

Subject: Proposal for introduction of two years Full Time PG programme in Chemistry.

Department of Chemistry has proposed the introduction of two years Full-Time PG Programme in Chemistry from the year-2020. The proposal is for the benefit of students and shall enhance the prestige of the Institute in the galaxy of sister Institutions.

The introduction of new programme always involves the additional expenditures by way of; (a) Engagement of additional manpower for additional workloads (b) Establishments of new laboratories (c) Miscellaneous expenditures etc. But the Department has not proposed any engagements of additional man power, establishments of new laboratories etc. for the course as the existing facilities are sufficient enough to cater to the need of introduction of new course as such no additional financial burdens on the Institute.

However, there shall be additional financial burdens on the Institute by way of "Running Expenditures". The semester tuition fee charged from the students shall be sufficient enough to meet out this burden. The introduction of quota of five seats under self financing scheme will boost the internal revenues generation of the Institute. It may be mentioned here that MHRD is encouraging the Institutes to increase their internal revenues generation and the introduction of admission under "Self Financing Schemes" in the proposal is a step forward in that direction which is appreciable.

The scheme has been perused and our suggestion in respect of Para 13, are as under;

"Fee structure for the Self Financing Scheme"

It is proposed to recast the Para as under:

Additional fee of Rs. 62,500 per semester per student (Total Rs. 2, 50,000/ for four semesters) shall be charged from each selected candidate under self financing quota from all the categories. This additional fee shall be payable at the time of Admission/Semester registration. The candidates can deposit the entire amount of Rs. 2, 50,000/ at the time of admission also, if he/she so desires.

The institute can revise the fee amount for subsequent admission as per the Institute policy. The revenues so generated shall be deposited in the "Department of Chemistry Research Fund" and Institute Corpus Fund" in the ration of 80:20.

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18
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Department of Chemistry
National Institute of Technology Srinagar

No. NIT/Chemistry/19/ 296

Dated: 17.12.2019

Subject: Scheme and Syllabus of proposed Two Years Full Time PG Programme in Chemistry.

Kindly find enclosed herewith the scheme and syllabus of proposed two years full time PG Programme in Chemistry (M. Sc. Chemistry) likely to be commenced in 2020, for perusal and approval in SPGC please.

The minutes of the DPGC meeting are also attached.

Regards,

(Dr. J. A. Bandy)

Head of the Department

Submitted

✓ Dean Academic Affairs

Copy to:

1. PA to Director for information of the Director please.
2. Chairman Senate Post Graduate Committee for information and necessary action please.



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

No. NIT/Chemistry/19/
Date: 10-12-2019

Minutes of Departmental Post Graduate Committee Meeting
Held on 09-12-2019

A meeting of Departmental Post Graduate committee (DPGC) was held on 09-12-2019 at 2.30 PM in the committee room of the Department. Following were present:

- | | |
|--------------------------|--|
| 1. Dr. J. A. Banday | In the Chair |
| 2. Prof. Kowsar Majid | Convener |
| 3. Dr. Hamida Chisti | Member |
| 4. Dr. Mohammad Aslam | Member |
| 5. Dr. Jignesh V. Rohit | Member |
| 6. Prof. M. Ikram | Member from other Department (Physics) |
| 7. Dr. Shrikant Maktedar | Special Invitee |
| 8. Dr. Ravi Kumar | Special Invitee |

The agenda of the meeting was:

To finalize scheme and syllabus of proposed M. Sc Programme in Chemistry from academic year 2020-21.

The course contents of the scheme and syllabus prepared by the faculty members of the Department were discussed thoroughly. It was felt that the syllabus has been prepared in line with the syllabi of various NITs and IITs. The committee members unanimously finalized the scheme and syllabus of proposed M. Sc. Programme in Chemistry from academic year 2020-21.

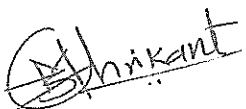
The scheme and syllabus of proposed M. Sc Programme in Chemistry is submitted for perusal and approval.

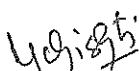
The meeting ended with a vote of thanks to the Chair.


(Dr. Ravi Kumar)

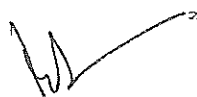
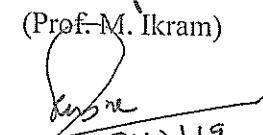

(Dr. Mohd. Aslam)


(Dr. Jignesh V. Rohit)
Staff Secretary


(Dr. Shrikant Maktedar)


(Dr. Hamida Chisti)


(Dr. J. A. Banday)
Chairman DPGC and HOD


(Prof. M. Ikram)

9/12/19
Prof. Kowsar Majid
Convener, DPGC

Copy to:

1. P.A. to Director for information of the Director please.
2. All concerned
3. Office file

An
ACADEMIC PROPOSAL

On
Two Years PG Programme in Chemistry
Entitled “M.Sc. Chemistry”



Department of Chemistry
National Institute of Technology Srinagar (J & K)
(Effective from: Autumn-2020)

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1. About the Department:

The Department of Chemistry was established in 1960 and Prof. R. P. Jeerath was the founder Head of the Department. After Prof. Jeerath, in 1975, the Department was guided by Dr. Ram Murthi, followed by Dr. Shakti Rais Ahmad, Dr. A. K. Choudhry, Dr. A. R. Shah, Dr. A. S. Bali, Dr. Siraj Ahmad, Dr. S. A. Shah and Dr. Tabassum Ara. Presently, it is being run under the headship of Dr. J. A. Banday.

About twenty five Ph. Ds and 35 M. Phils have been produced by the Department till date. The faculty members of the Department have published many scientific papers and reviews in National and International journals of repute. Research, in the areas of Physical, Organic, Inorganic and Environmental chemistry, are being carried out in the Department.

2. Mission:

To frame the Researchers and Scientists in Chemical Science through post-graduate education and research programme. To develop the competent manpower with technology based experimentation methodologies and value based practices for business and industries. To undertake projects to solve field base problems. To provide student centric learning facilities for the development of overall personality of learner.

3. Vision:

A respectable teaching-learning and research organization nationally and internationally in the area of chemical sciences, by providing competitive trained Chemists which will assist the chemical world, industries and stake holders. The mission and vision of the organization help in preparation of strategic plan.

4. Name and Address of Institute/University:

National Institute of Technology Srinagar,
Hazratbal,
Srinagar-190006 (J & K)

5. Title of the Program (s):

M. Sc. - Chemistry

6. Duration of the Course:

The course is a full time two year program comprising of a perfect combination of theoretical and experimental studies in various fields of Chemistry.

1st Year: Semester I & II

2nd Year: Semester III & IV

7. Objectives of the Programme:

PG program in Chemistry is designed to deliver a solid foundation in Chemistry with adaptability to a wide range of career objectives.

- The course will not only give the scientific training and skills, but will also help to develop the ability to diversify into broad science opportunities.
- Since, a strong emphasis on practical learning with extensive hands on practical's classes throughout the course has been proposed; therefore, it will help to apply learning from the classroom to the laboratory to develop practicals and transferable skills in chemistry applications.
- The Chemistry Department can provide excellent opportunities for interdisciplinary study and research in collaboration with the other Departments of Institutes and nearby University/Institutes.

8. Eligibility:

A candidate must be Graduate (10+2+3 pattern) in Science with Chemistry as Major Subject/Honors and must have secured at least 60% mark or CGPA 6.5/10 or equivalent for OC/OBC/EWS/SF and for SC/ST/PWD candidates, minimum marks are 50% or CGPA 5.5/10 at UG level from a recognized University/Institution with valid JAM score/Institute Entrance Examination Score.

9. Admission Procedure:

The admission will be made purely on the basis of JAM scores conducted by GoI. The remaining vacant seats will be filled up on the basis of merit in the entrance examination conducted by the Institute.

10. Intake Capacity:

The total number of seats will be 30 (Thirty) per year. Out of 30 seats, 25 seats will be filled on the basis of JAM score/Institute Entrance Examination Score and five seats will be filled up under self finance mode on the basis of merit of Institute Entrance Exams. Reservations will be applicable as per Institute rules (GoI Rules).

The seat matrix for 30 seats is given in the Table-1.

Table-1: Seat Matrix

Program Name	Eligible Degree with subject	Eligible JAM Paper	Number of Seats										Total No. of Seats
M. Sc Chemistry	B. Sc	CY	OC	EWS	OB	SC	ST	OC-PWD	EWS-PWD	OB-PWD	SC-PWD	ST-PWD	
			9	2	7	4	2	1	-	-	-	-	25
	Self-finance Seats		5										5
Total No. of Seats													30

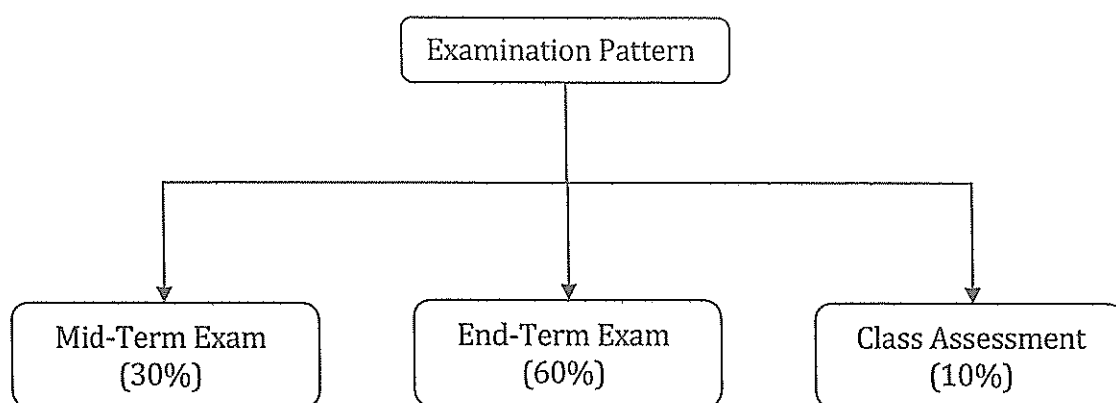
11. Pattern of Institute Entrance Examination:

The question paper will consist of 60 MCQ type questions of maximum marks 60. Each correct answer will carry one mark and for wrong answer, 0.25 mark will be deducted. Questions not attempted will result in zero mark. The duration of exam will be of 90 minutes. Question paper will be set as per Institute policy in vogue.

12. Scheme of Examination:

The scheme of examination will be as per Institute rules. The examination will be

conducted semester wise with one mid-term examination designated as “Mid-Term Examination” and one end term examination designated as “End-Term Examination”. On the basis of these two examinations as well as on class assessment, the students will be awarded grades on the scale of 10 as per Institute rules in vogue. The project will be evaluated in terms of a dissertation and viva voce/seminar.



The conversion of CGPA into % will be as per Institute rules which is $\% = \text{CGPA} \times 10$.

13. Fee Structure:

The current fee structures for PG programmes in Chemistry will be the same as for PG programmes in Physics offered by the Institute. The details of the current fee structure are given in Table 2 for the reference. The fee structure is excluding Mess Fee and the fee can be revised by the Institute from time to time.

Table -2: Fee Structure

Semester	Category	Institute fee per semester Day Scholar	Institute fee per semester Hosteller (excluding Mess fee)	Total
Ist Semester	OC/OBC/EWS	19,100/=	Rs.7,000/=	Rs. 26,100/=
2 nd to 4 th Semester		10,800/=	Rs.7,000	Rs. 17,800/=

Ist Semester	SC/ST/PWD	11,600/=	Rs.7,000	Rs. 18,600/=
2 nd to 4 th Semester		3,300/=	Rs.7,000	Rs. 10,300/=

Fee Structure for the Self finance Scheme:

The fee structure for candidates enrolled for PG programme under self finance mode includes an additional amount of Rs. 2.5 Lakhs (one time/non-refundable) for all categories as mentioned in Table 1, in addition to the routine fee as given in Table-2.

The revenue received/collected under self finance mode shall be trifurcated into 70:20:10 viz. 70% for Departmental funds, 20% for Institute/Administration and 10% for students' welfare funds.

14. Scope of Employment:

- a) Teaching Position (Universities/Institutes/Colleges/Schools)
- b) In Research & Development Organizations
- c) Quality Control Manager in Chemical, Pharma, food and PSU industries
- d) Scientific Content Writer/Patent Analyst/Technical Officers
- e) Testing Laboratories (Government & Private)
- f) Analytical & Technical Executives for MNCs
- g) Medical Representatives

15. Availability of required infrastructure and human resources for commencing the programme

(i) Human resources

The Department of Chemistry has well qualified and experienced staff members. All the faculty members are doctorates (PhD) and are engaged in research activities in the various fields such as organic chemistry, inorganic chemistry, physical chemistry, applied chemistry, natural products, organic synthesis, material chemistry, nano-materials, catalysis, bio-fuels and energy related materials.

The existing faculty members as mentioned in Para 17 (S. No. 1-9) are ample and highly competent to commence the PG programme in the Department of Chemistry successfully and therefore, there will be no requirement of additional faculty in the Department to commence the programme.

In addition to this, Department has got Ramanujan Fellow and Inspire Faculty, awardees from GoI. These fellows are highly experienced in modern research areas and are highly beneficial for Departmental academic and research activities.

(ii) Laboratories:

The Department of Chemistry has following graduate and research laboratories;

- a) Junior Chemistry Laboratory (UG Lab)
- b) Senior Chemistry Laboratory
- c) Organic Chemistry Research Laboratory
- d) Inorganic Chemistry Research Laboratory
- e) Physical Chemistry Research Laboratory
- f) Natural Products Research Laboratory
- g) Environmental Chemistry Laboratory

(iii) Space:

Lecture halls are available in the Institute for classes. For lab work, initially UG and Research laboratories of the Department shall be used for PG programme running lab activities.

(iv) Other facilities:

Institute Instrumentation Center:

NIT Srinagar has a highly sophisticated Instrumentation Center having the following instruments:

- 1. Scanning Electron Microscope (SEM-EDS)
- 2. X-ray Diffractometer (XRD)

3. Nanoindenter Hysitron TI Premier
4. Litesizer 500 Particle Analyzer
5. Raman Spectrophotometer

(v) Information and Resource Center:

NIT Srinagar has well equipped information and resource center.

16. The major areas of teaching and research:

Inorganic chemistry, Organic Chemistry, Physical Chemistry, Environmental Chemistry, Industrial Chemistry, Natural Products, Organic Synthesis, Nano-materials, Bio-fuels, Catalysis, Non-linear Optics, Polymer Chemistry etc.

17. Name, designation, field of specialization of the faculty members:

S. No.	Name of the faculty	Designation	Field of Specialization	Research Area
1.	Dr. Kowsar Majid	Professor	Physical Chemistry	Thermodynamics, Kinetics, Mechanistic Studies, Material Science, Tribochemistry
2.	Dr. Tabassum Ara	Professor	Organic Chemistry	Organic Chemistry, Organic Synthesis
3.	Dr. S. A. Shah	Associate Professor	Inorganic Chemistry	Inorganic Chemistry, Env. Chemistry
4.	Dr. J. A. Banday	Associate Professor	Organic Chemistry	Natural Products, Essential Oils, Non-linear Optics
5.	Dr. Hamida –Tun-Nisa Chisti	Associate Professor	Inorganic Chemistry	Inorganic Chemistry, Material Chemistry, Env. Chemistry

6.	Dr. Mohammad Aslam	Assistant Professor	Industrial Chemistry	Industrial Chemistry, Fuels, Liquid Biofuels, Catalysis
7.	Dr. Shrikant Maktedar	Assistant Professor	Physical Chemistry	Physical Chemistry, Material Science
8.	Dr. Ravi Kumar	Assistant Professor	Organic Chemistry	Organic synthesis, Synthetic Porphyrin Chemistry, Organic Materials
9.	Dr. Jignesh V. Rohit	Assistant Professor	Organic Chemistry	Organic Chemistry, Nanomaterials
10.	Dr. Saifullah Lone	Ramanujan Fellow	Inorganic Chemistry	Inorganic Chemistry, Material Science
11.	Dr. Malik Wahid	DST-Inspire Faculty	Physical Chemistry	Physical Chemistry, Material Science

18. List of existing major equipments and infrastructural facilities including Laboratory Space and Hostel accommodation:

Besides the routine equipments/instruments, the Department of Chemistry has the following major instruments:

1. High Performance Liquid Chromatography (HPLC)
2. Thermo-Gravimetric Analyzer (TG/DTA)
3. UV-Visible spectrophotometer (UV-Visible)
4. Fourier Transformation Infrared Spectrometer (FTIR)
5. BET Analyzer
6. Microwave Synthesizer
7. Rotary Vacuum Evaporators
8. High Energy Ball Mill
9. Reaction Station
10. Deep Freezers

11. Photolamps

19. Major research grants received in the Department from the agencies:

SERB-DST, CSIR etc.

20. Nearby Institutions engaged in M.Sc. Chemistry Programme:

(a) University of Kashmir, Srinagar

(b) Islamic University of Science and Technology, Awantipora, Srinagar

(c) Central University of Jammu, Jammu Tawi

(d) NIT, Jalandhar

(e) NIT, Hamirpur

Name and full address of the Director

Prof. (Dr.) Rakesh Sehgal

Director,

National Institute of Technology Srinagar,

Hazratbal (J & K)-190006

Telephone: 0194-2422032 (R):0194-2427426

Mobile: (M) 09419433770

Fax: 0194-2420475

Email: director@nitsri.net

Name and full address of the Head of the Department

Dr. Javid Ahmad Banday

Head,

Department of Chemistry,

National Institute of Technology Srinagar, Hazratbal (J & K)-190006

Tel. No.: 0194-2420475

Mobile No.: 9906626635

Email: jabanday@nitsri.net, hodchemistry@nitsri.net,

Name and full address of the Course Coordinator

Dr. Mohammad Aslam

Department of Chemistry,

National Institute of Technology Srinagar,

Hazratbal (J & K)-190006

Mobile No.: 9541026327

Email: maslam@nitsri.net, mdaslamic@gmail.com



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR
J & K-190006

M.Sc. Chemistry
Curriculum and Syllabi
(w.e.f. Autumn-2020)

CURRICULUM FOR POST-GRADUATE PROGRAM LEADING TO
MASTER OF SCIENCE (M.Sc.) DEGREE IN CHEMISTRY

(I). Program Details:

Name of the degree	Name of Specialization	Intake (Full Time)	Year of Starting (Proposed)	Duration	Eligibility for Admission
M.Sc.	Chemistry	25+*5 = 30	2020	2 years	A candidate must be Graduate (10+2+3 pattern) in Science with Chemistry as Major Subject/Honors and must have secured at least 60% mark or CGPA 6.5/10 or equivalent for OC/OBC/EWS/SF and for SC/ST/PWD candidates, minimum marks are 50% or CGPA 5.5/10 at UG level from a recognized University/Institution with valid JAM score/Institute Entrance Examination Score.

** Five (05) seats will be reserved for candidates under self finance scheme.*

(II). Programme Educational Objectives (PEOs):

PEO1	Achievement in the field of chemistry from a foundational level to the current knowledge
PEO2	Provide a solid foundation in chemistry, required to pursue higher studies and research.
PEO3	Acquire ability to identify, formulate, investigate and analyze scientific problems and innovatively design and create products and solutions for real life problems.
PEO4	Inculcate a professional and ethical attitude along with team work skills and an

	ability to relate with social awareness.
PE05	To communicate effectively, verbally and written, for the purposes of conveying chemical information to both professional scientists and to the public

(III). Programme Outcomes (POs):

PO1	Identify, formulate and analyze complex scientific problems on the basis of principles of sciences.
PO2	To understand the application of the advanced subjects in modern chemistry.
PO3	Conduct an investigation of a complex problem using scientific knowledge for analysis and interpretation of data.
PO4	Select, design and apply appropriate experiment techniques along with IT tools to generate experimental information.
PO5	To indulge in deeper learning of the principles of Organic, Inorganic, Physical and Analytical Chemistry
PO6	To learn modern analytical and spectroscopic tools and their applications to different disciplines of chemistry
PO7	To learn the interdisciplinary nature of Chemistry and to integrate the knowledge with a variety of chemical problems
PO8	Function effectively as an individual, and as a member or leader in diverse teams, in multidisciplinary settings.
PO9	Engage in independent and lifelong learning in the broadest context of technological change and also to enhance skills for future employability in teaching and research.
PO10	Understand to apply contextual knowledge to assess societal, health, safety, and cultural issues relevant to the science practices.

Programme Structures
M.Sc. Chemistry (Two Year Full Time Programme)

FIRST YEAR													
I Semester							II Semester						
S. No.	Course Code	Course Name	L	T	P	C	S. No.	Course Code	Course Name	L	T	P	C
1.	MCY- 101	Structure, Reactivity and Stereochemistry of Organic Molecules	4	0		4	1.	MCY- 201	Organic Reaction Mechanisms	4	0		4
2.	MCY- 102	General Inorganic Chemistry	4	0		4	2.	MCY- 202	Coordination Chemistry, Organometallics & Group Theory	4	0		4
3.	MCY- 103	Concepts in Physical Chemistry	3	1		4	3.	MCY- 203	Surface and Solid State Chemistry	3	1		4
4.	MCY- 104	Instrumental Methods of Chemical Analysis	3	1		4	4.	MCY- 204	Chromatographic Techniques	4	0		4
5.	MCY-105P	Inorganic Practical-I			4	2	5.	MCY-205P	Inorganic Practical-II			4	2
6.	MCY-106P	Organic Practical-I			4	2	6.	MCY-206P	Organic Practical-II			4	2
7.	MCY-107P	Physical Practical-I			4	2	7.	MCY-207P	Physical Practical-II			4	2
Total Hrs/Credits			28			22	Total Hrs/Credits			28			22

SECOND YEAR													
III Semester							IV Semester						
S. No.	Course Code	Course Name	L	T	P	C	S. No.	Course Code	Course Name	L	T	P	C
1.	MCY- 301	Organic Spectroscopy and Modern Organic Synthesis	4	0		4	1.	MCY- 401P	Project Work/Dissertation			30	15
2.	MCY- 302	Bio-inorganic & Nanotechnology	4	0		4							
3.	MCY- 303	Advanced Physical Chemistry	3	1		4							
4.	MCY- 304	Advanced Instrumentation Techniques	4	0		4							
5.	MCY-305P	Analytical Chemistry Lab			4	2							
6.	MCY-306P	Computational Methods in Chemistry Lab			4	2							
7.	MCY-307P	Pre-project Seminar			2	1							
Total Hrs/Credits			26		21		Total Hrs/Credits			30		15	

SUMMARY					
Semesters	Sem-I	Sem-II	Sem-III	Sem-IV	Overall
Credits	22	22	21	15	80

It is proposed that there will be 80 credits spread over the entire course. There will be 22, 22, 21 and 15 credits for I, II, III and IV semesters, respectively. Each semester will consist of four theory courses of 4 credits each and three lab courses of 2 credits each. In fourth/final semester there will be complete project work of six months duration with 15 credits. Thus, the total minimum credits required for completing the M.Sc. in Chemistry is 80.



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Structure, Reactivity and Stereochemistry of Organic Molecules (Code-MCY-101)	Syllabus for M.Sc.- 1st Semester (I Year)		Total Course Credit: 4		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	4	0	0

Course Objective	The course has been designed to enable the students to learn the structure, reactivity and stereochemistry of organic molecules.
Course Outcomes (COs)	
CO1	To learn and apply various electronic effects and concept of aromaticity to understand the basics of advance organic reactions.
CO2	To learn the involvement of reactive intermediates and understand their structure and reactivity through various organic reactions.
CO3	To impart the knowledge of structure-reactivity and the reaction mechanism.
CO4	To learn the stereochemistry of organic compounds at an advanced level. Stereo chemical implications on the structure, and reactivity of organic molecules.
UNIT-I	Nature of Bonding in Organic Molecules [10 L] Electron Displacement effects: Inductive effect, Resonance effect, Hyperconjugation, Rules for writing resonance structures. Tautomerism: Different types including valence tautomerism. Aromaticity: Concept of aromaticity-Huckel rule, Classification of aromatic compounds-homocyclic and heterocyclic, Homo-aromaticity and Anti aromaticity. Annulenes: Aromaticity of hetero annulenes. Aromaticity in fused ring systems. Aromaticity of ferrocene and azulene. Carcinogenesis due to aromatic hydrocarbons. Molecular orbital diagram of annulenes, Frost diagram.
UNIT-II	Reaction Mechanism: Structure and Reactivity [10 L] Reactive Intermediates: Generation, Structure, fate and stability of Carbocations (Classical and Non- Classical), Carbanions, Free radicals, Carbenes, Nitrenes, Arynes and Radical ions. Determination of Reaction Mechanism: Types of mechanisms, thermodynamic

	and kinetic requirements, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle, transition states and intermediates, methods of determining rxn mechanism isotope effects. Hard and soft acids and bases. Effect of structure on reactivity - resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation
UNIT-III	Stereochemistry [10 L] Conformations: Origin of conformational energy. Angle and Pitzer strain. Conformational analysis of cycloalkanes, and decalines. Effect of conformation on reactivity in acyclic and cyclic systems. Conformation of sugars & anomeric effect. Conformation of cyclohexane, cyclohexanones and bicycloheptane- a bridged system. Chirality: Introduction, Chirality due to chiral centre. Molecules with more than one Chiral centres, Threo and erythro isomers. Configuration-Relative (D, L) and absolute configuration (R, S) configurations. Optical activity due to chiral axis, chiral plane and helicity. Chirality involving atoms other than carbon. Chirality in metallic complexes. Enantiotopic and diastereotopic atoms, groups and faces. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes) Asymmetric Synthesis: Introduction, principle of asymmetric synthesis. Categories of asymmetric synthesis, stereo-specificity and stereo-selectivity of organic reactions.
UNIT-IV	Aliphatic Electrophilic Substitutions [10 L] Bimolecular mechanisms; SE2 and SE1. The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity. Aromatic Electrophilic Substitutions The arenium ion mechanism, orientation and reactivity, energy profile diagrams. ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeier reaction, Gattermann-Koch reaction. Elimination reactions: Factors affecting elimination reactions, Mechanism of E1, E2, E1cB and E2C reactions. Competition between substitution and elimination reactions. Stereochemistry and regioselectivity of E2 eliminations, Elimination in cyclic systems and vinyl halides. Mechanism and orientation in pyrolytic eliminations, Shapiro reaction.

Recommended Books:

1. March's Advanced Organic Chemistry Reactions, Mechanism and Structure, 6th Ed., Smith, M.B. (Wiley-2014)
2. Organic Chemistry 8th Ed. - F. A. Carey and Robert M. Giuliano (McGraw Hill-2012).
3. Reaction Mechanism in Organic Chemistry 3rd Ed., S.M. Mukherjee and S.P. Singh. (Macmillan- 1998).
4. Stereochemistry of Organic Compounds 2nd Ed., D. Nasipuri. (New Age Inter.- 2008)
5. Stereochemistry of Carbon Compounds - E.L.Eliel. (TMH -2007)
6. Stereochemistry of Organic Compounds 7th Ed. - P.S. Kalsi. (New Age Inter.- 2012).
7. Organic Chemistry - 2nd Ed., J. Hornback. (Brooks/Cole- 2006,
8. Organic Chemistry, 5th Ed., John McMurry. (Brooks/Cole-2000).
9. Advanced Organic Chemistry, 5th Ed., F.A Carey & R.J Sundberg (Springer-2007).
10. Organic Chemistry, 2nd Ed., Jonathan Clayden (OUP-2012)
11. Organic Chemistry, 11th Ed., Solomons, T.W.G., (Wiley-2015).



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: General Inorganic Chemistry (Code-MCY-102)	Syllabus for M.Sc.- 1 st Semester (I Year)		Total Course Credit: 4		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	4	0	0

Course Objective	The course aims at understanding the structural paradigms in main group and early transition elements, and their rings, cages and cluster compounds. To understand the chemistry and reactivity of transition elements, lanthanides and actinides, their properties and applications. The course also aims at the detailed interception of bonding concepts in coordination and organometallic compounds.
Course Outcomes (COs)	
CO1	To understand the structure and reactivity of main group compounds.
CO2	To learn about the chemistry and applications of Transition and Inner-transition elements.
CO3	To learn about the theories, bonding and structure of coordination and organometallic compounds.
CO4	To learn about the spectral analysis, Metal-Metal bonding & clusters of organometallic complexes.
UNIT-I	Chemistry of Main Group Elements [10 L] Synthesis, Properties, Structure and Bonding of: Nitrogen, Phosphorous, Sulfur, Pseudohalogen, Interhalogen and Xenon Compounds, Borazines, Phosphazenes, Sulfur-Nitrogen compounds, Silicones, bonding and reactions in higher boranes, Wades rules and styx numbers, Carboranes, Metallocarboranes. Preparation, structure, PSEPT theory, Capping principle, Electron precise molecules. Introduction, properties, structure, bonding, organometallic chemistry, synthesis and reactivity of organo lithium, beryllium, and magnesium compounds. Boron, aluminum, gallium, indium organyls, germanium, tin and lead organyls, multiple bonded compounds, cages, clusters, applications in organic synthesis.
UNIT-II	Chemistry of Transition & Inner Transition Elements [10 L] Transition elements & their compounds (structure, Bonding theories, spectral

	& magnetic properties). Inner transition elements: Introduction, Characteristics, Extraction, Lanthanide Contraction, energetics, binary compounds, coordination chemistry, General Principles, Coordination numbers in lanthanide and actinide complexes, electronic and magnetic properties, Electronic Spectra, Luminescence Spectra, organometallic chemistry, applications in organic synthesis. Transactinides.
UNIT-III	Coordination Chemistry-I [10 L] Theories of electronic Structure: Terminology and Historical background of VBT and CFT. Ligand Field Theory: Molecular Orbitals for octahedral complexes, Orbital splitting and electron spin, ligand Field stabilization energy, pi bonding, square planer complexes, tetrahedral complexes. Angular overlap: Sigma-donor interactions, pi acceptor interactions, pi donor interactions, types of ligands and the spectrochemical series, magnitudes of $e\sigma$, $e\pi$ and Δ . The Jahn Teller effect: octahedral and tetrahedral Complexes.
UNIT-IV	Organometallic Chemistry-I [10 L] Organic Ligands and Nomenclature. The 18-electron Rule: Counting electrons in octahedral, tetrahedral and square planar complexes. Ligands in Organometallic chemistry: Carbonyl complexes, Ligands similar to carbonyl, hydride and dihydrogen complexes, ligands having extended pi systems. Bonding between metals and organic pi systems: Linear pi systems, cyclic pi-systems, and fullerene complexes. Complexes containing M-C, M=C and M $\equiv$ C bonds: Alkyl and related complexes, Carbene and Carbyne complexes. Spectral analysis and characterisation of organometallic complexes: Infra-red spectra and NMR spectra. The Isolobal Analogy: Extensions of the Analogy. Metal-Metal bonds, Multiple Metal-Metal bonds. Cluster compounds: Boranes, Heteroboranes, Metallo-boranes and Metallo Carboranes, Carbonyl Clusters, Carbide Clusters.

Recommended Books:

1. Inorganic Chemistry, James E. Huheey, Pearson. 4th Edn.
2. Inorganic Chemistry, Gary L. Miessler, Donald A. Tarr, Pearson, Third Edn.
3. Inorganic Chemistry, F.A. Cotton, Wiley, 6th Edn.
4. Inorganic Chemistry, Weller and Armstrong, Oxford, 6th Edn.
5. Inorganic Chemistry, J. D. Lee, Wiley, 5thEdn.



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Concepts in Physical Chemistry (Code-MCY-103)	Syllabus for M.Sc.- 1st Semester (I Year)		Total Course Credit: 4		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	3	1	0

Course Objective	The course has been designed to enable the students to learn the concepts of physical chemistry.
Course Outcomes (COs)	
CO1	To get knowledge of concepts in thermodynamics.
CO2	To learn the principles of chemical kinetics.
CO3	To gain knowledge about electrical current in ionic solution.
CO4	To acquire the knowledge about the colloidal state and polymer science.
UNIT-I	Thermodynamics [10 L] Second Law of Thermodynamics, Criteria for Reversible and Irreversible Processes, Maxwell's Equations and Gibbs-Helmholtz Equation. Fugacity and Activity: Determination of Fugacity of Gas and Mixture, Activity and Activity Coefficient and Their Determination Nernst Heat Theorem, Third Law of Thermodynamics, Determination of Absolute Entropies of Solids, Liquids and Gases. Thermodynamics of Open Systems: Partial Molar Properties and Their Significance, Gibbs-Duhem Equation.
UNIT-II	Chemical Kinetics [10 L] Theories of Chemical Reactions: Collision Theory of Reaction Rate, Activated Complex Theory, Statistical & Thermodynamic Formulations, Comparison with Collision Theory. Lindemann Theory, Hinshelwood's Theory, Kassel, Rice and Ramsperger Theory (RRK), RRKM Theory, Kinetics of Opposing or Reversible Reaction, Kinetics of Consecutive Reaction, Kinetics of Chain Reaction, Kinetics of Branched Chain Reaction, Fast Reactions: General Features of Fast Reactions, Study of Fast Reactions by Flow Method, Relaxation Method and Flash Photolysis. Reactions in Solutions: Diffusion Controlled Reactions, Ionic Reactions; Single & Double Sphere Models of Ionic Reactions.

UNIT-III	Electrical Current in Ionic Solution [10 L] Conductance of Electrolytic Solutions, Specific Conduction, Equivalent Conduction, Molar Conduction, Variation of Molar Conduction with Dilution, Ionic Mobility, Transport Number, Determination of Transport Number, Kohlrausch's Law, Calculation of Molar Ionic Conductance, Relationship between Molar Ionic Conduction and Ionic Mobility, Debye Huckel Theory of Strong Electrolytes.
UNIT-IV	Colloidal State [10 L] Colloidal Systems, Properties of Colloidal System, Electrical Properties, Electrical Double Layer, DLVO Theory, Electrokinetic Properties, Surfactants, Micelle Formation, Critical Micelle Concentration (CMC), Thermodynamics of Micellization, Micellar Catalysis, Emulsification, Theories of Emulsion Macromolecules: Macromolecules, Classification of Polymers and Polymerization Reactions, Molar Masses of Polymers, Determination of Molar Masses of Macromolecules, Viscometry, Osmometry, Donnan Membrane Equilibrium

Recommended Books:

1. Principles of Physical Chemistry: Puri, Sharma, Pathania, Latest Edition
2. Text Book of Physical Chemistry - S. Glasstone (McMillan), Latest Edition
3. Modern Electrochemistry, Vol 1,2A and 2B, John O" M Bokris, Latest Edition
4. An Introduction to Electrochemistry, Samuel Glasstone, Latest Edition
5. Theoretical Electrochemistry, L.Antropov. Latest Edition
6. Advanced Physical Chemistry, Gurtu and Gurtu. Latest Edition



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Instrumental Methods of Chemical Analysis (Code-MCY-104)	Syllabus for M.Sc.- 1st Semester (I Year)		Total Course Credit: 4		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	3	1	0

Course Objective	The course has been designed to enable the students to learn the analysis of experimental data and learn various analytical techniques which would be applied in all areas of research and various industries.
Course Outcomes (COs)	
CO1	To get knowledge of data handling/statistical treatment of data.
CO2	To learn the principles of titrimetric analysis and its significance in analytical chemistry.
CO3	To gain knowledge about different types of electroanalytical techniques.
CO4	To acquire the knowledge about the various thermal methods like TGA, DTA, DSC and their applications.
UNIT-I	Data Analysis [10 L] Errors, classification of errors and their minimization; absolute, relative, determinate and indeterminate errors, statistical treatment of random errors, accuracy and precision, methods of expressing accuracy and precision, significant figures, computation rules for significant figures, The Gaussian distribution, mean and standard deviation, confidence intervals, statistical tests of data (the F test, the t test, Q test, ANOVA), Standard reference materials and procedures, standard and official methods.
UNIT-II	Titrimetric Methods of Analysis [10 L] Standard solutions, indicators, theory of indicators, types of titrations; acid-base, precipitation, redox, complexometric, conductometric and potentiometric titration, theory of acid base indicators, Mohr, Volhard and Fajans methods, EDTA based titration, redox indicators and their use in volumetric analysis, iodometry and iodimetry.
UNIT-III	Electroanalytical Methods of Analysis [10 L] Voltammetry and Polarography General principles, excitation signals, instrumentation, voltammogram; Polarography; the dropping mercury electrode (DME) and potential range,

	limiting current, diffusion current & Ilkovic equation, factors affecting the diffusion current, normal and differential-pulse polarography, square-wave polarography; Cyclic voltammetry; Stripping voltammetry. Potentiometry and Conductometry General principles, liquid-junction potential, reference electrodes, pH meter, direct potentiometric measurements, potentiometric pH measurements with glass electrode and combination pH electrode, potentiometric titration. Conductometry Basic principles, instrumentation, conductance cells, conductometric titrations-acids of different pka values at various concentrations by strong and weak base, modifications for titration of weak acid, mixture of a strong and weak acid.
UNIT-IV	Thermal and Calorimetric Methods of Analysis [10 L] Thermogravimetric analysis, apparatus, methodology, application; differential thermal analysis, apparatus, methodology; derivative thermogravimetry, instrumentation, methodology; differential scanning calorimetry; instrumentation, methodology. Comparative study of TGA, DTA and DSC. Interpretation of TGA and DTA curves of important compounds e.g., calcium oxalate monohydrate, magnesium oxalate monohydrate. Analysis of silver-copper alloy and dolomite sample by TGA. Thermometric titrimetry and applications to acid-base and complexometric titrations.

Recommended Books:

1. J. Heyrovsky and K. Kuta, Principles of Polarography, 1st Edition (1966), Academic Press, New York.
2. I.M. Kolthoff and J.J. Lingane, Polarography, 2nd Edition (1952), Wiley Intersciences, New York.
3. D. A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Principles of Instrumental Analysis, 5th Edition (1998), Saunders College Publishing, Philadelphia, London.
4. G. D. Christian, Analytical Chemistry, 5th Edition (1994), John Wiley & Sons, New York.
5. G.W. Ewing, Instrumental Methods of Chemical Analysis, 5th Edition (1978), McGraw Hill Books Co., New York.
6. D. Harvey, Modern Analytical Chemistry, McGraw Hill Higher Education, New York, 2000.
7. R.L. Pecsok, L. D. Shields, T. Cairns and L.C. Mc William, Modern Methods of Chemical Analysis, 2nd Edition (1976), John Wiley, New York.
8. J.H. Kennedy, Analytical Chemistry: Principles, 2nd Edition (1990), Saunders Holt, London.



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Inorganic Chemistry Lab-I (Code-MCY-105P)	Syllabus for M.Sc. -1 st Semester (I Year)		Total Course Credit: 2		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	0	0	4

Course Objective	To gain Practical knowledge of Inorganic Chemistry.
Course Outcomes (COs)	To learn synthesis of Inorganic complexes and salts.
Exp.1	To Synthesize tris(acetylacetonato)manganese(III), $[\text{Mn}(\text{C}_5\text{H}_7\text{O}_2)_3]$. Calculate the percentage yield and give the structure of the complex. Also write the chemical reactions involved.
Exp.2	To Synthesize Copper(I) tetraiodomercurate(II), $\text{Cu}_2[\text{HgI}_4]$. Calculate the percentage yield and give the structure of the complex. Also write the chemical reactions involved.
Exp.3	To Synthesize pentaaminechlorocobalt(III) chloride, $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$. Calculate the percentage yield and give the structure of the complex. Also write the chemical reactions involved.
Exp.4	To synthesize tris(acetylacetonato)Chromium(III), $[\text{Cr}(\text{C}_5\text{H}_7\text{O}_2)_3]$. Calculate the percentage yield and give the structure of the complex. Also write the chemical reactions involved.
Exp.5	To Synthesize nitropentaammine cobalt(III) chloride, $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$. Calculate the percentage yield and give the structure of the complex. Also write the chemical reactions involved.
Exp.6	To estimate the percentage of Copper ions in a given solution by titration method.
Exp.7	To Synthesize Mohr's Salt (Ferrous Ammonium Sulphate). Calculate the percentage yield and give the structure of the complex. Also write the chemical reactions involved.
Exp.8	To synthesize Reinecke's salt (Ammonium Tetrathiocyanate diamine chromate). Calculate the percentage yield and give the structure of the

	complex. Also write the chemical reactions involved.
Exp.9	To synthesize Hexa amine Nickel-II chloride. Calculate the percentage yield and give the structure of the complex. Also write the chemical reactions involved.
Exp.10	To Synthesis Sodium trioxalato ferrate trihydrate. Calculate the percentage yield and give the structure of the complex. Also write the chemical reactions involved.

Recommended Books:

1. Qualitative Inorganic Analysis. – A. I. Vogel, 6th Edition revised by G. Svehla ELB-London
2. Textbook of Chemistry Analysis – A. I. Vogel
3. Advanced Practical Inorganic Chemistry – Gurdeep Raj Goel Publishing House, Meerut.



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Organic Chemistry Lab-I (Code-MCY-106P)	Syllabus for M.Sc.- 1st Semester (I Year)		Total Course Credit: 2		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	0	0	4

Course Objective	The course has been designed to enable the students to learn the organic chemistry practical's skills.
Course Outcomes (COs)	
CO1	To familiarize the students with the purification techniques.
CO2	To learn the fundamental ideas of separation and purification of organic compounds.
CO3	To impart the knowledge about the separation of a binary mixture of organic compounds.
CO4	To learn the qualitative analysis of organic compounds.
Exp.1	Purification techniques (Demonstrations). Purification of solvents and reagents using Techniques like crystallization, sublimation, fractional distillation, vacuum distillation, drying and storage of solvents.
Exp.2-4	Separation and Purification Separation and Purification of organic compounds using thin layer chromatography and column chromatography. (Minimum three exercises).
Exp.5-7	Separation of a binary mixture Separation of a binary mixture of organic compounds based on solubility in water and organic solvents. (Minimum three exercises)
Exp.8-10	Identification of the organic compounds Identification of the organic compounds by systematic qualitative organic analysis. (Minimum three exercises)

Recommended Books:

1. Advanced Practical Organic Chemistry, 2nd ed. - N.K. Vishnoi (Vikas, 1999).
2. Experiments and Techniques in Organic Chemistry - D. Pasto, C. Johnson and M. Miller (Prentice-hall, 1992.)

3. Microscale and Macroscale Organic Experiments- K.L. Williamson (D.C. Heath and Co., 1989).
4. Vogel's Textbook of Practical Organic Chemistry, 5th ed.- A.R. Tatchell (ELBS, 1996)
5. Comprehensive Practical Organic Chemistry, V. K. Ahluwalia and Renu Aggarwal, (University Press-2000).



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Physical Chemistry Lab-I (Code-MCY-107P)	Syllabus for M.Sc.- 1st Semester (I Year)		Total Course Credit: 2		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	0	0	4

Course Objective	To develop the experimental skills by providing practical course dedicated to physical chemistry.
Course Outcomes (COs)	
CO1	To get the knowledge of coloumetric measurements.
CO2	To perform titrations using potentiometry, conductometry and pH-metry.
CO3	To acquire the knowledge about the surface tension measurements.
CO4	To study the rate of reaction.
S. No.	Details of the Experiments
Exp.1	Determination of strengths of halides in a mixture potentiometrically.
Exp.2	Determination of the strength of strong and weak acid in a given mixture conductometrically.
Exp.3	Determination of solubility and solubility product of sparingly soluble salt BaSO ₄ .
Exp.4	Determine the pK ₁ and pK ₂ value of phosphoric acid by pH metry.
Exp.5	Determine the indicator constant of given indicator by colorimetric measurements.
Exp.6	To study the kinetics of mutarotation of glucose/fructose polarographically.
Exp.7	To study the effect of surfactants (sodium chloride) on surface tension of given liquid.
Exp.8	To determine the radius of molecule by viscosity measurements.
Exp.9	Study the effect of surfactant (n-propyl alcohol) at various concentrations on the surface tension of water.
Exp.10	Investigate the influence of ionic strength on the rate constant of the reaction between K ₂ S ₂ O ₈ and KI.

Recommended Books:

1. A Text Book of Quantitative Inorganic Analysis (3rd Edition) – A. I. Vogel

2. Practical physical chemistry, A. Findary, T.A. kitchner (Longmans, Green and Co.)
3. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. richett (Pergamon Press)
4. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co., Delhi.)



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Organic Reaction Mechanisms (Code-MCY-201)	Syllabus for M.Sc. -2nd Semester (I Year)		Total Course Credit: 4		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	4	0	0

Course Objective	The course has been designed to enable the students to learn the organic reaction mechanisms.
Course Outcomes (COs)	
CO1	To familiarize the students with different organic reaction mechanisms in organic chemistry.
CO2	To learn various molecular rearrangements of synthetic importance.
CO3	To gain insight about advance organic synthesis on account of additions to multiple bonds.
CO4	To learn and understand the orbital interactions in concerted reactions. Learn to apply concerted and stepwise reactions in organic synthesis.
UNIT-I	Aliphatic Nucleophilic Substitutions [10 L] The SN₂, SN₁, mixed SN₁ and SN₂ and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. The S_Ni mechanism. Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, regioselectivity Aromatic Nucleophilic Substitutions The S_NAr, SN₁, benzyne and S_{RN}1 mechanisms. Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser, and Smiles rearrangements Free Radical Substitution: Free radical substitution mechanisms. Mechanisms at aromatic substrate. Neighbouring group assistance in free radical reactions, Reactivity for aliphatic and aromatic substrates. Reactivity in the attacking radical. Effect of solvent on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-

	oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts, Sandmeyer reaction, free radical rearrangements and Hunsdiecker reaction.	
UNIT-II	Addition to Multiple Bonds [10 L] Addition to carbon-carbon multiple bonds: General mechanism, reactivity, orientation and stereochemical implications of additions reactions involving electrophiles, nucleophiles and free radicals. Addition to cyclopropane ring. Hydrogenation of double/triple bonds and aromatic rings. Hydroboration, Ene-reaction, Michael reaction and Sharpless asymmetric epoxidation. Addition to carbon-hetero atom double bonds: Mechanisms of addition of water, hydrogen cyanide, alcohols, amines, organometallic reagents and hydrides to aldehydes and ketones. Mechanism of Wittig, Mannich, Aldol, Cross Aldol, Cannizzaro's, Knoevenagel, Robinson annulation, Claisen, Dieckmann, Benzoin, Perkin and Stobbes reactions.	
UNIT-III	Molecular Rearrangements [10 L] General mechanistic treatment of nucleophilic, electrophilic and free radical rearrangements. Nature of migration and migratory aptitude and memory effect. Detailed study of following rearrangements: Wagner-Meerwein, Pinacol-Pinacolone, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert, Neber, Hofmann, Curtius, Lossen, Schmidt, Beckmann, Baeyer-Villiger, Pyne and Dienone - phenol rearrangements.	
UNIT-IV	Pericyclic reactions [10 L] Molecular orbital symmetry, Frontier orbitals of ethene, 1,3-butadiene, 1,3,5-hexatriene and allylic systems. HOMO, LUMO concept, FMO approach. Classification of Pericyclic reactions. Woodward Hoffmann rules for the following pericyclic reactions. Cycloadditions: Thermal and Photochemical 2+2 and 4+2 cycloadditions. Suprafacial and antarafacial cycloadditions. Electrocyclic Reactions: Thermal and Photo-induced Electrocyclic reactions of $4n$ and $4n + 2$ systems and their stereochemistry. Conrotatory and disrotatory motions. Sigmatropic rearrangements: Classification, [1,3], [1,5] and [3,3] sigmatropic shifts. Cope and Claisen rearrangements. Suprafacial and antarafacial shifts of hydrogen atom.	

Recommended Books:

1. Advanced Organic Chemistry; Jerry March, Fourth edition, Wiley & Sons, (2007).

2. Advanced Organic Chemistry 4th Ed. - F. A. Carey and R. J. Sundberg. (Plenum, 2001).
3. A Guide Book to Mechanism in Organic Chemistry 6th Ed.- Peter Sykes. (Longman, 1996).
4. Structure and Mechanism in Organic Chemistry 2nd Ed. - C. K. Ingold. (CBS, 1994).
5. Modern Organic Reactions 2nd Ed. - H.O. House (Benjamin, 1972)
6. Principles of Organic Synthesis 2nd Ed. - R.O.C. Norman (Chapmann Hall, 1978)
7. Reaction Mechanism in Organic Chemistry 3rd Ed. - S.M. Mykherjee and S.P. Singh. Macmillan, 1998).
8. Organic Chemistry - J. Hornback, pk. (Brooks/Cole, 1998).
9. Fleming, I. Pericyclic reactions, Oxford science publication (1998)
10. S.M. Mukherjee and S.P. Singh, Pericyclic Reactions, MacMillan India, New Delhi.
11. Organic Chemistry, 5th Ed.- John McMurry. (Brooks/Cole, 2000)
12. Kurti, L. and Czako, B. Strategic applications of Named reactions, in organic synthesis(2004).
13. Carruthers, W. and Coldham, I. Modern methods of organic synthesis, Cambridge University Press(2004).
14. G. S. Zweifel and M. H. Nantz, Modern Organic Synthesis- An Introduction, W. H. Freeman and Company, 2006



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Coordination Chemistry, Organometallics & Group Theory (Code-MCY-202)	Syllabus for M.Sc.- 2nd Semester (I Year)		Total Course Credit: 4		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	4	0	0

Course Objective	To introduce the students to the reactions, magnetism and spectra of coordination compounds. Mechanistic aspects of several well-known industrial catalytic techniques will be studied. To understand the symmetry properties of molecules and application of group theory in understanding the molecular properties based on symmetry.
Course Outcomes (COs)	
CO1	To learn about the reactions, electronic spectra and magnetism of coordination compounds.
CO2	To learn and understand the bonding principles and reaction mechanism in organometallic chemistry.
CO3	To understand the industrially important homogenous catalysis cycles.
CO4	To apply group theory and character table to analyze the molecular properties.
UNIT-I	Coordination Chemistry-II [10 L] Absorption of light: Beer Lamberts Absorption law. Quantum numbers of multi electron atoms: Spin-Orbit Coupling, term Symbols. Electronic Spectra of coordination compounds: selection rules, Correlation diagrams (Orgel Diagrams), Tanabe Sugano Diagrams, Jahn teller distortions and spectra, Charge Transfer spectra, Magnetism: Definition of magnetic properties, Curie and Curie-Weiss Law, Orbital and spin contribution to magnetic susceptibility, Introduction to magnetic properties of lanthanides, Magnetic exchange coupling, Spin cross over phenomena.
UNIT-II	Coordination Chemistry-III [10 L] Substitution reactions: inert and Labile Compounds, Mechanisms of substitution. Kinetic consequences of reaction pathways: Dissociation, interchange and

	Association. Experimental evidence in octahedral substitution: Dissociation, Linear free energy relationships, associative mechanisms, The conjugate base mechanism, The kinetic chelate effect. Stereochemistry of reactions: substitution in trans complexes, substitution in Cis-complexes, Isomerization of chelate rings. Substitution reactions in square planar complexes: Kinetics and stereochemistry of Square planar substitutions, Evidence for Associative reactions. Trans effect: Explanations of trans effect. Oxidation reduction reactions: inner and outer sphere reactions, conditions for high and low oxidation numbers.
UNIT-III	Organometallic Chemistry-II [10 L] Reactions involving gain or loss of ligands: Ligand dissociation and substitution, oxidative addition, reductive elimination, nucleophilic displacement. Reactions involving modification of ligands: Insertion, Carbonyl insertion (Alkyl migration), 1, 2 Insertions, Hydride elimination, abstractions. Organometallic Catalysis: examples of Catalysis (Catalytic Deuteration), Hydroformylation, Monsanto acetic acid process, Wacker (Smidt) process, Hydrogenation by Wilkinson's Catalyst, Olefin Metathesis. Heterogeneous catalyst: Ziegler-Natta Polymerisation and water gas reaction.
UNIT-IV	Symmetry and Group theory [10 L] Symmetry elements and operations, Combination of symmetry operations, Groups, Subgroups, Classes, Group multiplication tables, Symmetry point groups, Identification of point groups, Systematic procedure for assignment of point groups to molecules, Symmetry classes and their geometrical significance reducible, Representations and Irreducible representations, Great orthogonally theorem (GOT), Applications of GOT, Character table (C_{2v}, C_{3v}, C_{2h}).

Recommended Books:

1. Inorganic Chemistry, James E. Huheey, Pearson. 4th Edn.
2. Inorganic Chemistry, Gary L. Miessler, Donald A. Tarr, Pearson, 3rd Edn.
3. Inorganic Chemistry, F.A. Cotton, Wiley, 6th Edn.
4. Inorganic Chemistry, Weller and Armstrong, Oxford, 6th Edn.
5. Inorganic Chemistry, J. D. Lee, Wiley, 5th Edn.
6. Organometallic Chemistry, B.D. Gupta & A.J. Elias, University Press, 2nd Edn.
7. Chemical Applications of Group Theory, F. Albert Cotton, John Wiley & Sons, 2008, 3rd Edn.



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Surface and Solid-State Chemistry (Code-MCY-203)	Syllabus for M.Sc.-2nd Semester (I Year)			Total Course Credit: 4		
Mid-Term	Class Assessment	Final-Term	L	T	P	
30 (Marks)	10 (Marks)	60 (Marks)	3	1	0	

Course Objective	The course has been designed to enable the students to learn the surface chemistry and solid state chemistry.
Course Outcomes(COs)	
CO1	To understand the phenomena of surface chemistry.
CO2	To learn about the solid state chemistry.
CO3	To gain knowledge about different properties of solids.
CO4	To acquire the knowledge of semiconductors and their devices.
UNIT-I	Surface Chemistry [10 L] Adsorption by Solids and Gases, Factors Influencing, Adsorption, Freundlich Adsorption Isotherm, Langmuir Theory of Adsorption, BET Theory of Multilayer Adsorption, Derivation of BET Equation, Types of Adsorption Isotherm
UNIT-II	Solid State Chemistry [10 L] Miller indices; Bragg equation, Debye-Scherrer method of X-ray structural analysis of crystals, identification of cubic unit cells from systematic absences in diffraction pattern. Classification of solids, Crystal lattice and Unit cell, Close packed structures, Packing efficiency, packing in ionic solids, atomic packing factor in crystal structures, ionic radius, radius ratio rule, (3, 4, 6, 8 coordinate structures). Octahedral and tetrahedral voids, isomorphism and polymorphism, numericals. Unit cell dimensions numericals. Imperfections in Solids: Perfect and imperfect crystal, point defects, stoichiometric defects, Schottky & Frenkel defects, thermodynamics of their formation, colour centers, Non-stoichiometric defects, metal excess and metal deficiency defects, line imperfections, Edge dislocation, Screw dislocation, Burgers circuits, Surface imperfections, grain boundaries & stacking faults.
UNIT-III	Properties of Solids [10 L] Electrical Properties: Thermoelectric effects, Thomson effects, Peltier effect,

	Seebeck effect, thermocouples, Hall Effect, Dielectric materials, Ferro, Pyro, Piezo electricity and their relations. Applications. Magnetic Properties: Dielectric Constant, Polarization and Polarizability, Piezoelectricity, Pyroelectricity and Ferroelectricity, Ferroelectric Materials and Their Applications, Effect of Temperature, Magnetic Domains and Hysteresis. Optical Properties: Luminescence and Phosphors, Lasers, Photoconduction, Photoelectric effects.
UNIT-IV	Semiconductors and their Devices [10 L] Free electron theory, Conduction by free electrons, Band theory, Refinement to simple band theory, Band structure of metals, Intrinsic and extrinsic semiconductors, semiconductors materials and their fabrication, semiconductors devices p-n junctions, properties of p-n junctions, semiconductors diode as rectifier, Filters circuits, Zener diode as a voltage stabilizer, transistors transistor as an amplifier Super conductivity: conventional super conductors, organic super conductors (organic metals), fullerene, high temperature super conductors, organic charge transfer complexes Applications.

Recommended Books:

1. Principles of Physical Chemistry: Puri, Sharma, Pathania, Latest Edition
2. Text Book of Physical Chemistry - S. Glasstone (McMillan), Latest Edition
3. Modern Electrochemistry, Vol 1, 2A and 2B, John O" M Bokris, Latest Edition
4. An Introduction to Electrochemistry, Samuel Glasstone, Latest Edition
5. Theoretical Electrochemistry, L. Antropov. Latest Edition
6. Advanced Physical Chemistry, Gurtu and Gurtu. Latest Edition



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Chromatographic Techniques (Code-MCY-204)	Syllabus for M.Sc.-2 nd Semester (I Year)		Total Course Credit: 4		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	4	0	0

Course Objective	The course has been designed to enable the students to learn the analysis of experimental data and learn various analytical techniques which would be applied in all areas of research and various industries.
Course Outcomes(COs)	
C01	To understand the basic concepts of chromatography and their related terms.
C02	To learn about the column chromatography like Gas chromatography and high performance liquid chromatography.
C03	To gain knowledge about ion-exchange chromatography and size exclusion chromatography.
C04	To acquire the knowledge of super critical fluid chromatography and extraction process.
UNIT-I	Chromatography [10 L] Introduction, principle of chromatography, classification of chromatographic methods; techniques of planar and column chromatography; paper chromatography, types of paper chromatography, experimental details for qualitative and quantitative analysis, applications, Thin-layer chromatography; scope; procedure; thin-layer plates and stationary phases; mobile phase; plate development; detection of the spots; performance characteristics of thin-layer plates-retardation and retention factor, plate heights; high-performance thin-layer chromatography; qualitative applications variables that influence R _f , elution methods, quantitative measurements.
UNIT-II	Gas Chromatography [10 L] Principles; instruments; carrier gases; columns and stationary phases; sample injection systems, detectors-characteristics of the ideal detectors, thermal conductivity detector, flame ionization detector, electron capture detector and others, factors affecting the efficiency of the column, qualitative analysis, Kovats retention index I, quantitative analysis, analyses based on peak height and peak areas, temperature programming; applications.

	High Performance Liquid Chromatography; Principles, instrumentations; isocratic and gradient elution, pumping systems, columns and column packings, detectors-absorbance, fluorescence, refractive-index and electrochemical detectors, basic difference between HPLC and conventional liquid chromatography, advantages and applications. Hyphenated Techniques An overview of hyphenated techniques viz. GC-MS, HPLC-MS, HPTLC-MS and their applications.
UNIT-III	Ion-Exchange/Ion Chromatography [10 L] Principles of separation, ion-exchange equilibria and selectivity, types of stationary phases, mobile phases, effect of pH on separation of amino acid, effect of complexing agent on separation of metal ions, distinction between ion-exchange and ion chromatography, ion-suppression in ion chromatography, ion chromatography with eluent suppressor column, single column ion chromatography, properties of mobile phases, detectors, applications. Size Exclusion Chromatography Principles of separation, theoretical basis-calibration curve, exclusion limit, total permeation and selective permeation regions, relation between elution volume and molecular weight, packing materials and applications.
UNIT-IV	Super Critical Fluid Chromatography and Extraction [10 L] Super critical fluids and its properties, principle, instrumentation, stationary and mobile phases, detectors, operating variables, comparisons with other types of chromatography, applications, super critical fluid extraction, choice of super critical fluids, advantages, applications.

Recommended Books:

1. James M. Miller, Chromatography: Concepts and Contrasts, 2ndEd., Wiley, 2009.
2. O David Sparkman, Zelda Penton and Fulton G. Kitson, Gas Chromatography and Mass Spectrometry:A Practical Guide, 2ndEd., Elsevier, 2011.
3. Veronika R. Meyer, Practical High-Performance Liquid Chromatography, 5thEd., Wiley, 2010.
4. Raymond P.W. Scott, Chromatography Theory-Chromatographic Science, 88, Jack Cazes, CRC Press; 2002.
5. Robert L. Grob & Eugene F. Barry, Modern Practice of Gas Chromatography, 4thEd., John Wiley & Sons, 2004.
6. Gary D. Christian, Analytical Chemistry, 6thEd., Wiley, 2003.
7. Douglas A. Skoog, F. James Holler, Instrumental Analysis, 2nd Indian Reprint, Stanley R. Crouch, Brooks Cole-Cenage Learning 2008.



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Inorganic Chemistry Lab-II (Code-MCY-205P)	Syllabus for M.Sc.- 2 nd Semester (I Year)		Total Course Credit: 2		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	0	0	4

Course Objective	To gain practical knowledge of Inorganic Chemistry.
Course Outcomes (COs)	To learn synthesis of Inorganic complexes and salts.
Exp.1	Synthesis of dichlorobis (triphenylphosphine) cobalt(II).
Exp.2	Synthesis of tris (2,4-pentadionato) chromium(III).
Exp.3	Synthesis of tris (2,4-pentadionato) manganese(III).
Exp.4	Synthesis of dichlorobis (triphenylphosphine) nickel(II).
Exp.5	Determination of the amount of (Fe ²⁺) in the given sample spectrophotometrically using 1,10-phenanthroline.
Exp.6	Determination of the amount of (Mn ²⁺) ion in the given sample spectrometrically.
Exp.7	Determination of the concentration of phosphate (PO ₄ ³⁻) in potassium dihydrogen phosphate (KH ₂ PO ₄) by spectrophotometer.
Exp.8	Synthesis of tris (ethylenediamine) cobalt (III) chloride.
Exp.9	Synthesis of Mercurytetrathiocyanatocobaltate (II).
Exp.10	Synthesis of Ammonium dodecamolbedophosphate.

Recommended Books:

1. Qualitative Inorganic Analysis. – A. I. Vogel, 6th Edition revised by G. Svehla ELB-London
2. Textbook of Chemistry Analysis – A. I. Vogel
3. Advanced Practical Inorganic Chemistry- Gurdeep Raj Goel Publishing House, Meerut.



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Organic Chemistry Lab-II (Code-MCY-206P)	Syllabus for M.Sc. -2 nd Semester (I Year)		Total Course Credit: 2		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	0	0	4

Course Objective	The course has been designed to enable the students to learn the organic chemistry practical's skills.
Course Outcomes (COs)	
CO1	To familiarize the students with the purification techniques.
CO2	To learn the fundamental ideas of separation and purification of organic compounds.
CO3	To impart the knowledge about the separation of a binary mixture of organic compounds.
CO4	To learn the qualitative analysis of organic compounds.
Exp.1-4	Preparations of the following compounds 1. Aspirin from salicylic acid 2. Haloform reaction: Preparation of Iodoform. 3. Nitrobenzene to m-dinitrobenzene to m-nitroaniline 4. Benzophenone_Benzophenoneoxime_Benzanilide (Beckmann rearrangement) 5. Aniline to Diazonium salt to p-Aminoazobenzene 5. Glucosone from glucose 6. Benzoin to Benzil to Benzilic Acid
Exp.5-6	Isolation of; 1. caffeine from tea leaves 2. Lycopene from tomatoes. 3. Casein from milk
Exp.7-8	Detection of functional groups Detection of functional groups using IR spectroscopy in a given organic compound (spectra to be provided). Minimum two exercises.
Exp.9-10	Calculation of λ_{max} Calculation of λ_{max} for a given organic compound using UV-Vis spectrophotometer. (Spectra to be provided). Minimum two exercises.

Recommended Books:

1. Advanced Practical Organic Chemistry, 2nd ed. - N.K. Vishnoi (Vikas, 1999).
2. Experiments and Techniques in Organic Chemistry - D. Pasto, C. Johnson and M. Miller (Prentice-hall, 1992.)
3. Microscale and Macroscale Organic Experiments- K.L. Williamson (D.C. Heath and Co., 1989).
4. Vogel's Textbook of Practical Organic Chemistry, 5th ed.- A.R. Tatchell (ELBS, 1996)
5. Comprehensive Practical Organic Chemistry, V. K. Ahluwalia and Renu Aggarwal, (University Press-2000)



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Physical Chemistry Lab-II (Code-MCY-207P)	Syllabus for M.Sc.- 2nd Semester (I Year)		Total Course Credit: 2		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	0	0	4

Course Objective	To develop the experimental skills by providing the practical course dedicated to the physical chemistry.
Course Outcomes (COs)	
CO1	To get the knowledge of adsorption phenomena.
CO2	To perform titrations using potentiometry, conductometry and pH-metry.
CO3	To acquire the knowledge about the dissociation constants.
CO4	To study the variation in viscosity of the mixture.
S. No.	Details of the Experiments
Exp.1	To study the adsorption of acetic acid from aqueous solution by activated charcoal and examine the validity of Freundlich and Langmuir's isotherm.
Exp.2	Investigate the adsorption of acetic / oxalic acid by activated charcoal and test the validity of Freundlich and Langmuir's isotherm.
Exp.3	To study auto catalysis reaction between potassium permanganate and oxalic acid.
Exp.4	Determination of acidic and basic dissociation constants of an amino acid and its isoelectric point.
Exp.5	To study the variation of viscosity with the composition of mixtures (ethanol-water-HNO ₃ -chloroform) and to determine the formation of complex between two liquids.
Exp.6	Titrate potentiometrically phosphoric acid solution against NaOH and calculate pK ₁ , pK ₂ and pK ₃ of the acid.
Exp.7	To determine the hydrolysis constant of aniline hydrochloride by pH measurements.
Exp.8	Determine the amount of trichloroacetic acid, monoacetic acid and acetic acid in a given solution by conductometric titration against sodium hydroxide solution.
Exp.9	Determination of dissociation constants of phosphoric acid potentiometrically.
Exp.10	Determination of dissociation constants of weak acid potentiometrically.

Recommended Books:

1. A Text Book of Quantitative Inorganic Analysis (3rd Edition) – A. I. Vogel
2. Practical physical chemistry, A. Findary, T.A. kitchner (Longmans, Green and Co.)
3. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. richett (Pergamon Press)
4. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co., Delhi.)



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Organic Spectroscopy and Modern Organic Synthesis (Code-MCY-301)	Syllabus for M.Sc.- 3rd Semester (II Year)		Total Course Credit: 4		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	4	0	0

Course Objective	The course has been designed to enable the students to learn the organic spectroscopy and modern organic synthesis.
Course Outcomes (COs)	
CO1	To familiarize the students with the organic structure determination methods involving spectroscopy.
CO2	To learn the fundamental ideas of photochemical excitation/deexcitation events, and the molecular events that can intervene at different levels and their applications.
CO3	To impart the knowledge of modern synthetic methods used in functional group transformations.
CO4	To learn retrosynthetic approach in the art of modern organic synthesis.
UNIT-I	UV, IR Spectroscopy and Mass Spectrometry [10 L] UV Spectroscopy: Electronic transitions in organic molecules, Woodward-Fieser rules for alkenes, Woodward rules for enones and aromatic compounds IR Spectroscopy: IR frequencies of alkanes, alkenes, alkynes, aromatic compounds, and for all other functional groups. Effects of hydrogen bonding and solvent on vibrational frequencies, overtones, combination bands and Fermi resonance. Mass spectrometry: Basic principles, hard and soft ionization techniques, mass analyzer in ESI-MS and MALDI-MS, high resolution MS, isotope abundance, molecular ion, fragmentation processes (McL) of organic molecules, deduction of structure through mass spectral fragmentation, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule High resolution mass spectrometry.
UNIT-II	Nuclear Magnetic Resonance Spectroscopy [10 L] Basic concepts, Mechanism of Measurements, Chemical shift values for various classes of compounds. Fourier Transform (FT), Techniques and advantages,

	Nuclear OVERHAUSER effect (NOE). One bond coupling, two bond coupling, three bond coupling, second order spectra A2, AB, AX, AB2, AX2, A2B2. Proton exchange, deuterium exchange, Peak broadening exchange C-13 NMR: Carbon 13-chemical shifts, proton coupled and decoupled spectra. Nuclear overhauser, Effect, Off-Resonance De-coupling, A quick dip in to DEPT-45, DEPT-90, DEPT-135. Introduction to two-dimensional spectroscopy methods, COSY techniques, HETCOR technique, NOESY, combined structure problems.
UNIT-III	Photochemistry [10 L] Photochemical Reactions: Interaction of electromagnetic radiation with matter. Types of excitations. Singlet and triplet states and their lifetimes. Fate of excited molecule: Physical and chemical processes. Transfer of excitation energy: Sensitization and Quenching. Quantum yield. Types of photochemical reactions. Photochemistry of alkenes: Geometrical isomerisations, cyclisation and dimerisation reactions. Photochemical reactions of 1,3- butadiene (excluding pericyclic reactions). Rearrangements of 1,4 and 1,5- dienes. Photochemistry of saturated carbonyl compounds: Intramolecular reactions of saturated acyclic and cyclic carbonyl compounds. (Norrish type-I and Norrish type-II processes). Intermolecular cycloaddition reactions (Paterno- Buchi reaction). Photochemistry of unsaturated carbonyl compounds: Photochemical reactions of α, β-unsaturated carbonyl compounds. (H-Abstraction and isomerisation to β, γ-unsaturated carbonyl compounds). Photolysis of cyclic α, β- unsaturated ketones (dimerisation and lumiketone rearrangement) and cyclohexadienones.
UNIT-IV	Designing Organic Synthesis [10 L] Retrosynthetic analysis: Basic principles and terminology of retrosynthesis, guidelines, synthesis of aromatic compounds, one group and two group C-X disconnections, one group C-C and two group C-C disconnections, amine and alkene synthesis, important strategies of retrosynthesis, functional group transposition, important functional group interconversions, reversal of polarity (umpolung). Protection and deprotection of functional groups: Protection and deprotection of hydroxy, carboxyl, carbonyl, carboxy amino groups and carbon-carbon multiple bonds, chemo- and regioselective protection and deprotection, illustration of protection and deprotection in multi-step synthesis.

Recommended Books:

1. Spectrometric identification of Organic Compounds. 5th Ed., R.M.Silverstein, G. C. Bassler and T.C.Morill. (Jhon Wiley-1991).
2. Introduction to NMR Spectroscopy, R.J.Abraham. J.Fisher and P.Loftus (Wiley-1991)
3. Applications of absorption spectroscopy of Organic Compounds, J.R.Dyer (Prentice Hall-1991).
4. Spectroscopic Methods in organic Chemistry, D.H.Williams; I.Fleming (Tata- McGraw Hill-1988).
5. Intoductory Photochemistry, A.Cox and T.Kemp (McGraw Hall-1971).
6. Organic Photochemistry, 2nd Ed., J.Coxon, and B.Halton (2nd Ed. Cambridge University press-1987).
7. Fundamentals of photochemistry, Rohtagi & Mukherjee (Wiley Eastern-1992).
8. Kemp, W, Organic Spectroscopy, W.H. Freeman & Co.
9. D. H. Williams, I. Fleming, Spectroscopic Methods in Organic Chemistry, Tata McGrawHill.
10. Carey, F. A. and Sundberg, R. J., "Advanced Organic Chemistry, Part B: Reactions and Synthesis", 5th Ed., Springer, 2007.
11. Smith, M.B., "Organic Synthesis", 3rd Ed., Academic Press, 2010.
12. Peter Sykes, A Guide Book to Mechanism in Organic Chemistry, 6th Edition (1997), Orient Longman Ltd., New Delhi.



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Bio-inorganic & Nanotechnology (Code-MCY-302)	Syllabus for M.Sc.- 3rd Semester (II Year)		Total Course Credit: 4		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	4	0	0

Course Objective	The course aims at a detailed understanding of bio-inorganic chemistry of metals and their actions. To impart the basic knowledge on nanotechnology which includes the exotic properties of materials at nanoscale, various techniques available for the processing and characterization of nanostructured materials and their applications.
Course Outcomes (COs)	
CO1	Understanding of Bioinorganic Chemistry of elements.
CO2	To learn the different biochemical reactions that occurs in living systems.
CO3	To describe important physical methods and structures in the field of nanoscience.
CO4	To familiarize the students with the applications of nanotechnology.
UNIT-I	Metal ions in Biochemical Systems [10 L] Introduction to bio-inorganic chemistry, Concept of essentiality, Criteria and classification of essential elements as per their role in living systems, Bulk metals and trace metals, Role of alkali and alkaline earth metals in biosystems, Metal ion toxicity, Na ⁺ -K ⁺ pump, Transport and storage of Iron (Ferritin, Transferrin and siderophores).
UNIT-II	Metalloporphyrins, Respiration and Electron Transport in Biosystems [10 L] Metalloporphyrins, Cytochromes (Cytochromes C, Cytochrome C-oxidase, Cytochrome P-450). Dioxygen transport (haemocyanin and hemoerythrin), Structure and physiological role of hemoglobin and myoglobin, Bohr Effect and cooperativity, Chloride effect, Iron-Sulfur proteins, Ferredoxins, Rubredoxin, Copper proteins, Photosynthesis (PS I and PS II), Z-scheme, Structure of chlorophyll a and b, Superoxide dismutase-A.
UNIT-III	Enzymes and medicinal Chemistry [10 L] Enzymes and co-enzymes, Structure and function of carboxypeptidase A, Carbonic anhydrase, Xanthine oxidase, Vitamin B12, Nitrogen fixation,

	Biochemical basis of essential metal deficient diseases and their therapies (Iron, Zinc, Copper and Manganese). Chelate therapy, Anticancer drugs- cisplatin, Auranofin and arthritis treatment, Vanadium complexes in medicine.
UNIT-IV	An Introduction to Nanotechnology [10 L] Fundamentals of nanotechnology, introduction to nano-scale, nanocomposites, thin films, nano-foam, Advanced Inorganic materials, Nanotechnology & its industrial application, potential application of inorganic nanomaterials. Methods of Preparation: Top down approach and bottom up approach for synthesis of nanomaterial, Ball milling, Sol-gel method, Solution based method, Solvothermal synthesis, and photochemical synthesis.

Recommended Books:

1. Inorganic Chemistry, James E. Huheey, Pearson. 4th Edn.
2. Inorganic Chemistry, Gary L. Miessler, Donald A. Tarr, Pearson, Third Edn.
3. Nanostructures and Nanomaterials – Synthesis, Properties and Applications, G. Cao, Imperial College Press, London, 2004.
4. The Chemistry of Nanomaterials, Volume 1, C. N. R. Rao, A. Muller and A. K. Cheetham, Wiley –VCH Verlag GmbH & Co. KGaA, Weinheim, 2004.
5. Nanochemistry: A chemical approach to nanomaterials, G. A. Ozin, A. C. Aresnault, L. Cadematriri RSC Publishing, 2008.



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Advanced Physical Chemistry (Code-MCY-303)	Syllabus for M.Sc.- 3rd Semester (II Year)		Total Course Credit: 4		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	3	1	0

Course Objective	The course has been designed to enable the students to learn the advanced physical chemistry.
Course Outcomes (COs)	
CO1	To acquire the knowledge about the quantum chemistry.
CO2	To gain knowledge about the molecular orbital theory of conjugates systems.
CO3	To study the advanced statistical thermodynamics.
CO4	To learn about the irreversible thermodynamics.
UNIT-I	Quantum Chemistry-I [10 L] The Schrodinger Equation, Particle in a One-Dimensional Box, Eigen Values and Eigen Functions, Operators, Properties of Quantum Mechanical Operators, Hermitian, Linear, Ladder, Hamiltonian and Angular Momentum Operators. Particle in Three-Dimensional Box, Harmonic Oscillator, Rigid Rotator and Numericals.
UNIT-II	Quantum Chemistry-II [10 L] Term Symbols and Selection Rules, Spin-Orbital Coupling, The Variation Theorem, Non-Degenerate Perturbation Theory and Applications. Huckel Molecular Orbital Theory of Conjugated Systems, Application to Ethylene, Butadiene, Cyclopropenyl Radical, Cyclobutadiene and Benzene, Numericals.
UNIT-III	Statistical Thermodynamics [10 L] Ensembles-canonical, grand canonical and micro canonical Combinatorial problems, Thermodynamics probability and most probable distribution, Starlings approximation, distribution laws, the law of equipartition of energies. Quantum statistics- Max Well-Boltzmann, Bose-Einstein and Fermi-Dirac, limit and applicability of various distribution laws. Molecular Partition Function: Partition function, Expression for translational, rotational, vibrational and electronic partition functions, Third law of thermodynamics and partition function, Numerical problems.

UNIT-IV	Irreversible Thermodynamics [10 L] Postulates, entropy production in heat, entropy production in matter flow, entropy production in chemical reactions, Onsager's theory, microscopic reversibility and Onsager's reciprocity, stationary states and entropy production, Prigogine's principle of minimum entropy, application to thermoelectric effects-Seebeck and Peltier effect.
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Recommended Books:

1. Quantum Chemistry: Ira N. Levine, Latest Edition
2. Quantum Chemistry: R.K. Prasad, Latest Edition
3. Quantum Chemistry: B.K. Sen, Latest Edition
4. Principles of Physical Chemistry: Puri, Sharma, Pathania, Latest Edition
5. Advanced Physical Chemistry: Gurdeep - Raj, Plenum. Latest Edition
6. Physical Chemistry: Peter Atkins, Latest Edition
7. Modern Quantum Chemistry, A. Szabo and N.L. Ostlund, Dover, New York (1996), Latest Edition
8. Approximate Molecular Orbital Theory, J. A. Pople and D. L. Beveridge, McGraw Hill, New York, Latest Edition
9. Thermodynamics for Chemists - S. Glasstone (EWP, New Delhi), Latest Edition
10. Statistical Thermodynamics, Donald A. Mc Quirrie, Harper & Row, New York 1973, Latest Edition
11. Statistical Thermodynamics, M.C. Gupta, Wiley Eastern Ltd. New Delhi, Latest Edition
12. Elements of Statistical Thermodynamics, L. K. Nash Addison Wesley, Menlo Park, 1972, Latest Edition
13. Non-Equilibrium Thermodynamics, Prigogine Kalyani Publication, Latest Edition
14. Thermodynamics and Non-Equilibrium Thermodynamics, Gurudeep & Raj, Latest Edition



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Advanced Instrumentation Techniques (Code-MCY-304)	Syllabus for M.Sc.- 3rd Semester (II Year)		Total Course Credit: 4		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	4	0	0

Course Objective	The course has been designed to enable the students to learn the analysis of experimental data and learn various analytical techniques which would be applied in all areas of research and various industries.
Course Outcomes (COs)	
CO1	To acquire the knowledge about the spectroscopic techniques like AAS, AES, XRD and XRF.
CO2	To gain knowledge about the molecular spectroscopy techniques like fluorescence, phosphorescence, chemiluminescence.
CO3	To study the advanced electron spectroscopy like XPS, AES etc.
CO4	To learn about the advanced electron microscopy like SEM/TEM.
UNIT-I	Atomic Spectroscopy [10 L] Origins of atomic spectra, production of atoms and ions, Atomic emission spectrometry (AES), Atomic absorption spectroscopy (AAS), Atomic fluorescence spectrometry (AFS), Atomic mass spectrometry (AMS); principle, instrumentations, working, applications. X-ray Methods of Analysis Principle, theory, instrumentation and applications of X-rays (emission, absorption, diffraction and fluorescence methods), Absorptive apparatus: chemical analysis using X-ray absorption, X-ray Diffraction; Chemical analysis with X-ray diffraction, numerical problems, X-ray Fluorescence; instrumentation and chemical analysis.
UNIT-II	Molecular Spectroscopy [10 L] UV-visible molecular absorption spectrometry; principle, instrumentation and application, Molecular fluorescence spectroscopy; theory of molecular fluorescence, effect of concentration on fluorescence intensity, fluorescence instruments, application of fluorescence methods, Molecular phosphorescence spectroscopy, chemiluminescence methods; principle, instrumentation and

	their applications.
UNIT-III	Electron Spectroscopy [10 L] Definition of a solid surface, Types of surface measurements; X-Ray photoelectron spectroscopy (XPS/ESCA): Introduction, principle, chemical shifts as a function of oxidation states, instrumentation, applications; Auger electron spectroscopy (AES); principle, instrumentation-radiation source, energy analyzer, detector, auxiliary system; applications-quantitative analysis.
UNIT-IV	Electron Microscopy [10 L] Scanning electron microscopy (SEM); basics, instrumentation, applications. Transmission electron microscopy (TEM); Introduction, basic theory, electron gun, electromagnetic lenses, imaging, operating parameters-magnification, resolution, depth of field; sample preparation, specimen orientation and manipulation; applications; selected area electron diffraction.

Recommended Books:

1. D. A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Principles of Instrumental Analysis, 5th Edition (1998), Saunders College Publishing, Philadelphia, London.
2. G. D. Christian, Analytical Chemistry, 5th Edition (1994), John Wiley & Sons, New York.
3. G.W. Ewing, Instrumental Methods of Chemical Analysis, 5th Edition (1978), McGraw Hill Books Co., New York.
4. R.L. Pecsok, L. D. Shields, T. Cairns and L.C. Mc William, Modern Methods of Chemical Analysis, 2nd Edition (1976), John Wiley, New York.
5. J.H. Kennedy, Analytical Chemistry: Principles, 2nd Edition (1990), Saunders Holt, London
6. J.M. Hollas, Modern Spectroscopy, 3rd Edition (1996), John Wiley, New York.



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Analytical Chemistry Lab (Code-MCY-305P)	Syllabus for M.Sc.- 3rd Semester (II Year)		Total Course Credit: 2		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	0	0	4

Course Objective	To develop the experimental skills by providing hands on experience of various sophisticated analytical techniques used in chemistry and to make the student competent to design, perform and analyse the experiments by using these techniques.
Course Outcomes (COs)	
CO1	To get the knowledge of solvent extraction using Soxhlet apparatus and its applications.
CO2	To perform titrations using potentiometry, conductometry and pH-metry.
CO3	To acquire the knowledge about the chromatographic separation to identify the mixture's components and their quantification.
CO4	To study the thermograms using TG/DTA method.
S. No.	Details of the Experiments
Exp.1	Extraction of oils from ground nuts using Soxhlet apparatus (Solid-Liquid extraction).
Exp.2	Determination of saponification value/Iodine value of an oil sample.
Exp.3	Determination of dissociation constant of an amino acid and hence the isoelectric point of the acid.
Exp.4	Determination of Cd ²⁺ ions concentration in given solution polarographically.
Exp.5	Determination of ferrous ammonium sulphate potentiometrically with standard ceric sulphate solution (Direct and back titration).
Exp.6	To determine the strength of strong and weak acids in a given mixture conductometrically.
Exp.7	Spectrophotometric determination (in ppm) of Fe (II) or Fe (III) using 1,10 Phenanthroline (or thiocyanate) as colorimetric reagent.
Exp.8	To separate the mixture of amino acids using thin layer chromatography.
Exp.9	Analysis of Paracetamol by HPLC technique.
Exp.10	Estimation of Ca and Mg from the mixture of oxalate by recording their TGA curve

Recommended Books:

1. A Text Book of Quantitative Inorganic Analysis (3rd Edition) – A. I. Vogel
2. Practical physical chemistry, A. Findary, T.A. kitchner (Longmans, Green and Co.)
3. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. richett (Pergamon Press)
4. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co., Delhi.)



DEPARTMENT OF CHEMISTRY
NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR

Subject: Computational Methods in Chemistry Lab (Code-MCY-306P)	Syllabus for M.Sc.- 3rd Semester (II Year)		Total Course Credit: 2		
Mid-Term	Class Assessment	Final-Term	L	T	P
30 (Marks)	10 (Marks)	60 (Marks)	0	0	4

Course Objective	The programs objective map to working knowledge of computers and graphics to address needs in chemistry and related areas.
Course Outcomes (COs)	
CO1	To formulate molecular representations and communication skills like drawing and writing structures and formulas using Microsoft Excel worksheet.
CO2	To draw bonding and structure models using ChemDraw software.
CO3	To draw FTIR spectra, Chromatograms and Thermograms using Origin software.
CO4	To study the parameters of molecules using ChemDraw/Origin software.
Exp. 1	To write chemistry formulae/composition and their calculation parameters using Microsoft Excel worksheet.
Exp. 2	To write statistical and mathematical equations and formulae in chemistry using of Mathtype software.
Exp. 3	To determine the value of correlation coefficient using Microsoft Excel worksheet.
Exp. 4	To determine the value of correlation coefficient using Origin software.
Exp. 5	To draw the FTIR spectrum/Gas Chromatogram/thermogram of chemical substance using Origin software.
Exp. 6	To draw linear and parabolic graphs using Origin software.
Exp. 7	To draw the structures of complex aliphatic molecules using ChemDraw software.
Exp. 8	To draw the structures of complex aromatic molecules using ChemDraw software.
Exp. 9	Determination of molecular formula, molecular weight and elemental percentage of chemical structures using ChemDraw software.
Exp. 10	Preparation of research proposal using MS Word/MS Power Point Presentation.

Recommended Books:

1. MS Office made easy, supplied by Microsoft Inc.
2. Curtin, Fuley Sen and Morin, Information Technology-The breaking wave, TMH 1999.
3. Norris, A.C. Computational Chemistry, 1st edition, John Wiley & Sons, 1981.
5. Origin Software latest version.
6. ChemDraw Software latest version.