

CURRICULUM & SYLLABUS



CHOICE BASED CREDIT SYSTEM (CBCS)

FOR

MASTER OF SCIENCE (M.Sc.)

(2 Year Postgraduate Degree Programme)

IN CHEMISTRY [w. e. f. 2023 onwards]

FACULTY OF SCIENCE & HUMANITIES

SRM UNIVERSITY DELHI-NCR, SONEPAT

**Plot No.39, Rajiv Gandhi Education City, P.S. Rai, Sonapat Haryana-
131029**

Vision

Department of Chemistry is committed to provide intellectual, innovative & motivational surroundings to students and faculty members. Department is focused to contribute for academic, scientific, research and experimental knowledge through excellence and to produce scientist, researchers and bureaucrats. Department wants to strive and achieve reputation of seeking attention of Government of India and use of others to be invited to provide services on the subjects involving Chemistry and allied areas.

Mission

- To improve the problem-solving capability of students through continuous learning to produce quality Chemists, Scientists, Academic intellectuals etc. in the field of Science and Technology.
- To bridge the gap between industry and academia by imparting technical/experimental knowledge along with its application in the practical world.
- To encourage innovation through multidisciplinary research and development activities.
- To inculcate human values and ethics into students to serve the society and nation with utmost devotion.
- To develop the overall personality of students along with the learning process simultaneously.

CHEMISTRY POST GRADUATE EMPLOYABILITY ATTRIBUTES

- Sound Knowledge and Understanding of the Domain Area.
- Analytical & Critical Thinking and Problem-Solving Skills.
- Scientific Temperament Towards Research & Innovation for the Betterment of Society.
- Efficient Communication & Presentation Skills.
- Dependability, Reliability, Responsibility and Independent Leadership Abilities.
- Awareness about Recent and Modern Applications and Techniques.

PROGRAM EDUCATIONAL OBJECTIVE

Degree is awarded to candidates who have completed the course and who have met the assessment criteria for all written, major/minor projects and practical examination/assignments. The overall assessment aims for each topic are that candidates should be able to:

- ❖ Grasp the concepts while teaching in classes
- ❖ Interpret and analyze the questions
- ❖ Bridge the multiple concepts of various topics via numerical and Practicals/Project
- ❖ Extract critical knowledge from the comprehensive topics.
- ❖ Ability to write & review of scientific articles.

PROGRAM LEARNING OUTCOME

On successful completion of this program, students will:

- ❖ Have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Physical Chemistry
- ❖ Think critically and analyze chemical problems.
- ❖ Present scientific and technical information resulting from laboratory
- ❖ Should broaden their professional foundations through activities such as teaching, internships, and fellowships
- ❖ Use technologies/instrumentation to gather and analyze data.
- ❖ Should be able to communicate scientific results in writing and in oral presentation.
- ❖ Should acquire the basic tools needed to carry out independent chemical research. Students should become proficient in their specialized area of chemistry and successfully complete an advanced research project.
- ❖ Will be able to describe the common methods of spectroscopic and chromatographic analysis, and discuss how they can be applied to pharmaceuticals

MAPPING OF PROGRAM EDUCATIONAL OBJECTIVES AND PROGRAM LEARNING OUTCOMES

Program Education al	Program Learning Outcomes
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Objectives (PEOs)	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
PEO1								
PEO2								
PEO3								
PEO4								
PEO5								

SEMESTER – I

Inorganic Chemistry-I (Co-ordination and Rare earth metals)	
Course Code: 21CYMS101	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Apply various theories of coordination compounds to explain their properties.
- Describe the electronic spectra of various transition metal complexes. □ Draw various reaction mechanisms for synthetic inorganic chemistry.
- Correlate between properties of inorganic compounds containing f-block elements of the periodic table as the central metal ion and their properties.

Organic Chemistry-I (GOC and Stereochemistry)	
Course Code: 21CYMS102	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Explain the formation, reactivity and stability of reactive intermediates.
- Illustrate the basic concept of symmetry and chirality in the molecules their spatial arrangement, properties and reactivity of stereoisomers, importance of the configuration of chiral organic compounds.
□ Describe the stereochemistry of *N*-heterocyclic system and dynamic stereochemistry.

- Demonstrate the knowledge on reaction mechanism & structure and reactivity involved in organic molecules.

Physical Chemistry-I (Quantum Chemistry and Chemical Kinetics)	
Course Code: 21CYMS103	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Describe the postulates of quantum chemistry and apply to obtain the expression for uncertainty principles and other quantum mechanical system.
- Apply the concept of quantum chemistry to get the wave functions, probability and energy of various models and systems.
- Demonstrate different theories of chemical kinetics.
- Illustrate the use of theories of chemical kinetics to different types of chemical and biochemical reactions.

Inorganic Chemistry Practical – I	
Course Code: 21CYMS151	Continuous Evaluation: 60 Marks
Credits: 2	End Semester Practical Examination: 40 Marks
L T P : 0 0 4	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Perform water analysis□
- Illustrate the separation of inorganic metal ions by gravimetric analysis.□
- Demonstrate the synthesis & determine the properties of inorganic complex compounds.□

Organic Chemistry Practical – I	
Course Code: 21CYMS152	Continuous Evaluation: 60 Marks
Credits: 2	End Semester Practical Examination: 40 Marks
L T P : 0 0 4	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Demonstrate safe laboratory practices by handling laboratory glassware, equipment, and chemical reagents.□
- Perform synthetic procedures, starting materials, functional groups, mechanism, and typical reaction conditions.□
- Replicate the mono & bi-functional groups in organic compounds.□

- Execute characterization by physical and spectroscopic techniques.□

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□

Physical Chemistry Practical – I	
Course Code: 21CYMS153	Continuous Evaluation: 60 Marks
Credits: 2	End Semester Practical Examination: 40 Marks
L T P : 0 0 4	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Perform the kinetics of various reactions by different methods.
- Apply distribution law in various systems.
- Describe the concept of phase equilibria & prepare phase diagram

SEMESTER II

Inorganic Chemistry-II (Organometallic Chemistry)	
Course Code: 21CYMS201	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Describe the fundamental understanding of organometallic compounds.
- Demonstrate bonding, properties & reactions of metal carbene, metal carbyne & fluxional organometallic compounds.
- Replicate various catalytic reactions by using transition metal catalyst.
- Explain the structure & bonding of low & high nuclear metal cluster.

Organic Chemistry-II (Organic Spectra and Reagents)	
Course Code: 21CYMS202	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Demonstrate the principles of IR spectroscopy for the structure determination of organic compounds.
- Apply the principles of UV spectroscopy and Mass spectrometry for the structure determination of organic compounds.
- Apply the basic principles of NMR spectroscopy such as chemical shift, coupling constant, and anisotropy in the characterization of compounds.

- Illustrate various reducing and oxidizing agents and their applications in organic synthesis.

Physical Chemistry - II (Statistical Thermodynamics and Electrochemistry)	
Course Code: 22CYMS203	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Explain concept of statistical thermodynamics and various types of systems.
- Demonstrate the applications of statistical thermodynamics in determination of partition function.
- Analyze the ion-ion interactions and its limitations in electrochemistry.
- Describe the ion transport in solution under different environment.

Inorganic Chemistry Practical – II	
Course Code: 21CYMS251	Continuous Evaluation: 60 Marks
Credits: 2	End Semester Practical Examination: 40 Marks
L T P : 0 0 4	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO);

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Identify various anions present in inorganic salt mixture qualitatively.
- Identify various cations present in inorganic salt mixture qualitatively.

Organic Chemistry Practical – II	
Course Code: 21CYMS252	Continuous Evaluation: 40
Credits: 2	End Semester Practical Examination: 60
L T P : 0 0 4	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Demonstrate the separation and identification of compounds.
- Execute synthesis of organic compounds and related steps such as aqueous workup, distillation, reflux, separation, isolation, and crystallization.

Physical Chemistry Practical – II	
Course Code: 21CYMS253	Continuous Evaluation: 40
Credits: 2	End Semester Practical Examination: 60
L T P : 0 0 4	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Replicate potentiometric and conductometric titration of acid and base to study the details of rates of chemical reactions. □
- Apply the principles of Thermochemistry in the determination of heat of reaction. □

SEMESTER III

Structure & Mechanism in Organic Chemistry	
Course Code: 21CYMS301	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Describe various nucleophiles and electrophiles and their reactions. Will also get to know about the various factors which affects the rate and outcomes of electrophilic & nucleophilic substitution reactions.
- Explain the various types of reactions involving arenium ion as in intermediate.
- Explain the role of free radicals in organic chemistry and in reaction mechanism. □ Demonstrate the mechanistic and stereochemical aspects of addition reactions.

1. Organic Chemistry, Plenum, 5th Edition, 2007.
2. Peter Sykes, A Guide Book to Mechanism in Organic Chemistry, 6th Edition, Pearson.
3. R.T. Morrison and R.N. Boyd, Organic Chemistry, 6th Edition, Prentice-Hall, 2010.

Inorganic and Physical Spectroscopy	
Course Code: 22CYMS302	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Describe the concepts of vibrational spectroscopy and ir spectra of molecules.
- Apply concepts Raman spectroscopic techniques to characterize different molecules and crystals.

- Demonstrate the electronic and spin.

Bio-Inorganic and Bio-Organic Chemistry	
Course Code: 21CYMS303	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Describe the function of alkali and alkaline earth metals in biological system & their role as biological carriers□
- Analyze the importance, function & mechanism of various metalloenzymes□
- Explain various classes of carbohydrates, their roles, synthesis & stereochemistry.□
- Identify various biomolecules such as nucleic acids, amino acids & proteins, their roles, synthesis & properties.□

□

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Photochemistry & Pericyclic Chemistry	
Course Code: 21CYMS304	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Describe concept of photochemistry and their applications in carbonyl compounds.
- Explain the intermolecular rearrangement in olefinic and carbonyl compounds.
- Apply the molecular orbital symmetry and possibility of thermal and photo-chemical pericyclic reactions of electro-cyclic reactions
- Explain cycloaddition reaction and sigmatropic reactions such as diels alder reactions, Claisen rearrangement, ene reactions etc.

Chemistry Practical – III	
Course Code: 22CYMS351	Continuous Evaluation: 40 Marks

Credits: 2	End Semester Practical Examination: 60 Marks
L T P : 0 0 4	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Synthesize, and characterize inorganic compounds.
- Describe various techniques used in isolation of organic compounds from natural sources.
- Demonstrate the synthesis and characterization of nanoparticles.
- Demonstrate the effect on conductance as the number of ions increases or decreases.

istry Practical – IV	
Course Code: 22CYMS352	Continuous Evaluation: 40 Marks
Credits: 2	End Semester Practical Examination: 60 Marks
L T P : 0 0 4	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Perform the multi-step synthesis of organic compounds.□
- Preparation of polymers
- Apply polarimetry to study the progress of chemical reactions.□

SEMESTER-IV

Subject Name: Group Theory	
Course Code: 21CYMS401	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Work out the symmetry point groups of molecules.
- Derive the character table and obtain the Mulliken symbol and irreducible representation for various point group molecules.
- Obtain normal modes of vibrations and the spectroscopic transition for various molecular point group.
- Apply the concepts of symmetry of hybrid orbitals for sigma and pi bonding and for the symmetry adapted linear combination of atomic orbitals.

Natural Products & Heterocyclic Compounds	
Course Code: 21CYMS402	Continuous Evaluation: 40 Marks

Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Explain natural products, their types and synthesis.
- Describe the chemistry of proteins, enzymes or carbohydrates and their structure determination methods.
- Demonstrate heterocyclic compounds with respect to their structure, synthesis and reactions.
- Comprehend the types of protecting groups in organic synthesis and their significance.

Chemistry in Industry & Environment	
Course Code: 21CYMS403	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Core Course
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Identify toxicity hazards of toxic gases, safe design systems for large scale production of industrial gases, manufacturing processes handling and storage of inorganic chemicals.
- Explain the hazardous effects of the inorganic chemicals on human beings and vegetation & the advantages of Green Chemistry over conventional methods.
- Describe about various perfume formulations & their synthesis used in perfumery industry.
- Demonstrate the processes that are used in milk & alcohol Industry.

GENERIC ELECTIVE COURSE (GE-I & II)

Mathematics for Chemists	
Course Code: 21GECY101	Continuous Evaluation: 40
Credits: 4	End Semester Examination: 60
L T P : 4 0 0	Course Type: Generic
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Explain the basic concepts of Vector analysis
- Apply the concept of differential calculus used in chemistry.
- Solve problems related to matrices & determinants in chemistry.
- Apply the concept of integral calculus used in chemistry.

Computer for Chemists	
Course Code: 21GECY102	Continuous Evaluation: 40
Credits: 4	End Semester Examination: 60
L T P : 4 0 0	Course Type: Generic
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Explain the basic knowledge of Python like data types & implementing conditional loops with the help of few examples.
- Apply basic operators on the text file using python fundamentals and implementing few Machine learning algorithms.
- Illustrate reaction mechanism along with theoretical calculations. □ Perform molecular docking.

Biology for Chemists	
Course Code: 21GECY201	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Generic
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Explain the structure and function of cells and metabolic process inside the body.
- Analyze the structure and function of carbohydrates & lipids.
- Describe the structure of proteins as well their functioning in biological systems. □ Analyze the structure and function of nucleic acids and genetic information.

Intellectual Property Rights (IPR)	
Course Code: 21GECY202	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: Generic
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Describe the theoretical concepts of evolution of Intellectual Property Laws, and to differentiate between the different kinds of IP.□
- Explain the basic knowledge of trademarks, Industrial Designs, patents & know the role of government through case studies.□
- Explain the basic knowledge of copy rights, Geographical Indications, trade secret & know the role of government through case studies.□
- Describe the various Different International agreements & the value of various IP's.□

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DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE)

Green Chemistry	
Course Code: 21CYMS305	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: DSE
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Describe the stoichiometric calculations and relate them to green chemistry metrics. □
- Explain to design safer chemical, products and processes that are less toxic, than current alternatives.□
- Describe the use of green chemistry in problem solving skills, critical thinking and valuable skills to innovate and find out solution to environmental problems.□
- Illustrate the future trends in green chemistry.□

Analytical Chemistry	
Course Code: 22CYMS306	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: DSE
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Demonstrate proper sampling procedure and data analysis.□
- Apply optical method to analyze the samples.□
- Explain and analyze the electroanalytical and thermal analysis.□
- Select the proper methods of solvent extraction and chromatography.□

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Pharmaceutical Chemistry	
Course Code: 22CYMS307	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: DSE

Prerequisite:

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Illustrate drug design, discovery and mode of action.□
- Describe various classes of antibiotics & their mode of action.□
- Explain functioning of Prostaglandins, Antipyretic-& analgesics.□
- Discuss the mode of action of antihypertensive & Contraceptive agents.□

Polymer Science & Medicinal Chemistry	
Course Code: 21CYMS404	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: DSE
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Explain the organic and inorganic polymers and properties and their applications.
- Describe inorganic polymers & their uses.
- Identify basic concept regarding development of drugs and drugs work inside the body.
- Explain about the historical development of drugs.

Solid State & Nuclear Chemistry	
Course Code: 21CYMS405	Continuous Evaluation: 40 Marks
Credits: 4	End Semester Examination: 60 Marks
L T P : 4 0 0	Course Type: DSE
Prerequisite:	

COURSE LEARNING OUTCOMES (CLO):

The syllabus has been prepared in accordance with National Education Policy (NEP). After completion of course, students would be able to:

- Illustrate the basic concept of Nuclear Chemistry and their applications.□
- Explain the internal structures and properties of solid materials.□
- Apply X-Ray diffraction techniques in the characterization of materials.□ □ Demonstrate different methods of synthesis of solid materials.□