

# A General Guide for MSc Chemistry Program



School of Basic Sciences  
Indian Institute of Technology Mandi

### **Course Coordinator:**

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Dr. Aniruddha Chakraborty (2015-2017)

### **Faculty advisors:**

Batch 2014-15: Dr. Aditi Halder

Batch 2015-16: Dr. Venkata Krishnan

Batch 2016-17: Dr. Aniruddha Chakraborty

Batch 2017-18: Dr. Aditi Halder

Batch 2018-19: Dr. Dr. Chayan K Nandi

Batch 2019-20: Dr. Subrata Ghosh

Batch 2020-21: Dr. Prem Felix Siril

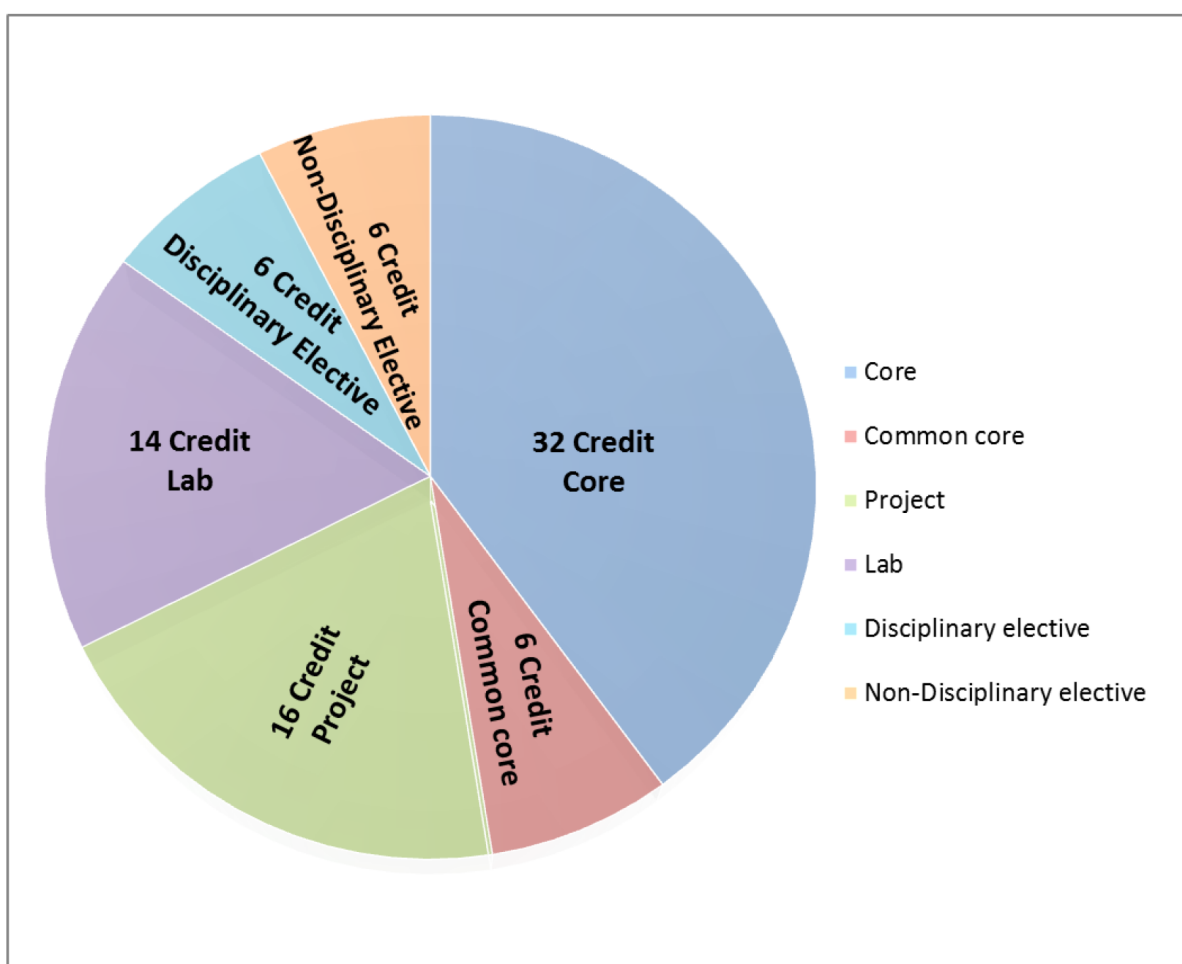
## Chemistry Faculty at IIT Mandi

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## Program faculty Group (PFG) members

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## Complete credit structure for the 2 years MSc Chemistry program at IIT Mandi



## SEMESTER-WISE CURRICULUM

### • First Semester:

Course No.	Course Title	L-T-P-C	Remarks (if any)
CY501	Organic Reaction and Mechanism	4-0-04	Core
CY506	Chemistry of Transition Elements	4-0-0-4	Core
CY511P	Physical Chemistry Laboratory	0-0-8-4	Lab course
CY512	Advanced Quantum Chemistry	3-0-0-3	Core
CY521	Mathematics for Chemists	3-0-0-3	Common Core
DP501P	Design Practicum – I	0-0-4-2	Project
	<b>Total</b>	<b>20</b>	

### • Second Semester:

Course No.	Course Title	L-T-P-C	Remarks (if any)
CY501P	Organic Chemistry Laboratory	0-0-8-4	Lab course
CY502	Photochemistry & Pericyclic Reactions	3-1-0-4	Core
CY507	Chemistry of Main Group Elements	3-1-0-4	Core
CY511	Group Theory & Spectroscopy	3-0-0-3	Core
DP502P	Design Practicum II	0-0-4-2	Project
	<b>Discipline Elective I</b>	3-0-0-3	Elective
	<b>Total</b>	<b>20</b>	

### • Third Semester:

Course No.	Course Title	L-T-P-C	Remarks (if any)
CY506P	Inorganic Chemistry Lab	0-0-8-4	Lab course
CY508	Organometallic Chemistry	2-0-0-2	Core
CY514	Chemical Thermodynamics & Electrochemistry	3-0-0-3	Core
CY522	Computational Chemistry	3-0-0-3	Core
DP503P	Basic Mechanical and Electrical Workshop	0-0-2-2	Core
DP-504P	Post Graduate Project I	0-0-8-3	Project
	<b>Discipline Elective II</b>	3-0-0-3	Elective
	<b>Total</b>	<b>20</b>	

### • Fourth Semester:

Course No.	Course Title	L-T-P-C	Remarks (if any)
CY504	Heterocyclic Chemistry	2-0-02	Core
CY513	Reaction Dynamics, Kinetics & Catalysis	3-0-0-3	Core
DP505P	Post Graduate Project II*	0-0-18-9	Final year project
	<b>Outside Discipline Elective III</b>	3-0-0-3	Elective
	<b>Outside Discipline Elective IV</b>	3-0-0-3	Elective
	<b>Total</b>	<b>20</b>	

**List of Core courses (32 credits)**

S. No.	Course code	Course Title	L-T-P-C	Semester
1	CY501	Organic Reactions & Mechanisms	4-0-0-4	I
2	CY506	Chemistry of Transition Elements	4-0-0-4	I
3	CY 512	Advanced Quantum Chemistry	3-0-0-3	I
4	CY502	Photochemistry & Pericyclic Reactions	3-1-0-4	II
5	CY507	Chemistry of Main Group Elements	3-1-0-4	II
6	CY511	Group Theory & Spectroscopy	3-0-0-3	II
7	CY508	Organometallic Chemistry.	2-0-0-2	III
8	CY514	Chemical Thermodynamics & Electrochemistry	3-0-0-3	III
9	Cy504	Heterocyclic Chemistry	2-0-0-2	IV
10	CY513	Reaction Dynamics, Catalysis & Kinetics	3-0-0-3	IV
		Total Credits	32	

**List of Common Core courses (6 credits)**

S. No.	Course code	Course Title	L-T-P-C	Semester
1	CY522	Computational Chemistry	3-0-0-3	III
2	CY521	Mathematics for Chemists	3-0-0-3	I
		Total Credits	6	

**List of Lab/project courses (30 credits)**

S. No.	Course code	Course Title	L-T-P-C	Semester
1	CY511P	Physical Chemistry Laboratory	0-0-8-4	I
2	DP501P	Design Practicum – 1	0-0-4-2	I
3	CY501P	Organic Chemistry Laboratory	0-0-8-4	II
4	DP502P	Design Practicum II	0-0-04-2	II
5	CY506P	Inorganic Chemistry Lab	0-0-8-4	III
6	DP504P	Mini Project	0-0-8-3	III
7	DP503P	Basic Mechanical and Electrical Workshop	0-0-2-2	III
8	DP505P	Main Project	0-0-18-9	IV
		Total Credits	30	

**List of Elective courses (12 credits)**

S. No.	Course code	Course Title	L-T-P-C	Semester
1		Discipline elective (CY XXX)	3-0-0-3	II
2		Discipline elective (CY XXX)	3-0-0-3	III
3		Outside discipline (Non-CY course)	3-0-0-3	IV
4		Outside discipline (Non-CY course)	3-0-0-3	IV
		Total	12	

**Total Credits: 32 (core) +6(common core)+30 (lab/project)+12 (electives)**

**List of Discipline elective courses**

S. No.	Course code	Course Title	L-T-P-C	Semester
1	CY553	Organic Inorganic Spectroscopy	3-0-0-3	
2	CY552	Hydrogen generation and storage	3-0-0-3	
3	CY554	Science & Technology of Nanomaterials	3-0-0-3	
4	CY644	Bioinorganic Chemistry	3-0-0-3	
5	Cy670	Spectroscopy, microscopy and application	3-0-0-3	
6	CY546	NMR spectroscopy	3-0-0-3	
7	CY555	Introduction to polymer science and technology	3-0-0-3	
8	CY547	Chemical Crystallography	3-0-0-3	
9	CY541	Fundamentals of organic chemistry	3-0-0-3	

**List of few outside Discipline elective courses taken by students  
(Students can choose any other course from any discipline)**

S. No.	Course code	Course Title	L-T-P-C	Semester
1	BY505	Nanobiotechnology	3-0-0-3	
2	BY514	Analytical biotechniques	3-0-0-3	
3	ME509	Nanomanufacturing	3-0-0-3	
4	PH603	Advanced condensed matter physics	3-0-0-3	
5	CY 502P	Basic data sciences	3-0-0-3	
6	HS533	Urban development	3-0-0-3	

## ***M.Sc. Chemistry Program***

M.Sc. in Chemistry program is the first master level program offered from School of Basic Sciences of IIT Mandi started in August 2014. This program is aimed to give the students, fundamental understanding of the principles of chemical sciences through core courses while expanding their knowledge in the allied areas and beyond through elective courses. The curriculum has been designed so as to prepare the students to take up a research career either in academia or in industries on completion of the program. The students will be effectively equipped to take up professional career in chemistry or an allied subject where adequate knowledge of the subject is required. The syllabus of the laboratory courses have been drastically amended from the conventional chemistry programs across the country by including hands on training on the methods of synthesis, separation and application of most modern analytical tools. The program is very much research oriented and designed to enable students to 'learn by doing'. The master's program may lead to specialization in conventional (like organic or inorganic or physical chemistry) or relatively unconventional branches (e.g., nanosciences or theoretical chemistry) of chemistry. The curriculum focus on an interdisciplinary approach wherein students learn about fabrication of small instruments (through mechanical and electronics workshop) that are required for understanding working principle of different instruments as well as fabricating new non-conventional instruments, which can be used in research and teaching purpose. The salient features of this program is given below.

- Broad based curriculum by the inclusion of a number of free electives and specialization electives and outside discipline electives, without compromising the core subjects.
- Modernized laboratory courses – close to current research.
- Research oriented curriculum to enable 'learn by doing'.
- Adequate blend of theory, computation and hands on experiments.
- Unique courses on design and innovation practicum in first year.
- Practical learning on methods of synthesis, separation and purification.

### **Objectives of the program**

After the completion of the degree, students would

- be prepared with a varied range of expertise in different aspects of the principles of chemical sciences through core courses while expanding their knowledge in the allied areas and beyond through elective courses
- curriculum has been designed so as to prepare the students to take up a research career either in academia or in industries on completion of the program
- The students will be effectively equipped to take up professional career in chemistry or an allied subject where adequate knowledge of the subject is required.
- hands on training in the methods of synthesis, separation and application of most modern analytical tools. The program is very much research oriented and designed to enable students to 'learn by doing'
- learn about the fabrication of small instruments (through mechanical and electronics workshop) that are required for understanding working principle of different instruments as well as fabricating new non-conventional instruments
- acquire good understanding of both the theory and application of fundamental and applied chemistry.



### **Basic description of the curriculum:**

Common core courses take care of 10% of the whole curriculum. The following courses constitute common core courses, Mathematics for Chemists, Basic Mechanical and Electronics Workshop, Design and Innovation Practicum, Computational Chemistry. They provide solid foundation to the students for studying other core courses.

Chemistry core courses take care of 40% of the whole curriculum. The following courses constitute chemistry core courses, Organic reactions and mechanism, Photochemistry and Pericyclic Reactions, Chemistry of transition elements, Chemistry of main group elements, Group Theory and spectroscopy, Advanced Quantum Chemistry, Chemical thermodynamics, Molecular reaction dynamics. They provide fundamental understanding of core areas of chemistry as well as applications.

Laboratory courses take care of 10% of the whole curriculum. We have three laboratory courses, organic, inorganic and physical chemistry. Unlike conventional laboratory courses these courses are designed in such a way that they act as bridge between M.Sc. In chemistry and experimental research in modern research areas. Our laboratory courses involve measurement of UV-VIS spectra, Fluorescence, FTIR, Dynamic light scattering (DLS), NMR etc..

Research component takes care of 20% of the whole curriculum. This aspect is unique in IIT Mandi, we believe in introducing research as early as possible. So in the first two semesters, we have introduced design & innovation practicum (D.P.) I & II, in the third semester we have introduced Post Graduate Project and in the last semester students have to do a final project. In D.P. I students are expected to do an extensive literature survey and in D.P. II they are expected to find a research area of their own interests. Research problem can be formulated and preliminary work is expected to be done by students in the 3rd semester while doing Post Graduate Project. In the final semester students are expected to do research on the same problem in their final project. Projects involve measuring UV-VIS, spectra, Fluorescence, Lifetime, FTIR, Dynamic light scattering (DLS), NMR, TEM, SEM, AFM, Microscope, and computation using softwares like Hyperchem etc..

Elective courses take care of 15% of the whole curriculum. Students have the option to choose elective courses, specialized in a particular area or they can choose any free electives - not related to any area of specialization. This option is given to the students with the hope that if they are curious about any area science/engineering/humanities they should get the options of exploring those areas. But the most notable aspect here is students have to take two outside discipline elective courses and that is mandatory. The idea here is to prepare students for doing research, which is expected to be unconventional. Studying standard chemistry subjects from books or research papers, helps in doing research - but that does not in general encourages students to think beyond those which were never thought before. So studying those subjects which were not studied by chemists before, helps students to think unconventionally - which was in general the aim of the elective basket.

We have a unique core course in our curriculum - Basic Mechanical and Electronic Workshop, where students have to learn about the principle and practical aspects of different instruments. Now-a-days all instruments will consist of mechanical part and electronics part. So this course will help students to understand what instrument is actually doing and how it is doing - after taking this course they are expected not to think instrument as a black box for data generation. Students taking this course will be highly encouraged to fabricate new instrument to measure new parameters, which were not known before.

To have diversity in teaching and research, we have a Course Interest Group (CIG) consists of faculty members from various disciplines like Chemistry, Physics, Bio-X and even engineering. All members of CIG are allowed to offer courses and projects to the M.Sc. Chemistry students - this allows students to get exposure to diverse areas of science and engineering, hence prepare them well for research. So in conclusion the M.Sc. chemistry program of IIT Mandi is designed in such a way that it produce students with a very diverse and unique skills set.