

Department of Chemistry

The Department of Chemistry under the School of Physical and Chemical Sciences forms a key component of the university. The department is composed of dynamic faculty members, students and research scholars who are actively engaged in knowledge creation and dissemination at the frontiers of the Chemical Sciences. The discipline has an encompassing effect on the biological and physical sciences and therefore considered a central science. The department believes in interdisciplinary approach of learning and fosters a culture of excellence. Undergraduate and Post-graduate students of chemistry are nurtured and mentored well to compete at the national and international level (e.g. selection for the summer research fellowships of National Academies of Sciences, award at National Science Film Festival, JAM, UGC-CSIR NET, GATE and more...). The masters (M.Sc.) and doctoral (Ph.D.) programmes were started in 2018 and 2019, respectively. Although the department is relatively younger, it is scaling new heights with every passing year. Many of the alumni are now well-placed in different research and academic institutions of repute. Knowledge and skills in chemistry play a crucial role in finding the solutions to most of the challenges (eg. energy, disease, and environment) faced by the mankind today. We envisage producing globally competent chemists who can solve the pressing problems of the nation.

MSc. Programme in Chemistry

The programme is for the students who have an interest in chemistry and a desire to explore the frontiers of science. This is a unique programme that combines core chemistry (Organic, Inorganic and Physical) with Nano Chemistry and Green Chemistry. Along with thorough grounding in chemistry, it equips the students with the knowledge and skills in the emerging interdisciplinary area of green nanotechnology which has now become a crucial requirement for the sustainable development globally. Computational Chemistry and Medicinal Chemistry have also been incorporated to equip the students better. The programme envisages creating good bench strength of future scientists who can solve a wide range of issues and contribute to the scientific advancement of the nation.

There is ample opportunities and employability for chemists having sound knowledge, analytical skills and hands-on training on sophisticated instruments. The chemical industry is India's one of the largest manufacturing sectors and plays an integral role in the country's economic development. The Indian chemical sector currently accounts for 13-14% of total exports. In terms of volume of production, it is the twelfth-largest in the world and the third-largest in Asia. Currently, the per capita consumption of products of the Indian chemical industry is one-tenth of the world average, which reflects the huge potential for further growth. The "Make in India" scheme has further given a fresh impetus to this sector. For sustainable, environment-friendly growth, the sector is looking for new technologies that incorporate green chemistry and nanotechnology, and there lies the exciting and excellent career opportunities for young chemists. Besides the chemical industry, the training imparted in the interdisciplinary area of green nanotechnology will also enable the students to diversify and join other sectors such as energy, photovoltaics, photonics, biosensing, and healthcare etc.

The curriculum has been designed to keep abreast with changing times. In the long run, the programme is likely to produce globally competent chemists with bright innovative ideas. By understanding the nuances of chemistry, these young scientists would be creating new tools, products and technologies to address some of the world's biggest challenges such as (just to name a few) clean affordable energy, biomedical devices and drugs for treating diseases, bio-sensing and environmental remediation etc.

- **DURATION OF THE PROGRAMME:** Four semesters, July – December (odd semesters) and January – May (even semesters).
- **ADMISSION PROCEDURE:** The admission to the course shall be through an entrance examination, Central University Common Entrance Test (CUCET-2023) to be conducted on all-India basis.
- **ELIGIBILITY OF THE CANDIDATES:**
Candidates who have passed B.Sc. examination of any recognized university or its equivalent examination with minimum of 55% marks in aggregate (or in honours subject) (50% in the case of SC/ST students) and who have taken Chemistry (General/Honours) as one of the subjects at the third year of the B.Sc.
- **Credit System: Theory:** 01-hour lecture per week – 01 credit.
Experimental Chemistry & Computational Chemistry: 02 hours – 01 credit
- **Distribution of Points:** Theory (T) = 100 points; Practical (P) = 100 points.

Theory of each paper: 100 points

Distribution of points (Theory):

1A: Continuous Assessment Test (CAT): 3 CATs will be conducted at regular intervals in the entire semester in during regular class hours to assess student's progress. Each CAT will carry 10 points.

Total $3 \times 10 = 30$ Points.

1B: End-Term: 70 points.

Experimental Chemistry Lab.: 100 points

Distribution of points (Practical): Tentative

1A: Class Participation/involvement in experiment/cleanliness/skill: 10 points

2B: Distribution of points of Final Exam: (i) Exam: 40 points, (ii) Viva: 30 points, (iii) Overall record (Performance, write-up, and on-time submission throughout the semester): 20 points.]

- **Grading System:**

There will be 10-point Scale Grading System starting with 4 and ending at 10. There will be additional Grade 'F' with Grade Point 'Zero'. A student having received Grade 'F' in a course will have to reappear in the examination of the said course. The following grading system will be used:

Letter Grade	Numerical Grade Point	Class Interval (in %)
O (Outstanding)	10	Above 90 and ≤ 100
A ⁺ (Excellent)	9	Above 80 and ≤ 90
A (Very Good)	8	Above 70 and ≤ 80
B ⁺ (Good)	7	Above 60 and ≤ 70
B (Above Average)	6	Above 50 and ≤ 60
C (Average)	5	Above 45 and ≤ 50
P (Pass)	4.5	40 to 45
F (Fail)	0	< 40
Ab (Absent)	0	Absent

Note:

- (i) F= Fail, and the students graded with 'F' in a Programme or Course shall be required to re-appear in the examination.
- (ii) The minimum qualifying points for a course shall be 4.5 (i.e., 'P' grade).
- (iii) The students shall have to qualify in the Continuous Internal Assessment and the End-Semester examinations taken together.

Types of Courses

Nature of Course		Course Code	Description of the course
1.	Discipline Based Core Course	DC	This is the foundational course which is to be compulsory studied by a student as a core requirement of a programme in a said discipline of study at PG level. This also includes the introductory course on research methodology, dissertation writing, project work, field work, lab work related to the subject.
2.	Discipline Based Core Elective Course	DE	This is the elective foundational course, aimed to expand the understanding in a specific area and emerged from the foundational knowledge. The students have choice to choose the course from a basket of DE
3.	Open Elective (Interdisciplinary) course	OE	This is elective course, aimed to enable exposure to some other discipline or domain. The students have to choose the open elective course from the other departments.
4.	Mandatory elective Non-Credit Course	ME	This is the value added course to promote multidisciplinary and holistic education among the students. The course is of non-credit nature but mandatory to complete successfully for the award of the Master's degree. The students have to choose the ME courses, equivalent to at least 02 credits, from a basket of offered course.

SEMESTER-I		
Course Code	Nature of the Course	Credit
DC	Discipline Based Core Courses	16
OE	Open Elective (Interdisciplinary) course	04
ME	None-Credit Course equivalent to 02 credits	--
Total		20
SEMESTER-III		
Course Code	Nature of the Course	Credit
DC	Discipline Based Core Courses	08
DC / DE	Discipline Based Core / Core Elective Courses	08
OE	Open Elective (Interdisciplinary) course	04
ME	None-Credit Course equivalent to 02 credits	--
Total		20

SEMESTER-II		
Course Code	Nature of the Course	Credit
DC	Discipline Based Core Courses (including 04 credits course on vocational Studies)	16
	Introductory Course on Research Methodology (04 Credits)	
DC / DE	Discipline Based Core / Core Elective Courses	04
ME	None-Credit Course equivalent to 02 credits	--
		20
Exit option with Post Graduate Diploma		
SEMESTER-IV		
Course Code	Nature of the Course	Credit
DC	Discipline Based Core Courses	12
	Dissertation/ Project Work / Lab Work/ Field Work*	
DC / DE	Discipline Based Core / Core Elective Courses	0
ME	None-Credit Course equivalent to 02 credits	--
Total		20

Salient features of the programme

- Nano Chemistry, Medicinal Chemistry, Green Chemistry and Green Energy systems have been incorporated in the curriculum to develop a thorough understanding of these emerging fields and their relevance in the daily life of mankind.
- Computational Chemistry, theory and labs, have also been made part of the curriculum to make the students proficient in theoretical modelling and simulations.
- Besides imparting in-depth knowledge, hands-on training will also be given to students on sophisticated instruments which are a prerequisite for being employable in industries and succeeding in cutting-edge research.
- For proper utilization of the summer break period, students will be encouraged to take up a summer activity. This activity may include research internships in academic/research institutions or industrial labs. It may also include activities related to science communication such as writing a popular science article in a magazine or writing a review article in a scientific journal. It also includes activities such as science film making etc. The summer project should be done at the end of 2nd Semester during the summer break period.
- Students from both PCB and PCM streams can join this degree programme. We believe that knowledge of both mathematics and biology is necessary to understand the nuances of chemistry.
- The M.Sc. Programme in Chemistry follows CBCS approach.
 - A minimum of 80 credits must be completed by the students during the entire programme. However, students can earn more credits by opting for additional courses from the elective baskets.

- Out of the 80 credits a total of 56 credits should be earned through core courses. For semester 1st and 3rd, students have to choose courses from the odd semester courses list. Similarly, for semester 2nd and 4th, students have to choose courses from even semester courses list.
- Out of the 80 credits a total of 24 credits should be earned through electives following cafeteria model under CBCS scheme. Out of 24 credits, 8 credits (two courses) should be earned through open elective interdisciplinary courses (OE) offered by other departments/centers /SWAYAM.
- Students can opt for the courses from SWAYAM portal in consultation with the faculty members/mentors of the department.
- The department will announce in advance about the elective courses, DE and OE, to be run in the coming semester.
- Along with the requisite core/and elective courses, the students must select two Mandatory Elective Non-Credit course (ME) in two semesters. For ME courses, the students will not get any kind credit score; only a certificate of satisfactory completion will be issued. These courses can be selected from the basket of ME courses offered by the department of chemistry or other department of the university or SWAYAM portal.
- Core and elective courses of the department are of 4 credits each.
- Students will not be allowed to repeat the elective courses during the programme.
- *Out of elective courses offered, only few selected ones will be floated in a particular academic session and at least a certain number (to be decided by the departmental committee) of total students enrolled must opt for a particular elective paper to run that course.*
- Allotment of different branches of specialization will be done at the end of second semester. An order of preference must be submitted by each student for the three different specializations. Based on the two parameters, the choice and performance upto 2nd semester, the specialization will be allotted subject to maximum of 40% of total strength of students in one specialization.

FIRST SEMESTER (ODD SEMESTER)

Paper Code	Course Title	Theory/ Practical (Hrs/Week)	Total Marks	Credits		
				L	T	P
	Semester I					
CHE81DC01004	Advanced Inorganic Chemistry-I	4	100	3	1	0
CHE81DC02004	Advanced Organic Chemistry-I	4	100	3	1	0
CHE81DC03004	Advanced Physical Chemistry-I	4	100	3	1	0
CHE81DC01104	Inorganic Chemistry Lab (Vocational Course)	8	100	0	0	4
CHE81OE - - - 04 / CHE81SW - - - 04	Open Elective (Inter-School or Inter Department or SWAYAM elective)	4	100	4	0	0
CHE81ME00100	Need To choose from the Given	2	50	0	0	0

	basket*					
Minimum Credits required for Semester I				20		

SECOND SEMESTER (EVEN SEMESTER)

Paper Code	Course Title	Theory/ Practical (Hrs/Week)	Total Marks	Credits		
				L	T	P
	Semester II					
CHE82DC01204	Photochemical and magnetic properties of complexes	4	100	3	1	0
CHE82DC02204	Reaction Mechanism (II), Pericyclic and Photochemical Reactions	4	100	3	1	0
CHE82DC03204	Quantum Chemistry	4	100	3	1	0
CHE82DC04004	Research Methodology	4	100	3	1	0
CHE82DC03104	Physical Chemistry Lab (Vocational Course)	8	100	0	0	4
CHE82ME00200	Need To choose from the Given basket*	2	50	0	0	0
Minimum Credits required for Semester II				20		

THIRD SEMESTER (ODD SEMESTER)

Paper Code	Course Title	Theory/ Practical (Hrs/Week)	Total Marks	Credits		
				L	T	P
	Semester III					
CHE91DC02104	Organic Chemistry Lab (Vocational Course)	8	100	0	0	4
CHE91DC03304	Molecular Spectroscopy	4	100	3	1	0
DC/ DE	Organic/ Inorganic/Physical Specialization Paper* (any one)					
CHE91DC01304	Inorganic Materials and their applications	4	100	3	1	0
CHE91DC02304	Modern Organic Synthesis	4	100	3	1	0
CHE91DC03404	Applied Electrochemistry	4	100	3	1	0
DC/ DE	Organic/ Inorganic/Physical Specialization Paper* (any one)					
CHE91DC01404	Inorganic Reaction Mechanism, Organometallics and Advance Bioinorganic Chemistry	4	100	3	1	0
CHE91DC02404	Chemistry of Biomolecules	4	100	3	1	0

CHE91DC03504	Advanced Photochemistry	4	100	3	1	0
CHE91OE---04 / CHE81SW---04	Open Elective (Inter-School or Inter-Department or SWAYAM elective)	4	100	4	0	0
ME	Need To choose from the Given basket*	2	50	0	0	0
Minimum Credits required for Semester III				20		

FOURTH SEMESTER (EVEN SEMESTER)

Paper Code	Course Title	Theory/ Practical (Hrs/Week)	Total Marks	Credits		
				L	T	P
	Semester IV					
CHE92DC03604	Surface Phenomena, Colloids and Statistical Thermodynamics	4	100	3	1	0
CHE92DC05108	Scientific literature Survey and Dissertation Work*	16	200	2	0	6

or

CHE92DC06104	Scientific literature Survey and Scientific Activities	4+4	100	2	0	2
CHE92DC07004	Chemical Education	4	100	3	1	0
DC /DE	Organic/ Inorganic/Physical Specialization Paper*(any one)					
CHE92DC01504	Chemistry of Materials	4	100	3	1	0
CHE92DC02504	Advanced Medicinal Chemistry	4	100	3	1	0
CHE92DC03704	Advanced Quantum Mechanics and Surface Chemistry	4	100	3	1	0
DC/ DE	Organic/ Inorganic/Physical Specialization Paper*(any one)					
CHE92DC01604	Applications of spectroscopy techniques to inorganic systems	4	100	3	1	0
CHE92DC02604	Spectroscopy and Chiroptical properties	4	100	3	1	0
CHE92DC03804	Lasers in Chemistry	4	100	3	1	0
ME	Need To choose from the Given basket*	2	50	0	0	0
Minimum Credits required for Semester IV				20		

***Note:**

1. Based on the choice and performance up to the second semester, students will be assigned projects under the supervision of various faculty members at the start of semester III.
2. The students will be required to carry out a thorough literature survey on the assigned topic and submit the report at the end of semester-III (equivalent to 2 Credits to be assigned at the end of semester-IV) and propose a research plan for the project work to be conducted in semester IV.
3. Based on the project work done in semester-IV, students will write and submit the dissertation. Evaluation will be done based on report submissions, presentations and open viva-voce examination which will be conducted at the end of semester-IV. The total of 8 credits will be assigned to the students for the entire course (2 for Sci. Lit. survey + 6 for Dissertation work).

#Note:

- (i) Students can choose any two courses from the MENC basket of any department/school of the university or the SWAYAM portal.
- (ii) The MENC basket of the Department of Chemistry is given below.

ELECTIVES COURSES

For DE/OE

Code No	Title	Theory/Practical (Hrs/Week)	Credits L/T/P
DE01004/ OE01004	Basics of Supramolecules and its advancement	4	3/1/0
DE02004 / OE02004	Green Chemistry I: Solvents & Synthesis	4	3/1/0
DE03004 / OE03004	Solid State and Structural Chemistry	4	3/1/0
DE03104 / OE03104	Advanced Instrumental Techniques-I	4	3/1/0
DE02104 / OE02104	Green Chemistry II: Catalysis	4	3/1/0
DE02204 / OE02204	Nucleoside, Advances in Nucleic Acid and Proteins	4	3/1/0
DE02304 / OE02304	Chemistry of Natural Products	4	3/1/0
DE02404 / OE02404	Agrochemicals	4	3/1/0
DE03204 / OE03204	Nano Chemistry	4	3/1/0
DE03304 / OE03304	Advanced Instrumental Techniques-II	4	3/1/0
DE02504 / OE02504	Green Energy Systems	4	3/1/0
DE03402 / OE03402	Fundamentals of Nuclear Chemistry	2	2/0/0

ME Non-Credit Course

Code No	Title	Theory/Practical (Hrs/Week)	Total Marks	Credits
ME00100	Contributions of Ancient, Medieval and Contemporary Indian Chemists	2	No Grading	0
ME00200	Science Communication	2	No Grading	0
ME Course on SWAYAM Platform				
ME ME00200	Academic writing (H.N.B. Garwhal University, Dr. Ajay Semalty)		12 Weeks	0

SWAYAM COURSES (OEIC)**Approved by Department of Chemistry***

SN	Code No	Swayam Course	Course Offered By	Course Duration
1.	SW01004	Transition metal organometallics in catalysis and biology	IIT Bombay Prof. P. Ghosh	12 Weeks
2.	SW02004	Medicinal Chemistry	IISER Pune Prof. Harinath Chakrapani	12 Weeks
3.	SW03004	Molecular Spectroscopy	IIT Bombay Prof. Anindya Datta	12 Weeks
4.	SW01104	Industrial Inorganic Chemistry	Prof. Debashis Ray IIT Kharagpur	12 Weeks
5.	SW02104	Essential of biomolecules Nucleic Acid and Peptides	Prof. Lal Mohan Kundu IIT Guwahati	12 Weeks
6.	SW02204	Biochemistry	Prof. Swagata Dasgupta IIT Kharagpur	12 Weeks
7.	SW01204	Chemistry of Main Group Elements	Prof. M. S. Balakrishna IIT Bombay	12 Weeks
8.	SW02304	Biomass Characterization	Prof. K. Arun Kumar Central University of Kerala	12 Weeks
9.	SW02404	Reagents in Organic Synthesis	IIT Guwahati Prof. Subhas Chandra Pan	12 Weeks

10.	SW02504	Principles of Organic Synthesis	IIT Guwahati Prof. T. Punniyamurthy	12 Weeks
11.	SW03104	Chemical Crystallography	IISER Mohali Prof. Angshuman Roy Choudhury	12 Weeks
12.	SW01304	Biological Inorganic Chemistry	Prof. Debashis Ray IIT Kharagpur	12 Weeks
13.	SW02504	Drug Delivery: Principle and Engineering	Prof. Rachit Agarwal IISc Bangalore	12 Weeks
14.	SW03204	Analytical Chemistry	Prof. Debashis Ray IIT Kharagpur	12 Weeks
15.	SW03304	Biophysical Chemistry	Prof. Pramit K Chowdhury, IIT-Delhi	12 Weeks

*The list is dynamic one and is revised every semester by the departmental committee which may involve addition/deletion of a few courses depending on their availability and suitability to our academic programme

FIRST SEMESTER (ODD SEMESTER)

Course Title: Advanced Inorganic Chemistry-I			
Course Code	CHE81DC01004	Credits	4
L + T + P	3 + 1 + 0	Course Duration	One Semester
Semester	Odd	Contact Hours	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, Tutorials, Group discussion; self-study, seminar, presentations		
Assessment and Evaluation	Lecture, Tutorials, Group discussion; self-study, seminar, presentations		

Course Objectives

- To develop understanding of group theory and apply the concepts of symmetry to molecular systems
- To enhance the understanding of ionic and covalent bonding in view of point groups and molecular symmetry.
- To impart in-depth knowledge about metal-ligand equilibrium reactions
- To equip the students with necessary skills to determine the equilibrium constants using various instrumental techniques

Learning Outcomes: After completion of the course the learners will be able to:

- Identify the symmetry elements present in a molecule,
- Assign the point groups to a molecule and perform symmetry operations
- Analyse the molecular structure and bonding in molecules and coordination complexes with the help of group theory