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 2024 - 2025)

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)
(2024-2025 onwards)

PG PROGRAMMES

Name of the Course	Course Code	Department
Introduction to Epigraphy	24PHIN21	History
Functional English	24PENN21	English
தமிழ் இலக்கிய வரலாறு	24PTAN21	Tamil
Taxation Concepts and Assessment	24PCON21	Commerce
Entrepreneurship Development	24PBAN21	Business Administration
Mathematics for Life Sciences	24PMTN21	Mathematics
Solid Waste Management	24PPHN21	Physics
Chemistry in Everyday Life	24PCHN21	Chemistry
Food Preservation	24PHSN21	Home Science - Nutrition and Dietetics
Nutritional Biochemistry	24PBCN21	Biochemistry
Tissue engineering	24PBON21	Biotechnology
Web Programming	24PCSN21	Computer Science
Fundamentals of Web Design	24PCAN21	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.1.2 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

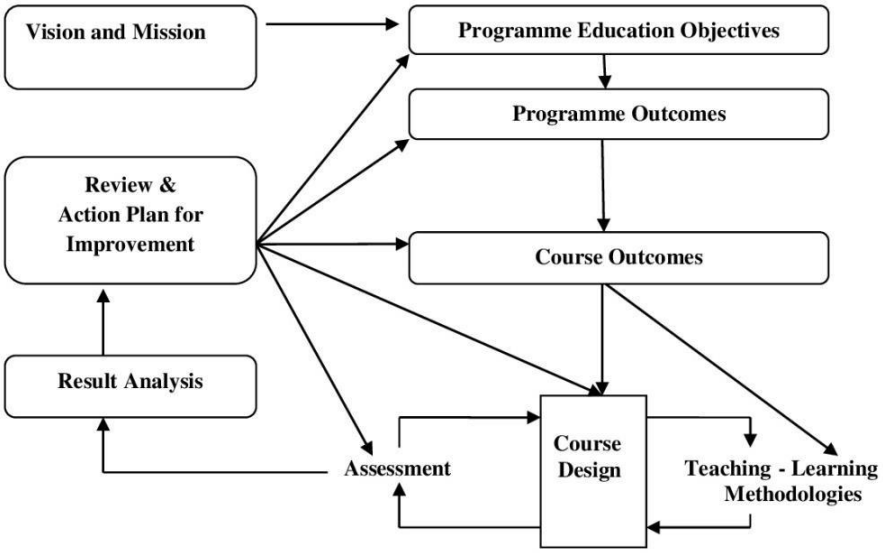
Attainment of PEOs can be measured by a PO-PEO matrix. PEOs should evolve through constant feedback from alumnae, students, industry, management, *etc*. It is mandatory that each PEO should be mapped to at least one of the Pos.

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)

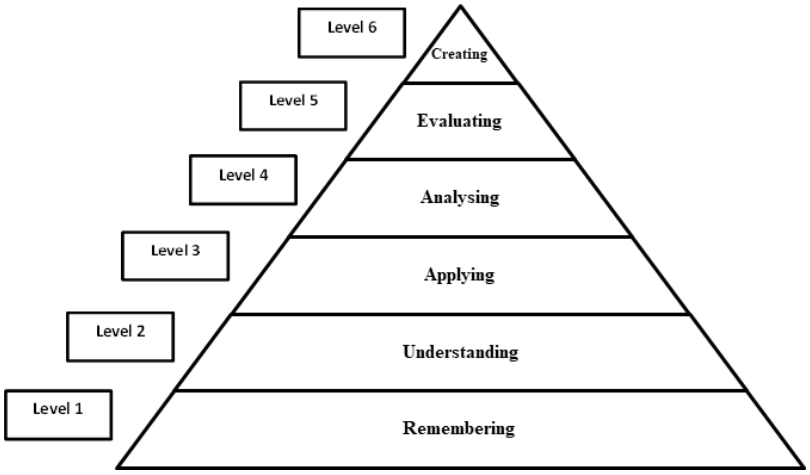
Course Outcomes are narrow statements restricted to the course contents given in five units. Course Outcomes describe what students would be capable of, after learningthe contents of the Course. They reflect the level of knowledge gained, skills

acquired andattributes 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
Periodic Test	:	30
Record Performance	:	10
Total	**:**	**40**

Periodic Test - Average of the best two 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
Periodic Test	:	30
Record Performance	:	10
Total	**:**	**40**

Periodic Test - Average of the best two 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)**

4 weeks 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 average mark 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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Quality Education with Wisdom and Values

MASTER OF CHEMISTRY

Outcome Based Education with Choice Based Credit System
Programme Structure - Allotment of Hours and Credits
For those who join in 2024-2025

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)
Core Course Practical	6 (4)	6 (4)	6 (4)	-	18 (12)
Project	-	-	-	6 (5)	6(5)
Elective Course (DSEC)	6 (3)	4 (3)	3 (3)	-	13 (9)
Elective Course (Generic)	6 (3)	4 (3)	-	-	10 (6)
Elective Course(NME)	-	4 (2)	3 (2)	-	7 (4)
Elective Course- (Industry / Entrepreneurship) 20% Theory 80 % Practical	-	-		6 (3)	6 (3)
Skill Enhancement Course/ Professional Competency Skill	-	-	-	6 (3)	6 (3)
Self Study Course	-	-	0 (1)	-	0 (1)
Internship/Industrial Activity	-	-	0 (2)	-	0 (2)
Extension Activity	-	-	-	0 (1)	0 (1)
Total	**30 (20)**	**30 (22)**	**30 (27)**	**30 (22)**	**120 (91)**
Extra Credit Course(Optional) - Offered by the Department	-	-	0(2)	-	0(2)
Extra Credit Course(Optional) - MOOC	-	-	-	-	Limited to a maximum of 15 credits

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	24PCHC11	6	5	3	25	75	100
2	Core Course-2	Structure and Bonding in Inorganic Compounds	24PCHC12	6	5	3	25	75	100
3	Core Course –3 Practical-1	Organic Chemistry Practical	24PCHC11P	6	4	6	40	60	100
4	Elective Course -1 (DSEC)	Electrochemistry	24PCHE11	6	3	3	25	75	100
5	Elective Course -2 (Generic)	Nanomaterials and Nanotechnology	24PCHE12	6	3	3	25	75	100
			Total	**30**	**20**				**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	24PCHC21	6	5	3	25	75	100
2	Core Course-5	Physical chemistry-I	24PCHC22	6	5	3	25	75	100
3	Core Course - 6 Practical-2	Inorganic Chemistry practical	24PCHC21P	6	4	6	40	60	100
4	Elective Course -3 (DSEC)	Green Chemistry	24PCHE21	4	3	3	25	75	100
5	Elective Course -4 (Generic)	Bio-inorganic chemistry	24PCHE22	4	3	3	25	75	100
6	Elective Course -5 (NME)	Chemistry in Everyday Life	24PCHN21	4	2	3	25	75	100
Total				**30**	**22**				**600**

DSEC: Discipline Specific Elective Course
NME: Non-major Elective Course

SEMESTER III

S.No.	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam Hours	Marks		
							Int.	Ext.	Total
1	Core Course-7	Organic Synthesis and Spectroscopy	24PCHC31	6	5	3	25	75	100
2	Core Course-8	Organometallics, Nuclear and Photochemistry	24PCHC32	6	5	3	25	75	100
3	Core Course-9	Group Theory and Molecular Spectroscopy	24PCHC33	6	5	3	25	75	100
4	Core Course – 10 Practical-3	Physical Chemistry Experiments	24PCHC31P	6	4	6	40	60	100
5	Elective Course -6 (DSEC)	Pharmaceutical Chemistry	24PCHE31	3	3	3	25	75	100
6	Elective Course -7 (NME)	Industrial Chemistry	24PCHN31	3	2	3	25	75	100
7	Self Study Course	Practice for CSIR NET – General Paper	24PGOL32	-	1	2	100	-	100
8		Internship/ Industrial Activity	24PCHI31	-	2	-	100	-	100
Total				**30**	**27**				**800**

NME: Non Major Elective Course

9.	Extra Credit Course	Spectral interpretation of compounds	24PCHO31	-	2	3	100	-	100

SEMESTER IV

S.No	Components	Title of the Course	Course Code	Hours per Week	Credits	Exam. Hours	Marks		
							Int.	Ext.	Total
1	Core Course-11	Heterocycles and Natural Products	24PCHC41	6	5	3	25	75	100
2	Core Course-12	Inorganic Spectroscopy and f-block elements	24PCHC42	6	5	3	25	75	100
3	Core Project	Research Methodology and Ethics	24PCHC41PR	6	5	-	40	60	100
4	Elective Course- 8 (Industry/ Entrepreneurship) 20 % Theory 80% Practical	Analytical Chemistry Practical	24PCHE41P	6	3	3	40	60	100
5	Skill Enhancement Course/ Professional Competency Skill	Advanced Chemistry for Competitive Examinations	24PCHS41	6	3	3	25	75	100
6		Extension Activity		-	1	-	100	-	100
Total				**30**	**23**				**600**

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M.Sc. CHEMISTRY
(for those who join in 2024-2025)

Semester I	**ORGANIC REACTION MECHANISM - I**	**Hours/Week: 6**	
Core Course -1		**Credits: 5**	
Course Code 24PCHC11		**Internal 25**	**External 75**

Course Outcomes:

On completion of the course, students will be able to

CO1: Recall the basic principles of organic chemistry.[K2]

CO2 Understand the formation and detection of reaction intermediates of organic reactions.[K3]

CO3: Predict the reaction mechanism of organic reactions and stereochemistry of organic compounds.[K3]

CO4: Apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions.[K4]

CO5: Design and synthesize new organic compounds by correlating the stereochemistry of organic compounds.[K4]

Unit I: Methods of Determination of Reaction Mechanism:

Reaction intermediates, the transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate.Methods of determining mechanism: nonkinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism.Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants. (18 Hours)

Unit II: Aromatic and Aliphatic Electrophilic Substitution

Aromaticity: Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds and annulenes. Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylationreactions.Aliphatic electrophilic substitution Mechanisms: SE2 and SEi, SE1- Mechanism and evidences. (18 Hours)

Unit III: Aromatic and Aliphatic Nucleophilic Substitution:

Aromatic nucleophilic substitution: Mechanisms - SNAr, SN1 and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attackingnucleophile. Reactions: Oxygen and Sulphur-nucleophiles, Bucherer and Rosenmund reactions, von Richter, SommeletHauser and Smiles rearrangements. SN1, ion pair, SN2 mechanisms and evidences.Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon.SN1, SN2, SNi, and SE1 mechanism and evidences, Swain-Scott, Grunwald-Winstein relationship - Ambident nucleophiles. (18 Hours)

Unit IV: Stereochemistry-I

Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers. Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shape, methods of determining theconfiguration. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation.D, L system, Cram's and Prelog's rules: R, S-notations, proR, proS, side phase and re phase Cahn-Ingold-Prelog rules, absolute and relative configurations. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds, exo-cyclic alkylidene-cycloalkanes.Topicity and prostereoisomerism, chiral shift reagents and chiral solvating reagents.Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, destruction. Stereoselective and stereospecific synthesis. (18 Hours)

Unit V: Stereochemistry-II

Conformation and reactivity of acyclic systems, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium - Curtin-Hammett Principle.Stability of five and six-membered rings: mono-, di- and polysubstitutedcyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule. Optical rotation and optical rotatory dispersion, conformational asymmetry, ORD curves, octant rule, configuration and conformation, Cotton effect, axial haloketone rule and determination of configuration. (18 Hours)

Text Books:

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

References:

1. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th edition, Kluwer Academic / Plenum Publishers, 2007.
2. D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001.
3. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987.
4. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGraw Hill, 2000.
5. I. L. Finar, Organic chemistry, Vol-1&2, 6th edition, Pearson Education Asia, 2004.

6. Sykes, P. (2013). *Guidebook to Mechanism in Organic Chemistry*.Singapore: Pearson Education Ltd,6th Edition.

7. Jerry March. (2010).*Advanced Organic Chemistry*.New Jersey: John Wiley & Sons.4th Edition.

WebResources:

1.https://sites.google.com/site/chemistryebookscollection02/home/organicchemistry/organic

2. https://www.organic-chemistry.org/

Course Code 24PCHC11	**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

Strong (3) Medium(2) Low (1)

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 I	**STRUCTURE AND BONDING IN INORGANIC COMPOUNDS**	**Hours/Week: 6**	
Core Course-2		**Credits: 5**	
Course Code 24PCHC12		**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 mono 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. Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM.

(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. A R West, Solid state Chemistry and its applications, 2nd Edition (Students Edition), John Wiley & Sons Ltd., 2014.
2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.
3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4 th Edition, CRC Press, 2012.

4. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunders Company: Philadelphia, 1977.
5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry; 4th ed.; Harper and Row: NewYork, 1983.
6. SathyaPrakash, Tuli, G.D.Basu, S.K. Madan, R.D.(2011). *Advanced inorganic chemistry.*Volume I , New Delhi: S.Chand& Company Ltd., 19th Edition.
7. Azaroff, V. (1989). *Introduction to Solids.* New York: Tata Ma Graw-Hill Publishing Company Ltd., 1st Edition.
8. Das, A.K. (2016). *Bioinorganic Chemistry.* New Delhi: ArunabhaSen Books and Allied (P) Ltd., 1st Edition.
9. Madan, R.D. (2018).*Modern Inorganic Chemistry.* New Delhi: S.Chand and Company Pvt.Ltd.,3rd Edition.

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. 1stEdition.
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.

Web Resources:

https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall2018/video_galleries/lecture-videos/

Course Code 24PCHC12	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	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

Strong (3) Medium(2) Low (1)

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

Dr.J.Kavitha
Head of the Department

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Semester I	**ORGANIC CHEMISTRY PRACTICAL**	**Hours/Week: 6**	
Core Course-3 Practical		**Credits: 4**	
Course Code 24PCHC11P		**Internal 40**	**External 60**

COURSE OUTCOMES

On completion of the course, students will be able to

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

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

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

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

CO5: 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 salt analysis and either estimation or preparation is to be given.

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.
4. Donald L Pavia, Gary M. Lampman, George and S Kritz, (2009).Organic Chemistry – A Lab Manual New Delhi: Sengage Learning. Print.
5. N.S. Gnanpragasam and G. Ramamurthy, Organic Chemistry Lab Manual, S. ViswanathanPvt. Ltd

REFERENCE BOOKS

1. Venkateswaran, V.; Veeraswamy, R.; Kulandaivelu, A.R. Basic Principles of Practical Chemistry, 2nd ed.; Sultan Chand: New Delhi, 2012.
2. Manna, A.K. Practical Organic Chemistry, Books and Allied: India, 2018.
3. Gurtu, J. N; Kapoor, R. Advanced Experimental Chemistry (Organic), Sultan Chand: New Delhi, 1987.
4. Furniss,B. S.; Hannaford, A. J.; Smith, P. W. G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, 5th ed.; Pearson: India,1989.
5. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994.
6. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013.
7. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199.

Web Resources

https://www.vlab.co.in/broad-area-chemical-sciences

Course Code	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
24PCHC11P	**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

Strong (3) Medium (2) Low (1)

Dr.J.Kavitha
Heads of the Department

Dr.K.Malathi
Course Designer

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M.Sc. CHEMISTRY
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Semester I	**ELECTROCHEMISTRY**	**Hours/Week: 6**	
Elective Course -1 (DSEC)		**Credits: 3**	
Course Code 24PCHE11		**Internal 25**	**External 75**

Course Outcomes

On completion of the course students will be able to:

CO1: Understand the behaviour of electrolytes in solution and compare the structures of electrical double layer of different models. [K2]

CO2: Predict the kinetics of electrode reactions applying ButlerVolmer and Tafel equations [K3]

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

CO4: Discuss the theories of electrolytes, electrical double layer, electrodics and activity coefficient of electrolytes [K4]

CO5: Gain knowledge on 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. Born equation.Debye-HuckelBjerrum model. Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications. Electrolytic conduction-Debye-HuckelOnsager 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, Electrocapillary phenomena - Lippmann equation electro capillary curves. Electrokinetic phenomena electro-osmosis, electrophoresis, streaming and sedimentation potentials, colloidal and poly electrolytes. Structure of double layer: Helmholtz -Perrin, Guoy- Chapman and Stern models of electrical double layer. Zeta potential and potential at zero charge. Applications and limitations. (18 hours)

UNIT III: Electrodics of Elementary Electrode Reactions

Behavior of electrodes: Standard electrodes and electrodes at equilibrium. Anodic and Cathodic currents, condition for the discharge of ions. Nernst equation, polarizable and non-polarizable electrodes.Model of three electrode system, over potential. Rate of electro chemical reactions: Rates of simple elementary reactions. Butler-Volmer equation-significance of exchange current density, net current density and symmetry factor.Low and high field approximations.symmetry factor and transfer coefficient Tafel equations and Tafel plots. (18 hours)

UNIT IV: Electrodics of Multistep Multi Electron System

Rates of multi-step electrode reactions, Butler - Volmer equation for a multi-step reaction.Rate determining step, electrode polarization and depolarization. Transfer coefficients, its significance and determination, Stoichiometric number. Electro-chemical reaction mechanisms-rate expressions, order, and surface coverage. Reduction of I_3^- , Fe^{2+}, and dissolution of Fe to Fe^{2+} . Overvoltage - Chemical and electro chemical, Phase, activation and concentration over potentials. Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan's diagrams. (18 hours)

UNIT V: Concentration Polarization, Batteries and Fuel cells

Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes. Polarography-principle and applications. Principle of square wave polarography. Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. Sodium and lithium-ion batteries and redox flow batteries. Mechanism of charge storage: conversion and alloying. Capacitors- mechanism of energy storage, charging at constant current and

constant voltage. Energy production systems: Fuel Cells: classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells. (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.

5. 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.

5. K.L. Kapoor, A Text book of Physical chemistry, volume-3, Macmillan, 2001.

Web Resources:

1. https://www.pdfdrive.com/modern-electrochemistry-e34333229.

Course Code	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
24PCHE11	**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

Strong (3) Medium(2) Low (1)

Dr.A.Anitha
Dr.J.Kavitha Dr.N. Ramila Devi
Head of the Department **Course Designers**

V.V.VANNIAPERUMAL COLLEGE FOR WOMEN
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VIRUDHUNAGAR
Quality Education with Wisdom and Values

M.Sc. CHEMISTRY

(for those who join in 2024-2025)

Semester I	**NANO MATERIALS AND NANO TECHNOLOGY**	**Hours/week: 6**	
Elective Course – 2 (Generic)		**Credits: 3**	
24PCHE12		**Internal 25**	**External 75**

Course Learning Outcomes :

On completion of the course, students will be able to

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

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

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

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

CO5: 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. Techniques of synthesis of nanomaterials, Tools of the nanoscience. Applications of nanomaterials and technologies. (18 Hours)

UNIT II: Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance crystal structure. Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties. Synthesis Physical and chemical methods - inert gas condensation, arc discharge, laser ablation, sol-gel, solvothermal and hydrothermal-CVD-types, metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis. (18 Hours)

UNIT III: Mechanical properties of materials, theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials Nanoparticles: gold and silver, metal oxides: silica, iron oxide and alumina - synthesis and properties. (18 Hours)

UNIT IV: Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials. Classification of magnetic phenomena. Semiconductor materials – classification-Ge, Si, GaAs, SiC, GaN, GaP, CdS,PbS. Identification of materials as p and n –type semiconductor-Hall effect - quantum and anomalous, Hall voltage - interpretation of charge carrier density. Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell. (18 Hours)

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

Web Resources:

1. http://xrayweb.chem.ou.edu/notes/symmetry.html.

2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.

Course Code 24PCHE12	**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	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

Strong (3) Medium(2) Low (1)

Dr.J.Kavitha
Head of the Department

Dr.N. Ramila Devi
Course Designer

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M.Sc. CHEMISTRY
(for those who join in 2024-2025)

Semester II	**ORGANIC REACTION MECHANISM-II**	**Hours/week: 6**	
Core Course-4		**Credits: 5**	
24PCHC21		**Internal 25**	**External 75**

Course Learning Outcomes :

On completion of the course, students will be able to

CO1: understand the concept of aromaticity in benzenoid, non-benzenoid, heterocyclic and annulene compounds. [K2]

CO2: understand the mechanism involved in various types of organic reactions with evidences.[K3]

CO3: understand the applications of synthetically important reagents.[K3]

CO4: correlate the reactivity between aliphatic and aromatic compounds.[K4]

CO5: design synthetic routes for synthetically used organic reactions.[K4]

UNIT I: Elimination and Free Radical Reactions:

Mechanisms: E2, E1, and E1cB mechanisms. Syn- and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules. Reactivity: Effect of substrate, attacking bases, leaving group and medium. Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination. Long lived and short-lived radicals – Production of radicals by thermal and photochemical reactions, Detection and stability of radicals, characteristics of free radical reactions and free radical, reactions of radicals; polymerization, addition, halogenations, aromatic substitutions, rearrangements. Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent. (18 Hours)

UNIT II

Oxidation and Reduction Reactions: Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition-elimination, oxidative and reductive coupling reactions. Mechanism of oxidation reactions: Dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate lead tetraacetate, permanganate, manganese dioxide, osmium tetroxide, oxidation of saturated hydrocarbons, alkyl groups, alcohols, halides and amines. Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allylic oxidation, oxidation by chromium trioxide-pyridine, DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation, dimethyl sulphoxide- dicyclohexylcarbodiimide (DMSO-DCCD). Mechanism of reduction reactions: Wolff-Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyltin hydrides, McFadyen-Steven's reduction, Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault-Blanc reduction. (18 Hours)

UNIT III: Rearrangements

Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements -applications and stereochemistry, Wagner-Meerwein, Demjanov, Dienone-phenol, Baker-Venkataraman, Benzilic acid and Wolff rearrangements. Rearrangements to electron deficient nitrogen: Hofmann, Curtius, Schmidt, Lossen, Beckmann and abnormal Beckmann rearrangements. Rearrangements to electron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements. Rearrangements to electron rich atom: Favorskii, Quasi-Favorskii, Stevens, [1,2]-Wittig and [2,3]-Wittig rearrangements.Fries and Photo Fries rearrangement. Intramolecular rearrangements – Claisen, abnormal Claisen, Cope, oxy-Cope Benzidine rearrangements. (18 Hours)

UNIT IV

Addition to Carbon Multiple Bonds: Mechanisms: (a) Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanisms-Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen; (b) Addition to carbon-hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction, Prinsreaction. Stereochemical aspects of

addition reactions. Addition to Carbon-Hetero atom Multiplebonds: Addition of Grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates – Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters. (18 Hours)

UNIT V:Reagents and Modern Synthetic Reactions

Lithium diisopropylamine (LDA), Azobisisobutyronitrile (AIBN), Sodium cyanoborohydride ($NaBH_3CN$), *meta*-Chloroperbenzoic acid (m-CPBA), Dimethyl aminiopyridine (DMAP), n-Bu_3SnD, Triethylamine (TEA), Diazobicyclo[5.4.0]undec-7-ene (DBU), Diisopropylazodicarboxylate (DIAD), Diethylazodicarboxylate (DEAD), *N*-bromosuccinimide (NBS), Trifluoroacetic acid (TFA), Tetramethyl piperiridin-1-oxyl (TEMPO), Phenyltrimethylammoniumtribromide (PTAB).Diazomethane and Zn-Cu, Diethyl maleate (DEM), Copper diacetylacetonate ($Cu(acac)_2$), $TiCl_3$, $NaIO_4$, Pyridiniumchlorochromate (PCC),Pyridinium dichromate (PDC), Meisenheimer complex**.** Suzuki coupling, Heck reaction, Negishi reaction, Baylis-Hillman reaction. (18 Hours)

TEXT BOOKS

1. J. March and M. Smith, *Advanced Organic Chemistry*, 5th ed., John-Wiley and Sons.2001.
2. E. S. Gould, *Mechanism and Structure in Organic Chemistry,* Holt, Rinehart and Winston Inc.,1959.
3. P. S. Kalsi, *Stereochemistry of carbon compounds*, 8thedn, New Age International Publishers,2015.
4. P. Y.Bruice, *Organic Chemistry*, 7thedn.,Prentice Hall, 2013.
5. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee*Organic Chemistry*, 7thedn., Pearson Education,2010.

REFERENCE BOOKS

1. S. H. Pine, *Organic Chemistry*, 5thedn, McGraw Hill International Editionn,1987.
2. L. F. Fieser and M. Fieser, *Organic Chemistry*, Asia Publishing House, Bombay,2000.
3. E.S. Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc.,1959.

4. T. L. Gilchrist, *Heterocyclic Chemistry*, Longman Press, 1989.

5. J. A. Joule and K. Mills, *Heterocyclic Chemistry*, 4th ed., John-Wiley,2010.

Website and e-learning source

1.https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic

2. https://www.organic-chemistry.org/

Course Code 24PCHC21	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

Strong (3) Medium (2) Low (1)

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
(for those who join in 2024-2025)

Semester II	**PHYSICAL CHEMISTRY-I**	**Hours/week: 6**	
Core Course-5		**Credits: 5**	
24PCHC22		**Internal 25**	**External 75**

Course Learning Outcomes :

On completion of the course, students will be able to

CO1: recall the fundamentals of thermodynamics and the composition of partial molar quantities.[K2]

CO2: understand the classical and statistical approach of the functions.[K3]

CO3: compare the significance of Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein.[K3]

CO4: correlate the theories of reaction rates for the evaluation of thermodynamic parameters.[K4]

CO5: study the mechanism and kinetics of reactions.[K4]

UNIT I: Classical Thermodynamics:

Partial molar properties-Chemical potential, Gibb's-Duhem equation-binary and ternary systems.Determination of partial molar quantities. Thermodynamics of real gases - Fugacity- determination of fugacity bygraphical and equation of state methods-dependence of temperature, pressure and composition. Thermodynamics of ideal and non-ideal binary mixtures, Duhem - Margulus equation applications of ideal and non-ideal mixtures. Activity and activity coefficients-standard states -determination-vapour pressure, EMF andfreezing point methods. (18 Hours)

UNIT II: Statistical thermodynamics:

Introduction of statistical thermodynamics concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles. Assemblies, ensembles, canonical particles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics- comparison and applications. Partition functions-evaluation of translational, vibrational and rotational partition functions for monoatomic,

diatomic and polyatomic ideal gases. Thermodynamic functions in terms of partition functions-calculation of equilibrium constants. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function residual entropy, equilibrium constants and equipartition principle. Heat capacity of mono and di atomic gases-ortho and para hydrogen. Heat capacity of solids-Einstein and Debye models. (18 Hours)

UNIT III: Irreversible Thermodynamics:

Theories of conservation of mass and energyentropy production in open systems by heat, matter and current flow, force and flux concepts. Onsager theory-validity and verification- Onsager reciprocal relationships. Electro kinetic and thermo mechanical effects-Application of irreversible thermodynamics to biological systems. (18 Hours)

UNIT IV: Kinetics of Reactions:

Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions -Lindeman and Christiansen hypothesis- molecular beams, collision cross sections, effectiveness of collisions, Potential energy surfaces. Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules, time and true order-kinetic parameter evaluation. Factors determine the reaction rates in solution - primary salt effect and secondary salt effect, Homogeneous catalysis- acid- base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law, enzyme catalysis-Michelis-Menton catalysis. (18 Hours)

UNIT V: Kinetics of complex and fast reactions:

Kinetics of complex reactions, reversiblereactions, consecutive reactions, parallel reactions, chain reactions. Chain reactions-chain length, kinetics of $H_2 - Cl_2$& $H_2 - Br_2$ reactions (Thermal and Photochemical reactions) - Rice Herzfeldmechanism. Study of fast reactions-relaxation methods- temperature and pressure jump methods electric and magnetic field jump methods -stopped flow flash photolysis methods and pulse radiolysis. Kinetics of polymerization-free radical, cationic, anionic polymerization - Polycondensation. (18 Hours)

TEXT BOOKS

1. J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, 2nd edition,S.L.N.Chand and Co., Jalandhar, 1986.
2. I.M. Klotz and R.M. Rosenberg, Chemical thermodynamics, 6th edition, W.A.BenjaminPublishers, California, 1972.
3. M.C. Gupta, Statistical Thermodynamics, New Age International, Pvt. Ltd., New Delhi,1995.
4. K.J. Laidler, Chemical Kinetics, 3rd edition, Pearson, Reprint - 2013.
5. J. Rajaram and J.C. Kuriokose, Kinetics and Mechanisms of chemical transformation,Macmillan India Ltd, Reprint - 2011.

REFERENCE BOOKS

1.Viva Books Pvt. Ltd., New Delhi, 1999.
2.R.P. Rastogi and R.R. Misra, Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi, 1990.
3. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Publishers, New York, 1974
4 D.A. Mcqurrie And J.D. Simon, Physical Chemistry - A Molecular Approach,. K.B. Ytsiimiriski, "Kinetic Methods of Analysis", Pergamom Press,1996.
5. Gurdeep Raj, Phase rule, Goel Publishing House, 2011.

Website and e-learning source

1. https://nptel.ac.in/courses/104/103/104103112/
2. https://bit.ly/3tL3GdN

Course Code 24PCHC22	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	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

Strong (3) Medium(2) Low (1)

Dr.J.Kavitha
Head of the Department

Dr. J. Kavitha
Dr.N. Ramila Devi
Course Designers

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M.Sc. CHEMISTRY

(for those who join in 2024-2025)

Semester II	**INORGANIC CHEMISTRY PRACTICAL**	**Hours/week: 6**	
Core Course-6 Practical - 2		**Credits: 4**	
24PCHC21P		**Internal 40**	**External 60**

Course Learning Outcomes:

On completion of the course, students will be able to

CO1: understand and enhance the visual observation as an analytical tool for the quantitative estimation of ions.[K2]

CO2: recall the principle and theory in preparing standard solutions.[K2]

CO3: train the students for improving their skill in estimating the amount of ion accurately presen t in the solution.[K3]

CO4: estimate metal ions, present in the given solution accurately without using instruments.[K3]

CO5: determine the amount of ions, present in a binary mixture accurately.[K4]

UNIT I: Analysis of mixture of cations: Analysis of a mixture of four cations containing two common cations and two rare cations. Cations to be tested.

Group-I : W, Tl and Pb.

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

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

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

Group-V : Ca, Ba and Sr.

Group-VI : Li and Mg. (30 Hours)

UNIT II: Preparation of metal complexes: Preparation of inorganic complexes:

a. Preparation of tristhioureacopper(I)sulphate

b. Preparation of potassium trioxalatechromate(III)

c. Preparation of tetramminecopper(II) sulphate

d. Preparation of Reineck's salt

e. Preparation of hexathioureacopper(I) chloridedihydrate

f. Preparation of *cis*-Potassium tri oxalate diaquachromate(III)

g. Preparation of sodium trioxalatoferrate(III)

h. Preparation of hexathiourealead(II) nitrate (30 Hours)

UNIT III: Complexometric Titration:

1. Estimation of zinc, nickel, magnesium, and calcium.
2. Estimation of mixture of metal ions-pH control, masking and demasking agents.
3. Determination of calcium and lead in a mixture (pH control).
4. Determination of manganese in the presence of iron.
5. Determination of nickel in the presence of iron. (30 Hours)

TEXT BOOKS

1. A. JeyaRajendran, Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis, United global publishers, 2021.
2. V. V. Ramanujam, *Inorganic Semimicro Qualitative Analysis*; 3rded.,The National Publishing Company, Chennai, 1974.
3. *Vogel's Text book of Inorganic Qualitative Analysis,* 4thed., ELBS, London.

REFERENCE BOOKS

1. G. Pass, and H. Sutcliffe, *Practical Inorganic Chemistry*; Chapman Hall, 1965.
2. W. G. Palmer, Experimental *Inorganic Chemistry*; Cambridge University Press, 1954.

Course Code 24PCHC21P	**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

Strong (3) Medium (2) Low (1)

Dr.J.Kavitha
Heads of the Department

Dr. M. Vairalakshmi
Course Designer

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M.Sc. CHEMISTRY
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Semester II	**GREEN CHEMISTRY**	**Hours/Week: 4**	
Elective Course - 3 (DSEC)		**Credits: 3**	
Course Code 24PCHE21		**Internal 25**	**External 75**

Course Outcomes

On completion of the course students will be able to:

CO1: recall the basic chemical techniques used in conventional industrial preparations and in green innovations. [K2]

CO2: understand the various techniques used in chemical industries and in laboratory. [K3]

CO3: compare the advantages of organic reactions assisted by renewable energy sources and non-renewable energy sources. [K3]

CO4: apply the principles of PTC, ionic liquid, microwave and ultrasonic assisted organicsynthesis. [K4]

CO5: design and synthesize new organic compounds by green methods. [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. (12 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. (12 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. (12 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. (12 Hours)

UNIT V: Micro wave induced green synthesis-Introduction, Instrumentation, Principle and applications. Sonochemistry – Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and Applications. (12 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. ChandrakantaBandyopadhyay, An Insight into Green Chemistry, Books and Allied (P) Ltd, 2019.

Website and e-learning source

1. https://www.organic-chemistry.org/
2. https://www.studyorgo.com/summary.php

Course Code 24PCHE21	**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	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

Strong (3) Medium (2) Low (1)

Dr.J.Kavitha
Head of the Department

Dr.C. Vidya Rani
Course Designer

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

M.Sc. CHEMISTRY

(for those who join in 2024-2025)

Semester II	**BIO-INORGANIC CHEMISTRY**	**Hours/week: 4**	
Elective Course - 4 (Generic)		**Credits: 3**	
24PCHE22		**Internal 25**	**External 75**

Course Learning Outcomes :

On completion of the course, students will be able to

CO1: analyses trace elements.[K2]

CO2: explain the biological redox systems.[K3]

CO3: gain skill in analyzing the toxicity in metals.[K3]

CO4: experience in diagnosis.[K4]

CO5: learn about the nitrogen fixation and photosynthetic mechanism.[K4]

UNIT I: Essential trace elements:

Selective transport and storage of metal ions: Ferritin, Transferrin and sidorphores; Sodium and potassium transport, Calcium signalling proteins. Metalloenzymes: Zinc enzymes–carboxypeptidase and carbonic anhydrase. Ironenzymes–catalase, peroxidase. Copperenzymes – superoxide dismutase, Plastocyanin, Ceruloplasmin, Tyrosinase. Coenzymes - Vitamin-B12 coenzymes. (12 Hours)

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

(12 Hours)

UNIT III: Nitrogen fixation-Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase- redox property – Dinitrogen complexes transition metal complexes of dinitrogen - nitrogen fixation via nitride

formation and reduction of dinitrogen to ammonia. Photosynthesis:photosystem-I and photosystem-II-chlorophylls structure and function. (12 Hours)

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

(12 Hours)

UNIT V: Enzymes -Introduction and properties -nomenclature and classification. Enzyme kinetics, free energy of activation and the effects of catalysis. Michelis - Menton equation - Effect of pH, temperature on enzyme reactions. Factors contributing to the efficiency of enzyme. (12 Hours)

TEXT BOOKS

1. Williams,D.R. –Introdution to Bioinorganic chemistry.
2. F.M. Fiabre and D.R. Williams– The Principles of Bioinorganic Chemistry, RoyolSoceity of Chemistry, Monograph for Teachers-31
3. K.F. Purcell and Kotz., Inorganic chemistry, WB Saunders Co., USA.
4. G.N. Mugherjea and Arabinda Das, Elements of Bioinorganic Chemistry - 1993.
5.R.Gopalan, V.Ramalingam, *Concise Coordination Chemistry*, S. Chand, **2001**.

REFERENCE BOOKS

1. M.Satake and Y.Mido, Bioinorganic Chemistry- Discovery Publishing House, New Delhi (1996)
2. M.N. Hughes, 1982, The Inorganic Chemistry of Biological processes, II Edition, Wiley London.
3. R. W. Hay, Bio Inorganic Chemistry, Ellis Horwood, 1987.
4. R. M. Roat-Malone, Bio Inorganic Chemistry, John Wiley, 2002.
5. T. M. Loehr, Iron carriers and Iron proteins, VCH, 1989.

Website and e-learning source

1. https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry-the-instant-notes-chemistry-series-d162097454.html
2. https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry-5th-edition-d161563417.html

Course Code 24PCHE22	**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	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

Strong (3) Medium(2) Low (1)

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Dr.M.Vairalakshmi
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M.Sc. CHEMISTRY

(for those who join in 2024-2025)

Semester II	**CHEMISTRY IN EVERYDAY LIFE**	**Hours/week: 4**	
Elective Course – 5 NME-1		**Credits: 2**	
24PCHN21		**Internal 25**	**External 75**

Course Learning Outcomes :

On completion of the course, students will be able to

CO1: understand the basic concepts of dairy products, cosmetics, food nutrients, agriculture and environmental pollutants. [K1]

CO2: classify the milk and cosmetic products, food and plant nutrients, pesticides, sources of air and water pollution. [K2]

CO3: interpret the composition and preparation of dairy products, cosmetics, fertilizer, pesticides, composition of air and water pollutants. [K2]

CO4: illustrate on the characteristics of dairy products and cosmetics, structure and function of carbohydrates, vitamins, fats, oil, fertilizer, pesticides, effect of air and water pollution. [K3]

CO5: analyze the effect of heat on milk, composition of cosmetics, purity of fats and oil, manufacture of fertilizers and pesticides, treatment for air and water pollutants. [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. (12 Hours)

UNIT II

Chemistry in Cosmetics

Dental Preparations: Tooth pastes- ingredients, their characteristics and functions- Mouth washes (Composition only)-Face powder (Composition only), Deodorants and antiperspirants- Distinction between astringents and deodorants, deodorant powders (Composition only) - shampoo - different types and formulations, hair conditioners and setting lotions. Hair colourants: Hair lighteners and bleaches, Temporary colourant, Semi-permanent colourants, permanent colourants – vegetable dyes. (12 hours)

UNIT III

Chemistry in Food

Carbohydrates: Structure, function and Chemistry of some important mono and disaccharides**.**

Vitamins: Classification and Nomenclature. Sources, deficiency diseases and structures of Vitamin A1, Vitamin B1, Vitamin C, Vitamin D, Vitamin E & Vitamin K1.

Oils and fats: Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like aregemone oil and mineral oils. (12 hours)

UNIT IV

Chemistry in Agriculture

Fertilizers: Classification of Fertilizers- Straight Fertilizers, Compound/Complex Fertilizers, Fertilizer Mixtures -NPK, superphosphate, triple superphosphate, preparation and uses –Micro and macronutrients and their role in plant growth

Pesticides: Classification of pesticides with examples. Insecticides-Manufacture and uses of insecticides-DDT, BHC -Fungicides: Preparation of Bordeaux mixture -Mention of lime-sulphur, creosote oil and formula. (12 hours)

UNIT V

Pollution chemistry

Air Pollution: Air pollutants, effects and prevention - Green house gases and acid raid.Ozone hole and CFC's.Photochemical smog and PAN.Catalytic converters for mobile sources.Bhopal gas tragedy.

Water Pollution: sources, effects and control measures-Detergents- pollution aspects, eutrophication- Pesticides and insecticides-pollution aspects.Heavy metal pollution- Treatment of industrial liquid wastes.Sewage and industrial effluent treatment. (12 hours)

TEXT BOOKS

1. B. K. Sharma: introduction to Industiral Chemistry, Goel Publishing, Meerut (1998)
2. JayashreeGhosh, (2013), *Fundamental concepts of applied chemistry*, S.Chand&Company Ltd
3. Analysis of Foods – H.E. Cox: 13. Chemical Analysis of Foods – H.E.Cox and pearson.
4. Handbook on Feritilizer Technology by Swaminathan and Goswamy, 6th ed. 2001, FAI.

REFERENCE BOOKS

1. Sivasankar.B, (2009), *Engineering Chemistry,* Tata McGraw-Hill Education Pvt.Ltd.
2. Jain.P.C. and Dr.Monika Jain, (2013), *Engineering Chemistry*,DhanpatRai Publishing Company Pvt.Ltd.

Course Code 24PCHN21	**PO1**		**PO2**	**PO3**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
	PSO 1a	**PSO 1b**	**PSO2**	**PSO 3a**	**PSO 3b**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**
CO 1	3	2	2	3	3	2	3	3	3	3
CO 2	3	3	3	3	3	2	2	2	3	3
CO 3	3	2	3	2	3	1	1	2	2	2
CO 4	3	3	2	2	2	1	2	2	2	2
CO 5	3	2	2	3	3	2	3	2	3	2

Strong (3) Medium (2) Low (1)

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