to the respective PSO.

On Successful completion of M.Sc. Chemistry Programme, the students will be able to

PO 1: *Disciplinary Knowledge*

PSO 1.a: Apply in - depth knowledge on advanced concepts in Organic, Inorganic, Physical, Analytical, Biological, Environmental, Medicinal, spectral, Qualitative & Quantitative techniques and Industrial applications of chemistry in research based endeavours.

PSO 1.b: contribute new scientific insights and innovative applications of chemical research to the next generation. Develop focused field knowledge and amalgamate knowledge across different disciplines.

PO2: *Communication Skills*

PSO 2: Communicate effectively on scientific achievements, basic concepts and recent developments with experts and with society at large. Students will develop various communication skills such as reading, listening, speaking, etc., which we will help in expressing ideas and views clearly and effectively.

PO3: *Scientific Reasoning and Problem Solving*

PSO 3a: Develops analytical, technical skills and problem solving skills requiring application of chemical principles.

PSO 3b: Use modern chemical tools, Models, Chemdraw, Charts and Advanced Equipments for the potential uses in all fields of R& D laboratories, analytical industrial chemistry, medicinal chemistry and green chemistry.

PO4: *Critical thinking and Analytical Reasoning*

PSO 4: Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of chemical reactions to create an awareness of the impact of chemistry on the environment and society.

PO5: *Research Related Skills*

PSO 5: Come out with clear idea of choosing original research problems, writing new projects and publishing research papers to open up new research methods to develop environmental protection, resource management, public health and safety.

PO6: *Digital Literacy, Self - directed and Lifelong learning*

PSO 6 : Use ICT tools for literature survey of the topic of research, manuscript preparation and online submission for publication. Apply disciplinary or interdisciplinary learning across multiple contexts, integrating knowledge and equip the students to face the employment challenges and to get good placement and instill confidence to turn into entrepreneur.

PO7: *Cooperation/Team Work and Multicultural Competence*

PSO 7: Engage in intellectual exchange of ideas with researchers of other disciplines to address important research issues. To produce employable, ethical and innovative professionals to sustain in the dynamic business world.

PO8: *Moral and Ethical awareness*

PSO 8: Explore the impact of the solutions in ethical, societal and environmental contexts and demonstrate the knowledge of and need for sustainable development and to contribute to the development of the society by collaborating with stakeholders for mutual benefit.

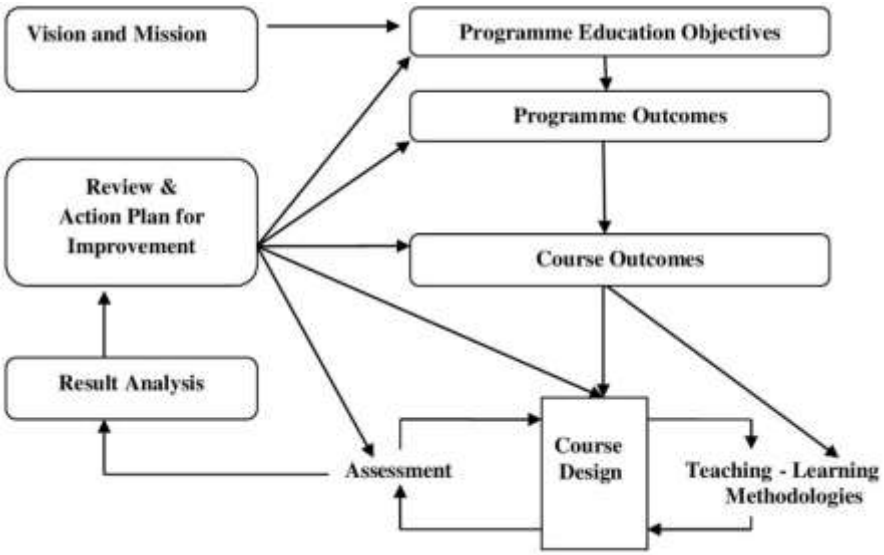
PO-PEO Mapping Matrix

Attainment of PEOs can be measured by a PO-PEO matrix. PEOs should evolve through constant feedback from alumnae, students, industry, management, *etc*. It is mandatory that each PEO should be mapped to at least one of the Pos.

PEOs / **POs/PSOs**	**PEO1**	**PEO2**	**PEO3**
PO1/PSO1	✓	✓	✓
PO2/PSO2	✓	✓	✓
PO3/PSO3	✓	✓	✓
PO4/PSO4	✓	✓	-
PO5/PSO5	-	✓	✓
PO6/PSO6	✓	✓	✓
PO7/PSO7	✓	✓	✓
PO8/PSO8	✓	✓	-

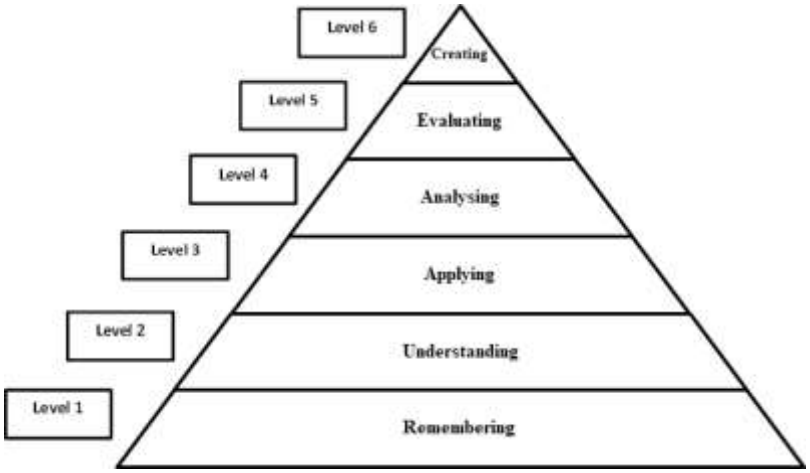
B.1.4 Course Outcomes (COs)

Course Outcomes are narrow statements restricted to the course contents given in five units. Course Outcomes describe what students would be capable of, after learningthe contents of the Course. They reflect the level of knowledge gained, skills acquired and attributes developed by the students after learning of Course contents. COs are measurable, attainable and manageable in number. COs contribute to attain POs in such a way that each CO addresses at least one of the POs and also each PO is reasonably addressed by adequate number of CO



It is important to determine the methods of assessment. A comprehensive assessment strategy may be outlined using the revised Bloom's Taxonomy levels.

BLOOM'S TAXONOMY



CO - PO Mapping of Courses

After framing the CO statements, the COs framed for each course is mapped with POs based on the relationship that exists between them. The COs which are not related to any of the POs is indicated with (-), signifying Nil. Measurement Mapping is based on Four Points Scale [High (H), Medium (M), Low (L) and Nil (-)]. For calculating weightedpercentage of contribution of each Course in the attainment of the respective POs, the weights assigned for H, M and L are 3, 2 and 1 respectively.

CO-PO/PSO Mapping Table (Course Articulation Matrix)

PO/PSOs / COs	PO1/ PSO1	PO2/ PSO2	PO3/ PSO3	PO4/ PSO4	PO5/ PSO5	PO6/ PSO6	PO7/ PSO7	PO8/ PSO8
CO1								
CO2								
CO3								
CO4								
CO5								

ELIGIBILITY FOR ADMISSION

The candidate should have passed in B.Sc. Degree in Chemistry from any recognized University.

DURATION OF THE PROGRAMME

The candidates shall undergo the prescribed Programme of study for a period of two academic years (four semesters).

MEDIUM OF INSTRUCTION

English

B.2 EVALUATION SCHEME

Components	Internal Assessment Marks	External Examination Marks	Total Marks
Theory	25	75	**100**

B.2.1 Core Courses, Elective Courses (Discipline Specific Elective Courses, Generic Elective Courses & Non Major Elective Courses

INTERNAL ASSESSMENT

Distribution of Marks

Theory

Mode of Evaluation		Marks
Periodic Test	:	20
Assignment	:	5
Total	**:**	**25**

Three Periodic Tests - Average of the best two will be considered
Two Assignments - Better of the two will be considered

Practical

Mode of Evaluation		Marks
Practical Test	:	30
Record Performance	:	10
Total	**:**	**40**

Practical Test - Average of the two Practical Tests will be considered

Performance - Attendance and Record

Question Pattern for Periodic Test **Duration: 2 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6-9	Internal Choice – Either… or Type	4	4	5	20
C	10 - 11	Internal Choice – Either…. or Type	2	2	10	20
					Total	**45***

*The total marks obtained in the Periodic Test will be calculated for 20 marks

SUMMATIVE EXAMINATION

External Assessment

Distribution of Marks

Mode of Evaluation		Marks
Summative Examination	**:**	60
Seminar Presentation	**:**	15
Total	**:**	**75**

SUMMATIVE EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6 - 10	Internal Choice - Either ….or Type	5	5	5	25
C	11 - 13	Internal Choice - Either …or Type	3	3	10	30
					Total	**60**

B.2.2. PROJECT

Individual Project is compulsory for II PG Students in IV Semester.

Distribution of Marks

Mode of Evaluation		Marks
Internal Assessment	:	40
External Examination	:	60
Total	:	**100**

Internal Assessment: Pre-submission Presentation - 10 Marks

Review Report - 20 Marks

One Open Online Course related to the Project - 10 Marks

External Examination: Project Report - 40 Marks

Viva Voce - 20 Marks

B. 2.3 SKILL ENHANCEMENT COURSES
INTERNAL ASSESSMENT
Distribution of Marks

Theory

Mode of Evaluation		Marks
Periodic Test	:	20
Assignment	:	5
Total	:	**25**

Three Periodic Tests - Average of the best two will be considered
Two Assignments - Better of the two will be considered

Practical

Mode of Evaluation		Marks
Practical Test	:	30
Record Performance	:	10
Total	:	**40**

Practical Test - Average of the two Practical Tests will be considered
Performance - Attendance and Record

Question Pattern for Periodic Test **Duration: 2 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 4	Internal Choice – Either… or Type	4	4	5	20
B	5	Internal Choice – Either… or Type	1	1	10	10
					Total	**30***

*The total marks obtained in the Periodic Test will be calculated for 20 marks

SUMMATIVE EXAMINATION

External Assessment

Distribution of Marks

Mode of Evaluation		Marks
Seminar Paper		10
Seminar Presentation	:	15
Summative Examination	:	50
Total	:	**75**

SUMMATIVE EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6 - 10	Internal Choice - Either ….or Type	5	5	5	25
C	11 - 12	Internal Choice - Either …or Type	2	2	10	20
					Total	**50**

B. 2.3.1 Skill Enhancement Course - Professional Competency Skill

Types of Question – Multiple Choice Questions Only

INTERNAL ASSESSMENT

Distribution of Marks

Mode of Evaluation		Marks
Periodic Test	:	20
Assignment	:	5
Total	:	**25**

Three Periodic Tests - Average of the best two will be considered

Two Assignments - Better of the two will be considered

Question Pattern for Periodic Test **Duration: 2 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6-9	Internal Choice – Either… or Type	4	4	5	20
C	10 - 11	Internal Choice – Either…. or Type	2	2	10	20
		Total				**45***

*The total marks obtained in the Periodic Test will be calculated for 20 marks

SUMMATIVE EXAMINATION

External Assessment

Distribution of Marks

Mode of Evaluation		Marks
Summative Examination	:	60
Seminar Presentation	:	15
Total	:	**75**

SUMMATIVE EXAMINATION

Question Pattern **Duration: 3 Hours**

Section	Q. No.	Types of Question	No. of Questions	No. of Questions to be answered	Marks for each Question	Total Marks
A	1 - 5	Multiple Choice Questions	5	5	1	5
B	6 - 10	Internal Choice - Either ….or Type	5	5	5	25
C	11 - 13	Internal Choice - Either …or Type	3	3	10	30
					Total	**60**

B.2.4. Self Study - Online Course

Practice for CSIR NET-General Paper –Online

Internal Examination only

- Two Periodic Tests (Online) with Multiple Choice Questions will be conducted in III Semester.
- Model Examination will be conducted after two periodic tests.

Distribution of Marks

Mode of Evaluation		Marks
Periodic Test	:	25
Model Examination	:	75
Total	**:**	**100**

Two Periodic Tests - Better of the two will be considered

B.2.5. Extension Activities

Assessment by Internal Examiner only

Distribution of Marks

Mode of Evaluation		Marks
Attendance	:	5
Performance	:	10
Report	:	10
Total	**:**	**25***

*The marks obtained will be calculated for 100 marks

B.2.6. EXTRA CREDIT COURSES (OPTIONAL)

2.6.1 Extra Credit Course offered by the Department.

Assessment by Internal Examiner Only (To be conducted along with the III Periodic Test)

Distribution of Marks

Mode of Evaluation		**Marks**
Quiz (Multiple Choice Questions)	:	25
Model Examination	:	75
Total	**:**	**100**

Question Pattern for Model Examination

Section	**Types of Question**	**No. of Questions**	**No. of Questions to be answered**	**Marks for each Question**	**Total Marks**
A Q.No.(1-5)	Internal Choice-Either or Type	5	5	7	35
B Q.No.(6-9)	Internal Choice-Either or Type	4	4	10	40
				Total	**75**

2.6.2 Extra credit Course offered by MOOC (Massive Open Online Course)

- The Courses shall be completed within the first III Semesters of the Programme.
- The allotment of credits is as follows **(Maximum of 15 credits)**

4weeks Course - 1 credit

8 weeks Course - 2 credits

12 weeks Course - 3 credits

ELIGIBILITY FOR THE DEGREE

- The candidate will not be eligible for the Degree without completing the prescribed Courses of study and a minimum of 50% Pass marks in all the Courses.
  - No Pass minimum for Internal Assessment for other Courses.
  - Pass minimum for External Examination is 27 marks out of 60 marks for Core Courses, Discipline Specific Elective Courses and Non-Major Elective Course.
  - Pass minimum for Practice for SET/NET - General Paper is 50 Marks.
- Attendance
  - The students who have attended the classes for 76 days (85%) and above are permitted to appear for the Summative Examinations without any condition.
  - The students who have only 60-75days (66% -84%) of attendance are permitted to appear for the Summative Examinations after paying the required fine amountand fulfilling other conditions according to the respective cases.

- The students who have attended the classes for 59 days and less – upto 45 days (50% - 65%) can appear for the Summative Examinations only after getting special permission from the Principal.
- The students who have attended the classes for 44 days or less (<50%) cannot appear for the Summative Examinations and have to repeat the whole semester.
- These rules are applicable to UG, PG and M.Phil. Programmes and come into effect from 2020-2021 onwards.
- For Certificate, Diploma, Advanced Diploma and Post Graduate Diploma Programmes, the students require 75% of attendance to appear for the Theory/Practical Examinations.

B.3 ASSESSMENT MANAGEMENT PLAN

An Assessment Management Plan that details the assessment strategy both at the Programme and the Course levels is prepared. The continuous assessment is implemented using an assessment rubric to interpret and grade students.

B.3.1 Assessment Process for CO Attainment

Assessment is one or more processes carried out by the institution that identify, collect and prepare data to evaluate the achievement of Course Outcomes and Programme Outcomes. Course Outcome is evaluated based on the performance of students in the Continuous Internal Assessments and in End Semester Examination of a course. Target levels of attainment shall be fixed by the Course teacher and Heads of therespective departments.

Direct Assessment (Rubric based) - Conventional assessment tools such as Term Test, Assignment, Quiz and End Semester Summative Examination are used.

Indirect Assessment - Done through Course Exit Survey.

CO Assessment Rubrics

For the evaluation and assessment of COs and POs, rubrics are used. Internal assessment contributes 40% and End Semester assessment contributes 60% to the total attainment of a CO for the theory courses. For the practical courses, internal assessment contributes 50% and Semester assessment contributes 50% to the total attainment of a CO. Once the Course Outcome is measured, the PO can be measured using a CO-PO matrix.

CO Attainment

Direct CO Attainment

Course Outcomes of all courses are assessed and the CO - wise marks obtained by all the students are recorded for all the assessment tools. The respective CO attainment level is evaluated based on set attainment rubrics.

Target Setting for Assessment Method

For setting up the target of internal assessment tools, 55% of the maximum mark is fixed as target. For setting up the target of End Semester Examination, the averagemark of the class shall be set as target.

Formula for Attainment for each CO

Attainment = Percentage of students who have scored more than the target marks

$$\text{Percentage of Attainment} = \frac{\text{Number of Students who Scored more than the Target}}{\text{Total Number of Students}} \times 100$$

Attainment Levels of COs

Assessment Methods	**Attainment Levels**	
Internal Assessment	Level 1	50% of students scoring more than set target marks in Internal Assessment tools
	Level 2	55% of students scoring more than set target marks in Internal Assessment tools
	Level 3	60% of students scoring more than set target marks in internal Assessment tools
End Semester Summative Examination	Level 1	50% of students scoring more than average marks in End Semester Summative Examination
	Level 2	55% of students scoring more than average marks in End Semester Summative Examination
	Level 3	60% of students scoring more than average marks in End Semester Summative Examination

Indirect CO Attainment

At the end of each Course, an exit survey is conducted to collect the opinion of the students on attainment of Course Outcomes. A questionnaire is designed to reflect the views of the students about the Course Outcomes.

Overall CO Attainment=75% of Direct CO Attainment + 25 % of Indirect CO Attainment

In each Course, the level of attainment of each CO is compared with the predefined targets. If the target is not reached, the Course teacher takes necessary steps for the improvement to reach the target.

For continuous improvement, if the target is reached, the Course teacher can set the target as a value greater than the CO attainment of the previous year.

B.3.2 Assessment Process for Overall PO Attainment

With the help of CO - PO mapping, the PO attainment is calculated. PO assessment is done by giving 75% weightage to direct assessment and 25% weightage to indirect assessment. Direct assessment is based on CO attainment, where 75% weightage is given to attainment through End Semester Examination and 25 % weightage is given to attainment through Internal assessments. Indirect assessment is done through Graduate Exit Survey and participation of students in Co-curricular/Extra-curricular activities.

PO Assessment Tools

Mode of Assessment	Assessment Tool	Description
Direct Attainment (Weightage -75%)	CO Assessment	This is computed from the calculated CO Attainment value for each Course.
Indirect Attainment (Weightage - 25%)	Graduate Exit Survey 10%	At the end of the Programme, Graduate Exit Survey is collected from the graduates and it gives the opinion of the graduates on attainment of Programme Outcomes.
	Co-curricular / Extra-curricular activities 15%	For participation in Co-curricular/Extra-curricular activities during the period of their study.

Programme Articulation Matrix (PAM)

Course Code	Course Title	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Average Direct PO Attainment									
Direct PO Attainment in percentage									

Indirect Attainment of POs for all Courses

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Graduate Exit Survey								
Indirect PO Attainment								

Attainments of POs for all Courses

POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Direct Attainment(Weightage - 75%)								
Indirect Attainment(Weightage - 25%)								
Overall PO Attainment								

Overall PO Attainment= 75% of Direct PO Attainment +
25% of Indirect PO Attainment (Graduate Exit Survey & Participation in Co- curricular and Extra-curricular Activities)

Expected Level of Attainment for each of the Programme Outcomes

POs	Level of Attainment
Attainment Value ≥70%	Excellent
60% ≤ Attainment Value < 70%	Very Good
50% ≤ Attainment Value < 60%	Good
40% ≤ Attainment Value < 50%	Satisfactory
Attainment Value <40%	Not Satisfactory

Level of PO Attainment

Graduation Batch	Overall PO Attainment(in percentage)	Whether Expected Level ofPO is Achieved? (Yes/No)

B.3.3 Assessment Process for PEOs

The curriculum is designed so that all the courses contribute to the achievement of PEOs. The attainment of PEOs is measured after 3 years of completion of the Programme only through Indirect methods.

Target for PEO Attainment

Assessment Criteria	Target (UG)	Target (PG)
Record of Employment	15% of the class strength	30 % of the class strength
Progression to Higher Education	50% of the class strength	5 % of the class strength
Record of Entrepreneurship	2 % of the class strength	5 % of the class strength

Attainment of PEOs

Assessment Criteria & Tool	Weightage
Record of Employment	10
Progression to Higher Education	20
Record of Entrepreneurship	10
Feedback from Alumnae	30
Feedback from Parents	10
Feedback from Employers	20
Total Attainment	**100**

$$\text{Percentage of PEO Attainment from Employment} = \frac{\text{Number of Students who have got Employment}}{\text{Target}} \times 100$$

$$\text{Percentage of PEO Attainment from Higher Education} = \frac{\text{Number of Students who pursue Higher Education}}{\text{Target}} \times 100$$

$$\text{Percentage of PEO Attainment from Entrepreneurship} = \frac{\text{Number of Students who have become Entrepreneurs}}{\text{Target}} \times 100$$

Expected Level of Attainment for each of the Programme Educational Objectives

POs	Level of Attainment
Attainment Value ≥70%	Excellent
60% ≤ Attainment Value < 70%	Very Good
50% ≤ Attainment Value < 60%	Good
40% ≤ Attainment Value < 50%	Satisfactory
Attainment Value <40%	Not Satisfactory

Level of PEO Attainment

Graduation Batch	Overall PEO Attainment (in percentage)	Whether Expected Level of PEO is Achieved? (Yes/No)

C. PROCESS OF REDEFINING THE PROGRMME EDUCATIONAL OBJECTIVES

The college has always been involving the key stakeholders in collecting information and suggestions with regard to curriculum development and curriculum revision. Based on the information collected, the objectives of the Programme are defined, refined and are inscribed in the form of PEOs. The level of attainment of PEOs defined earlier will be analysed and will identify the need for redefining PEOs. Based on identified changes in terms of curriculum, regulations and PEOs, the administrative system like Board of Studies, Academic Council and Governing Body may recommend appropriate actions. As per the Outcome Based Education Framework implemented from the Academic Year 2020 - 2021, the following are the Programme Structure, the Programme Contents and the Course Contents of M.Sc. Chemistry Programme.

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VIRUDHUNAGAR
Quality Education with Wisdom and Values

MASTER OF CHEMISTRY (7019)

Outcome Based Education with Choice Based Credit System
Programme Structure - Allotment of Hours and Credits
For those who join in 2023-2024

Components	Semester				Total Number of Hours (Credits)
	I	II	III	IV	
Core Course	6 (5)	6 (5)	6 (5)	6 (5)	24 (20)
Core Course	6 (5)	6 (5)	6 (5)	6 (5)	24 (20)
Core Course	6 (5)	6 (5)	6 (4)	-	18 (14)
Core Course Practical	6 (3)	6 (3)	5 (3)	-	17 (9)
Project	-	-	-	6 (5)	6(5)
Elective Course (DSEC)	6 (4)	6 (4)	-	6 (5)	18 (13)
Elective Course(NME)	-	-	5 (3)	-	5 (3)
Skill Enhancement Course/ Professional Competency Skill	-	-	2 (2)	6 (3)	8 (5)
Self Study Course	-	-	0 (1)	-	0 (1)
Total	**30 (22)**	**30 (22)**	**30 (23)**	**30 (23)**	**120 (90)**
Extra Credit Course(Optional) - Offered by the Department	-	0(2)	-	-	0(2)
Extra Credit Course(Optional) - MOOC	-	-	-	-	Limited to a maximum of 15 credits

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VIRUDHUNAGAR

Quality Education with Wisdom and Values

M.Sc. CHEMISTRY – 7019
PROGRAMME CONTENT

For those who join in the Academic Year 2023- 2024

SEMESTER-I

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course-1	Organic Reaction Mechanism-I	23PCHC11	6	5	3	25	75	100
2	Core Course-2	Structure and Bonding in Inorganic Compounds	23PCHC12	6	5	3	25	75	100
3	Core Course-3	Electrochemistry	23PCHC13	6	5	3	25	75	100
4	Core Course Practical -1	Organic Chemistry Practical	23PCHC11P	6	3	6	40	60	100
5	Discipline Specific Elective -1	Nanomaterials and Nanotechnology/ Material Science/ Pharmacognosy and Phytochemistry	23PCHE11/ 23PCHE12/ 23PCHE13	6	4	3	25	75	100
Total				**30**	**22**				**500**

DSEC: Discipline Specific Elective Course

SEMESTER II

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course-4	Organic Reaction Mechanism-II	23PCHC21	6	5	3	25	75	100
2	Core Course-5	Coordination and Bioinorganic Chemistry	23PCHC22	6	5	3	25	75	100
3	Core Course-6	Quantum chemistry, Statistical and Non-Equilibrium Thermodynamics	23PCHC23	6	5	3	25	75	100
4	Core Course Practical -2	Semi micro Qualitative Analysis and Complexometric Titration Practical	23PCHC21P	6	3	6	40	60	100
5	Discipline Specific Elective -2	Instrumental Techniques in Analytical Chemistry / Polymer Chemistry/ Environmental Chemistry	23PCHE21/ 23PCHE22/ 23PCHE23	6	4	3	25	75	100
Total				**30**	**22**				**500**

DSEC: Discipline Specific Elective Course

EXTRA CREDIT COURSES OFFERED IN II SEMESTER

Code	Title of the Paper	Credits	Exam Hours	Total Marks
23PCHO21	Pharmaceutical Chemistry	2	3	100

SEMESTER III

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credit	Exam Hours	Marks		
							Int	Ext.	Total
1	Core Course-9	Organic Synthesis and Spectroscopy	23PCHC31	6	5	3	25	75	100
2	Core Course-10	Organometallics, Nuclear and Photochemistry	23PCHC32	6	5	3	25	75	100
3	Core Course-11	Group Theory and Molecular Spectroscopy	23PCHC33	6	4	3	25	75	100
4	Core Course - 12	Physical Chemistry Experiments	23PCHC31P	5	3	6	40	60	100
5	Elective Course NME	Advanced Chemistry for Competitive Examinations	23PCHN31	5	3	3	25	75	100
6	Skill Enhancement Course/ Professional Competency Skill	Green Chemistry	23PCHS31	2	2	3	25	75	100
7	Self Study Course	Practice for CSIR NET –General Paper- online	23PGOL32	-	1	2	100	-	100
Total				**30**	**23**				**700**

SEMESTER IV

S.No	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int	Ext	Total
1	Core Course-13	Heterocycles and Natural Products	23PCHC41	6	5	3	25	75	100
2	Core Course-14	Inorganic Spectroscopy and f-block elements	23PCHC42	6	5	3	25	75	100
3	Core Project	Project	23PCHC41PR	6	5	-	40	60	100
4	Discipline Specific Elective Course-3	Chemical Kinetics and Catalysis, Photo, Biophysical and Supramolecular Chemistry	23PCHE41	6	5	3	25	75	100
5	Skill Enhancement Course / Professional Competency Skill	Inorganic Quantitative Analysis and Inorganic Complex Preparation	23PCHS41P	6	3	6	40	60	100
Total				**30**	**23**				**500**

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M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023-2024)

Semester I	**ORGANIC REACTION MECHANISM - I**	**Hours/Week: 6**	
Core Course 1		**Credits: 5**	
Course Code 23PCHC11		**Internal 25**	**External 75**

Course Outcomes:

On completion of the course, students will be able to

CO1: explain electron displacement effects in covalent molecules, energy profile diagram, configuration, aromatic character [K2]

CO2: interpret the methods of determination of reaction mechanism, the effect of structure and configuration on reactivity of organic compounds and their spectral values and the chemistry of novel ring systems. [K3]

CO3: analyze the significance of Hammett equation, stability of reaction intermediates, relationship between symmetry and chirality of stereoisomers, distinction between alternant [K3]

CO4: categorize nucleophilic substitution at various carbon centers, electrophilic, nucleophilic and free radical additions to multiple bonds, α - elimination, β – elimination and pyrolyticcis elimination reactions and stereospecific and stereoselective reactions [K4]

CO5: scrutinize the addition compounds, kinetic and thermodynamic requirements for reaction, erythro and threoisomers, aromatic sextet in different ring systems and the pattern of fragmentation in mass spectrum [K4]

UNIT I

Electron Displacement

Inductive and field effects – bond distance – bond energies – delocalized bonds – cross - conjugation – rules of resonance – resonance energy – resonance effect – steric inhibition of

resonance – Hyperconjugation – hydrogen bonding - addition compounds: EDA complexes – Crown ether complexes – inclusion compounds – Quantitative treatment of the effect of structure on reactivity – The Hammett relationship – significance of reaction and substituent constants – application of the Hammett equation in reaction mechanism – limitations and deviations. **(18 Hours)**

UNIT II

Introduction to Reaction Mechanism

Reaction intermediates – free radicals, carbenes, nitrenes, carbanions, carbocations – formation and stability of reaction intermediates – methods of determination of reaction mechanism: kinetic and thermodynamic control of chemical reactions. Kinetic and non-kinetic methods of determining organic reaction mechanism – Principles of microscopic reversibility – Energy profile diagram – Hammond postulate. **(18 Hours)**

UNIT III

Aromatic Character

Aromatic character in benzene, five, seven and eight membered rings – other systems with aromatic sextets – Huckel's rule – Craig's rule – concept of alternant and non-alternant hydrocarbons, homoaromaticity and anti-aromaticity. Chemistry of cyclopentadienyl anion – Fulvene, Azulene, Tropolones, Sydnones and Annulenes.

Novel ring systems:

Nomenclature of bi-cyclic and tri-cyclic systems – chemistry of adamantane, cubane and catenanes. **(18 Hours)**

Unit IV

Aromatic and Aliphatic Electrophilic Substitution:

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. Partial rate factors – ortho / para ratio - quantitative treatment of reactivity of the electrophile (the selectivity relationship) -Aliphatic electrophilic substitution Mechanisms: SE2 and SEi, SE1- Mechanism and evidence. **(18 Hours)**

Unit V

Stereochemistry – I

Symmetry elements and point group classification – Concept of chirality - necessary and sufficient conditions for chirality – Relationship between substrate symmetry and chirality. Projection formulae –Wedge, Fischer, Sawhorse and Newmann.Optical isomerism due to centre of chirality. Molecules with one stereogeniccentre (chiral centre) and molecules with more than one chiral centre.Properties of enantiomers and diastereoisomers.Erythro and threo nomenclature. Configuration – determination of configuration. Cahn Ingold and Prelog system of designation of configuration.

Geometrical Isomerism:

E-Z nomenclature – determination of configuration of geometrical isomers using physical and chemical methods – stereoisomerism in monocyclic compounds (upto six membered ring).

(18 Hours)

TEXT BOOKS

1. Ahluwalia, V.K. (2015).*Organic Reaction Mechanism.*New Delhi: Narosa Publishing House, 4th Edition.
2. Chatwal, G.R. (2014).*Reaction Mechanism and Reagents in Organic Chemistry.* Mumbai: Himalaya Publishing House, 5th Edition.
3. Parmar & Chawla,(2001). *Reaction Mechanism in Organic Chemistry.* New Delhi:Sultan Chand & Sons, 2nd Edition.
4. D J. March and M. Smith, Advanced Organic Chemistry, 5th edition, John-Wiley and Sons.2001.
5. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959.
6. P.S.Kalsi, Stereochemistry of carbon compounds, 8th edition, New Age International Publishers, 2015.
7. P. Y. Bruice, Organic Chemistry, 7th edn, Prentice Hall, 2013.
8. J.Clayden, N. Greeves, S. Warren, Organic Compounds, 2ndedition, Oxford University Press, 2014.

REFERENCE BOOKS

1. Sykes, P. (2013). *Guidebook to Mechanism in Organic Chemistry.* Singapore: Pearson Education Ltd,6th Edition.
2. Jerry March. (2010).*Advanced Organic Chemistry*. New Jersey: John Wiley & Sons.4th Edition.
3. Gould, E.S. (1959).*Mechanism and Structure in Organic Chemistry.* New York: Henry Holt & Co, 1st Edition.
4. Finar, I.L. (2003).*Organic Chemistry.* Vol.I, Singapore: Pearson Education5thEdition.
5. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th edition, Kluwer Academic / Plenum Publishers, 2007.
6. D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001.
7. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987.
8. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000.
9. I. L. Finar, Organic chemistry, Vol-1 & 2, 6th edition, Pearson Education Asia, 2004.

Course Code 20PCHC11	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1..b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	2	3	2	2	3	2	2	2	1
CO 2	3	3	2	2	2	3	2	2	1	1
CO 3	3	3	2	2	2	2	2	2	3	3
CO 4	3	3	2	2	1	3	2	2	1	1
CO 5	3	3	3	3	2	3	3	3	3	3

3 – Strong, 2 – Medium, 1 - Low

Mrs.R.Nagasathya
Mrs. A.Prasanna
Dr. J. Kavitha — Dr. K.Malathi
Head of the Department — **Course Designers**

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M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023-2024 onwards)

Semester I	**STRUCTURE AND BONDING IN INORGANIC COMPOUNDS**	**Hours/Week: 6**	
Core Course-2		**Credits: 5**	
Course Code 23PCHC12		**Internal 25**	**External 75**

COURSE OUTCOMES

On completion of the course, the students shall be able to

CO1: understand the various types of ionic crystal systems and their structural features [K2].

CO2: apply the radius ratio rule to predict the coordination number of cations and learn about the ions packing in crystals[K3].

CO3: predict the geometry of main group compounds and clusters [K3].

CO4: analyze the crystal growth methods [K4].

CO5: examine the principles of diffraction techniques and microscopic techniques [K4].

UNIT-I: Structure of main group compounds and clusters

VB theory – Effect of lone pair and electronegativity of atoms (Bent's rule) on the geometry of the molecules; Structure of silicates - 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. **(18 Hours)**

UNIT-II: Solid state chemistry – I

Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio rule, Crystal systems and Bravis lattices, Symmetry operations in crystals, glide planes and screw axis; point group and space group; Solid state energetics: Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant. **(18 Hours)**

UNIT-III: Solid state chemistry – II

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. **(18 Hours)**

UNIT-IV: Techniques in solid state chemistry

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. Neutron Diffraction-scattering factor and structure factor-Fourier synthesis-Fourier series. **(18 Hours)**

UNIT-V: Band theory and defects in solids

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.

(18 Hours)

TEXT BOOKS

1. Sathya Prakash, Tuli, G.D.Basu, S.K. Madan, R.D.(2011). *Advanced inorganic chemistry.*Volume I , New Delhi: S.Chand & Company Ltd., 19th Edition.

2. Azaroff, V. (1989). *Introduction to Solids.* New York: Tata Ma Graw-Hill Publishing Company Ltd., 1st Edition.
3. Das, A.K. (2016). *Bioinorganic Chemistry.* New Delhi: Arunabha Sen Books and Allied (P) Ltd., 1st Edition.
4. Madan, R.D. (2018).*Modern Inorganic Chemistry*. New Delhi: S.Chand and Company Pvt.Ltd.,3rd Edition.
5. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014.
6. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.
7. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.
8. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunders company: Philadelphia, 1977.
9. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: NewYork, 1983.

REFERENCE BOOKS

1. Huheey, E. Keitler, A. and Keitler, L. (2006),*Inorganic Chemistry.*New York: Harper, Dorling Kindersley Pvt. Ltd., 4th Edition.
2. Hussain Reddy, K. (2017). *Bioinorganic Chemistry.* New Delhi: New Age International (P) Ltd., Publishers.1st Edition.
3. Cotton, F.A & Wilkinson, G. (2007).*Advanced Inorganic Chemistry*. Singapore: John, Wiley & sons, PTE Ltd., 6th Edition.
4. Purcell, K. F & Kotz. (2010*). Inorganic Chemistry.* US: Cengage Learning India Pvt.Ltd., Boston. 1st Edition.
5. Sharpe, A.G.(2007).*Inorganic Chemistry.* London: Pearson Education Ltd. 3rd Edition.
6. Meissler G.L. and Tarr T.A., (2004) Inorganic Chemistry, Pearson Academy,New Delhi, 3rd Edition.
7. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994.

8. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013.
9. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199.
10. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982.
11. D. F. Shriver, P. W. Atkins and C.H. Langford; Inorganic Chemistry; 3rd ed.; Oxford University Press: London, 2001.

Course Code	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
23PCHC12	**PSO 1.a**	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	3	2	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	2	2	3	3
CO 3	3	3	2	2	3	3	3	2	3	2
CO 4	3	3	2	2	3	3	2	2	2	2
CO 5	3	3	2	3	2	2	3	2	3	2

3 – Strong, 2 – Medium, 1 - Low

Dr. M. Vairalakshmi
Dr.C.Vidya Rani
Course Designers

Dr.J.Kavitha
Head of the Department

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M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023)

Semester I	**ELECTROCHEMISTRY**	**Hours/Week: 6**	
Core Course -3		**Credits: 5**	
Course Code 23PCHC13		**Internal 25**	**External 75**

Course Outcomes

On completion of the course students will be able to:

CO1: To understand the behaviour of electrolytes in solution, compare the structures of electrical double layer of different models and electrode reactions. [K2]

CO2: To predict the activity coefficient, kinetics of electrode reactions applying Butler-Volmer and Tafel equations [K3]

CO3: To study different thermodynamic mechanism of corrosion and energy storage. [K3]

CO4: To discuss the theories of electrolytes, electrical double layer, electrodics, activity coefficient of electrolytes and oxygen, hydrogen evolution. [K4]

CO5: To have knowledge on polarography, voltammetry storage devices and electrochemical reaction mechanism. [K4]

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 ion solvent and ion-ion interactions. Debye-Huckel Bjerrum model. Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes. Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte-qualitative and quantitative verification and limitations. Evidence for ionic atmosphere. Ion association and triple ion formations. **(18 Hours)**

UNIT-II: Electrode-electrolyte interface: Interfacial phenomena -Evidences for electrical double layer, polarizable and non-polarizable interfaces Electro-kinetic phenomena electro-osmosis, electrophoresis, streaming and sedimentation potentials. Structure of double layer: Helmholtz -Perrin, Guoy- Chapman and Stern models of electrical double layer. Zeta potential and potential at zero charge. Applications and limitations. **(18 Hours)**

UNIT-III: Elementary Electrode Reactions: Determination of activity coefficients using Bronsted equation – Applications of conductivity measurements; Nernst equation and its significance – reversible and irreversible cells - electrodes – SHE – Calomel – Glass electrode – Platinum electrode – Glassy carbon electrode – ion selective electrode and measurement of pH. **(18 Hours)**

UNIT-IV: Over voltage and Corrosion: Over voltage – theories of over voltage-applications of over voltage-hydrogen and oxygen overvoltage; Butler-Volmer equation-Tafel equation; Corrosion- principles of electrochemical corrosion – dry and wet corrosion and its mechanism – Pilling-Bedworth rule. Types of corrosion- galvanic, aeration, stress, pitting corrosion and passivity – factor influencing corrosion – corrosion control- cathodic production - corrosion inhibitors. **(18 Hours)**

UNIT-V: Batteries and Fuel cells: Principles of Polorography - Cyclic Voltametry – quasi – reversible – irreversible voltamogram; electrochemical energy conversions-Nickel Cadmium, lead acid battery; Fuel cells – H2 - O2 Fuel cell – methyl alcohol fuel cell. Sodium and lithium-ion batteries and redox flow batteries. **(18 Hours)**

Text Books:

1. D. R. Crow, Principles and applications of electrochemistry, 4thedition, Chapman & Hall/CRC, 2014.
2. J. Rajaram and J.C. Kuriakose, Kinetics and Mechanism of chemical transformations Macmillan India Ltd., New Delhi, 2011.
3. S. Glasstone, Electro chemistry, Affiliated East-West Press, Pvt., Ltd., New Delhi, 2008.

4. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan, Electrochemistry-Principles and applications, S. Viswanathan Printers, Chennai,2007.
Joseph Wang, Analytical Electrochemistry, 2nd edition, Wiley, 2004.

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 Electro chemistry, vol. 2A, Springer, Plenum Press, New York, 2008.
3. Philip H. Rieger, Electrochemistry, 2nd edition, Springer, New York, 2010.
4. L.I. Antropov, Theoretical electrochemistry, Mir Publishers, 1977.
K.L. Kapoor, A Text book of Physical chemistry, volume-3, Macmillan, 2001.

Course Code 23PCHC13	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	2	2	3	3	3	3	1	2	2
CO 2	3	2	2	3	3	3	3	3	2	2
CO 3	3	2	3	3	3	3	3	3	3	2
CO 4	3	2	2	3	3	3	3	3	2	2
CO 5	3	2	2	3	3	3	2	3	2	2

3 – Strong, 2 – Medium, 1 - Low

Dr.A.Anitha

Dr.J.Kavitha
Head of the Department

Dr.N. Ramila Devi
Course Designers

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M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023-2024 onwards)

Semester I	**ORGANIC CHEMISTRY PRACTICAL**	**Hours/Week: 6**	
Core Course Practical-1		**Credits: 3**	
Course Code 23PCHC11P		**Internal 40**	**External 60**

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: To understand the concept of separation techniques, qualitative analysis and preparation of organic compounds. [K2]

CO2:To develop analytical skill in the handling of chemical reagents for separation of binary organic mixtures. [K2]

CO3: To analyze the separated organic components systematically and derivatize them suitably. [K3]

CO4: To construct suitable experimental setup for the organic preparations involving two stages. [K3]

CO5: To experiment different estimation process of organic compounds using various strategies. [K4]

UNIT-I: Separation and analysis:

Two component mixtures

UNIT-II: Estimations:

a) Estimation of Ethyl methyl ketone (iodimetry)
b) Estimation of Glucose (redox)
c) Estimation of Glycine (acidimetry)
d) Estimation of Formalin (iodimetry)

UNIT-III: Two stage preparations:

a) *p*-Bromoacetanilide from aniline

b) *p*-Nitroaniline from acetanilide

c) Acetyl salicyclic acid from methyl salicylate

d) *m*-Nitrobenzoic acid from methyl benzoate

Note: For external practical Separation and Analysis of Two component mixture + Any one preparation of organic compound/ Separation and Analysis of Two component mixture +Estimation of anyone organic compound.

Text Books:

1. A R West, Solid state Chemistry and its applications, 2ndEdition (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, 4th Edition, CRC Press,2012.

Reference Books:

1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994.
2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013.
3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199.

Course Code 23PCHC11P	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	3	3	3	3	3	1	1	2	1
CO 2	3	3	3	3	3	3	1	2	2	1
CO 3	3	3	3	3	3	3	1	2	2	1
CO 4	3	3	2	3	3	3	2	2	2	1
CO 5	3	3	2	3	3	3	2	2	2	1

3 – Strong, 2 – Medium, 1 - Low

Dr. J.Kavitha
Heads of the Department

Dr. K.Malathi
Course Designer

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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VIRUDHUNAGAR - 626 001

M.Sc. CHEMISTRY -7019

(For those who join in the Academic Year 2023-2024)

Semester I	**NANO MATERIALS AND NANO TECHNOLOGY**	**Hours/week: 6**	
DSEC - 1		**Credits: 4**	
23PCHE11		**Internal 25**	**External 75**

Course Learning Outcomes :

On completion of the course, students will be able to

CO1: To understand methods of fabricating nanostructures and their classification and properties. [K2]

CO2: To relate the unique properties of nanomaterials to reduce dimensionality of the material and application of Nano thin films nanocomposites . [K2]

CO3: To sketch out the tools for properties of nanostructures, bonding and structure of the nanomaterials. [K3]

CO4: To uses of the applications of nanomaterials properties of nanomaterial [K3]

CO5: To analyze the properties, applications of health and safety related to nanomaterial. [K4]

UNIT-I: Introduction of nanomaterials and nanotechnologies, Introduction-role of size, classification-0D, 1D, 2D, 3D. Synthesis - Bottom –Up, Top–Down, consolidation of Nano powders. Features of nanostructures, Background of nanostructures. Nanoparticle Size and Properties. Techniques of synthesis of nanomaterials, Tools of the nanoscience. **(18 Hours)**

UNIT-II: b) Synthesis of Nanomaterials:

i) Physical Approach – Arc-discharge method, Laser ablation, High-energy ball milling, Chemical approach - Chemical vapour deposition, Aero-sol synthesis, arc discharge, sol-gel, solvothermal and hydrothermal- Microwave assisted and electrochemical synthesis, sonochemical process, Co-precipitation, Reverse micelles / micro emulsion method.

(18 Hours)

UNIT-III: Mechanical properties of materials, theories relevant to mechanical properties. Electrical properties, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials. Semiconductor materials –Identification of materials as p and n –type semiconductor- Applications of semiconductors. **(18 Hours)**

UNIT-IV: Nano thin films, nanocomposites. Core-shell nanoparticles - types, synthesis, and properties. Nanocomposites - metal-, ceramic- and polymer-matrix compositesapplications. Characterization – SEM, TEM and AFM - principle, instrumentation and applications.

(18 Hours)

UNIT- V: Applications of nanomaterials

i) in energy sector – high energy density batteries

ii) in next generation computer technology: phosphors for high-definition TV, low-cost flat-panel displays iii) for water purification and in food

iv) for environment – Elimination of pollutants

v) Medicinal applications of nanomateials. **(18 Hours)**

Text Books:

1. S.Mohan and V. Arjunan, Principles of Materials Science, MJP 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.

Reference Books

1. S.Mohan and V. Arjunan, Principles of Materials Science, MJP 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.

Course Code	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
23PCHE11	**PSO 1.a**	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	3	3	3	3	3	3	1	2	1
CO 2	3	3	2	3	3	3	3	2	2	1
CO 3	3	3	3	3	3	3	3	2	2	1
CO 4	3	3	3	3	3	3	3	2	2	1
CO 5	3	3	3	3	3	3	2	2	2	1

3 – Strong, 2 – Medium, 1 - Low

Dr.J.Kavitha
Head of the Department

Dr.N. Ramila Dev
Course Designer

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M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023-2024)

Semester	**MATERIAL SCIENCE**	**Hours/week: 6**	
DSEC - 1		**Credits: 4**	
23PCHE12		**Internal 25**	**External 75**

Course Learning Outcomes :

On completion of the course, students will be able to

CO1: To understand and recall the synthesis and characteristics of crystal structures, semiconductors, magnets, nanomaterials and renewable energy materials. [K2]

CO2: To integrate and assess the structure of different materials and their properties. [K2]

CO3: To analyse and identify new materials for energy applications. [K3]

CO4: 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. [K3]

CO5: To design and develop new materials with improved property for energy applications. [K4]

UNIT-I: Crystallography: 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. **(18 hours)**

UNIT-II: Crystal growth methods: 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. **(18 hours)**

UNIT-III: Properties of crystals: 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. **(18 hours)**

UNIT-IV: Special Materials: 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 gian 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 $LiNbO_3$**.** **(18 hours)**

UNIT-V: Materials for Renewable Energy Conversion: 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, CO2 and N2. Manganese based photo systems for water-splitting. Complexes of Rh, Ru, Pd and Pt - photochemical generation of hydrogen from alcohol.

(18 hours)

Text Books:

1. S. Mohan and V. Arjunan, Principles of Materials Science, MJP 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.

Reference Books

1. M.G. Arora, Solid State Chemistry, Anmol Publications, New Delhi, 2001.

2. R.K. Puri and V.K. Babbar, Solid State Physics, S Chand and Company Ltd, 2001.

3.. C. Kittel, Solid State Physics, John-Wiley and sons, NY, 1966.

4. H.P. Meyers, Introductory Solid State Physics, Viva Books Private Limited, 1998.

5. A.R. West, Solid State Chemistry and Applications, John-Wiley and sons, 1987.

Course Code	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
23PCHE12	**PSO 1.a**	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	3	3	3	3	3	3	1	2	1
CO 2	3	3	2	3	3	3	3	2	2	1
CO 3	3	3	3	3	3	3	3	2	2	1
CO 4	3	3	3	3	3	3	3	2	2	1
CO 5	3	3	3	3	3	3	2	2	2	1

3 – Strong, 2 – Medium, 1 - Low

Dr.J.Kavitha
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Dr.N. Ramila Devi
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M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023-2024)

Semester I	**PHARMACOGNOSY AND PHYTOCHEMISTRY**	**Hours/week: 6**	
DSEC - 1		**Credits: 4**	
23PCHE13		**Internal 25**	**External 75**

Course Learning Outcomes :

On completion of the course, students will be able to

CO1: To recall the sources of natural medicines and analysis of crude drugs. [K2]

CO2: To understand the methods of evaluation based on various parameters. [K2]

CO3: To analyze the isolated drugs [K3]

CO4: To apply various techniques to discover new alternative medicines. [K3]

CO5: To evaluate the isolated drugs for various pharmacological activities. [K4]

UNIT-I: Pharmacognosy and Standardization of Herbal drugs: Introduction, definition, development classification and Source of Drugs: Biological, mineral, marine,and plant tissue cultures. Study of pharmacognostic of a crude drug. Biosynthesis: Shikimic acid pathway and acetate pathway. Systematic analysis of Crude drugs. Standardization of Herbal drugs. WHO guidelines, Sampling of crude drug, Methods of drug evaluation. Determination of foreign matter, moisture Ash value. Phytochemical investigations-General chemical tests.

(18 hours)

UNIT-II: Extraction Techniques: General methods of extraction, types – maceration, Decoction, percolation, Immersion and soxhlet extraction.

Advanced techniques- counter current, steam distillation, supercritical gases, sonication, Micro waves assisted extraction. Factors affecting the choice of extraction process.

(18 hours)

UNIT-III: Drugs containing Terpenoids and volatile oils: Terpenoids: Classification, Isoprene rule, Isolation and separation techniques, General properties Camphor, Menthol, Eucalyptol. Volatile Oils or Essential Oils: Method of Preparations, Classifications of Volatile oils, Camphor oil, Geranium oil, Citral- Structure uses. Pentacyclic triterpenoids: amyrines; taraxasterol: Structure and pharmacological applications. **(18 hours)**

UNIT-IV: Drugs containing alkaloids: Occurrence, function of alkaloids in plants, pharmaceutical applications. Isolation, Preliminary Qualitative tests and general properties. General methods of structural elucidation. Morphine, Reserpine, papaverine - chemical properties, structure and uses. papaverine - structure, chemical properties and uses.

(18 hours)

UNIT-V: Plant Glycosides and Marine drugs: Glycosides: Basic ring system, classification, isolation, properties, qualitative analysis. Pharmacological activity of Senna glycosides, Cardiac glycosides-Digoxin, digitoxin, Steroidal saponins glycosides- Diosgenin, hecogenin. Plant pigments: Occurrence and general methods of structure determination, isolation and synthesis of quercetin and cyanidin chloride. Marine drugs -Selected Drug Molecules: Cardiovascular active substances, Cytotoxic compounds, antimicrobial compounds, antibiotic compounds, Anti-inflammatory agents. Marine toxins**.** **(18 hours)**

Text Books:

1. Gurdeep R Chatwal (2016), Organic chemistry of Natural products, Volume I&II, 5th edition, Himalaya publishing House.
2. S.V.Bhat, B.A. Nagasampagi, M.Sivakumar (2014), Chemistry of Natural Products, Revised edition, Narosa Publishers.

Reference Books:

1. Jeffrey B. Harborne (2012), Phytochemical methods: A Guide to Modern Techniques of Plant Analysis, 4th edition, Indian reprint, Springer.
2. Ashutoshkar (2007), Pharmacognosy and Pharmacobiotechnology, 2 nd edition, New age international (P) limited, New Delhi.

Course Code 23PCHE13	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	1	1	1	1	2	1	1	1	1	2
CO 2	2	1	1	1	1	2	1	1	1	1
CO 3	1	1	2	1	1	1	1	2	1	1
CO 4	2	1	1	1	1	2	1	1	1	1
CO 5	2	1	2	1	1	2	1	2	1	1

3 – Strong, 2 – Medium, 1 - Low

Dr.J.Kavitha
Head of the Department

Dr.J.Kavitha
Course Designer

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M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023-2024 onwards)

Semester II	**ORGANIC REACTION MECHANISM-II**	**Hours/Week: 6**	
Core Course-4		**Credits: 5**	
Course Code 23PCHC21		**Internal 25**	**External 75**

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: correlate the optical isomerism in molecules with no chiral centers, conformations of acyclic and cyclic systems with their physical and chemical properties, nucleophilicity and basicity, nucleophilic substitution and Elimination reactions. [K2]

CO2: correlate the optical isomerism in molecules with no chiral centers, conformations of acyclic and cyclic systems with their physical and chemical properties, nucleophilicity and basicity, electrophilic, nucleophilic and free radical additions and aromatic electrophilic and nucleophilic substitution reactions. [K3]

CO3: describe prochirality and prostereoisomerism, the conformations of acyclic and Cyclic systems and the basic concepts of substitution, addition and elimination reactions. [K3]

CO4: predict the nomenclature of prostereoisomers, interpret Cram and Prelog rules, Curtin - Hammett principle, neighbouring group participation of n, π and σ electrons and the stereochemical factors in substitution, addition and elimination reactions. [K4]

CO5: interpret the concepts of NMR to assign and ascertain the types of protons and carbon frame work in organic compounds, mechanism of reactions and the usage of activating and blocking groups in synthesis. [K4]

UNIT I

Nucleophilic substitution and Elimination reactions

Aliphatic Nucleophilic substitution:

Nucleophilicity and basicity – S_N1 and S_N2 mechanisms – effect of substrate structure – effect of the attacking nucleophile – effect of the leaving group – effect of the reaction medium – ambident nucleophiles – ambident substrates – neighbouring group participation of n, π and σ electrons – S_Ni mechanism – nucleophilic substitution at an aliphatic trigonal carbon – nucleophilic substitution at allylic carbon – nucleophilic substitution at vinyl carbon.

Aromatic Nucleophilic substitution:

Aromatic nucleophilic substitution reactions - S_N1Ar, S_N2 and benzyne mechanisms.

Elimination reactions:

α - elimination - β - elimination - E1, E2 and E1cB mechanisms - stereochemistry of elimination - orientation of the double bond - effect of change in the substrate, base, leaving group and medium on E1, E2 and EIcB reactions. (18 Hours)

UNIT II

Addition to multiple bonds:

Electrophilic, nucleophilic and free radical additions - addition to conjugated systems - orientation of the addendum - stereochemical factors in reactions like addition of hydrogen, halogens, hydrogen halides and hypohalous acids hydroboration and hydroxylation – epoxidation. Addition to carbonyl groups - mechanism of Aldol condensation - Perkin reaction - Knoevenagel reaction –Mannich reaction- Cannizzaro reaction - Benzoin condensation - Claisen ester condensation - Darzen's reaction - Reformatsky reaction - Wittig reaction - Grignard reactions. Addition to α , β - Unsaturated carbonyl groups - Michael addition - Diels - Alder reaction - Esterification of acids and hydrolysis of esters. (18 Hours)

UNIT III Stereochemistry II

Prochirality and prostereoisomerism, enantiotopic and diastereotopic ligands and faces and their nomenclature - pro - R and pro-S and Re and Si faces. Stereospecific and stereoselective reactions. Asymmetric synthesis : Cram and Prelog rules. Optical isomerism due to axial chirality - biphenyls, allenes and spiranes. Molecules with planar chirality - paracyclophanes, trans-cyclooctene, ansa compounds. (18 Hours)

UNIT IV Conformational analysis

Configuration and conformation - conformations of ethane and n-butane - conformational analysis - stereoelectronic and steric factors - conformation of simple acylic compounds - conformation of monosubstituted and disubstitutedcyclohexanes - correlation of the conformation of acyclic and cyclic systems with their physical and chemical properties - conformational free energy - Curtin - Hammett principles - Quantitative treatment of mobile system - Eliel-Ro equation- conformations and reactivity of cyclohexanones - conformational analysis of aldohexopyranoses-conformation of fused ring system-decalin- conformational effects in medium sized rings –concept of I strain. (18 Hours)

UNIT V

Photochemistry and Pericyclic reaction

Conservation of orbital symmetry – construction of molecular orbital and symmetry elements to simple molecules like 1,3-butadiene, 1,3,5-hexatriene, cyclobutene, cyclohexadiene- electrocyclic reactions – cycloaddition reactions and sigmatropic rearrangements reactions– applications of FMO approach, Correlation approach-Huckel–Mobius approach-(dis- and con- rotatory ring closure of 1,3-butadiene, 1,3,5-hexatriene and $(2\pi+2\pi)$, $(4\pi+2\pi)$ cycloaddition reactions.

Photochemical reactions of ketones – photosensitization – Norrish I and Norrish II type reactions – Paterno-Buchi reaction – photo oxidation – photo reduction.

Radical Initiated Reactions-Barton, Sandmeyer, Gomberg - Bachmann, Pschorr, Ullmann, and Hundsdieckerreactions. (18Hours)

TEXT BOOKS

1. Ramesh, P. (2005).*Basic Principles of Organic Stereochemistry.* Madurai: Meenu Publishers, 1st Edition.
2. Ahluwalia, V.K. (2015).*Organic Reaction Mechanism.*New Delhi: Narosa Publishing House, 4th Edition.
3.Chatwal, G.R. (2014). *Reaction Mechanism and Reagents in Organic Chemistry.* Mumbai: Himalaya Publishing House, 5th Edition.
4. Parmar & Chawla, (2001). *Reaction Mechanism in Organic Chemistry.* New Delhi: Sultan Chand & Sons, 2nd Edition.

REFERENCE BOOKS

1. Eliel, E. Wilen,S.H. & Mander, L.N. (2008).*Stereochemistry of Organic Compounds.* New Jersey: John Wiley &sons,1st Edition.
2. Finar, I.L. (2003). *Organic Chemistry.* Vol.II, Singapore: Pearson Education, 5th Edition.
3. Nasipuri, D. (2004).*Stereochemistry of Organic Compounds.* New Delhi: New Age International (P) Ltd., 2ndEdition.
4. Kalsi, P.S. (2015).*Stereochemistry, Conformation and Mechanism.* New Delhi: New Age International Publishers, 8thEdition.
5. Jerry March, (2010). *Advanced Organic Chemistry.* New Jersey: John Wiley & Sons,4th Edition.
6. Gould, E.S. (1959). *Mechanism and Structure in Organic Chemistry.* New York: Henry Holt & Co., 1stEdition

Course Code	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
23PCHC21	**PSO 1.a**	**PSO 1..b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	3	1	3	3	3	3	3	2	2
CO 2	3	2	2	3	3	3	3	3	2	2
CO 3	3	2	2	3	3	3	3	3	2	2
CO 4	3	3	2	3	3	3	3	3	2	2
CO 5	3	3	2	3	3	3	3	3	2	2

3 – Strong, 2 – Medium, 1 – Low

Dr. J.Kavitha

Head of the Department

Mrs.R.Nagasathya
Mrs.A.Prasanna
Dr. K. Malathi

Course Designers

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M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023-2024 onwards)

Semester II	**COORDINATION AND BIOINORGANIC CHEMISTRY**	**Hours/Week: 6**	
Core Course-5		**Credits: 5**	
Course Code 23PCHC22		**Internal 25**	**External 75**

COURSE OUTCOMES

On completion of the course, the students shall be able to

CO1: understand the concepts involved in bonding and stability of coordination compounds, magnetic properties of metal complexes and bioinorganic chemistry.[K2]

CO2: predict the basic features of LFT and CFT of co-ordination compounds, agnetic properties of lanthanides and actinides and bioinorganic compounds.[K3]

CO3: apply LFT,CFT, MOT, Magnetic properties of transition metal complexes, bioenergetics and ATP cycle and molecular mechanism of ion transport across the membrane in bioinorganic chemistry. [K3]

CO4: analyze the structure, stability and reactivity of coordination and inorganic Compounds, Calculation of CFSE in octahedral and tetrahedral complexes, Comparison of magnetic properties of Oh, Td and square planar complexes, hemoglobin and myoglobin and mechanistic studies of Cytochrome C oxidase . [K4]

CO5: evaluate the structure, stability and reactivity of coordination and inorganic compounds, magnetic properties of metal complexes and bioinorganic chemistry.[K4]

UNIT I - Bonding in Coordination Compounds

CFT and LFT: Basic features of CFT and LFT. Splitting of the metal *d*- orbitals in tetrahedral,octahedral and square planar symmetries –CFSE: Calculation of CFSE in octahedral and tetrahedral complexes –Factors affecting crystal field splitting- Spectral properties - Spectrochemical series - calculation of spin only magnetic moments-quenching of orbital magnetic moments– Kinetic properties.

MOT: σ-bonding and π-bonding in octahedral complexes - Effect of π-bonding on the value of (10Dq). MOT for square planar (16 e^-) and tetrahedral (18 e^-)complexes. Application of MOT to spectrochemical series (18 Hours)

UNIT II - Stability and Reactions of Co-ordination Compounds

Stability of complexes: Thermodynamic and kinetic stabilities -stepwise and overall stability constants of the metal complexes – factors affecting stability – chelate and template effects - Determination of stability constants and composition of the complexes: Bjerrum's method, potentiometric determination, spectrophotometric method, ion-exchange method, polarographic method, continuous variation (Job's) method.

Reactions of complexes: Lability – inertness – Ligand substitution reactions of square planar complexes – Trans effect– Theories of trans effect – use of trans effect in synthesis of complexes– Substitution reactions in octahedral complexes – acid hydrolysis, base hydrolysis and anation reactions – Electron transfer reactions – Inner sphere and outer sphere processes– complementary and non-complementary reactions. (18 Hours)

UNIT III - Magnetic Properties of Metal Complexes

Magnetic Susceptibility – Types of Magnetic behaviours – Magnetically diluted and concentrated materials – Determination of magnetic susceptibility: Guoy Balance and Faraday methods – temperature dependence of magnetic susceptibility – Quenching of orbital contribution and effect of Spin – orbit coupling to magnetic moment – Magnetic properties of complexes with A, E and T terms; Magnetic properties of Lanthanides and Actinides – Comparison of magnetic properties of Oh, Td and square planar complexes of Fe(II), Co(II), Ni(II) and Cu(II). (18 Hours)

Unit IV - Bio-inorganic Chemistry-I

Essential and trace elements in biological systems -Porphyrin ring system – metalloporphyrins – hemoglobin and myoglobin – structures and work functions – synthetic oxygen carries – cytochromes – structure and work function in respiration – chlorophyll – structure – photosynthetic sequence –bioenergetics and ATP cycle- Electron Transfer System: Iron sulphur proteins (non-heme iron protein) – Copper containing proteins – classification – blue copper proteins – structure of blue copper electron transferases – copper proteins as oxidases – cytochrome C oxidase – mechanistic studies of Cytochrome C oxidase – Hemocyanin. (18 Hours)

Unit V Bio-inorganic Chemistry-II

Carboxypeptidase A: structure, function – carbonic anhydrase – inhibition and poisoning – corin ring system – vitamin B12 and B12 coenzymes – *in-vivo* and *in-vitro* nitrogen fixation – essential and trace elements in biological systems – metal ion toxicity and detoxification – molecular mechanism of ion transport across the membrane – sodium and potassium ions pumps – chelate therapy – *cis*platin. (18 Hours)

TEXT BOOKS

1. Soni, P.L.(2016).*Coordination Chemistry*.New Delhi:Ane Books Pvt.Ltd.,1st Edition.
2. Gopalan, R.& Ramalingam, V. (2003).*Concise Coordination Chemistry*. New Delhi:Vikas Publishing House Pvt.Ltd.,1st Edition.
3. Sarkar, R. (2009).*General and Inorganic Chemistry*.New Delhi: New Central Book Agency, Pvt.Ltd.,1st Edition.

REFERENCE BOOKS

1. Sathya Prakash, Tuli, G.D,Basu. S.K, Madan, R.D.(2008). *Advanced Inorganic Chemistry*.Volume - I , New Delhi: S.Chand & Company Ltd., 2nd Edition.
2. Huheey, E. Ellen Keitler, A. & Richard Keitler, L. (2006). *Inorganic Chemistry*. New York:Dorling Kindersley Pvt. Ltd., 4th Edition.
3. Cotton, F.A.& Wilkinson, G. (2007). *Advanced Inorganic Chemistry*.Singapore: John Wiley& sons, PTE Ltd., 6th Edition.

4. Lee, J.D. (2007).*Concise Inorganic Chemistry*.Australia:Black Well Publishing Company, 5thEdition.
5. Puri B.R, Sharma L. R, Kalia K.C (2007).*Principles of Inorganic Chemistry*.Milestone Publishers & Distributors, 1th Edition.
6 . I.Bertini et al. (1998) Bioinorganic Chemistry, Viva Books Private Ltd., Chennai.

Course Code 23PCHC22	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	3	3	3	3	2	3	3	3	2
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CO 3	3	3	2	3	3	3	3	2	3	2
CO 4	3	3	3	3	3	3	3	2	3	2
CO 5	3	3	3	3	3	3	3	2	3	2

3 – Strong, 2 – Medium, 1 - Low

Dr. M. Vairalakshmi
Dr.J.Kavitha Dr.C.Vidya Rani
Head of the Department Course Designers

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M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023-2024 onwards)

Semester II	**QUANTUM CHEMISTRY, STATISTICAL AND NON-EQUILIBRIUM THERMODYNAMICS**	**Hours/Week: 6**	
Core Course-6		**Credits: 5**	
Course Code 23PCHC23		**Internal 25**	**External 75**

COURSE OUTCOMES

On completion of the course, the students shall be able to

CO1: discuss the basic concepts of quantum chemistry, statistical and non equilibrium thermodynamics. [K2]

CO2: Make use of the applications of quantum chemistry and predict ensemble averaging , thermodynamic properties of partition functions, heat capacity behavior of solids, entropy production. [K3]

CO3: apply the concepts of quantum chemistry and statistical and non-equilibrium thermodynamics[K3]

CO4: analyze approximation methods in quantum chemistry and identify relation of irreversible thermodynamics with biological systems. [K4]

CO5: develop applications of Polorography, electrochemical energy conversions, statistical entropy and Onsager's theory. [K4]

UNIT I The Birth Of Quantum Mechanics

Deviations from classical mechanics - Planck's concept of black-body radiation – de-Broglie's concept of matter waves – Heisenberg's uncertainty principle and complementarity. Operators – Linear operators – commutation relations – Method of getting the following

quantum mechanical operators – Position, Momentum, Kinetic energy, Potential energy, Total energy and Angular momentum – Ladder operator.

Postulates of quantum mechanics – Hermicity and proving that quantum mechanical operators are Hermitian – Eigen value and Eigen function – Orthogonality and Normalization of wave functions. (18 Hours)

UNIT II Application of Quantum Mechanics to Simple Systems

Derivation of Schrodinger wave equation – Application to SWE to simple systems – Free particle – Particle moving in one dimensional box – Particle moving in 3D box - Particle moving in a Ring – Rigid rotator – Spherical harmonics – Simple Harmonic Oscillator – Hermite Polynomials – Hydrogen atom problem – radial wave function – Radial Probability Distribution – Shapes of various atomic orbitals. (18 Hours)

UNIT III Approximation methods in Quantum Mechanics:

Need for approximation methods – Schrodinger equation for Helium atom and many electron systems – The Time independent Perturbation theory (first order only) – Application to Hydrogen atom – Variation theorem – Application to Hydrogen and Helium atom – Hartee-Fock-Self Consistent(HFSCF) method of many electron system – Application to Helium atom – Electron spin and Pauli principle – Antisymmetric nature of wave functions – Slater determinants – Born-Oppenheimer approximation – Born-Oppenheimer break-down – VB and MO theories. (18 Hours)

UNIT IV

STATISTICAL THERMODYNAMICS

Concept of distribution, Thermodynamic probability and entropy, Maxwell-Boltzmann most probable distribution – Ensemble averaging – Postulates of ensemble averaging – Canonical – Grand canonical and microcanonical ensembles.

Partitions functions – translational, rotational vibrational and electronic partition functions – calculation of thermodynamic properties in terms of partition functions – Applications of partition functions.

Heat capacity behavior of solids – Chemical equilibria and Equilibrium constant in terms of partition functions - Fermi-Dirac statistics, Bose-Einstein's statistics. (18 Hours)

UNIT V

NON-EQUILIBRIUM THERMODYNAMICS - I:

Introduction – Conservation of mass and energy – Entropy production – Entropy production in heat flow, Entropy production in chemical reaction, Entropy production and entropy flow in open system – Forces and fluxes – Phenomenological Laws and Onsager Reciprocal Relations – Principle of microscopic reversibility and Onsager Reciprocal relation. Linear laws - Transformation properties of rates and affinities-Transference in aqueous solutions of electrolytes – Stationary non-equilibrium states – Irreversible thermodynamics to biological systems – Non-linear thermodynamics of irreversible process. (18 Hours)

TEXT BOOKS

1. Puri **,**B.R. Sharma .L. R and Pathania .M.S .(2003)**.***Principles of Physical Chemistry.*New Delhi **:**Vishal Publishing Co**,** 1st Edition.
2. Gurdeep Raj,S.(2003). *Advanced Physical Chemistry.*Meerut: Goel Publishing Co. 25thEdition.
3. Bajpai, D.N. (2011).*Advanced Physical Chemistry*.New Delhi**:** S.Chand& Co.,Ltd.,1st Edition.
4. Rajaram, J. & Kuriakose, J.C. (2003).*Thermodynamics.* New Delhi: Shoban Lal Nagin, Chand & Co., Ltd., 3rdEdition.
5. Glasstone, S.(2008).*Thermodynamics for Chemists.* New Delhi**:** East-West Press (P) Ltd.,1st Edition.

REFERENCES BOOKS

1. Atkins, P.W. (2001).*Physical Chemistry*.Tokyo: Oxford University Press, 6th Edition.
2. Castellan, G.W. (2011) *Physical Chemistry.* New Delhi: Narosa Publishing House, , 2nd Edition.
3. Glasstone, S.(2006) *An Introduction to Electrochemistry.* New Delhi: East-West Press Pvt. Ltd., 1st Edition.

Course Code	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
23PCHC23	**PSO 1.a**	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3.b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	3	2	2	3	3	3	2	2	2
CO 2	3	3	3	2	3	3	3	2	2	2
CO 3	3	3	3	2	3	3	3	2	2	2
CO 4	3	3	3	2	3	3	3	2	2	2
CO 5	3	3	3	2	3	3	3	2	2	2

3 – Strong, 2 – Medium, 1 - Low

Dr.J.Kavitha
Dr.Anitha
Dr. N.Ramiladevi
Course Designers

Dr.J.Kavitha
Head of the Department

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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VIRUDHUNAGAR - 626 001

M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023-2024 onwards)

Semester II	**SEMI MICRO QUALITATIVE ANALYSIS AND COMPLEXOMETRIC TITRATION PRACTICAL**	**Hours/Week: 6**	
Core Course Practical-2		**Credits: 3**	
Course Code 23PCHC21P		**Internal 40**	**External 60**

COURSE OUTCOMES

On completion of the course, the students shall be able to

CO1: Apply systematic procedure and find out the familiar cations present in the given mixture of salts. [K2]

CO2: Apply systematic procedure and find out the less familiar cations present in the given salt mixture.[K2]

CO3: Calculate the amount of Nickel ions present in the given solution by direct and indirect EDTA volumetric methods. [K3]

CO4: Examine the amount of metal ions such as like Zinc, Magnesium and Copper present in the given solution by EDTA volumetric method ad compare the result with the standard solution. [K3]

CO5: Develop the laboratory skill to deduct any unknown metal ions both by quantitative and qualitative analysis. [K4]

I **Semi – micro qualitative analysis:**

Analysis of mixtures containing two less familiar cations and two familiar cations from the following:

W, Se, Te, Mo, Ce, Zr, V and Li, Pb, Bi, Cu, Ni, Mn, Ba, Cd, Mg, Zn, Sr (Maximum Five Mixtures)

II. Complexometric Titrations with EDTA

1. Estimation of ZINC

2. Estimation of MAGNESIUM

3. Estimation of COPPER

4. Estimation of NICKELa) By Direct Method b) By Indirect Method

Course Code 23PCHC21P	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1.a	**PSO 1.b**	**PSO 2**	**PSO 3.a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	2	2	3	3	3	3	2	3	2
CO 2	3	2	3	3	3	3	3	2	3	2
CO 3	3	2	3	3	3	3	3	2	3	2
CO 4	3	2	3	3	3	3	3	2	3	2
CO 5	3	2	3	3	3	3	3	2	3	2

3 – Strong, 2 – Medium, 1 - Low

Dr.J.Kavitha
Dr. J. Kavitha — Dr.M.Vairalakshmi
Head of the Department — Course Designers

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M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023-2024 onwards)

Semester II	**INSTRUMENTAL TECHNIQUES IN ANALYTICAL CHEMISTRY**	**Hours/Week: 6**	
DSEC - 2		**Credits: 4**	
Course Code 23PCHE21		**Internal 25**	**External 75**

COURSE OUTCOMES

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

CO1: Knowledge of lab safety measures and the handling of chemicals, error analysis and the data treatment method. Understand the types of chemical reagents and the choice of Indicators.[K2]

CO2: Illustrate the methods of precipitation, Volumetric and the gravimetric analysis, and the principles of TGA, DSC, DTA.[K3]

CO3: Interpret the measurement of conductometric and coulometric titrations, separation and the extraction techniques. Summarize the electrochemical cell and the voltametric methods. [K3]

CO4: Analyze the Polorography method and the application of thermogravimetic methods. Analyze the F-Test, Q-Test and the T-Test[K4]

CO5: Summarize the steps involved in Electrochemical sensor, thermogravimetry, electrogravimetry and the measurement of dissociation constant [K4]

Unit-I

Principle of GLP and handling of first aid and safety, storage and handling of chemicals, threshold vapour concentration, accuracy, precision, sensitivity, specificity, standard deviation,

classification of errors and their minimization, significant figures, criteria for rejection of data, Q-test,T test and F-test, control chart, sampling methods, sampling error, statistical data

treatment, standard reference materials. Analar reagents, granular reagents, commercial reagents. (18 Hours)

Unit-II

Principle of volumetric analysis, theories of acid-base, redox, complexometric, and iodimetric titrations, buffer solutions, theories of indicators, acid-base indicators, choice of indicators, redox-metal ion and adsorption indicators, metal ion indicators and their characteristics, limitations of volumetric analysis.

concept of solubility product, common ion effect and their applications in qualitative and volumetric analyses, principles of gravimetric analysis, theories of precipitation, precipitation from homogenous medium, co-precipitation and post precipitation reactions. (18 Hours)

Unit-III

Distillation, solvent extraction and separation processes, partition chromatography,column chromatography, thinlayer chromatography (TLC), paper chromatography and their applications.

Ion exchange chromatography: principle, instrumentation with applications.

Principles, instrumentation and applications of GC, LC, and HPLC, signal to noise ratio, sources of noise in instrumental analysis. (18 Hours)

Unit-IV

Specific and molar conductances, Kohlrausch's law, measurement of dissociation constant, coulometric and conductometric titrations.

Galvanic cells: Introduction to electrochemical cells, standard electrode potential, electrochemical series, Nernst equation.

Potentiometry, ion-selective electrodes, polarography and

voltammetry principles, modified voltametric methods, cyclic voltammetry, amperometry, anodic stripping voltammetry.

Electrochemical sensors, modified electrodes and their applications, electronic tongue, principle, instrumentation, operation and applications. (18 Hours)

Unit-V

Thermoanalytical methods: principles of thermogravimetric analysis and differential thermal analysis, characteristics of TGA and DTA, thermograms, factors affecting TGA and DTA curves, instrumentation, applications of thermogravimetry, applications of DTA, thermometric titration, electrogravimetry, principle and applications. (18 Hours)

TEXT BOOKS

1. Skoog,D.A., West,D.M. and Hollar.F.J,(2014). *Fundamentals of Analytical Chemistry.* U.K: Harcourt College Publishers, 9th Edition.
2. Usharani,S. (2000). *Analytical Chemistry*.Chennai: Macmillan India Ltd, 1st Edition.
3. Srivastava, A.K &Jain.P.C. (2009). *Instrumental Approach to Chemical Analysis.* New Delhi: S.Chand & Company Ltd., 4th Edition.

REFERENCE BOOKS

1. Gopalan,R., Subramanian,P.S., Rengarajan,K. (2016).*Elements of Analytical Chemistry.* New Delhi: Sultan Chand & Sons., 1st Edition.
2. Sharma,B.K. (2015).*Instrumental Methods of Chemical Analysis.*New Delhi: Krishna Prakashan Media Pvt.Ltd., 30th Edition.
3. Ahluwalia,V.K. (2016).*Instrumental Methods of Chemical Analysis*. New Delhi: Ane Books Pvt.Ltd.,1st Edition.

Course Code 23PCHE21	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	1	3	3	3	3	2	2	1
CO 2	3	3	1	3	3	3	3	2	2	1
CO 3	3	3	1	3	3	3	3	2	2	1
CO 4	3	3	1	3	3	3	3	2	2	1
CO 5	3	3	1	3	3	3	3	2	2	1

3 – Strong, 2 – Medium, 1 - Low

Dr. N.Ramiladevi
Dr.J.Kavitha
Course Designers

Dr.J.Kavitha
Head of the Department

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M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023-2024 onwards)

Semester II	**POLYMER CHEMISTRY**	**Hours/Week: 6**	
DSEC -2		**Credits: 4**	
Course Code 23PCHE22		**Internal 25**	**External 75**

COURSE OUTCOMES

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

CO1: understand the classification of polymers. [K2]

CO2: apply the kinetics of polymerization techniques. [K3]

CO3: illustrate the preparation of individual polymers. [K3]

CO4: outline the properties of polymers and various techniques for processing polymers. [K4]

CO5: evaluate the polymerization techniques, degradation and uses of polymers. [K4]

UNIT I Classification of polymers and chemistry of polymerization

Classification of polymers: Linear polymers, non-linear or branched polymers, cross– linked polymers, homo chain and hetero chain, homo polymers, co-polymers, block polymers and graft polymers.

Chemistry of polymerization: Types of polymerization–mechanism–chain, growth, free radical, ionic, co-ordination, ring opening, group transfer, poly addition and poly condensation polymerizations. (18 Hours)

UNIT II Individual polymers

Monomers required for general methods of preparation, repeat units and uses of the following polymers and resins – polyethylene, polystyrene, polyacrylonitrile, polymethylacrylate, PVC, polytetrafluoroethylene, polyisoprenes, polybutadienes and polychloroprene, polyesters, polycarbonates, polyimides, polyamides(Kelvar),

polyurethanes, polyethylene glycols, phenol-formaldehyde, urea-formaldehyde, melamine formaldehyde and epoxyresins– silicone polymers. (18 Hours)

UNIT III Properties of polymers

Intrinsic properties–processing properties–article properties–basic idea of isomerism of polymers–configuration of polymer chain–geometrical structure–syndiotatic, isotatic and atatic polymers.

Glass transition temperature–Definition –factors affecting glass transition temperature–relationshipsbetweenglasstransitiontemperatureand(a)molecularweight,(b)meltingpoint and (c) plasticizer – importance of glass transition temperature– heat distortion temperature.

Molecular weight and size of polymers: Number average, weight average, sedimentation and viscosity average molecular weights–molecular weights and degree of polymerization– poly dispersity–molecular weight distribution in polymers–size of polymer molecules– kinetics of polymerization (18 Hours)

UNIT IV Polymerization techniques, degradation and uses of polymers

Polymerization techniques: Bulk, solution, suspension, emulsion, melt condensation and interfacial poly condensation polymerizations.

Degradation: Types of degradation–thermal, mechanical, ultrasonic and photo degradation–photo stabilizers–oxidative degradation–antioxidants–hydrolytic degradation. Uses of polymers in electronics and biomedicine. (18 Hours)

UNIT V Polymer processing

Polymer processing – plastics (thermo and thermosetting), elastomers, fibres, compounding, plasticizers, colorants, flameretardants. Compression and injection mouldings–film extrusion and calendaring –diecasting and rotational casting–thermoforming– reinforcing. (18 Hours)

TEXT BOOKS

1. Billmeyer, F.W.(2009).*Textbook of PolymerScience.*New Jersey:John Wileyand Sons, 3rd Edition.
2. Jain & Jain.(2013).*Engineering Chemistry.* New Delhi:Dhanpat Rai Publishing Company (P) Ltd,16th Edition.
3. Jayashree Ghosh.(2013).*Fundamental Concepts of Applied Chemistry.*New Delhi: S.Chand & Company Ltd, 1st Edition.

REFERENCEBOOKS

1. Gowariker, V.R, Viswanathan, N.V. &Jayadev Sreedhar. (2009).*Polymer Science.* New Delhi: New Age International Publishers, 1st Edition.
2. Sharma.B.K,(1989).*Polymer Chemistry.*Meerut: Goel PublishingHouse, 1st Edition.
3. Bhatnagar. M.S. (2004).*A Text Book of Polymers* .Vol I,New Delhi: S.Chand & Company Ltd, 1st Edition.
4. Arora .M.G. Singh.M. (1996). *Polymer Chemistry.* New Delhi: Anmol Publications Pvt.Ltd.,1st Edition.
5. Davis.F.J. (2011).*Polymer Chemistry.* US: Oxford University Press.

Course Code (23PCHE22)	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	1	3	3	3	1	2	2	1
CO 2	3	3	1	3	3	3	1	2	2	1
CO 3	3	3	1	3	3	3	1	2	2	1
CO 4	3	3	1	3	3	3	1	2	2	1
CO 5	3	3	1	3	3	3	1	2	2	1

3 – Strong, 2 – Medium, 1 - Low

Dr. J. Kavitha
Head of the Department

Dr.J.Kavitha
Course Designer

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M.Sc. CHEMISTRY

(For those who join in the Academic Year 2023-2024 onwards)

Semester II	**ENVIRONMENTAL CHEMISTRY**	**Hours/Week: 6**	
DSEC -2		**Credits: 4**	
Course Code 23PCHE23		**Internal 25**	**External 75**

COURSE OUTCOMES

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

CO 1 : understand the chemical concepts involved in dairy, leather and polymer products ; chemistry involved in paint, pigments, energy resources and biofuels. [K2]

CO 2 : apply knowledge in the manufacturing processes of industrial products. [K3]

CO3 : analyse purity of industrial products. [K3]

CO4: apply the concept to harvest more energy from the natural resources and produce quality products. [K4]

CO5: analyse the novel industrial products. [K4]

Unit - I

Dairy Chemistry

Composition and structure of milk - milk lipids –fat globules –milk enzymes –vitamins – minerals - physical properties of milk –effect of heat –milk processing –clarification – pasteurization - homogenisation –milk products - cream, butter, ice cream, milk powder and ghee. (18 hours)

Unit - II

Leather Chemistry

Introduction –structure of hide and skin –leather processing –process before tannage – flaying and curing –tanning process –methods of tanning –vegetable tanning –chrome

tanning –aldehyde tanning –finishing processes after tanning –Tannery effluent and by –product problems –treatment of tanning wastes. (18 hours)

Unit - III

Polymer Chemistry

History and significance of polymers- characteristics of polymers-Identification of polymers –polymers as adhesives –fillers –reinforcements-common plastic polymers used in packaging –PET,HDPE, PVC ,LDPE and PP-Revelation of polymer conductivity –doping –potential applications of conductivity polymers-polymers in lenses –biodegradable polymers-composition of biodegradable plastics –starch –based plastics –bacteria –based plastic – Soy –based plastics –biodegradable polyesters –PHA,PLA, PCL, PBS,AAC copolymers and modified PET –applications of biodegradable polymers –medical sutures, pins and dental implants. (18 hours)

Unit - IV

Pigments and Paints

(a) White pigments –white lead, Zinc oxide, lithopone, titanium dioxide –
characteristics and uses.

Blue pigments: ultra marine blue , cobalt blue and iron blue – characteristics & uses

Red pigments: Red lead, synthetic iron oxide - characteristics & uses

Green pigments: Chrome green, Reinmann's green –uses.

(b)P**aints :** Requirements of a good paint –constituents of paint- manufacture of paints –emulsion paints –latex paints –varnishes –manufacture and uses –lacquers (18 hours)

Unit - V

Energy resources and Biofuels:-

Chemical / Electrochemical and solar energy system- conventional and non –correctional energy resources, biomass and biochemical routes- hydrogen storage.

Biofuels-introduction, types of bio fuels (bioethanol and biodiesel)- raw materials for the synthesis of bio fuels, properties of bio fuels and the environment (Emissions from bio

fuels),biofuels and economy, standard specification of biofuel, uses of biofuels – modification of vegetable oils as biodiesel. (18 hours)

TEXT BOOKS

1. BK. Sharma, *Industrial Chemistry*, GOEL Publishing House, Meerut
2. K.Bagavathi Sundari, *Applied Chemistry*; MJP Publishers, Chennai,
3. Jayashree Ghosh, *Fundamental concepts of applied chemistry*, S.Chand &Company Ltd, Ram Nagar, New Delhi.

REFERENCEBOOKS

1. Dr. Vandana Meshram - Ingle, *A Textbook of Industrial Chemistry*, Educational Publisher and Distributors.
2. Raghunath B. Toche, Satish Kale, Eknath H. Gade, *A Textbook of Industrial Chemistry*, Vision Publications.

Course Code (23PCHE23)	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1a	PSO 1b	PSO 2	PSO 3a	PSO 3b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	1	3	3	3	3	2	2	2
CO 2	3	3	1	3	3	3	3	2	2	2
CO 3	3	3	1	3	3	3	3	2	2	2
CO 4	3	3	1	3	3	3	3	2	2	2
CO 5	3	3	1	3	3	3	3	2	2	2

3 – Strong, 2 – Medium, 1 - Low

Dr.M.Vairalakshmi
Course Designers

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M.Sc. CHEMISTRY
(For those who join in the Academic Year 2023-2024 onwards)

Semester II	**PHARMACEUTICAL CHEMISTRY**	**Hours/Week:**	
Extra Credit Course		Credits: 2	
Course Code **23PCHO21**		Internal 100	External

COURSE OUTCOMES

On completion of the course, the students shall be able to

CO1: understand the basic knowledge on medicinal chemistry and Computer aided drug design. [K2]

CO2: predict the development of new drugs - Lead identification and structural features, synthesis and therapeutic action of antibiotics, antimalarial, antitubercular drugs [K3]

CO3: interpret the structural features, synthesis and therapeutic action of anti-inflammatory, antihypertensive and CNS drugs. [K3]

CO4: Analyze the basic concepts of bioinformatics in computer aided drug design and antibiotics - the synthesis and therapeutic action of drugs. [K4]

CO5: evaluate the concept of Quantitative Structure Activity Relationship and Drug Metabolism - Molecular docking. [K4]

UNIT I Fundamentals of Medicinal Chemistry

Definitions of Medicinal Chemistry- Pharmacology and molecular pharmacology – Nature and sources of drugs- Drug delivery systems - Definition and types - Carrier based drug delivery system, Transdermal drug delivery system, Mucoadhesive drug delivery system- Drug Metabolism general principles – Phase I & II Transformations– General principle of drug action- major processes involved in drug action – pharmacokinetics - Definition and

elementary aspects of ADME – Pharmacodynamics –Definition - receptors and their structures - agonist and antagonist - design of its requirements - prodrugs- Classification, design and application - factors affecting the drug action.

UNIT II: DRUG DESIGN AND ENZYMES: CATALYTIC ROLE OF RECEPTORS

Development of new drugs - Lead identification and optimization- Structure Activity Relationship – structural modifification, Homologattion, chain branching, Ring chain transformation - concept of bioisosterism -Quantitative Structure Activity Relationship (QSAR) – Electronic effect, Taft equation, Lipophilicity effects, Hansch approach.

Enzymes : catalytic role of Receptors- mechanism of a catalytic reaction- Enzyme catalysis- mechanism of enzyme catalysis - enzyme inhibition- classification enzyme inhibitors - enzyme inhibitors as drugs (illustrated with one example).

UNIT III Medicinally useful antibiotics

Structural features and mode of the following antibiotics: Penicillin G-analogues-sensitivity of Pencillins, Cephalosporin and their semi synthetic analogs (β-lactum), Novel β-lactum antibiotics- Clavulanic acid, Thienamycin, Olivanic acid

Aminoglycoside antibiotics- streptomycin, Kanamycin, Neomycin, Gentamycin terramycin (tetracycline), erythromycin (macrolide) and chloramphenicol.

UNIT IV Synthesis, Therapeutic action and SAR of certain drugs

Antitubercular drugs: Classification, Synthesis, Assay, e.g., Isoniazid, Pyrazinamide, Ethambutol, - **Antimalarial drugs:** Classification, synthesis, assay, e.g., Chloroquin, Proguanil, Pyrimethamine.

Anti-hypertensive drugs: Nifedipine, Sodium nitropruside,- A**nti-inflammatory drugs:** Aspirin andss paracetamol - **CNS Stimulant Drugs:** caffeine, and peracetum - **CNS Depressant Drugs:** Phenelazine and Imipramine.

UNIT V

a) Bioinformatics in computer- aided Drug design:

Introduction, drug discovery process- historical perspective-hit identification –structural bioinformatics in drug discovery –some basics about in silico drug designing-SAR and QSAR technique in drug design-development of linear –free energy relationships-application of Hammett equation-Hansch equation –application of QSAR in CADD

b) Molecular Docking:

Introduction-flexibility calculation- Simulation techniques widely used in molecular docking-M D simulation - software for structure based drug design and molecular docking-A briefing on drug bank- auto dock-steps for flexible docking in auto dock –preparing the ligand and the macromolecule for auto dock-auto grid- auto dock file formats-choose the docking algorithm-viewing conformational clusters by RMSD Self study (Assignment) : Building R & D for Drug discovery.

TEXT BOOKS

1) Ashutosh Kar. (2010).*Medicinal Chemistry*. New Delhi: New Age International Publishers, 5th Edition.
2) Ahluwalia,V.K. & Madhu Chopra. (2012). *Medicinal Chemistry*. New Delhi: Ane Books Pvt.Ltd., 2nd Edition.
3) Sriram, D & Yogeeswari, P. (2008).*Medicinal Chemistry.* New Delhi: Pearson Education,1st Edition.
4) Ilango, K & Valentina, P. (2007).*Text Book of Medicinal Chemistry.*Chennai:, Keerthi Publishers, 1st Edition.
5) Zhumur ghosh, Bibekan & Mallick.(2008). *Bioinformatics –Principles and Applications.*New York: Oxford University Press ,1st Edition.

REFERENCE BOOKS

1. Patrick,G.L. (2001).*An Introduction to Medicinal Chemistry.*New York:Oxford University Press, 2nd Edition.
2. Parimoo, P. (2011),*A Text Book of Medicinal Chemistry*.New Delhi:CBS Publishers & Distributors Pvt.Ltd.,1st Edition.

3. Delgado, J.N.& Remers, W.A.(1998).*Text book of Organic, Medicinal & Pharmaceutical Chemistry.* Vol I, Philadelphia:J.B.Lippincott Company,9th Edition.

Course Code 23PCHO21	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	2	1	3	3	2	3	2	2	2
CO 2	3	2	1	3	3	2	3	2	2	2
CO 3	3	2	1	3	3	2	3	2	2	3
CO 4	3	2	1	3	3	2	3	3	2	3
CO 5	3	2	1	3	3	2	3	3	2	3

3 – Strong, 2 – Medium, 1 - Low

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VIRUDHUNAGAR
Quality Education with Wisdom and Values

M.Sc. CHEMISTRY
(for those who join in 2023-2024)

Semester III	**ORGANIC SYNTHESIS AND SPECTROSCOPY**	**Hours/Week: 6**	
Core Course-9		**Credits: 5**	
Course Code 23PCHC31		**Internal 25**	**External 75**

COURSE OUTCOMES

On completion of the course, students will be able to

CO 1: precise the basic concepts of NMR Spectroscopy, pericyclic reactions, Oxidation and Reduction reactions, Rearrangements and Retrosynthetic analysis.[K2]

CO 2: interpret the concepts of NMR to assign and ascertain the types of protons and carbon frame work in organic compounds, mechanism of reactions and the usage of activating and blocking groups in synthesis [K3]

CO 3: identify ^{1}H NMR and ^{13}C NMR spectrum, the different approaches in pericyclic reactions, intermolecular and intramolecular mechanisms in rearrangements, the pathway of catalytic oxidation and reduction reactions and relay and convergent approaches to total synthesis [K3]

CO4: examine correlation spectrums and categorize photochemical reactions, molecular rearrangements, reagents in organic synthesis, stereoselective problems of geometrical and optical isomerism in planning a synthesis. [K4]

CO 5: predict the factors affecting ^{1}H NMR and ^{13}C NMR, the stereo chemical aspects of oxidation, reduction reactions and rearrangements, novel synthetic strategies in organic chemistry and justify the conservation of orbital symmetry in pericyclic reactions. [K4]

UNIT I

Molecular rearrangements:

Mechanism of the following rearrangement reactions:

Wagner-Meerwein, Pinacol-Pinacolone, Demzanov, Beckmann, Hofmann, Curtius, Wolff, Baeyer-Villeger, Stevens, Sommelet-Hauser, Favorskii, Benzil-benzilic acid, Claisen, Cope, Fries, Dienone-phenol, hydroxylamino-p-aminophenol, di-π methane and benzidine rearrangement. (18 Hours)

UNIT II

Retro Synthesis:

Planning a synthesis – Relay approach and convergent approach to total synthesis – Retrosynthetic analysis of simple organic compounds–carbon skeleton–functional group located on the skeleton–disconnection- C-X disconnection functional group interconversions – use of activating and blocking groups in synthesis – stereoselective problems of geometrical and optical isomerism – steric crowding – Transition metal complexes in organic chemistry – Homogeneous hydrogenation – Regioselectivity – Diastereoselectivity – Enantioselectivity – Umpolung synthesis – Robinson annelation – A schematic analysis of the total synthesis of the following compounds: 2,4-dimethyl-2-hydroxypentanoic acid, trans-9- methyl-1-decalone and isonootkatone. (18 Hours)

UNIT III

Reagents:

Gilman's reagent (lithium dimethylcuparate), lithium diisopropylamide (LDA), Dicyclohexylcarbodiimide, 1, 3 – dithiane, trimethylsilyl iodide, tri-n-butyltinhydride, Woodward and Prevost hydroxylation, DDQ, Merrifield resin, phase transfer catalysis, Peterson's synthesis, Baker's yeast. (18 Hours)

Oxidation and Reduction:

Catalytic oxidation — mechanism, applications and stereo chemical aspects of the following oxidation reactions: Oxidation reaction involving CrO_3, SeO_2, OsO_4, lead tetraacetate, periodic acid, N-bromosuccinimide, H_2O_2 – Oppenauer oxidation.

Catalytic reduction – mechanism, applications and stereochemical aspects of the following reduction reactions reaction involving lithiumaluminium hydride, triisobutylaluminium hydride, DIBAL and sodium borohydride – Birch reduction – Meerwin-Pondorf – Verley reduction – Wolf-Kishner reduction, Huang-Minon modification – hydroboration – selectivity in oxidation and reduction

UNIT IV

Spectroscopy I:

UV, IR and Mass Spectroscopy

UV Spectroscopy: Principle - absorption spectra of conjugated dienes - α, β-unsaturated carbonyl compounds - Woodward - Fieser rules.

IR Spectroscopy: Molecular vibrations - vibrational frequency - factors influencing group frequencies - quantitative studies.

Applications of UV and IR spectroscopy in distinguishing axial and equatorial conformers, inter-and intra-molecular hydrogen bonding and keto-enol tautomerism.

Mass Spectroscopy:Principle - type of ions-base peak - parent ion, metastable and isotopic peaks - general rules - pattern of fragmentation for various classes of compounds - McLafferty rearrangement - Retro Diels - Alder reaction. (18 Hours)

UNIT V

Spectroscopy II: NMR spectroscopy

^{1}H NMR spectroscopy : Origin of NMR spectra– assignment of signal, relaxation time– chemical shift – coupling constant – first and second order spectra – spin-spin splitting – influence of stereochemical factors on chemical shift of protons – simplification of complex spectra – deuterium substitution – spin decoupling – double resonance – shift reagents – Nuclear Overhauser Effect – CIDNP – NMR concept of aromaticity-H-H-COSY.

^{13}C NMR spectroscopy: Introduction – Comparision of ^{13}C NMR and ^{1}H NMR spectroscopy – chemical shifts in ^{13}C NMR and factors affecting^{13}C NMR – Off-resonance decoupling–additivity relationship- calculation of chemical shifts for aromatic and aliphatic compounds – DEPT ^{13}C spectra – ^{13}C -^{13}C correlation COSY, HETCOR ROESY, NOESY and TOCSY- Inadequate. (18 Hours)

TEXT BOOKS

1. Depuy. C.H. & Chapman, O.L. (1972).*Molecular Reactions and Photochemistry.* New Jersey: Prentice Hall, 1st Edition.
2. Chatwal, G.R. (2014). *Reaction Mechanism and Reagents in Organic Chemistry*. Mumbai: Himalaya Publishing House, 5th Edition.

3. Jagdamba Singh, Yadav, L.D.S. (2014). *Organic Synthesis*. Meerut: Pragati Prakashan, 1st Edition.
4. Finar, I.L. (2003).*Organic Chemistry.* Vol.II, Singapore: Pearson Education,5th Edition.
5. Ireland, R.E. (1975).*Organic Synthesis.* New York: Prentice-Hall of India Pvt. Ltd., 1st Edition.
6. Kalsi, P.S. (2014).*Spectroscopy of Organic Compounds.* New Delhi: New Age International Publishers, 6th Edition.
7. William Kemp. (2009). *Organic Spectroscopy.* New York: Palgrave, 3rdEdition.

REFERENCE BOOKS

1. Ratan Kumar Kar. (2008). *Fundamentals of Organic Synthesis*. Vol.II, New Delhi: New Central Book Agency Pvt.Ltd., 1st Edition.
2. Agarwal O. P, Organic *Chemistry Reactions and Reagents*. Meerut: GOEL Publishing House, 22nd Edition
3. Sanyal S.N (2006), *Reactions, Rearrangements and Reagents.*Bangalore: Bharathi Bhawan Publishers and Distributors, 4th edition
4. John Dyer, R. (2010).*Application of Absorption Spectroscopy of Organic Compounds.* New Delhi: PHI Learning Pvt. Ltd, 1stEdition .
5. Robert Silverstein, M. & Francis Webster, X. (2004). *Spectrometric Identification Organic Compounds.* New Jersey: John Wiley & Sons, Inc., 6th Edition.

Course Code 23PCHC31	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3a	PSO 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	3	2	3	3	3	3	2	2
CO 2	3	3	2	2	2	1	2	1	2	2
CO 3	3	3	2	2	2	2	2	2	2	3
CO 4	3	3	2	2	2	2	1	1	1	3
CO 5	3	3	2	2	2	3	2	3	2	3

3 – Strong, 2 – Medium, 1 - Low

Mrs. R. Nagasathya
Mrs. A. Prasanna
Dr. K.Malathi
Course Designers

Dr. J. Kavitha
Head of the Department

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M.Sc. CHEMISTRY
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Semester III	**ORGANOMETALLICS, NUCLEAR AND PHOTO CHEMISTRY**	**Hours/Week: 6**	
Core Course - 10		**Credits: 5**	
Course Code 23PCHC32		**Internal 25**	**External** 75

COURSE OUTCOMES

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

CO1: understand the principle of organometallic chemistry, acid-base concept, non-aqueous solvent photochemistry, nuclear and chemistry [K2].

CO2: predict the bonding, isolobal, isoelecronic and catalytic behavior of organometallic compounds, reactions of acids and bases, non-aqueous solvents and types of nuclear reaction and reactors, photochemistry of electronic transition metal complexes. [K3]

CO3: apply the organometallic chemistry to synthesize industrial chemical reactions, reactions of non-aqueous solvents, nuclear chemistry to predict the radioactive substances and photochemical reaction mechanism for metal complexes. [K3]

CO4: examine the stability, structure, bonding, synthesis and reactivity of organometallic compounds, isotopes, nuclear reaction and reactor, photochemical reactions of Co(III),Cr(III), ruthenium-polypyridine complexes and applications of HSAB. [K4]

CO 5: interpret the synthetic method, bonding, structural elucidation, stability and catalytic efficiency of organometallic compounds, acidity and basicity, radio isotopes and its applications, electron and energy transfer reactions for metal complexes in photochemistry. [K4].

UNIT I - ORGANOMETALLIC CHEMISTRY - I

Organo metallic compounds- sixteen and eighteen electron rule - sigma, pi and hapto nomenclature – isoelectronic and isolobal analogy- Synthesis, structure and bonding of metal carbonyls,metal nitrosyls, dinitrogen complexes, Ferrocene, Arene complexes, olefin, acetylene and pi allyl complexes - use of IR in the structural elucidation of carbonyl compounds.

(18 hours)

UNIT II - ORGANOMETALLIC CHEMISTRY –II

Oxidative addition and reductive elimination – insertion of alkenes and β-hydrogen elimination-Catalytic reactions- hydrogenation of olefins – Wilkinson‘s catalyst – hydroformylation – oxidation of olefins – Wacker process - Olefin metathesis -Ziegler Natta catalyst – ethylene polymerization - cyclo oligomerisation of acetylene , butadiene- Reppe‘s catalyst . Mansanto’s acetic acid synthesis-Fischer-Tropsch’s synthesis of Synthetic gasoline. (18 hours)

UNIT III - Acid Base Concepts and Non-Aqueous Solvents

Acid Base concepts: A generalized acid – base concepts - Steric effect, Solvation effects - Relative strength of acids and bases – Factors affecting the strength of acid and bases – common ion effect – Henderson’s equation.

HSAB: Classification of Hard and Soft acids and bases – Pearson’s concept – Acid – base strength and Hardness and Softness – Symbiosis – Theoretical basis of Hardness and Softness – Electronegativity and Hardness and Softness – Applications of HSAB.

Non-aqueous solvents: Classification of protic and aprotic solvents – General characteristics of solvents - Self ionization and leveling effect – Reactions in liquid ammonia, liquid sulphur dioxide – superacids. (18Hours)

UNIT IV- NUCLEAR CHEMISTRY

Radioactive decay and equilibrium- Different types of nuclear reaction – spallation – fission and fusion.Theories of fission.Fissile and Fertile isotopes -Nuclear fusion – stellar energy-Nuclear forces: Liquid drop model, shell model-Calculation of Q-values – Cross section. Detectors: Scintillation counter, Gas ionisation chamber, G.M. counter. Accelerators: Cyclotron, Synchrocyclotron, Betatron. Radio isotopes and their Applications: Activation analysis, Isotopic dilution technique-radiometric titration. Nuclear reactors: Types (Thermo nuclear and breeder reactors) feed materials production. Reprocessing of nuclear materials waste disposal. (18hours)

Unit V - INORGANIC PHOTOCHEMISTRY

Selection rules-electronic transitions in metal complexes-Radiation relaxation rates-Metal-centered and charge transfer transitions-emission spectra-photo physical properties-Intermolecular energy transfer-collision energy transfer-Photochemical Unimolecular reactions-charge transfer photochemistry of cobalt(III)-am(m)ine complexes- Mechanism of CTTM photoreactions of Co(III) complexes-Dioxygencomplexes-polydentate chelates-Photochemistry of Cr(III) complexes-Cr(III)hexam(m)ines-Adamson's rules-redox potentials-electron and energy transfer reactions- photochemistry of ruthenium-polypyridine complexes

(18hours)

TEXT BOOKS

1. Gopalan, R. & Ramalingam,V. (2003). *Concise Coordination Chemistry*. New Delhi: Vikas Publishing House Pvt.Ltd., 1st Edition.
2. Arnikar, H.I. (2016). *Essentials of Nuclear Chemistry*. New Delhi: Wiley Eastern Ltd., 4th Edition.

REFERENCE BOOKS

1. Huheey, E. Keitler, A.& Keitler, L. (2006). *Inorganic Chemistry.*New York: Harper, Dorling Kindersley Pvt. Ltd.,4th Edition.
2. Shekar, C.V. (2014). *Nuclear Chemistry*. New Delhi: Dominant Publishers and Distributors Pvt. Ltd., 1st Edition.
3. Cotton,F.A. & Wilkinson, G. (2007).*Advanced Inorganic Chemistry.*Singapore:John, Wiley & Sons, 6th Edition.
4. Lee, J.D. (2007).*Concise Inorganic Chemistry*. Australia: Black Well Publishing Company, 5th Edition.
5. Soni, P.L. & PandnaSoni. (2016). *Coordination Chemistry*. New Delhi: Ane Books Pvt.Ltd., 1st Edition.
6. Meissler G.L. and Tarr T.A., (2004) Inorganic Chemistry, Pearson Academy,New Delhi, 3rd Edition.

Course Code 23PCHC32	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	2	3	3	2	3	3	2	2
CO 2	3	3	2	3	3	2	3	3	2	2
CO 3	3	3	1	3	3	2	3	3	1	2
CO 4	3	3	1	3	3	2	3	3	1	2
CO 5	3	3	2	3	3	2	3	3	2	2

3 – Strong, 2 – Medium, 1 - Low

Dr. M. Vairalakshmi
Dr.J.Kavitha Dr.C.Vidya Rani
Head of the Department **Course Designers**

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M.Sc. CHEMISTRY

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Semester III	**GROUP THEORY AND MOLECULAR SPECTROSCOPY**	Hours/Week: 6	
Core Course – 11		Credits: 4	
Course Code 23PCHC33		Internal 25	**External** 75

COURSE OUTCOMES

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

CO1: discuss the basic concepts of Group theory and molecular microwave, vibrational and electronic spectroscopy.[K2]

CO2: Make use of the applications of group theory and molecular spectroscopy.[K3]

CO3: apply the concepts of Group theory to spectroscopy and predict Huckel molecular orbital theory and spectroscopic techniques such as electronic and microwave.[K3]

CO4: analyze the approach of Group theory to molecular problems and analyze molecular structure determination using microwave, IR & Raman spectra.[K4]

CO5: evaluate the group theory applied to hybridization and ESR, NMR spectroscopic techniques.[K4]

Unit-I: Group Theory-I

Molecular symmetry elements and symmetry operations – vector and matrix algebra – symmetry operations and transformation matrices – Group definition and properties of a group – Symmetry point groups – Representation of a group – reducible and irreducible representations – Great Orthogonality theorem – Characters – construction of character tables – C_{2v}, C_{3v} – Direct Product concept. (18Hours)

U nit-II: Application of group theory to spectroscopy and molecular problems:

Symmetry of normal modes of vibrations, Application of group theory to normal modes of vibrations and to normal mode analysis – symmetry properties of integrals – application for spectral selection rules of vibration spectra – IR and Raman active fundamentals (NH_3, BF_3) – Mutual Exclusion principle - Symmetry of molecular orbital symmetry selection rule for electronic transitions in simple molecules like ethylene, formaldehyde – Group theory and quantum mechanics – Wave functions as the basis of irreducible representation – group theory

applied to hybridization – HMO theory – HMO calculations of delocalization energy for butadiene and benzene. (18 Hours)

UNIT III

Molecular Spectroscopy – I: Rotational & Vibrational Spectroscopy

Introduction to electromagnetic radiation and its interaction with atoms and molecules - Quantization of energy- regions and representation of spectra.

Rotational Spectroscopy: Rotational spectra of diatomic molecules, effect of isotopic substitution- Rotational spectra of linear and symmetric top polyatomic molecules- Microwave spectrometer-Information derived from rotational spectra.

Vibrational spectra of a diatomic molecule- Vibrational spectra of polyatomic molecule- Fermi resonance. Rotation-vibration spectra of polyatomic molecule: linear molecule, symmetric top molecule. Over tones, combination frequencies and group frequencies.IR spectrophotometer-Instrumentation. (18 Hours)

UNIT IV Molecular Spectroscopy – II: Raman and Photo Electron Spectroscopy

Raman spectroscopy: Theory of Raman scattering: Classical and Quantum theory. Rotational Raman Spectra: linaer molecule, symmetric top molecule, spherical top molecule. Vibrational Raman spectra of diatomic molecule.Mutual exclusion principle.

Photo Electron Spectroscopy: Principle, Instrumentation – XPS, UPS, ESCA (18 Hours)

UNIT V

Molecular Spectroscopy – III: Electronic and NMR spectroscopy

Electronic spectroscopy: Vibrational coarse Intensity of vibrational electronic spectra-Franck- Condon principle-Rotation fine structure of electronic vibrational spectra- the Fortrat parabola-Dissociation and predissociation spectra .

NMR Spectroscopy: Theory – Relaxation processes - spin-spin relaxation and spin-lattice relaxation. Bloch equations - NMR instrumentation – Nuclear Overhauser effect. (18 Hours)

TEXT BOOKS

1. Ramakrishnan,V.& Gopinath, (2013).*Group Theory in Chemistry.*New Delhi:Vishal Publications, 2nd Edition.
2. Raman, K.V. (1990)**.***Group Theory and Its Applications to Chemistry.* New York: Tata McGraw-Hill Publishing Company, 1st Edition.
3. Bhattacharya,P.K.(2010).*Group Theory and Its Chemical Applications.*Mumbai**:** Himalaya Publishing House, 1st Edition.

4. Puri **,**B.R. Sharma .L. R and Pathania .M.S .(2003)**.***Principles of Physical Chemistry*.New Delhi **:**Vishal Publishing Co**,** 1st Edition.
5. Gurdeep Raj,S.(2003). *Advanced Physical Chemistry*.Meerut: Goel Publishing Co. 25thEdition.
6. Bajpai, D.N. (2011).*Advanced Physical Chemistry*.New Delhi**:** S.Chand& Co.,Ltd.,1st Edition.
7. Aruldhas, G.(2001).*Molecular Structure and Spectroscopy*. New Delhi: Prentice –Hall of India Pvt. Ltd., 1st Edition.
8. Banwell, C.N. &McCash, E.M. (2000). *Molecular Spectroscopy*. New York:Tata McGraw Hill,4th Edition.

REFERENCE BOOKS

1. Cotton,F.A. (2016).*Chemical Applications of Group Theory*. New York: John Wiley& Sons, 3rdEdition.
2. Salahuddin Kunju, A., Krishnan, G. (2015).*Group Theory and Its Application in Chemistry*.Delhi: PHI Learning Pvt. Ltd., 3rdEdition.
3. Atkins.P.W,(2002). *Physical Chemistry*.New York: ELPS and Oxford University Press, 4thEdition.
4. Barrow, G.M.(2000). *Introduction to Molecular Spectroscopy* New York: McGraw Hill, 1st Edition.

Course Code 23PCHC33	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	2	2	3	3	3	2	1	2
CO 2	3	3	3	2	3	3	3	2	1	2
CO 3	3	3	3	2	3	3	3	2	1	2
CO 4	3	3	3	2	3	3	3	2	1	2
CO 5	3	3	3	2	3	3	3	2	1	2

3 – Strong, 2 – Medium, 1 - Low

Dr.J.Kavitha
Dr.A.Anitha
Dr. N. Ramila Devi

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M.Sc. CHEMISTRY
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Semester III	**PHYSICAL CHEMISTRY EXPERIMENTS**	Hours/Week: 5	
Core Course -12		Credits: 3	
Course Code **23PCHC31P**		Internal 40	External 60

COURSE OUTCOMES

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

CO1: understand the standard procedure to carryout the various types of conductometric titrations.[K2]

CO2: discuss the metal ions such as Cu^{2+}, Fe^{2+} and Ni^{2+} ions by spectrophotometric techniques. And compare their strengths with the standard solution. [K2]

CO3: develop analytical skill to perform adsorption experiments. [K3]

CO4: apply standard procedure to carryout the various types of potentiometric titrations. [K3]

CO5: interpret the spectral results obtained of the unknown compounds by using pHmeter, UV-Vis and IR specrophotometric techniques. [K4]

I. Conductometric Experiments

i. Double displacement & acid-base titrations

NH_4Cl NaOH Mixture of CH_3COOH &HCl

ii. Estimation of $BaCl_2$by conductometric precipitation titration

iii. Determination of solubility productof sparingly soluble salts,

anddissociation constant of weak acids.

II. Adsorption Experiments

Adsorption of oxalic acid / Acetic acid on charcoal

III. Kinetic Experiments

Perdisulphate and iodide ion reaction: Study of primary salt effect and determination of the concentration of given KNO_3

IV. Potentiometric methods

i. Precipitation titration: Ag^+ Vs halide mixture

ii. Redox titrations:

Ceric ammonium sulphate/ potassium dichromate Vs ferrous ion

iii. Determination of pH of buffer solution& solubility product of sparingly soluble salts.

V. Titrations using pH meter

Determination of first, second and third dissociation constants of phosphoric acid.

VI. Experiments based on UV - Visible and IR spectrometer

VII. Determination of Cu, Ni and Fe ions by Spectro Photometric method

Course Code 23PCHC31P	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	3	3	3	3	2	2	2	1
CO 2	3	3	3	3	3	3	2	2	2	1
CO 3	3	3	3	3	3	3	2	2	2	1
CO 4	3	3	3	3	3	3	2	2	2	1
CO 5	3	3	3	3	3	3	2	2	2	1

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M.Sc. CHEMISTRY
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Semester III	**GREEN CHEMISTRY**	Hours/Week: 2	
SEC-1		Credits: 2	
Course Code **23PCHS31**		Internal 25	External 75

COURSE OUTCOMES

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

CO1: understand the principles of green chemistry. [K1]

CO2: propose green solutions for chemical energy storage and conversion. [K2]

CO3: understand green solutions for industrial production of Petroleum and Petrochemicals. [K2]

CO4: apply solutions for pollution prevention in Industrial chemical and fuel production, Automotive industry and Shipping industries. [K3]

CO5: analyze green solutions for industrial production of Surfactants, Organic and inorganic chemicals. [K4]

UNIT-I: 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. (6 hours)

UNIT-II: 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 $scCO_2$. Green synthesis-adipic acid and catechol.

(6 hours)

UNIT-III: Environmental pollution, Green Catalysis-Acid catalysts, Oxidation catalysts, Basic catalysts, Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts, Poly supported photosensitizers. (6 hours)

UNIT-IV: Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction. Applications in organic synthesis. (6 hours)

UNIT-V: Micro wave induced green synthesis-Introduction, Instrumentation, Principle and applications. Sonochemistry – Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and Applications. (6 hours)

TEXT BOOKS

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

REFERENCE BOOKS

1. Anastas, P.T. and Warner, J.K. Oxford Green Chemistry -Theory and Practical, University Press, 1998
2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001
3. Cann, M.C. and Connely, M.E. Real-World Cases in Green Chemistry, American Chemical Society, Washington, 2000
4. Ryan, M.A. and Tinnesand, M., Introduction to Green Chemistry, American Chemical Society Washington, 2002.
5. Chandrakanta Bandyopadhyay, An Insight into Green Chemistry, Books and Allied (P) Ltd, 2019.

Course Code 23PCHS31	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	3	3	3	3	2	2	2	2
CO 2	3	3	3	3	3	3	2	2	2	3
CO 3	3	3	3	3	3	3	2	2	2	2
CO 4	3	3	3	3	3	3	2	2	2	3
CO 5	3	3	3	3	3	3	2	2	2	3

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Semester III	**ADVANCED CHEMISTRY FOR COMPETITIVE EXAMINATIONS**	**Hours/Week: 5**	
Elective Course NME		**Credits: 3**	
Course Code - 23PCHN31		**Internal 25**	**External 75**

COURSE OUTCOMES

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

CO1: know the fundamentals of chemistry. [K1]

CO2: understand the basics of chemistry to predict the acidity and basicity, synthetic chemicals and reagents, analyze data and chemistry in service of man. [K2]

CO3: identify the types of chemical reactions, concepts of acids and bases, laboratory reagents, polymers, cement, carbohydrates, oil and fats [K2]

CO4: Apply the rudiment in chemistry, laboratory chemicals and reagents, data analysis and in service of man. [K3]

CO5: interpret important acid base concept, buffer, chemical reactions, laboratory chemicals and reagents chemical data, and chemistry in service of man. [K4]

UNIT I - Basic Chemistry

Atomic theory: Dalton's and Bohr's theory. Molecules: atomic and molecular mass, empirical and molecular formula. Definition of ore, mineral, alloy with examples. Types of chemical reactions: exothermic and endothermic, oxidation and reduction, addition, substitution and elimination reactions – ideal and real gas: definition. Concepts of Acids and Bases (Arrhenius, Bronsted and Lewis) – pH concept, Buffer solution: definition and types of buffer– Water – Hard and soft water – hardness of water and types- determination of hardness of water by ion exchange process. (15 Hours)

UNIT II - Laboratory chemicals and reagents

a) Laboratory chemicals and reagents – different grades – commercial, LR, GR, AR, Chromatographic pure and spectral pure.
b) Preparation of reagents in the laboratory – Tollen's reagent – Neutral FeCl 3 – Borsche's reagent – Schiff's reagent – Fehling solution A & B.
c) Units of concentration of solution – Normality, Molarity, Molality, Mole fraction, Mass percentage and Volume percentage- simple problems to predict concentration of unknown samples (15 hours)

UNIT III - Data Analysis

Mean, median, Precision and Accuracy– Confidence limits – Errors- types of error- rules of improving Accuracy of data – Rejection of data – significant figure- Method of least squares. Statistical tests of data -F- test, Students t- test, Q test Calibration curve.

(15 hours)

Unit IV - Chemistry In Service Of Man –I: (Only elementary idea can be given)

Oils and fats – Definition, Structural and their properties- Soaps and detergent – Definition, Manufacturing method, Properties- Difference between soaps and detergent - Cement – Constituents -setting and hardening of cement - Allotropes of carbon (diamond, graphite, graphene, and buckminsterfullerene) – properties, applications- Conductor, Semiconductor, insulator – properties. (15 hours)

Unit V - Chemistry in service of man –II: (Only elementary idea can be given)

Polymer—Classification (natural and synthetic) with examples- Rubber – Types with examples and vulcanization of rubber- Dye - classification based on the application - Carbohydrates – sources, classification, function – Sources and deficiency of Vitamins A, B6, B12, C, D, E and K (structural elucidation not required). (15 hours)

TEXT BOOKS

1.Pui, B.R. Sharma, L.R. Pathania, M.S. (2003). *Principles of Physical Chemistry.* New Delhi: Vishal Publishing Co, 1st Edition.

2.Puri, B.R. Sharma, L.R. & Kalia, K.C. (2008). *Principles of Inorganic Chemistry*, New Delhi: Milestone Publishers, 2nd Edition.

3.Sharma, B. K.(2008). *Industrial Chemistry.* Meerut:GOEL Publishing House, 1st Edition.

4.Jayashree Ghosh, (2013). *Fundamental Concepts of Applied Chemistry*, New Delhi:S.Chand& Company Ltd.,1st Edition.

5 BagavathiSundari, K.(2008).*Applied Chemistry*. Chennai: MJP Publishers, 1st Edition.

6. Gopalan R. Subramanian P.S.(2017). Elements of Analytical Chemistry. Chennai: Sultan chand @Sons Publishers, 3rd Edition.

REFERENCE BOOKS

1. Jain, P.C. & Monika Jain, (2013). *Engineering Chemistry*.New Delhi: DhanpatRai Publishing Company Pvt.Ltd., 1st Edition.
2. Jayashree Ghosh. (2014).*A Text Book of Pharmaceutical Chemistry.* New Delhi: S.Chand & Company Ltd, 3rd Edition.

Course Code **23PCHN31**	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	3	3	3	3	2	2	2	2
CO 2	3	3	3	3	3	3	2	2	2	3
CO 3	3	3	3	3	3	3	2	2	2	2
CO 4	3	3	3	3	3	3	2	2	2	3
CO 5	3	3	3	3	3	3	2	2	2	3

3 – Strong, 2 – Medium, 1 - Low

Dr.J.Kavitha

Dr. J. Kavitha
Head of the Department

Dr.M.Vairalakshmi
Course Designers

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M.Sc. CHEMISTRY
(for those who join in 2023-2024)

Semester III	**PRACTICE FOR CSIR NET – GENERAL PAPER**	Hours/Week:-	
Course Code		Credits: 1	
23PGOL32		Internal 100	External -

COURSE OUTCOMES

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

CO1 : explain various concepts related to numbers, quantitative comparison, monetary problems and logical reasoning. [K2]

CO2 : apply the analytical skills and logical reasoning in solving problems related to competitive examinations. [K3]

CO3 : solve typical problems, geometrical type problems, daily life problems in a effective manner. [K3]

CO4 : analyze the techniques used in solving complicated real life problems. [K4]

CO5 : examine the data using logical reasoning and observational ability. [K4]

UNIT I

Typical Problems- Series formation

Numerical Ability- Numbers

UNIT II

Geometrical Type Problems

Mensuration and quantitative comparison

UNIT III

Typical Problems- Moving locomotive problem

Numerical Ability- Distance and Directions

UNIT IV

Daily Life Problems

Finding the X – Average - Monetary problems

UNIT V

Logical Reasoning

Data interpretation – Observational ability – Logical puzzles

BOOKS FOR STUDY:

Christy Varghese (2016).,*CSR – NET, General aptitude –A new outlook,* Lilly publishing house, Changanacherry, Kerala

REFERENCE BOOKS

1. Pradip Kumar Ray, General Aptitude Theory ,CSIR NET, Previous question and answer with explanation and hint to solve, Notion Press, India
2. Ram Mohan Pandey (2021)., *CSIR-UGC-NET General Aptitude Theory and Practice,* Pathfinder Publication, a unit of Pathfinder Academy Pvt. Ltd., India.

Unit	Chapter	Section/Page Number
1	4	142-162
	5	163-192
2	12	272-294
3	3	132-141
	7	206-220
4	8	221-230
	9	231-239
	10	240-249
5	13	295-309
	14	310-323
	15	324-332

Course code 23PGOL32	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	-	2	-	-
CO2	3	3	3	3	-	2	-	-
CO3	3	3	3	3	-	3	-	-
CO4	3	2	3	3	-	3	-	-
CO5	3	2	3	3	-	3	-	-

Dr. M. C. Maheshwari
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Semester IV	**HETEROCYCLES AND NATURAL PRODUCTS**	**Hours/Week: 6**	
Core Course-13		**Credits: 5**	
Course Code 23PCHC41		**Internal 25**	**External 75**

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: comprehend the structural and synthetic aspects of biomolecules, heterocycles and Natural products and describe the analytical techniques. [K2]

CO2: predict the ring size in carbohydrates, elucidate the structure of natural products, sketch the Preparation of heterocycles and apply the Octant rule in determining the configuration and Conformation of simple monocyclic and bicyclic ketones. [K3]

CO3: interpret the structure of RNA and DNA, demonstrate the synthesis of biomolecules, relate the structure and reactivity of heterocycles, natural products and practice chromatographic techniques. [K3]

CO4: analyze the synthetic routes to peptides, heterocycles, and natural products and relate CD and ORD curves. [K4]

CO5: categorize the significance of biomolecules, heterocycles and natural products in day to- day life and plan the suitable chromatographic technique for their project. [K4]

UNIT I Heterocycles:

Nomenclature of heterocycles having not more than two hetero atoms-structures, and reactions of Oxazole, Coumarin, thiazole, diazoles (imidazole and pyrazole), quinoline and isoquinoline.Pyrimidines (uracil) and Purines (synthesis of Caffeine, Theobromine and theophylline. (18 Hours)

UNIT II Proteins, Nucleic acids and Carbohydrates:

Classification of proteins –peptides-structure and synthesis of peptides-Chemistry of gluthathione and oxytocin-an elementary treatment of enzymes, coenzyme and nucleic acids- biosynthesis of amino acids-RNA and protein synthesis-Genetic code-DNA and determining the basic sequence of DNA.

Pyranose and furanose forms of aldohexoses and keto hexoses-methods used for determination of ring size- structure and synthesis of lactose, cellobiose. A brief study of starch and cellulose. (18 Hours)

UNIT III Alkaloids and Terpenoids:

General methods of structural determination of alkaloids- Hofmann, Emde and Von Braun degradations.Structure and synthesis of quinine, papaverine, atropine, narcotine, morphine.Biogenesis of Alkaloids.

Classification of terpenoids – structural elucidation and synthesis of α – pinene, cadinene, abietic acid.Biogenesis of Terpenoids. (18 Hours)

UNIT IV Steroids and Chiro optical techniques:

Classification –conformational aspects of A/B *cis* and A/B *Trans* steroids – complete chemistry and stereochemistry of cholesterol – male sex harmone-testosterone – female sex harmones – oestrone and progesterone.

ORD and CD – Principle – Cotton effect – types of cotton effect curves – α -haloketone rule – Octant rule – applications to determine the configuration and conformation of simple monocyclic and bicyclic ketones – application of CD-advantages and Limitation of ORD and CD.Application of ORD measurements to steroid ketones. (18 Hours)

UNIT V Flavonoids and Isoflavonoids:

Flavonoids: Introduction, isolation and separation techniques of flavonoids, general method for determination of the structure of flavone – Rutin and Quercetin

Isoflavonoids: Occurrence and biosynthesis pathway of isoflavones. (18 hours)

TEXT BOOKS

1. Chatwal, G.R. (2018). *Organic Chemistry of Natural Products. Vol.I&II,*Mumbai: Himalaya Publishing House, 5th Edition.
2. Agarwal, O.P. (2017). Chemistry of *Organic Natural Products. Vol.I,*Meerut: Goel Publishing House, 47th Edition.
3. Agarwal.O.P. (2018), Chemistry of *Organic Natural Products. Vol.II,*Meerut:Goel Publishing House, 46th Edition.
4. Finar, I.L. (2003).*Organic Chemistry*. Vol.II.,Singapore:Pearson Education,5th Edition.
5. Ireland, R.E. (1975).*Organic Synthesis.* New York: Prentice-Hall of India Pvt. Ltd., 1st Edition
6. Jagdamba Singh, Yadav L.D.S. (2014). *Organic Synthesis*. Meerut: PragatiPrakashan, 1st Edition.
7. Gurdeep R. Chatwal (2016), *Organic Chemistry of Natural Products*, Himalaya Publishing House, 4th Edition.

REFERENCE BOOKS

1. Klyne,W(1965).*The Chemistry of Steroids.* New York :Methuen& Co.,1st Edition.
2. Crabbe, P.(1972).*ORD and CD in Chemistry and Biochemistry.* Cambridge:Academic Press. 1st Edition.

Course Code 23PCHC41	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1..b	PSO 2	PSO 3.a	PSO 3..b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	2	3	2	2	3	2	2	2	1
CO 2	3	3	2	2	2	3	2	2	1	1
CO 3	3	3	2	2	2	2	2	2	3	3
CO 4	3	3	2	2	1	3	2	2	1	1
CO 5	3	3	3	3	2	3	3	3	3	3

3 – Strong, 2 – Medium, 1 - Low

Mrs.R.Nagasathya
Mrs.A.Prasanna

Dr. J. Kavitha
Head of the Department

Dr. K. Malathi
Course Designers

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M.Sc. CHEMISTRY
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Semester IV	**INORGANIC SPECTROSCOPY AND f-BLOCK ELEMENTS**	**Hours/Week: 6**	
Core Course - 14		**Credits: 5**	
Course Code 23PCHC42		**Internal 25**	**External 75**

COURSE OUTCOMES

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

CO1: understand the principle of inorganic spectroscopic techniques and f block elements. [K2]

CO2: predict the electronic spectra for octahedral and tetrahedral metal complexes, application of spectroscopy in structural problem and separation techniques for lanthanide and actinide elements. [K3]

CO3: apply the spectral and magnetic behavior of f-block elements, electronic absorption spectroscopy for transition metal complexes and spectroscopic study for different metal ions and complexes. [K3].

CO4: analyze the chemistry of f-block elements and electronic absorption spectroscopy for metal complexes, Mossbauer spectroscopy, PES, EPR, NMR and NQR. [K4]

CO 5: evaluate the method of separation and characterization of f-block elements, Orgel and Tanabe – Sugano diagrams to transition metal complexes, applications of PES, EPR, NMR, NQR and Mossbauer spectroscopy. [K4].

UNIT I

a) Electronic absorption spectroscopy:

Term symbols – selection rules – mechanism of breakdown of selection rules – band widths and shapes – Orgel diagrams – applications of orgel diagrams to electronic spectra of transition metal complexes – octahedral (d^3, d^6, d^7, d^8) and tetrahedral complexes of (d^6, d^7, d^8) configurations – evaluation of 10Dqand β for octahedral (d^2, d^7) and tetrahedral complexes of (d^7, d^8) configurations using Tanabe – Sugano diagram- charge transfer spectra – effect of John – Teller distortion on the electronic spectrum of complexes.

(18 Hours)

UNIT II NMR AND NQR SPECTROSCOPY:

a) NMR Spectroscopy:

Multinuclear NMR- ^{31}P, ^{19}F and ^{15}N NMR – introduction application in structural problem - ClF_3, SF_4, PF_5, BrF_5, P_4S_3, $PF_3(NH_2)_2$ - evaluation of rate constants –NMR of fluxional molecules –NMR of paramagnetic molecules- contact shifts and shift reagents.

b) NQR Spectroscopy:

Introduction – effect of magnetic field on the spectra – relation between electric field gradient and structure – applications of NQR. (18 hours)

UNIT III ESR Spectroscopy

Principles – presentation of a spectrum – hyperfine coupling constant- hyperfine splitting in radicals containing a single set of equivalent protons– evaluation of g tensor –Isotropy, Anisotropy in g value - factors affecting the magnitude of g – values – zero field splitting – Kramer's degeneracy – ESR of d^3 octahedral complexes — application of ESR in the study of transition metal complexes – VO^{2+}, Fe^{3+}, Co^{2+}, Mn^{2+}, Ni^{2+} and bissalicylaldimine copper (II) – Jahn Teller distortion studies in Cu (II) complexes. (18 hours)

UNIT IV

a)Photo Electron Spectroscopy (PES)

Theory – XPS - UV- PES- Instrumentation evaluation of ionization potential – chemical identification of elements - Koopmann's theorem – chemical shift – UPS – XPES of spectra of homonuclear diatomic molecules (N_2, O_2) – hetero nuclear diatomic molecule (CO) – polyatomic molecules (H_2O, NH_3) – evaluation of vibrational constants from UPS – spin orbit coupling – Auger spectroscopy – principle and its applications.

b) Mossbauer spectroscopy

Mossbauer effect resonance absorption – Doppler effect – Doppler velocity – Experimental technique of measuring resonance absorption – isomer shift- effect of quadrapole nucleus – magnetic hyperfine splittings – applications of Mossbauer spectroscopy in the study of iron and tin complexes. (18 Hours)

UNIT V THE f-BLOCK ELEMENTS

a) Lanthanides:- General features – occurrence –variable valencies -Separation techniques (Fractional crystallisation, precipitation, ion-exchange, solvent-extraction and thermal decomposition- Selective reduction and oxidation)- Electronic configuration- Oxidation states, Lanthanide contraction- absorption spectra of Ln - Ln chelates- Uses of lanthanides (shift reagents)

b) Actinides: General features – occurrence –variable valencies - electronic configuration and oxidation states, spectral properties- trans actinide elements – chemistry of uranium – uranyl complexes – extraction cycles of U and Np. (18 Hours)

TEXT BOOKS

1. Drago, R.S. (1977). *Physical Methods in Chemistry.* London: Saunders Golden Suburst Series,W.B.Saunders Company, 1st Edition.
2. Aruldhas, G.(2013). *Molecular Structure and Spectroscopy.* New Delhi: PHI Learning Pvt.Ltd.,2nd Edition.

REFERENCE BOOKS

1. Huheey, E. Keitler, A.& Keitler, L. (2006). *Inorganic Chemistry.*New York: Harper, Dorling Kindersley Pvt. Ltd.,4th Edition.
2. Cotton,F.A. & Wilkinson, G. (2007).*Advanced Inorganic Chemistry.*Singapore:John, Wiley & Sons, 6th Edition.
3. Lee, J.D. (2007).*Concise Inorganic Chemistry.* Australia: Black Well Publishing Company, 5th Edition.
4. Soni, P.L. & PandnaSoni. (2016). *Coordination Chemistry.* New Delhi: Ane Books Pvt.Ltd., 1st Edition.
5. Meissler G.L. and Tarr T.A., (2004),*Inorganic Chemistry*, Pearson Academy,New Delhi, 3rd Edition.

Course Code 23PCHC42	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	3	2	3	3	2	3	3	2	2
CO 2	3	3	2	3	3	2	3	3	2	2
CO 3	3	3	1	3	3	2	3	3	1	2
CO 4	3	3	1	3	3	2	3	3	1	2
CO 5	3	3	2	3	3	2	3	3	2	2

3 – Strong, 2 – Medium, 1 - Low

Dr. M. Vairalakshmi
Dr.J.Kavitha Dr.C.Vidya Rani
Head of the Department **Course Designers**

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Quality Education with Wisdom and Values

M.Sc. CHEMISTRY
(for those who join in 2023-2024)

Semester IV	**PROJECT**	**Hours/Week: 6**	
Core Course -15 Project		**Credits: 5**	
Course Code 23PCHC41PR		**Internal 40**	**External 60**

COURSE OUTCOMES

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

CO1: understand the fundamentals of research methodologies and develop ability to choose methods appropriate to research aims and objectives [K2]

CO2: select and define appropriate research problem [K3]

CO3: apply various methods for collecting primary and secondary data along with literature Survey. [K3]

CO4: analyse research ethical issues related to Research and Publication. [K4]

CO5: evaluate new methodologies to develop novel materials through new synthetic routes. [K4]

Project General Rules:

1. Each learner can select her research project in any one of the areas of chemistry in consultation with her guide and the Head of the department.
2. The project can be either developing novel materials through new synthetic routes or review of literature paper.
3. Either individual project or team work (only two students in a team) shall be chosen.
4. The project report should be submitted to the Principal through the Head of the Department of chemistry one week prior to the commencement of the summative examinations. If a candidate fails to submit her project report on the date presented above, she may be permitted to submit the same four days prior to the date of *Viva-voce* examination with a fine as prescribed by the college.
5. Each learner shall submit 2 copies of her project report for valuation.
6. The project report shall contain at least 25 pages excluding bibliography and appendices.

7 The project report shall be valued for a total of 100 marks out of which the external examiner and guide share 60 and 40 marks respectively. The sum of marks awarded by both the examiners shall be considered to be the final mark. Further for a pass in this paper as a whole a learner should secure at least 60 marks in project report and viva-voce put together.

8 If the learner fails to get the minimum pass mark in the project report, she shall be permitted to resubmit her project report once again within a period of 3 months after the publication of the result.

Course Code 23PCHC41PR	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	2	2	3	3	3	2	2	2	3
CO 2	3	2	2	3	3	3	2	2	2	3
CO 3	3	2	2	3	3	3	2	2	2	3
CO 4	3	2	2	3	3	3	2	2	2	3
CO 5	3	2	2	3	3	3	2	2	2	3

3 – Strong, 2 – Medium, 1 - Low

Evaluation Pattern (100 marks)				
Internal Assessment (40marks)			External Assessment (60 marks)	
Project Report (20)	Pre-Submission Presentation (10)	One Open online Course related to the Project (10)	Project Presentation (40)	Viva Voce (20)

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Head of the Department

Dr. J. Kavitha
Course Designer

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Semester IV	**CHEMICAL KINETICS AND CATALYSIS, PHOTO, BIOPHYSICAL AND SUPRAMOLECULAR CHEMISTRY**	**Hours/Week: 6**	
Elective Course DSEC-3		**Credits: 5**	
Course Code 23PCHE41		**Internal 25**	**External 75**

COURSE OUTCOMES

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

CO1: extend the fundamental concepts and theories of reaction rate in kinetics, surface, photo, biophysical and supramolecular chemistry. [K2]

CO2: make use of the principle and applications of kinetics and catalysis, Biophysical, photo, surface and Supramolecular chemistry. [K3]

CO3:develop advanced knowledge of catalysis, kinetics of complex reactions, Bioenergetics, Photo, biophysical and supramolecular Chemistry. [K3]

CO4: analyze the concepts of the fast reactions, biomolecular techniques, self assembly in supramolecular chemistry, surface, biophyical and photo chemistry. [K4]

CO5:evaluate about complex reactions, catalysis, photo chemistry, bimolecular study and molecular recognition. [K4]

UNIT I

Chemical Kinetics

Theories of reaction rates: Collision theory of bimolecular gaseous reaction, Activated Complex theory of bimolecular gaseous reaction-Eyring equation. Theory of unimolecular gaseous reactions-Lindemann, Hinshelwood, RRK, RRKM and Slater treatment.

Kinetics of reaction in solution - influence of solvent, ionic strength, and pressure on rate of the reactions in solution - Significance of volume and entropy of activation - Primary and secondary salt effect.

Kinetics of complex reactions – reversible reactions, consecutive reactions – Parallel reactions and Chain reactions - photochemical $H_2 – Cl_2$ reaction.

Rice Herzfeld mechanism of dissociation of organic molecules viz. dissociation of ethane, decomposition of acetaldehyde –study of H_2- O_2 explosive reactions - Study of fast reactions: Relaxation methods-temperature and pressure jump methods - Stopped flow technique, flash photolysis and Crossed molecular beam method.

(18 Hours)

UNIT II Surface Chemistry and Catalysis

Adsorption-Physical and chemical adsorption – adsorption isotherms – Langmuir, Freundlich and B.E.T-Temkin adsorption isotherms – measurement of surface area from BET - Adsorption on liquid surface-surface tension-Gibbs's adsorption isotherm.Mechanism of surface reactions, unimolecular and bimolecular surface reactions, Langmuir – Hinshelwood mechanism for gases only.

Catalysis- acid – base catalysis - Bronsted catalysis law –heterogeneous catalysis-Enzyme catalysis – effect of substrate concentration- Michaelis – Menton equation-effect of pH and temperature on enzyme catalysis. (18 Hours)

UNIT III

Photo Chemistry

Photophysical processes in electronically excited molecule: Types of photophysical pathways-Radiationless transition-internal conversion and intersystem crossing-Fluorescence emission-Triplet state and Phosphorescence emission-Photophysical kinetics of unimolecular process- delayed fluorescence- effect of temperature on emission process.

Photophysical kinetics of bimolecular processes: Bimolecular collision and mechanism of fluorescence quenching-Kinetics of collisional quenching-Stern-Volmer equation – excimer and exciplexes formation. Photosynthesis - solar energy conversion and storage-Lasers in photochemical kinetics. (18 Hours)

UNIT IV

Biophysical Chemistry

Standard free energy change in biochemical reaction-conversion of ADP to ATP-Biological redox reactions-redox potential, redox reactions and free energy. Hydrophobic interaction and membrane- Hydrogen bond-Biological significance of

pKa and pH.Active transport: Thermodynamic treatment of membrane transport, ion-driven and ATP driven active transport, Ion channel opening.

Technique for bio-molecular study: Principle and factors affecting electro-phoretic mobility – Types of electrophoresis - zone electrophoresis–Paper electrophoresis, cellulose acetate electrophoresis, Gel electrophoresis and Capillary Electrophoresis, - Application of electrophoresis. (18 Hours)

UNITV

Molecular recognition and Supramolecular Chemistry

Introduction: Guest-Host interaction, Classification of receptors-cation, anion and neutral receptors, chelate effect and macrocyclic effect - Molecular Recognition:Cation recognition- Crown ethers and Cryptands as receptors – Anion receptors – porphyrins. Calixarene and Cyclodextrin as receptors.

Molecular self Assembly: Based on hydrogen bond, one-pot reaction. Synthesis of Catenanes and Rotaxanes. Formation of novel self-assemblies to be utilized for diversified applications including drug delivery, self-sortng materials, smart self-healing materials and bio-sensors in industry. Applications of supramolecules as electrochemical sensor, optical sensor and molecular switches and wires. (18 Hours)

TEXT BOOKS

1. Puri, B.R. Sharma, L.R. &Pathania, M.S. (2003). *Principles of Physical Chemistry.* Jalandhar, Delhi: (Millennium Edn.,) Vishal Publishing Co.,1st Edition.
2. Gurdeep Raj, S.(2001). *Advanced Physical Chemistry.* Chennai: Goel Publishing Co., 25th Edition.
3. Bajpai, D.N.,(2012). *Advanced Physical Chemistry.* New Delhi: S.Chand& Company Ltd.,1st Edition.
4. Rohatgi, K.K.& Mukherjee. *(2008). Fundamentals of Photochemistry.* New Jersey: Wiley Eastern, 1st Edition.
5. Dash, U.N.(1996), *A Text Book of Biophysical Chemistry.*New Delhi: Macmillan India Ltd, 1st Edition.
6. Kalsi, P.S., (2017), *Biophysical Chemistry,* New Delhi, New Age International(P) Limited Publisher, 1st edition.
7. Asim K Das, Mahua Das,(2017) *An Introduction to Supramolecular Chemistry,* , West Bengal, CBS Publishers and Distributers (P) Limited, 1 st edition.

REFERENCES BOOKS

1. Laidler, K.J. (2012). *Chemical Kinetics.* London: Harper International Edn., 3rd Edition.
2. McQuarrie, D.A. & Simon, J.D. (1998). *Physical Chemistry- A Molecular Approach*, New Delhi: Viva Books (P) Ltd., 1st Edition.
3. Atkins, P.W.(2000). *Physical Chemistry.* London: ELPS and Oxford University Press, , 6th Edition.
4. Upadhyay &Nath, *Biophysical chemistry.* New Delhi: S.Chand& Company Ltd., 2nd edition.

Course Code **23PCHE41**	PO1		PO2	PO3		PO4	PO5	PO6	PO7	PO8
	PSO 1.a	PSO 1.b	PSO 2	PSO 3.a	PSO 3.b	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO 1	3	2	2	3	3	3	2	2	2	1
CO 2	3	2	2	3	3	3	2	2	2	1
CO 3	3	2	2	3	3	3	2	2	2	3
CO 4	3	2	2	3	3	3	2	2	2	3
CO 5	3	2	2	3	3	3	2	2	2	3

3 – Strong, 2 – Medium, 1 - Low

Dr.J.Kavitha
Dr.N.Ramiladevi
Course Designers

Dr. J. Kavitha
Head of the Department

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Semester IV	**Inorganic Quantitative Analysis and Inorganic Complex Preparation**	**Hours/Week: 6**	
Skill Enhancement Course-2 Professional Competency Skill		**Credits: 3**	
Course Code 23PCHS41P		**Internal 40**	**External 60**

COURSE OUTCOMES

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

CO1: understand and enhance the visual observation as an analytical tool for the quantitative estimation of ions and to understand the concept of preparation of inorganic complexes [K1]

CO2: train the students for improving their skill in estimating the amount of ion accurately present in the solution and to construct suitable experimental setup for the inorganic preparations of complexes. [K2]

CO3: estimate metal ions, present in the given solution accurately without using instruments. [K2]

CO4: experiment different purification and drying techniques for the preparation of inorganic complexes. [K3]

CO5: determine the amount of ions, present in a binary mixture accurately and to develop analytical skill in the handling of chemical reagents for the preparation of inorganic complexes. [K4]

1. Quantitative Analysis: Separation and estimation of mixtures by volumetric and gravimetric methods. Some recommended mixtures are

a. Estimation of Copper(V) and Nickel(G)
b. Estimation of Copper (V) and Calcium(G)
c. Estimation of Fe(III)(V) and Nickel (G)
d. Estimation of Copper (V)and Barium(G)

e. Estimation of Copper (V)and Zinc(G)

f. Estimation of Calcium (V) and Copper(G)

2. Preparation of the following Inorganic complexes.

a. Preparation of Tristhioureacopper(II) sulphate

b. Preparation of Potassium trioxalato aluminate(III)

c. Preparation of Tetramminecopper(II) sulphate

d. Preparation of Reineck's salt

e. Preparation of *trans*-Potassium dioxalatodiaquachromate(III)

f. Preparation of *cis*-Potassium dioxalatodiaquachromate(III)

g. Preparation of Sodium trioxalatoferrate(III)

h. Preparation of Hexathiourealead(II) nitrate

Course Code 23PCHS41P	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO 2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	3	2	3	2	2	2	3	1	1
CO 2	3	3	2	3	2	2	2	3	1	1
CO 3	3	3	2	3	2	2	2	3	1	1
CO 4	3	3	3	3	2	2	2	3	1	1
CO 5	3	3	2	3	2	2	2	3	1	1

3 – Strong, 2 – Medium, 1 - Low

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