GIRIJANANDA CHOWDHURY UNIVERSITY

Hathkhowapara, Azara, Guwahati 781017, Assam

Curriculum and Credit Framework

As per NEP 2020

For

PG Programme in Chemistry

Syllabus up to 2nd semester

Effective from the session 2026-2027

DEPARTMENT OF CHEMISTRY

School of Natural Sciences

Girijananda Chowdhury University, Azara Assam

Guwahati-781017

1.Preamble

Education aims to foster the holistic development of individuals by nurturing intellectual, ethical, moral, cultural, and social values while promoting scientific temper, creativity, and responsible citizenship. It facilitates the acquisition of knowledge, skills, attitudes, and values that enable learners to adapt to a dynamic and rapidly evolving global environment and contribute meaningfully to society. The Postgraduate Programme in Chemistry has been developed in accordance with the principles of the National Education Policy (NEP) 2020 and the UGC Curriculum and Credit Framework for Postgraduate Programmes. The curriculum is designed to provide advanced knowledge in chemical sciences through a research-oriented, and learner-centric approach. The programme emphasizes experiential and inquiry-based learning, research, innovation, critical thinking, problem-solving, and the application of chemical principles to address contemporary scientific, industrial, environmental, and societal challenges. It integrates laboratory training, research projects and internships to enhance analytical, technical, and professional competencies.

Aligned with the outcome-based education framework, the curriculum aims to develop postgraduates with strong disciplinary knowledge, ethical values, scientific temperament and a commitment to sustainable development. It prepares students for higher education, research, entrepreneurship, and diverse career opportunities in academia, industry, government organizations, and emerging interdisciplinary fields, while fostering lifelong learning and global competitiveness.

2. Programme Outcomes and Programme Specific Outcomes

Programme Outcomes/ Learning Outcomes:

1. ***Advanced disciplinary knowledge:*** Acquire comprehensive, in-depth knowledge and detail understanding of one or more disciplines from the field of Natural Sciences.

2. ***Critical thinking:*** Develop analytical skills to evaluate scientific evidence, identify relevant assumptions or implications, formulate coherent arguments, and critically evaluate practices, policies, and theories using a scientific approach.

3. ***Analytical reasoning:*** Ability to evaluate the reliability and relevance of evidence; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples addressing opposing viewpoints.

4. ***Complex problem-solving:*** Develop competencies for resolving complex scientific problems on the basis of knowledge acquired from disciplinary and interdisciplinary fields.

5. ***Research-related skills:*** Develop inquisitiveness for asking relevant/appropriate questions, identifying problems, and formulating hypotheses; analyze, interpret, and draw conclusions from data; ability to plan, execute, and report the results of an experiment or investigation.

6. ***Information/digital literacy:*** Capability to use ICT in a variety of learning situations; demonstrate the ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.

7. ***Self-directed learning:*** Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.

8. ***Moral and ethical awareness*****:** Demonstrate the ability to identify ethical issues related to one's work; avoid unethical behavior such as fabrication, falsification, or misrepresentation of data or committing plagiarism, appreciating environmental and sustainability issues; and adopting objective, unbiased, and truthful approaches in all aspects of work.

9. ***Communication Skills:*** Demonstrate communication skills to confidently express scientific ideas, listen attentively, analyze, and present complex information clearly to diverse audiences using different media.

10. ***Teamwork and Leadership qualities:*** Ability to work effectively with diverse teams in a cooperative or coordinated manner and demonstrate leadership qualities by motivating and inspiring team members to engage with a vision and using management skills to guide people in the right direction.

11. ***Multicultural competence*****:** Possess knowledge of the values and beliefs of multiple cultures so as to develop empathy towards diverse groups and contribute to the holistic development of society.

12. ***Lifelong learning:*** Ability to acquire knowledge and skills that are necessary for participating in learning activities throughout life in the broadest context of science and innovation through self-paced and self-directed learning.

Program Specific Outcomes (PSOs)

The PSOs of the M.Sc. Program in Chemistry are as follows:

PSO1: Chemistry masters students will be well equipped with knowledge of pure and applied chemistry to utilize the knowledge in related and interdisciplinary fields to meet the demands of various industries as well as government in India and worldwide with better and efficient problem-solving skills, critical thinking, effective communication for disseminating the knowledge of chemistry to the scientific community and common people.

PSO2: The students will be well trained with adequate skills of chemistry laboratory with emphasis on industrial and real-world applications to further their career both independently and as a team as professional chemist, researcher, scientist, or science communicator with strong ethical morality and leadership skills to fulfil the needs of greater society.

PSO 3: Chemistry masters students will be trained to achieve individual career success along with being responsible citizens with strong desire for sustainable development and environmental justice, expand the knowledge of chemistry for life-long learning, teaching and research maintaining solid ethical guidelines.

3. Nature and Duration:

3.1 Subject to the provisions contained in the Act and other policies of the university, the department of Chemistry shall offer 2 Years Master's (PG) Degree programmes to cater the diverse academic and professional needs.

3.2. Each academic year shall have two semesters: Autumn and Winter. A candidate enrolled to the PG programme shall be required to earn a minimum of 40 credits to complete 1 year and minimum 80 credits to complete 2-year PG programme.

3.3. A student shall get the maximum duration of 7 years to complete the PG degree.

4. Eligibility and Entry/Exit pathways:

4.1. A 2-year PG programme requires a 3-year/6-semester bachelor's degree with a minimum of 120 credits for a 2-year/4-semester PG programme at level 6.5 on the NHEQF.

4.2. (i). A student is eligible for a PG programme in a discipline corresponding to either major or minor(s)discipline in UG programme.

(ii) Irrespective of the major or minor disciplines taken by a student in a UG programme, a student is eligible for admission in any discipline of PG programmes if the student qualifies the National level entrance examination in the discipline of PG programme.

(iii) A student is eligible for admission in any discipline of PG programmes if the University found the competency of the student in that discipline. Finding lack of knowledge, bridge course(s) may be provided from the university.

4.3. For those who join two- year PG programmes, there shall only be one exit point. Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma after completion of vocational course of 4 credit.

5. Credit structure and Course Distribution:

As per the UGC framework, a two-year PG programme requires a minimum total of 80 credits (typically 40 credits per year / 20 credits per semester, with a maximum cap usually around 24 credits per semester).

Flexibility is the key of NEP 2020. While a student entering into a two-year PG programme after a three-year UG programme need to do coursework of minimum 40 credits in total during the first and second semester, the student can choose to pursue any of the following format:

I. Only coursework in the third and fourth semester

II. Coursework in the third semester and research in the fourth semester

III. Only research in the third and fourth semester.

Table 1: Course Structure 1 year PG:

Model Type	Course Particulars	Course Components	Coursework	Research	Total credits
1.	**1-year PG**	Coursework + Research	20	20	40
		OR			
2.	**1-year PG**	Coursework	40	-	40
		OR			
3	**1-year PG**	Research	-	40	40
	Total credits				**40**

Table 2.: Credit Framework two- year PG

Course Particulars	Course Components	Coursework	Research	Total credits
1st Semester	Coursework	20	-	20
2nd Semester	Coursework	20	-	20
Total credits at end of 1 year				**40**
Students who exit at end of one year in a two-year PG programme should complete a vocational course relevant to the chosen discipline and shall be awarded a PG Diploma				
3rd Semester	Coursework	20	-	20
4th Semester	Coursework	20	-	20
OR				
3rd Semester	Coursework	20	-	20
4th Semester	Research	-	20	20
OR				
3rd Semester	Research	-	20	20
4th Semester	Research	-	20	20
Total credits at end of 2nd year				**40**
Total Credit at the end of 2 year				**80**

Table 3: Master Degree Course Structure:

Type	Course Structure Table (PG level)	Minimum Total Credit	Course Level	Discipline
3+2	**Table 2**	**120 (UG)+80=200**	**1st Year-400-499** **2nd Year -500-599**	**Under UGC**
4+1	**Table 1**	**160(UG)+40=200**	**500-599**	**Under UGC**

Table.4- Summary of Minimum Credit Framework for PG Programme in Chemistry

Type of Programme	Semester	DSCC	DSEC	Project	Internship	Total Credits offered	Exit option
2-Year PG with Couse work	I	16	4			20	PG Diploma
	II	16	4			20	
	III	12	4		4	20	
	IV		12	8		20	
	Total Credit at the end of 2-year PG					80	
2-year PG with Coursework +Research (4^{th} sem)	I	16	4			20	PG Diploma
	II	16	4			20	
	III	12	4		4	20	
	IV			20		20	
	Total Credit at the end of two-year PG Programme					80	
2-Year PG With only Research in 3^{rd} and 4^{th} sem	I	16	4			20	PG Diploma
	II	16	4			20	
	III			20		20	
	IV			20		20	
	Total Credit at the end of two-year PG Programme					80	
1-Year PG with only Course Work	I	12	4		4	20	
	II		12	8		20	
	Total Credit at the end of 1-year PG Programme					40	
1-Year PG with Course-Work+ Research	I	12	4		4	20	
	II			20		20	
	Total Credit at the end of 1-year PG Programme					40	
1-Year PG with Research	I			20			
	II			20			
	Total Credit at the end of 1-year PG Programme					40	

6.The PG Programme will have the following components

1. Discipline Specific core courses (DSCC)
2. Discipline Specific Elective Courses (DSEC)
3. Internship
4. Research Project
5. Project

Table 7.1: Detail Course structure two- year PG

(A)Model-1- Only Course Work

1st Semester					
Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
MCH26400T	DSCC	Inorganic Chemistry-I	4-0-0	4	20
MCH26401T	DSCC	Organic Chemistry-I	4-0-0	4	
MCH26402T	DSCC	Physical Chemistry-I	4-0-0	4	
MCH26420T / MCH26421T	DSEC	Chemistry for Sustainability/Advanced Polymer Chemistry	4-0-0	4	
MCH26403P	DSCC	Laboratory Course-I	0-0-8	4	
2nd Semester					
Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
MCH26404T	DSCC	Inorganic-Chemistry-II	4-0-0	4	20
MCH26405T	DSCC	Organic Chemistry-II	4-0-0	4	
MCH26406T	DSCC	Physical Chemistry-II	4-0-0	4	
MCH26422T / MCH26423T	DSEC	Industrial Chemistry and Environmental impact/Materials Chemistry	4-0-0	4	
MCH26407P	DSCC	Laboratory Course-II	0-0-8	4	
Total Credit at the end of 1st year					40
3rd Semester					
Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
MCH26500T	DSCC	Modern Methods of Chemical Analysis	4-0-0	4	20
MCH26501T	DSCC	Research Methodology & Ethics	4-0-0	4	
MCH26502P	DSCC	Laboratory Course-III	0-0-8	4	
MCH26503R	Internship/ Fieldwork/Workshop	Internship	0-0-8	4	
MCH26520T / MCH26521T	DSEC	Bioinorganic and Bio-Chemistry /Chemistry of food and Agri based Chemicals	4-0-0	4	
4th Semester					

Course Code	Course Components	Course Name	L-T-P	Credit	Total credits
MCH26522T / MCH26523T	DSEC	Heterocyclic Chemistry/ Organometallic Chemistry	4-0-0	4	20
MCH26524T / MCH26525T	DSEC	Medicinal Chemistry /Supramolecular Chemistry/ MOOC	4-0-0	4	
MCH26526T / MCH26527T	DSEC	Advanced Organic Synthesis and Natural Products Chemistry/ Catalysis Science	4-0-0	4	
MCH26504R	Project	Project	0-0-16	8	
		Total credits at end of 2^{nd} year			**40**
		Total Credit at the end of 2 year PG			**80**

(B)Model-2- Course work + Research

Course Code	Course Components	Course Name	L-T-P	Credit	Total credits
		1^{st} Semester			
Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
MCH26400T	DSCC	Inorganic Chemistry-I	4-0-0	4	20
MCH26401T	DSCC	Organic Chemistry-I	4-0-0	4	
MCH26402T	DSCC	Physical Chemistry-I	4-0-0	4	
MCH26420T / MCH26421T	DSEC	Chemistry for Sustainability/Advanced Polymer Chemistry	4-0-0	4	
MCH26403P	DSCC	Laboratory Course-I	0-0-8	4	
		2^{nd} Semester			
Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
MCH26404T	DSCC	Inorganic-Chemistry-II	4-0-0	4	20
MCH26405T	DSCC	Organic Chemistry-II	4-0-0	4	
MCH26406T	DSCC	Physical Chemistry-II	4-0-0	4	
MCH26422T / MCH26423T	DSEC	Industrial Chemistry and Environmental impact/Materials Chemistry	4-0-0	4	
MCH26407P	DSCC	Laboratory Course-II	0-0-8	4	
Total Credit at the end of 1^{st} year					40
		3^{rd} Semester			

Course Code	Course Components	Course Name	L-T-P	Credit	Total credits
MCH26500T	DSCC	Modern Methods of Chemical Analysis	4-0-0	4	20
MCH26501T	DSCC	Research Methodology & Ethics	4-0-0	4	
MCH26502P	DSCC	Laboratory Course-III	0-0-8	4	
MCH26503R	Internship/ Fieldwork/ Workshop	Internship	0-0-8	4	
MCH2520T/ MCH26521T	DSEC	Bioinorganic and Bio-Chemistry / Chemistry of food and Agri based Chemicals	4-0-0	4	
4^{th} Semester					
Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
MCH26505R	Project$^{\$\$}$	Project	0-0-40	20	20
		Total credits at end of 2^{nd} year			**40**
		Total Credit at the end of 2-year PG			**80**

(C)Model-3- Course Work(40) + Research(40)

1st Semester					
Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
MCH26400T	DSCC	Inorganic Chemistry-I	4-0-0	4	20
MCH26401T	DSCC	Organic Chemistry-I	4-0-0	4	
MCH26402T	DSCC	Physical Chemistry-I	4-0-0	4	
MCH26420T / MCH26421T	DSEC	Chemistry for Sustainability/Advanced Polymer Chemistry	4-0-0	4	
MCH26403P	DSCC	Laboratory Course-I	0-0-8	4	
2nd Semester					
Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
MCH26404T	DSCC	Inorganic-Chemistry-II	4-0-0	4	20
MCH26405T	DSCC	Organic Chemistry-II	4-0-0	4	
MCH26406T	DSCC	Physical Chemistry-II	4-0-0	4	
MCH26422T / MCH26423T	DSEC	Industrial Chemistry and Environmental impact/Materials Chemistry	4-0-0	4	
MCH26407P	DSCC	Laboratory Course-II	0-0-8	4	
Total Credit at the end of 1st year					40
Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
3rd Semester					
MCH26506R	Research Project – I**	Research Project-I	0-0-40	20	20
4th Semester					
MCH26507R	Research Project – II##	Research Project-II	0-0-40	20	20
Total Credit at the End of 2nd year					40
Total Credit after 2 years of PG					80

7.2. Detailed Course Structure with 1 year PG

(A)Model-1- Only Course Work

1st Semester					
Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
MCH26500T	DSCC	Modern Methods of Chemical Analysis	4-0-0	4	20
MCH26501T	DSCC	Research Methodology & Ethics	4-0-0	4	
MCH26502P	DSCC	Laboratory Course-III	0-0-8	4	
MCH26503R	Internship/ Fieldwork/ Workshop	Internship	0-0-8	4	
MCH26520T / MCH26521T	DSEC	Bioinorganic and Bio-Chemistry / Chemistry of food and Agri based Chemicals	4-0-0	4	
2nd Semester					
Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
MCH26522T / MCH26523T	DSEC	Heterocyclic Chemistry/ Organometallic Chemistry	4-0-0	4	20
MCH26524T / MCH26525T	DSEC	Medicinal Chemistry/Supramolecular Chemistry/ MOOC	4-0-0	4	
MCH26526T / MCH26527T	DSEC	Advanced Organic Synthesis and Natural Products Chemistry/ Catalysis Science	4-0-0	4	
MCH26504R	Project	Project	0-0-16	8	
		Total credits at end of 1year PG			**40**

(B) Course Work +Research

1st Semester					
Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
MCH26500T	DSCC	Modern Methods of Chemical Analysis	4-0-0	4	20
MCH26501T	DSCC	Research Methodology & Ethics	4-0-0	4	
MCH26502P	DSCC	Laboratory Course-III	0-0-8	4	
MCH26503R	Internship/ Fieldwork/ Workshop	Internship	0-0-8	4	
MCH26520T / MCH26521T	DSEC	Bioinorganic and Bio-Chemistry / Chemistry of food and Agri based Chemicals	4-0-0	4	
2nd Semester					
Course Code	**Course Components**	**Course Name**	L-T-P	**Credit**	**Total credits**
MCH26505R	Project$^{\$\$}$	Project	0-0-40	20	20
		Total Credit at the end of 1years of PG			**40**

(C)Model-3- ONLY RESEARCH

Course Code	**Course Components**	**Course Name**	**L-T-P**	**Credit**	**Total credits**
1st Semester					
MCH26506R	Research Project – I**	Research Project-I	0-0-40	20	20
2nd Semester					
MCH26507R	Research Project – II$^{\#\#}$	Research Project-II	0-0-40	20	20
Total Credit at the End of 1year PG					40

List of Courses offered in various semester

Sem	Course Code	Course Components	Course Name	L-T-P	Credit
I	MCH26400T	DSCC	Inorganic Chemistry-I	4-0-0	4
	MCH26401T	DSCC	Organic Chemistry-I	4-0-0	4
	MCH26402T	DSCC	Physical Chemistry-I	4-0-0	4
	MCH26420T/ MCH26421T	DSEC	Chemistry for Sustainability/Advanced Polymer Chemistry	4-0-0	4
	MCH26403P	DSCC	Laboratory Course-I	0-0-8	4
II	MCH26404T	DSCC	Inorganic-Chemistry-II	4-0-0	4
	MCH26405T	DSCC	Organic Chemistry-II	4-0-0	4
	MCH26406T	DSCC	Physical Chemistry-II	4-0-0	4
	MCH26422T/ MCH26423T	DSEC	Industrial Chemistry and Environmental impact/Materials Chemistry	4-0-0	4
	MCH26407P	DSCC	Laboratory Course-II	0-0-8	4
III	MCH26500T	DSCC	Modern Methods of Chemical Analysis	4-0-0	4
	MCH26501T	DSCC	Research Methodology & Ethics	4-0-0	4
	MCH26502P	DSCC	Laboratory Course-III	0-0-8	4
	MCH26503R	Internship/ Fieldwork/ Workshop	Internship	0-0-8	4
	MCH2520T/ MCH26521T	DSEC	Bioinorganic and Bio - Chemistry / Chemistry of food and Agri based Chemicals	4-0-0	4
II/IV	MCH26504R	Project	Project	0-0-16	8
I/III	MCH26505R	Research Project – I**	Research Project-I	0-0-40	20
IV	MCH26522T/ MCH26523T	DSEC	Heterocyclic Chemistry/Organometallic Chemistry	4-0-0	4
	MCH26524T/ MCH26525T	DSEC	Medicinal Chemistry/Supramolecular Chemistry/ MOOC	4-0-0	4
	MCH26526T/ MCH26527T	DSEC	Advanced Organic Synthesis and Natural Products Chemistry/ Catalysis Science	4-0-0	4
II/IV	MCH26505R	Project$$	Project	0-0-40	20
II/IV	MCH26507R	Research Project – II##	Research Project-II	0-0-40	20

DSEC-Any one of the DSEC course to be opted out of two.

Project: By the end of the fourth semester the following outcomes are expected:
I. Identifying the research problem.
II. Reviewing existing literature.
III. Experimental work and Preparation of a technical report.
With progress report presentation after 1st, 2nd and 3rd month followed by final submission with presentation at the end of the semester.

Project$$: By the end of the fourth semester the following outcomes are expected:
I. Identifying the research problem.
II. Reviewing existing literature.
III. Preparation of a high-quality technical report or monograph.
With progress report presentation after 1st, 2nd and 3rd month followed by final submission with presentation at the end of the semester.

Research Project – I:** By the end of the third semester at least the first three outcomes from the following outcomes are expected:
I. Identifying the research problem and defining the scope of the study.
II. Reviewing existing literature to understand the current state of knowledge in the area.
III. Designing the research methodology and planning the study.
IV. Beginning experimental work, field surveys, data collection, or other related research activities.
With progress report presentation after 1st, 2nd and 3rd month followed by an overall presentation at the end of the semester.

Research Project – II##: By the end of the IV Semester, the following outcomes should be successfully achieved:

I. Completion of all experimental work, field studies, or other research-related activities.

II. Submission of the project report incorporating the findings and outcomes of the research work.

III. Demonstration of a significant research outcome in any one of the following forms:

- Development of a prototype, product, or patentable innovation.
- Any other scholarly contribution recommended by the Program Committee /HoD /Dean.
- Publication of research findings in a reputed journal, such as a Scopus-indexed journal or another journal of comparable quality.
- Authorship of a book or book chapter published by a recognized and reputable publisher.
- Presentation of research findings at National or International Conference.
- Publication of research findings in a reputed Conference proceeding.

With progress report presentation after 6th, 9th and 12th Months followed by final submission of the report with viva.

Distribution of Marks

End semester-60% Internal-40%

Modes of Assessment

Internal-Class Test, Assignment, viva, quiz, Presentation, Participation in Activities,

skill test.

End Semester Examination-Theory and Practical, viva, Project Report, Lab Report.

DETAILED SYLLABUS UPTO 2ND SEMESTER

DSCC	INORGANIC CHEMISTRY- I	L	T	P	C
		4	0	0	4

Pre-requisite: Knowledge of chemistry at B.Sc. level

Course Objectives:

The course aims to enable students to:

1. Develop an advanced understanding of chemical bonding, molecular symmetry, acid–base concepts, and the structure of inorganic compounds.
2. Acquire knowledge of coordination chemistry, electronic structure, spectroscopy, and magnetic behaviour of transition metal complexes.
3. Understand the principles governing redox chemistry, transition metal chemistry, and the structure, synthesis, and properties of inorganic solids.
4. Strengthen analytical and problem-solving skills for interpreting the structure, bonding, reactivity, and properties of inorganic systems.
5. Develop practical skills in the synthesis, characterization, interpretation of experimental data, and safe handling of advanced materials in the laboratory.

Course Outcome:

After successful completion of the course, the students will be able to:

CO1. Explain the principles of chemical bonding, molecular symmetry, and acid–base chemistry to predict the structure and properties of inorganic compounds. *(Understand)*
CO2. Apply ligand field theory, molecular orbital theory, and spectroscopic principles to determine the electronic structure, spectra, and magnetic behaviour of coordination compounds. *(Apply)*
CO3. Analyse the redox behaviour, stability, and aqueous chemistry of inorganic species using electrochemical principles and graphical methods such as Latimer, Frost, and Pourbaix diagrams. *(Analyze)*
CO4. Evaluate the structure, synthesis, and physical properties of inorganic solids using concepts of solid-state chemistry and diffraction techniques. *(Evaluate)*

Module 1: CHEMICAL BONDING, MOLECULAR SYMMETRY AND ACID–BASE CHEMISTRY — 20 **hours**

Molecular Orbital Theory (LCAO-MO) of homonuclear and heteronuclear diatomic molecules (N_2, O_2, CO, NO, HF). MO treatment of simple polyatomic molecules (BeH_2, H_2O, CO_2, BF_3, NO_2). Walsh diagrams. Bond order, bond length and bond strength. VSEPR theory and molecular geometry. Structure and bonding in polyhedral boranes, carboranes, S–N, P–N and Se–N compounds. Symmetry elements and symmetry operations. Point groups and assignment of point groups to simple molecules. Applications of molecular symmetry in inorganic chemistry. Hard and Soft Acid–Base (HSAB) concept and applications. Periodic trends in acidity and basicity.

Oxoacids, halogen acids, superacids, superbases and non-aqueous solvents.

Module 2: COORDINATION CHEMISTRY, ELECTRONIC STRUCTURE AND SPECTROSCOPY — **20 hours**

Spectrochemical series. Jahn–Teller distortion. Electronic spectra of transition metal complexes: d–d and charge-transfer transitions. Selection rules and term symbols. Orgel and Tanabe–Sugano diagrams. Determination of Dq and Racah parameters. Nephelauxetic effect. Magnetic properties of coordination compounds (spin-only magnetic moment, orbital contribution, spin crossover and exchange interactions).

Module 3: REDOX CHEMISTRY, TRANSITION METALS AND SOLID-STATE CHEMISTRY	**20 hours**
Standard electrode potentials. pH dependence of electrode potentials. Redox stability of metal ions in aqueous solution. Latimer and Frost diagrams and their applications. Oxidation by atmospheric oxygen. Chemistry of transition metals, lanthanides and actinides. Aqueous chemistry of transition metals: hydration, hydrolysis, aquo, oxo and hydroxo complexes. Qualitative Pourbaix (Eh–pH) diagrams. Irving–Williams series. Chelate and macrocyclic effects. Structure of ionic solids, metals and alloys. Ceramic, hydrothermal and chemical vapour deposition (CVD) methods for solid-state synthesis. Introduction to powder X-ray diffraction. Free-electron and band theories. Optical, magnetic and electrical properties of solids.	
Total Lecture hours	**60 hours**

Textbook (s)

1.	**Miessler, G. L., Fischer, P. J., & Tarr, D. A.** *Inorganic Chemistry*, 6th Edition, Pearson.
2.	**Housecroft, C. E. & Sharpe, A. G.** *Inorganic Chemistry*, 5th Edition, Pearson.
3.	**Cotton, F. A., Wilkinson, G., Murillo, C. A., & Bochmann, M.** *Advanced Inorganic Chemistry*, 6th Edition, Wiley.
4.	**Satya Prakash, Tuli, G. D., Basu, S. K., & Madan, R. D.** *Advanced Inorganic Chemistry*, S. Chand.
5.	**Lee, J. D.** *Concise Inorganic Chemistry*, 5th Edition (Adapted by Sudarsan Guha), Wiley India.

Reference books

1.	**Shriver, D. F., Weller, M., Overton, T., Rourke, J., & Armstrong, F.** *Shriver &*
2.	*Atkins' Inorganic Chemistry*, 6th Edition, Oxford University Press.
3.	**Cotton, F. A.** *Chemical Applications of Group Theory*, 3rd Edition, Wiley.
4.	**Lever, A. B. P.** *Inorganic Electronic Spectroscopy*, 2nd Edition, Elsevier.
5.	**Huheey, J. E., Keiter, E. A., Keiter, R. L., & Medhi, O. K.** *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th Edition, Pearson.
6.	**West, A. R.** *Solid State Chemistry and Its Applications*, 2nd Edition, Wiley.

DSCC	ORGANIC CHEMISTRY – I	L	T	P	C
		4	0	0	4

Pre-requisite: Knowledge of B. Sc level chemistry

Course Objectives:

1. To make students understand the stereochemistry of different molecules.
2. To provide an insight into the various concepts associated with the kinetics of organic reaction mechanisms.
3. To provide knowledge of the generation and application of different reaction intermediates in organic synthesis.
4. To Introduce students to various photophysical processes and their application in different photochemical reactions.

Course Outcome:

After successful completion of the course students will be able to

CO1-understand the fundamental concepts of stereochemistry, kinetics and intermediates In reaction mechanism and photochemistry.

CO2-apply the knowledge acquired in finding solutions involving organic molecules.

CO3-analyze the stereochemical aspects of organic molecules, along with concepts of reaction mechanisms, reaction intermediates and photochemistry, emphasizing their roles in molecular reactivity and transformations.

CO4-evaluate the appropriate applications of stereochemistry, reaction mechanisms, intermediates and photochemistry in various contexts.

Module 1: STEREOCHEMISTRY	**15 hours**

R/S, E/Z nomenclature in C, N, S, P containing compounds; absolute and relative configuration; concept of chirality, optical activity in absence of chiral carbon - Allenes, Spiranes and biphenyls (Atropisomerism). Conformational analysis of cyclohexane and decalins

Stereogenic center – chirotopic and achirotopic center; homotopic and heterotopic ligands and faces (prostereoisomerism and prochirality etc.); Cram's rule, Prelog's rule, optical purity and enantiomeric excess.

Conformational effect on reactivities and physical properties of molecules.

Module 2: Kinetics and Energetics of Reaction Mechanism	**15 hours**

TS theory of reaction rates: kinetics & thermodynamics requirements. Reaction profiles for multistep reactions, Hammond postulate, Curtin-Hammett Principle; kinetic and thermodynamic control.

Linear free energy relationships (LFER): Hammett equation, Taft equation, kinetic isotope effects in organic reactions.

Effects of conformation on reactivity: anomeric effect, stereoelectronic effects, neighbouring group participation.

Module 3: Reaction Mechanisms & Intermediates: Structure & Reactivity I	**15 hours**

Carbanions: enolates and enamines, Kinetic and thermodynamic enolates, lithium and boron enolates in aldol and Michael reactions, alkylation and acylation of enolates; name reactions under carbanion chemistry - Claisen, Dieckmann, Stobbe, Darzen, Shapiro reaction, Brook rearrangement, Sakurai reaction, Henry reaction, Nef reaction, Baylis-

Hillman reaction. Ylids: Chemistry of phosphorous and sulfur ylids - Wittig and related reactions, Peterson olefination. Carbocation: classical and non-classical carbocations, neighbouring group participation and rearrangements including Wagner-Meerwein, pinacol-pinacolone, semi-pinacol rearrangement, C-C bond formation involving carbocations, oxymercuration, halo-lactonisation, Prins reaction.	
Module 4: PHOTOCHEMISTRY	**15 hours**
Frank-Condon principle, Jabolonski diagram, fluorescence and phosphorescence, singlet and triplet states, photosensitization. Photochemistry of carbonyl compounds, Norrish Type-I and Norrish Type-II, Paterno-Buchi reaction; Photochemistry of olefins - photostereomutation of cis-trans isomers, optical pumping, cycloaddition, photochemistry of conjugated polyenes. Photochemistry of enones; Photo-rearrangement reactions viz di-π-methane rearrangement, Photo-rearrangement of cyclohexadienones, Barton rearrangement. Fluorescence sensing.	
Total Lecture hours	**60 hours**

Text - Book(s)

1	F. A. Cary and R. I. Sundberg, Advanced Organic Chemistry, Part A and B, 5th Edition, Springer, 2009.
2	T. H. Lowry, K. S. Richardson, Mechanism and Theory in Organic Chemistry, Pearson; 3rd edition, 1997.
3	J. Clayden, N. Greeves, S. Warren, Organic Chemistry, 2nd edition, OUP 2012
4	Stereochemistry of Organic Compounds – D. Nasipuri, Wiley Eastern, 1991.
5	A Guidebook to Mechanism in Organic Chemistry, P. Sykes, Pearson Education, 2003.
6	A Gilbert & J.E. Baggott, Essentials of Molecular Photochemistry, Blackwell Scientific Oxford, 1991.
7	Basic stereo chemistry of organic molecules by Subrata Sengupta, Oxford University Press, 2014

Reference Books

1.	Strategies and Tactics in Organic Synthesis 4 & 5, M. Harmata, Academic Press, 2004.
2	W. Carruthers and I. Coldham, Modern Methods of Organic Synthesis, First South Asian Edition, Cambridge University Press, 2005
3	Organic Chemistry, T. W. G. Solomons, John Wiley and Sons, Wiley, 2017.
4	Organic Chemistry, R. T. Morrison and R. N. Boyd, Pearson India, 2016.
5	E.L. Eliel, S. H. Wilen, Stereochemistry of Organic Compounds, Wiley, 2008.

	PHYSICAL CHEMISTRY – I	L	T	P	C
		4	0	0	4

Pre-requisite: Knowledge of chemistry at B.Sc. level

Course Objectives:

1. To introduce the student with the basic concepts of equilibrium thermodynamics.
2. To introduce students with statistical thermodynamics and its various concepts.
3. To give an insight into surface chemistry and catalysis.
4. To make students familiar with the concepts and applications of smart and nanomaterials.

Course Outcome:

After successful completion of the course, the students will be able
CO1: To explain the fundamentals laws, rules and theories related to equilibrium and statistical thermodynamics, smart materials, and surfaces in chemistry.
CO2: To apply the concepts of thermodynamics, surface chemistry concepts and smart materials in various applications.
CO3: To elaborate different processes in thermodynamics, catalysis and smart and nano material systems.

Module	Hours
Module 1: EQUILIBRIUM THERMODYNAMICS	**12 hours**
Fugacity, Determination of fugacity. Ideal solution and non-ideal solutions, Activity, activity coefficient, Determination of activity coefficient, Excess function for non-ideal solutions. Partial molar quantities: chemical potential, Determination of partial molar volume, Thermodynamics of mixing. Third law of thermodynamics, its experimental verification, Applications of third, Determination of absolute entropy, non-equilibrium thermodynamics.	
Module 2: STATISTICAL THERMODYNAMICS	**18 hours**
Statistical mechanics of systems independent particles: Maxwell Boltzmann distribution, entropy and probability. Calculation of thermodynamic properties for independent particles, -molecular partition functions- evaluation of translational, rotational and vibrational and nuclear partition functions. Thermodynamic properties of monatomic and diatomic gases (Suckur-Tetrode equation)- calculation of partition functions, thermodynamic function, principles of equipartition, heat capacities (Einstein model and Debye modification), residual entropy, equilibrium constant.	
Module 3: SURFACE CHEMISTRY AND CATALYSIS	**15 hours**
Adsorption and free energy changes at interfaces-Solid-gas interface-Langmuir, BET isotherms-Surface area determination-soluble and insoluble film-Solid - liquid interfaces Gibbs adsorption isotherm-contact angle and wetting-applications of adsorption. Role of surface in catalysis-semiconductor catalysis-n and p-type surfaces. Specific and general acid base catalysis: Bronsted catalysis law-Hammett acidity functions. Enzyme catalysis: Michaelis Menten Law- Influence of pH and temperature on enzyme catalysis. Heterogeneous catalysis: Kinetics of bimolecular surface reactions-Langmuir-Hinshelwood mechanism, Langmuir Rideal mechanism and Rideal-Eley mechanism, Industrial applications of catalysts, Green catalysts	
Module 4: SPECIAL TOPICS IN PHYSICAL CHEMISTRY	**15 hours**
Smart Materials-Introduction, design of intelligent materials, thermoresponsive, pH sensitive, light sensitive materials, smart polymers, shape memory alloys. Nanomaterials-Theories, Concepts and Applications.	
Total Lecture hours	**60 hours**

Text-Book(s)

1.	Levine I. R., Physical chemistry 6th Edition, Mcgraw Hill Education, 2011.
2.	Atkins P., Paula J., Physical Chemistry, 9th Edition, Oxford University Press, Oxford 2010.
3.	McQuarrie D. A., Simon J. D., Physical Chemistry: A Molecular Approach, Viva Student Edition, 1st Edition, 2011.
Reference Books	
1.	Thermodynamics: Statistical Thermodynamics and Kinetics by Thomas Engel and Philip Reid, Pearson
2.	McQuarrie, D. A. Statistical Mechanics, Viva Books Pvt. Ltd.: New Delhi (2003).
3.	Physical Chemistry: Thomas Engel and Philip Reid
4.	Bagchi B. Statistical Mechanics for Chemistry and Material Science, CRC Press (2018).
5.	Landau L. D. and Lifshitz E. M., Statistical Mechanics, Part I, Butterworth-Heinemann, 3rd ed. (2005).
6.	Berry R. S., Rice S. A. and Ross J., Physical Chemistry, 2nd Edition, Oxford University Press, Oxford 2007.
7.	Puri B. R.; Sharma L. R., Pathania M. S., Principles of Physical Chemistry; 47th Ed, Vishal Publishing, New Delhi (2017).

	Advanced Polymer Chemistry	L	T	P	C
		4	0	0	4

Pre-requisite: Knowledge of chemistry at B.Sc. level

Course Objectives:

The course is being offered with the following objectives:

1. To provide advanced concept of polymer chemistry with mechanisms, techniques, rheology and morphology.
2. To offer concept of polymer processing techniques.
3. To deliver in depth knowledge of polymer analysis and characterization.
4. To provide knowledge of commodity and engineering industrial polymers.

Course Outcome:

After successful completion of the course, the students will be able to

CO1: Explain about basic chemistry, mechanisms, techniques, processing, properties, and analysis of polymers.

CO2: Apply the understanding of polymer chemistry for different polymer synthesis, their characterization, processing, and applications.

CO3: Elaborate the methods of synthesis, properties, behaviors, processing and recycling of industrially important polymers.

Module 1: Concepts of High Polymer Systems, Rheology and Morphology — **15 hours**

Overview of raw materials for polymers, gas cracker, naphtha cracker, synthesis of some industrially important monomers. Techniques of polymerization, advantages and limitations of different techniques, special features of polymerization, polymerization reactors.

Molecular weight distribution and control of molecular weight.

Structure-property relationships in polymers, Glass transition temperature of polymers, molecular basis of Tg.
Polymer Rheology, Theories of viscoelastic behavior of polymers,

Mechanical models: Maxwell model, Kelvin-Voigt model, Burgers Model.

Polymer crystallization, Polymer Single Crystals, Spherulites

Module 2: Polymer Processing — **12 hours**

Plastic Molding methods, Compression molding, Transfer molding, Injection molding, Blow molding, Reaction injection molding, Extrusion, Single screw and twin-screw extrusion, Calendaring, Rotational molding, Thermoforming, Rubber processing in two-roll mill, Internal mixer.
Spinning-solvent based, melt spinning and electrospinning, 3D printing
Hands on practice on polymer processing techniques.

Module 3: Testing, Analysis, and Characterization of Polymers — **15 hours**

Determination of molecular weight and molecular weight distribution, GPC, light scattering, end group analysis method, Analysis involving spectroscopy, X-ray diffraction analysis – Thermogravimetric Analysis (TGA), Differential thermal analysis (DTA), Differential Scanning Calorimetry (DSC), Microscopic (Optical and Electronic) techniques. Testing of Mechanical strength, Tensile strength, Flexural and Compressive strength, Toughness, Elastic and plastic deformation, stress-strain relationship, Testing of Abrasion, Adhesion testing, testing of Endurance, Fatigue, Hardness, Tear, Resilience, Izod and Charpy Impact tests, Ageing resistance, Environmental stress cracking resistance, testing for biodegradability. Hands on practice on testing and characterizing a given polymer sample.	
Module 4: Synthesis and Properties of Industrially Important Polymers	**18 hours**
Commodity, Engineering and Speciality Plastics. Synthesis, Structure-property relation and applications of Commodity Plastics: Polyethylene (LDPE, HDPE, LLDPE), Polypropylene, Polystyrene, HIPS, Poly (vinyl chloride) etc., methods of their synthesis and properties. Engineering plastics: Poly(acrylonitrile), Polyamides, Polyesters, Polyurethanes, poly(tetrafluoroethylene), etc. and their properties. Industrial thermosetting resins: phenolic resins, amino-resins, alkyds, unsaturated polyesters, polyurethanes, epoxy resins etc. Biobased and bio-degradable polymers. Polymers used in 3D printing. Plastic waste management-current scenario, recycling and upcycling strategies. Integrated waste management for sustainable development.	
Total Lecture hours	**60 hours**

Text-Book(s)

1.	F.W. Billmeyer, Jr.(1984) “Text Book of Polymer Science” 3rd Edition, Willey – Interscience, New York.
2.	P. Ghosh, Polymer Science and Technology: Plastics, Rubbers, Blends and Composites, Third Edition, McGraw Hill Education Private Limited (India), 2011
3.	J. A. Brydson, Plastics Materials, 4th edn., Butterworths, London, 1982
4.	1. Odian, G. Principles of Polymerization (Wiley, 2004).

Reference Books/Journals

1.	Charrier, J. (1991) Polymeric Materials and Processing: Plastics,Elastomers and Composites. München: Carl Hanser Verlag.
2	Polymer Rheology and Processing, A.A. Collyer, Leszek A. Utracki; Springer, 1990.
3	R.F. Speyer, Thermal Analysis of Materials, Marcel Decker, 1994.
4	Yang Leng: Materials Characterization-Introduction to Microscopic and Spectroscopic

	Methods, John Wiley & Sons (Asia) Pte Ltd., 2008.
5	Journal of Chemical Education, ACS Publications

DSEC	CHEMISTRY FOR SUSTAINABILITY	L	T	P	C
		4	0	0	4

Pre-requisite: Knowledge of chemistry at B.Sc. level

Course Objectives:

The course is being offered with the following objectives:

1. To develop a fundamental understanding of the concepts, principles, and significance of sustainable and green chemistry.
2. To explain and apply the principles of green chemistry in designing safer, environmentally benign chemical processes and sustainable industrial practices.
3. To understand and promote the efficient use of renewable resources, waste minimization, circular economy concepts, and sustainable waste management strategies.
4. To appreciate and evaluate the role of chemistry in addressing environmental challenges, promoting sustainable technologies, and achieving the Sustainable Development Goals (SDGs).

Course Outcome:

After successful completion of the course, the students will be able to:

CO1: Explain the fundamental concepts and principles of sustainable chemistry and green chemistry. **(Understand)**

CO2: Apply the principles of green chemistry to design safer, environmentally friendly chemical processes and practices. **(Apply)**

CO3: Analyze the role of renewable resources, waste management, circular economy, sustainable energy, and pollution control strategies in achieving environmental sustainability. **(Analyze)**

CO4: Evaluate the contribution of chemistry in environmental protection, sustainable industrial development, and the achievement of the Sustainable Development Goals (SDGs). **(Evaluate)**

Module 1: Introduction to Sustainable Chemistry	**12 hours**
Sustainable Development and Sustainable Development Goals (SDGs), Need for sustainable chemistry, Green chemistry and sustainable chemistry, Twelve Principles of Green Chemistry, Benefits of sustainable chemistry, Examples of green chemical processes	
Module 2: Green Chemical Processes	**12 hours**
Green solvents and water as a solvent, Catalysis and biocatalysis, Microwave-assisted synthesis, Photochemical reactions (basic idea), Energy-efficient chemical processes, Applications of green chemistry in chemical industries	
Module 3: Renewable Resources and Waste Management	**12 hours**
Renewable and non-renewable resources, Biomass and biofuels, Biodegradable and biodegradable alternatives to plastics, Recycling and reuse of materials, Electronic waste (E-waste), Circular economy, Waste minimization and resource conservation	
Module 4: Sustainable Energy and Environmental Protection	**12 hours**

Solar energy, Hydrogen as a clean fuel, Fuel cells (basic concepts), Green batteries, Air pollution and its control, Water pollution and its control, Carbon footprint and climate change (basic concepts)	
Module 5: Applications of Sustainable Chemistry	**12 hours**
Sustainable agriculture and green fertilizers, Green pharmaceuticals, Green nanotechnology (basic idea), Sustainable household chemicals, Environmental laws and chemical safety (basic concepts), Case studies: - Bhopal Gas Disaster, Biodegradable plastics, Plastic waste management, Sustainable packaging	
Total Lecture hours	**60 hours**

Text Book(s)	
1.	Paul T. Anastas and John C. Warner, Green Chemistry: Theory and Practice, Oxford University Press, New York.
2.	Mike Lancaster, Green Chemistry: An Introductory Text, Royal Society of Chemistry (RSC Publishing), Cambridge, UK.
3.	Stanley E. Manahan, Environmental Chemistry, CRC Press, Taylor & Francis Group.
4.	B.K. Sharma, Environmental Chemistry, Krishna Prakashan Media (P) Ltd., Meerut.
5.	V.K. Ahluwalia, Green Chemistry, Narosa Publishing House Pvt. Ltd., New Delhi.
6.	James H. Clark and Duncan Macquarrie, Handbook of Green Chemistry and Technology, Blackwell Science Ltd. (now Wiley-Blackwell).
Reference Books	
1.	Albert Matlack, Introduction to Green Chemistry, CRC Press, Taylor & Francis Group.
2.	Indu Tucker Sidhwani & Rakesh K. Sharma, An Introductory Text on Green Chemistry, Wiley India Pvt. Ltd.
3.	Vera M. Kolb, Green Organic Chemistry and Its Interdisciplinary Applications, CRC Press, Taylor & Francis Group.

	LABORATORY COURSE – I	L	T	P	C
		0	0	8	4

Pre-requisite: Knowledge of chemistry at B.Sc. level

Course Objectives:

The course aims to enable students to:

1. Develop advanced skills in inorganic qualitative and quantitative analysis of complex samples.
2. Synthesize coordination compounds and understand their structural, electronic, and magnetic properties.
3. Apply modern instrumental techniques for the characterization of inorganic and coordination compounds.
4. Analyze and interpret experimental data using principles of coordination chemistry, spectroscopy, and crystallography.
5. Develop scientific competence through laboratory safety, data analysis, technical reporting, and ethical laboratory practices.

Course Outcome:

After successful completion of the course, students will be able to:

CO1: Perform advanced inorganic qualitative and quantitative analyses. *(Apply)*
CO2: Synthesize and characterize coordination compounds. *(Apply)*
CO3: Apply instrumental techniques for characterization of inorganic compounds. *(Apply)*
CO4: Analyze and interpret experimental data from spectroscopic and structural studies. *(Analyze)*
CO5: Demonstrate laboratory safety, scientific reporting, and ethical practices. *(Apply)*

Module 1: ADVANCED INORGANIC ANALYSIS	**40 hours**

1. Qualitative analysis of tertiary mixture, alloy, ore.
2. Quantitative analysis of alloys (Cu–Zn brass, Pb–Sn solder, Ni steel, etc.)
3. Quantitative analysis of ores (Ca–Mg ore, iron ore)
4. Estimation of Fe^{2+} and Fe^{3+} in a mixture

Module 2: COORDINATION COMPOUND SYNTHESIS	**40 hours**

Synthesis of the co-ordination compounds

1. Potassium tris(oxalato)ferrate(III) trihydrate $K_3[Fe(C_2O_4)_3].3H_2O$
2. Potassium dioxalatocuprate(II) dihydrate $K_2[Cu(C_2O_4)_2(H_2O)_2]$
3. cis-/trans- dichloro bis (ethylene diamine) cobalt (III) chloride $[Co(en)_2Cl_2]Cl$
4. Pentaamminechloro cobaltic(III) chloride $[Co(NH_3)_5 Cl]Cl_2$
5. Synthesis of Pentaammine nitro cobaltic(III) chloride $[Co(NH_3)_5(NO_2)]Cl_2$
6. Synthesis of Pentaammine nitrito cobaltic(III) chloride $[Co(NH_3)_5(ONO)]Cl_2$

Module 3: INSTRUMENTAL CHARACTERIZATION	**40 hours**

1. FTIR of linkage isomers
2. UV–Visible spectra of coordination compounds, calculation of extinction coefficient and identification of the bands.
3. Colorimetric determination of Fe (III) in solution by photometric titration (static) with EDTA.
4. Spectrophotometric determination of Ni-DMG complex
5. PXRD analysis of synthesized compounds (Phase identification, Index major peaks, calculate crystallite size using Scherrer equation)
6. Magnetic susceptibility measurement.

Total Lecture hours	**120 hours**

Text Book(s)

1.	Vogel's Qualitative Inorganic Analysis; Svehla G. and Sivasankar B.; 7th edition; Pearson.
2.	Barua, S.; A textbook of Practical Chemistry; 2th edition; 2016; Kalyani Publishers.
3.	Mendham J., Denney R.C., Barnes J.D. and. Thomas M.J.K.; Vogel’s Textbook of Quantitative Chemical Analysis, 6th edition, 3rd Indian Reprint, 2003, Pearson Education Pvt. Ltd., New Delhi.

2^{ND} SEMESTER

DSCC	INORGANIC CHEMISTRY - II	L	T	P	C
		4	0	0	4

Pre-requisite: Knowledge of chemistry at B.Sc. level

Course Objectives:

The course is being offered with the following objectives:

1. To develop a comprehensive understanding of the mechanisms of inorganic reactions, including substitution and redox reactions, stability concepts, and factors influencing the reactivity of coordination compounds.

2. To provide knowledge of the structure, bonding, synthesis, and properties of boranes, organoboron compounds, inorganic polymers, crown ethers, cryptands, metal chalcogenides, and other advanced inorganic materials.

3. To familiarize students with the chemistry of lanthanides and actinides, including their electronic structure, periodic trends, extraction methods, coordination chemistry, and technological applications.

4. To impart a thorough understanding of the synthesis, bonding, reactivity, and catalytic applications of organometallic compounds, with emphasis on industrially important catalytic processes and modern synthetic methodologies.

Course Outcome:

After successful completion of the course, the students will be able to:

CO1: Explain the concepts of kinetic and thermodynamic stability, substitution and redox reaction mechanisms, stability constants, and the factors governing the reactivity of coordination compounds. **(Understand)**

CO2: Apply Wade's rules, electron counting methods, and bonding theories to interpret the structure, properties, and reactivity of boranes, organoboron compounds, inorganic polymers, crown ethers, cryptands, and other descriptive inorganic compounds. **(Apply)**

CO3: Analyze the electronic configuration, periodic trends, magnetic and spectral properties, extraction methods, and coordination chemistry of lanthanides and actinides. **(Analyze)**

CO4: Evaluate the synthesis, bonding, reactivity, and catalytic applications of organometallic compounds, including metal carbonyls, metallocenes, and transition metal-catalyzed industrial processes such as hydrogenation, hydroformylation, the Monsanto process, Wacker process, olefin metathesis, and Suzuki coupling reaction. **(Evaluate)**

Module 1: MECHANISM OF INORGANIC REACTIONS	**12 hours**

Kinetic and thermodynamic stability, Lability and inertness, Stability Constants, Mechanistic pathways of Substitution reactions in octahedral and square planer complexes, Trans effect and its application to the synthesis of metal complexes, Inner sphere and outer sphere mechanisms of Redox Reactions, Marcus Theory.

Module 2: DESCRIPTIVE INORGANIC CHEMISTRY	23 hours
Structure and bonding in polyhedral boranes, carboranes and heterocarboranes, electron count in polyhedral boranes – styx numbering, Wade's rules – polyhedral skeletal electron pair theory (PSEPT), synthesis of polyhedral boranes. The hydroboration reaction, organoboranes such as boronic acids, tetrahydridoborates, boron nitride, borazines and borazines. Reactivity of lithium aluminium hydride; alkyl aluminium compounds; chemistry of Al, Ga, In and Tl in +1 and +2 oxidation states.Fullerenes and fullerides, nonmolecular compounds of carbon, clays and zeolites; organo compounds of Si, Ge, Sn and Pb; phosphates, metaloxo compounds, calixarenes, cryptands and crown ethers in complexation chemistry, metal chalcogenides. Properties of inorganic polymers, polysilanes (Si–Si bonds), polysiloxanes (Si–O bonds, or silicones), polysilazanes (Si–N bonds), polysulfides (S–S bonds), polyphosphazenes (P–N bonds), polyborazylenes (B–N bonds), silicon rubber and resins.	
Module 3: LANTHANIDES AND ACTINIDES	**10 hours**
Electronic configuration, lanthanide/ actinide contraction and consequences, magnetic and spectral properties, various physical and chemical properties, stability of lanthanide/actinide complexes, occurrence and extraction of lanthanides and actinides.	
Module 4: ORGANOMETALLIC CHEMISTRY	**15 hours**
Synthesis, structure, bonding and reactivity of mono and polynuclear metal carbonyls. Substituted metal carbonyls. Types of M-C bonds, Calculation of M-C bonds in complexes, synthesis and reactivity of metal alkyls, carbenes, alkenes, alkynes, and arene complexes; metallocenes and bent metallocenes. Reactions of organometallic complexes: substitution, oxidative addition, reductive elimination, insertion and deinsertion; catalysis: hydrogenation, hydroformylation, Monsanto process, Wacker process, alkene polymerization, olefin metathesis, Suzuki coupling reaction.	
Total Lecture hours	**60 hours**

Text Book(s)	
1.	Lee, J.D. Concise Inorganic Chemistry ELBS, 1991
2.	P. W. Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong; Shriver & Atkins' Inorganic Chemistry, 5th Ed. Oxford University Press, 2010.
3.	J. E. Huheey, E. A. Keiter and R. L. Keiter; Inorganic Chemistry: Principles of Structure and Reactivity, 4th Ed. Pearson Education, 2006
Reference Books	
1.	F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann; Advanced Inorganic Chemistry, 6th ed. Wiley, 1999
2.	Fundamental Concepts of Inorganic Chemistry, Vols. 1-7, by A.K. Das and M. Das, CBS Publishers and Distributors, 2015
3.	G. L. Miessler, D Tarr; Inorganic Chemistry. 3rd Ed., Pearson Education, 2004.
4.	C. Elschenbroich, A. Salzer, Organometallics: A Concise Introduction, 2 nd Ed. Wiley VCH, 1995.
5.	R. H. Crabtree, Organometallic Chemistry of the Transition Metals 2nd Ed., John Wiley, 1993.

<table>
<tr><td>DSCC</td><td colspan="2">ORGANIC CHEMISTRY – II</td><td>L
4</td><td>T
0</td><td>P
0</td><td>C
4</td></tr>
<tr><td colspan="7">Pre-requisite: B. Sc knowledge in Chemistry</td></tr>
<tr><td colspan="7">Course Objectives:</td></tr>
<tr><td colspan="7">1. To provide knowledge of the generation and application of different reaction intermediates in organic synthesis.
2. To give a comprehensive idea of various oxidizing agents used in organic transformations.
3. To discuss different reduction reactions.
4. To make students familiar with pericyclic reactions and their utilities.</td></tr>
<tr><td colspan="7">Course Outcome:</td></tr>
<tr><td colspan="7">After successful completion of the course, the students will be able to
CO1-understand the chemistry of reaction intermediates and reactivity, oxidation, reduction and pericyclic reactions.
CO2-apply the knowledge gained to identify suitable reagents and reactive intermediates for various reactions as well as strategies for pericyclic reactions.
CO3- analyze the reactivity of reaction intermediates along with the different approaches to oxidation, reduction and pericyclic reactions to draw conclusions.
CO4- evaluate the reagents, intermediates and reaction pathways to defend conclusions.</td></tr>
<tr><td colspan="6">Module 1: REACTION MECHANISMS & INTERMEDIATES: STRUCTURE & REACTIVITY – II</td><td>15 hours</td></tr>
<tr><td colspan="7">Carbenes and Nitrenes: Structure of carbenes, generation of carbenes, addition and insertion reactions, rearrangement reactions of carbenes such as Wolff rearrangement, generation and reactions of ylids, structure of nitrene, generation and reactions of nitrene and related electron deficient nitrogen intermediates, Curtius, Hoffmann, Schmidt, Beckmann rearrangement, Tebbeolefination reactions.
Radicals: Generation of radical intermediates and its (a) addition to alkenes, alkynes (inter &intramolecular) for C-C bond formation and Baldwin's rules (b) fragmentation and rearrangements. Name reactions involving radical intermediates such as Barton deoxygenation and decarboxylation, McMurry coupling.</td></tr>
<tr><td colspan="6">Module 2: OXIDATION REACTIONS</td><td>15 hours</td></tr>
<tr><td colspan="7">Oxidation: Metal and non-metal-based oxidations of alcohols to carbonyls (Chromium, manganese, aluminium, silver, DMSO and hypervalent iodine). Oxidation of phenols: Fremy's salt, alkenes to epoxides: via halohydrin, peroxides/per acids based, Sharpless asymmetric epoxidation; alkenes to diols (Manganese, osmium-based reagents), Prevost reaction and Woodward modification; oxidation of alkyl or alkenyl fragments: selenium dioxide, ketones to ester/lactones: Baeyer-Villiger oxidation.</td></tr>
<tr><td colspan="6">Module 3: REDUCTION REACTIONS</td><td>15 hours</td></tr>
<tr><td colspan="7">Reduction: Catalytic hydrogenation (Heterogeneous: Palladium/ Platinum/ Rhodium/ Nickel etc; Homogeneous: Wilkinson catalyst); metal-liquid ammonia processes: Birch reduction, Pinacol formation etc.; stereo selection and mechanism of the following reagents: Lithium aluminium hydride, L-selectride, K-selectride, sodium borohydride,</td></tr>
</table>

DIBAL, sodium cyanoborohydride, alkyl borane, non-metallic reducing agents: diimide.		
Module 4: PERICYCLIC REACTIONS		**15 hours**
Introduction, general orbital symmetry rules, Woodward Hoffmann description, types: electrocyclic reaction, sigmatropic rearrangement, cycloaddition reaction, 1,3 – dipolar cycloaddition, cheletropic reactions, group transfer reactions and ene reactions.		
Total Lecture hours		**60 hours**
Text-Book(s)		
1.	Cary F. A., Sundberg R. I., Advanced Organic Chemistry, Part A and B, 5th Edition,Springer, 2009.	
2.	Smith M. B., Organic Synthesis, 4th Ed., Academic Press, Cambridge, Massachusetts,2016.	
3.	Carruthers W. and Coldham I., Modern Methods of Organic Synthesis, First South AsianEdition, 2005, Cambridge University Press.	
4.	Greeves N., Clayden J.,Warren S., Organic Chemistry, 2nd Ed., Oxford University Press,New Delhi, 2012.	
5.	Anslyn E. V., Dougherty D. A., Modern Physical Organic Chemistry, University Science Books, 2005.	
	Reference Books	
1.	Smith M. B., March J., March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 7th Ed., Wiley India, New Delhi, 2015.	
2.	Carruthers W., Modern Methods of Organic Synthesis, 4th Ed., Cambridge University Press, New Delhi, 2005.	
3.	Zweifel G. S., Nantz M. H., Somfai P., Modern Organic Synthesis: An Introduction, 2nd Ed., Wiley-Blackwell, New York, 2017.	
4.	Morrison R. T., Boyd R. N., Bhattacharjee S. K., Organic Chemistry, 7th Edition, Pearson Education India, 2010.	
5.	Solomons T. W. G., Fryhle C. B., Snyder S. A., Organic Chemistry, 12th Edition, Wiley, 2017.	
6.	Harmata M., Strategies and Tactics in Organic Synthesis, Volume 4, Academic Press, 2004.	

	PHYSICAL CHEMISTRY – II	L	T	P	C
		4	0	0	4

Pre-requisite: Knowledge of chemistry at B.Sc. level

Course Objectives:

1. To introduce the student with the basic concepts of chemical kinetics.
2. To give an insight into molecular reaction dynamics.
3. To introduce the students with the basic concepts of polymer chemistry.
4. To make students familiar with data analysis.

Course Outcome:

After successful completion of the course, the students will be able

CO1: To explain the fundamentals laws, rules and theories related chemical kinetics, molecular reaction dynamic, electrical interface, polymerization kinetics and data analysis.

CO2: To apply theories of chemical kinetics, molecular reaction dynamics, polymers, sampling, and data analysis in various systems.

CO3: To elaborate different processes and mechanisms in chemical kinetics, molecular reaction dynamics, corrosion and polymers.

Module	Hours
Module 1: MOLECULAR REACTION DYNAMICS	**15 hours**
Collisions of real molecules- trajectory calculations, Laser techniques, reactions in molecular beam, reaction dynamics, estimation of activation energy and calculation of potential energy surface- the transition state theory (TST) of bimolecular gaseous reactions. Comparison between transition state theory and hard sphere collision theory. Diffusion controlled reactions; kinetics of reactions in solution diffusion controlled and chemically controlled reactions.	
Module 2: THEORIES OF UNIMOLECULAR REACTIONS	**10 hours**
Theory of unimolecular reactions Lindemann theory and its drawbacks, Hinselwood modification, RRK theory, slaters treatment, RRKM theory.	
Module 3: THEORIES OF ELECTRICAL INTERFACE	**12 hours**
Electrocapillary phenomena- Lippmann equation, electron transfer at interfaces, polarizable and non-polarizable and nonpolarizable interfaces, Butler-Volmer equation, Tafel plot. Electrode Processes, Mechanism of electrode reactions, mechanism of hydrogen evolution and oxygen evolution reactions. Corrosion of Metals – mixed potential mechanism – different types of corrosion – methods protection of metals from corrosion.	
Module 4: CHEMICAL KINETICS	**15 hours**
Mechanisms of complex reactions, Steady state approximation, kinetics of straight-chain reaction, branching-chain reactions, enzyme catalyzed reactions, reactions in solutions, diffusion-controlled reactions in solutions, influence of ionic strength in reaction rates, kinetics of fast reactions, potential energy surfaces. Kinetics of polymerization reaction, molecular weight determination, copolymerization, average dimension of polymer molecules, size exclusion Chromatography and gel permeation chromatography.	
Module 5: SAMPLING AND DATA ANALYSIS	**8 hours**
Sampling of solid, liquid and gaseous samples, mean and standard deviation, absolute and relative errors, linear regression, covariance and correlation coefficient, t-test and f-test.	
Total	**60 hours**

Text Book(s)	
1.	Levine I. R., Physical chemistry 6 th Edition, Mcgraw Hill Education, 2011.
2.	Atkins P., Paula J., Physical Chemistry, 9th Edition, Oxford University Press, Oxford 2010.
3.	McQuarrie D. A., Simon J. D., Physical Chemistry: A Molecular Approach, Viva Student Edition, 1st Edition, 2011.
4.	V. R. Gowarikar, N. V. Viwanathan, J. Sreedhar, Polymer Science, 1st Edition, New age International Publishers, 1986.
Reference Books	
1.	Physical Chemistry: Thomas Engel and Philip Reid
2.	Bagchi B. Statistical Mechanics for Chemistry and Material Science, CRC Press (2018).
3.	Landau L. D. and Lifshitz E. M., Statistical Mechanics, Part I, Butterworth- Heinemann, 3rd ed. (2005).
4.	Berry R. S., Rice S. A. and Ross J., Physical Chemistry, 2nd Edition, Oxford University Press, Oxford 2007.
5.	Puri B. R.; Sharma L. R., Pathania M. S., Principles of Physical Chemistry; 47th Ed, Vishal Publishing, New Delhi (2017).
6	Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed., McGraw-Hill: New York (2003).
7	Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co., New York (2003).

DSEC	INDUSTRIAL CHEMISTRY AND ENVIRONMENTAL IMPACT	L	T	P	C
		4	0	0	4

Pre-requisite: Knowledge of chemistry at B.Sc. level

Course Objectives:

The course is being offered with the following objectives:

1. To introduce the fundamental concepts of industrial chemistry, industrial raw materials, manufacturing processes, material and energy balance, and industrial safety practices.

2. To develop an understanding of the manufacturing processes, properties, applications, and environmental aspects of major industrial chemicals, fertilizers, cement, glass, polymers, petroleum products, and pharmaceuticals.

3. To familiarize students with the petroleum, petrochemical, pharmaceutical, food, and cosmetic industries, including quality control measures, good manufacturing practices (GMP), and industrial applications.

4. To create awareness of industrial pollution, waste management, pollution control technologies, environmental impact assessment (EIA), and sustainable industrial practices for environmental protection and sustainable development.

Course Outcome:

After successful completion of the course, the students will be able to:

CO1: Explain the scope of industrial chemistry, industrial raw materials, unit operations, unit processes, material and energy balance concepts, and essential industrial safety practices. **(Understand)**

CO2: Apply the principles of industrial chemical manufacturing to describe the production processes of major industrial chemicals, fertilizers, cement, glass, polymers, petroleum products, and pharmaceuticals. **(Apply)**

CO3: Analyze the processing, refining, quality control, and industrial applications of petroleum, petrochemicals, pharmaceutical products, food additives, and cosmetic products, relating them to industrial practices. **(Analyze)**

CO4: Evaluate the environmental impacts of industrial activities by assessing pollution sources, waste management strategies, pollution control technologies, environmental impact assessment (EIA), carbon footprint, and sustainable industrial practices. **(Evaluate)**

Module 1: Introduction to Industrial Chemistry	**15 hours**

Introduction - Definition and scope of industrial chemistry, Industrial Raw Materials - Mineral resources, Petroleum, Natural gas, Coal, Water, Renewable and non-renewable resources, Industrial Processes **-** Unit operations and unit processes, Batch and continuous processes, Flow diagrams, Material balance (basic concept), Energy balance (basic concept),

Industrial Safety - Chemical hazards, Fire and explosion hazards, Safety symbols and labels, Personal Protective Equipment (PPE), Safe handling and storage of chemicals		
Module 2: Manufacture of Industrial Chemicals		**15 hours**
Heavy Chemicals - Manufacture of sulphuric acid (Contact Process), Manufacture of ammonia (Haber Process), Manufacture of nitric acid (Ostwald Process), Manufacture of sodium carbonate (Solvay Process), Fertilizer Industry - Nitrogenous fertilizers, Phosphatic fertilizers, Potassic fertilizers, Compound fertilizers, Cement and Glass Industries - Raw materials, Manufacturing process, Types and applications, Environmental issues, Polymer Industry - Manufacture of polyethylene, PVC, Polystyrene, Biodegradable plastics (basic idea)		
Module 3: Petroleum, Petrochemicals and Pharmaceutical Industries		**15 hours**
Petroleum Industry - Composition of crude oil, Fractional distillation, Petroleum refining, Cracking, Reforming, Petrochemical products, Fuels – LPG, CNG, Biofuels, Hydrogen fuel, Fuel quality, Pharmaceutical Industry - Bulk drugs, Active Pharmaceutical Ingredients (APIs), Good Manufacturing Practices (GMP), Quality control, Food and Cosmetic Industries - Food additives, Preservatives, Flavours, Cosmetics, Quality standards		
Module 4: Industrial Pollution and Environmental Impact		**15 hours**
Industrial Pollution - Sources of industrial pollution, Air pollution, Water pollution, Soil pollution, Industrial Waste - Solid waste, Liquid waste, Hazardous waste, Pollution Control - Air pollution control devices, Wastewater treatment, Solid waste management, Recycling and resource recovery, Environmental Impact - Environmental Impact Assessment (EIA), Carbon footprint, Greenhouse gases, Global warming		
Total Lecture hours		**60 hours**
Text -Book(s)		
1.	B. K. Sharma, Industrial Chemistry, Goel Publishing House, Meerut.	
2.	B. K. Sharma, Environmental Chemistry, Krishna Prakashan Media Pvt. Ltd.	
3.	Shashi Chawla, A Textbook of Engineering Chemistry, Dhanpat Rai Publications.	
4.	V. K. Ahluwalia, Environmental Chemistry, Ane Books India.	
Reference Books		
1.	M. Gopala Rao and Marshall Sittig, *Outlines of Chemical Technology,* Khanna Publishers, New Delhi	
2.	George T. Austin, *Chemical Process Industries,* McGraw-Hill Education	
3.	Stanley E. Manahan, *Environmental Chemistry,* CRC Press (Taylor & Francis Group)	

<table>
<tr><td rowspan="2"></td><td rowspan="2">MATERIALS CHEMISTRY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td colspan="6">Pre-requisite: Knowledge of chemistry at B.Sc. level</td></tr>
<tr><td colspan="6">Course Objectives:</td></tr>
<tr><td colspan="6">The course aims to enable students to:
1. Understand the principles governing the structure, bonding and properties of materials.
2. Develop knowledge of crystal chemistry, defects, diffusion and structure–property relationships in solids.
3. Understand various synthesis strategies and characterization techniques employed in materials chemistry.
4. Explore the chemistry of nanomaterials, soft materials, functional materials, composites and sustainable materials.
5. Correlate the chemistry of advanced materials with applications in energy, catalysis, electronics, healthcare and environmental remediation.
6. Develop the ability to critically evaluate recent advances in materials chemistry.</td></tr>
<tr><td colspan="6">Course Outcome:</td></tr>
<tr><td colspan="6">After successful completion of the course, the students will be able
CO1: Explain the relationship between crystal structure, bonding, defects, diffusion and the physicochemical properties of materials. (Understand)
CO2: Compare and evaluate various synthesis approaches for designing advanced functional materials with desired properties. (Analyze)
CO3: Interpret structural, spectroscopic, microscopic and thermal characterization data for advanced materials. (Analyze)
CO4: Critically evaluate the chemistry, properties and applications of nanomaterials, soft materials, functional materials, composite materials and sustainable materials. (Evaluate)
CO5: Propose suitable material systems for applications in energy storage, catalysis, environmental remediation, healthcare and emerging technologies based on structure–property relationships. (Create)</td></tr>
<tr><td colspan="4">Module 1: FUNDAMENTALS OF MATERIAL CHEMISTRY AND CRYSTAL CHEMISTRY</td><td colspan="2">20 Hours</td></tr>
<tr><td colspan="6">Classification of materials: Metals, ceramics, polymers, composites, nanomaterials, smart materials, biomaterials and porous materials. Structure–property relationships. Chemical bonding in solids. Crystal systems and Bravais lattices. Packing in solids and radius ratio rules. Coordination polyhedral. Crystal structures: Rock salt, Zinc blende, Wurtzite, Fluorite, Spinel, Perovskite and Garnet. Crystal defects: Point, line and planar defects; non-stoichiometry and defect chemistry. Diffusion in solids: Fick's laws, diffusion in ionic solids, role of diffusion in sintering and solid-state reactions. Ionic conductivity. Binary phase diagrams (basic concepts).</td></tr>
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Module 2: MATERIALS SYNTHESIS AND CHARACTERIZATION	20 hours
Materials synthesis: Top-down and bottom-up approaches, Solid-state reaction, Sol–gel synthesis, Co-precipitation, Hydrothermal and solvothermal synthesis, Combustion synthesis, Microwave-assisted synthesis, Spray drying and freeze drying, Aerogels and xerogels, Chemical vapour deposition (CVD), Physical vapour deposition (PVD), Green synthesis of nanomaterials, Introduction to dendrimers. **Characterization techniques:** Powder X-ray diffraction (XRD), Introduction to Rietveld refinement, FTIR spectroscopy, Raman spectroscop, UV–Visible diffuse reflectance spectroscopy (DRS), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Energy dispersive X-ray spectroscopy (EDX), BET surface area analysis, Thermal analysis (TGA and DSC), X-ray photoelectron spectroscopy (XPS), Interpretation of characterization data.	
Module 3: FUNCTIONAL MATERIALS AND EMERGING APPLICATIONS	**20 Hours**
Nanomaterials: Size-dependent properties, Quantum confinement, Carbon nanotubes, Graphene, Fullerenes, Carbon dots, Semiconductor nanomaterials, MXenes (introductory concepts), Surface functionalization. **Soft materials:** Introduction to soft materials, Liquid crystals: Nematic, smectic, cholesteric and lyotropic liquid crystals, Colloids and colloidal stability, Amphiphiles, Micelles, Vesicles, Microemulsions, DLVO theory (qualitative treatment). **Functional and sustainable materials:** Conducting polymers, Shape-memory alloys, Piezoelectric materials, Magnetostrictive materials, Superconductors, Zeolites, Metal–Organic Frameworks (MOFs), Composite materials: Polymer, metal and ceramic matrix composites; clay-polymer composites; carbon composites; bioceramics. Energy materials: Lithium-ion batteries, sodium-ion batteries, supercapacitors, fuel cells, hydrogen storage materials and solar cells. Environmental and sustainable materials: Photocatalysts, water purification materials, LEDs/OLEDs, circular economy, green materials and environmental remediation.	
Total Lecture hours	**60 hours**
Text Book(s)	

1.	Anthony R. West, *Solid State Chemistry and Its Applications*, 2nd Edition, Wiley.
2.	C. N. R. Rao and J. Gopalakrishnan, *New Directions in Solid State Chemistry*, Cambridge University Press.
3.	William D. Callister Jr. and David G. Rethwisch, *Materials Science and Engineering: An Introduction*, Wiley.
4.	Guozhong Cao and Ying Wang, *Nanostructures and Nanomaterials: Synthesis, Properties and Applications*, World Scientific.
Reference Book(s)	

1.	C. N. R. Rao, A. Müller and A. K. Cheetham (Eds.), *The Chemistry of Nanomaterials*, Wiley-VCH.
2.	C. J. Brinker and G. W. Scherer, *Sol–Gel Science: The Physics and Chemistry of Sol–Gel Processing*, Academic Press.
3.	Ian W. Hamley, *Introduction to Soft Matter: Synthetic and Biological Self-Assembling Materials*, Wiley.
4.	Donald R. Askeland and Wendelin J. Wright, *The Science and Engineering of Materials*, Cengage.

DSCC	LABORATORY COURSE – II	L	T	P	C
		0	0	8	4
Pre-requisite: Knowledge of B.Sc. level chemistry					

Course Objectives:

This course is being offered with the following objectives

1. To provide knowledge about different qualitative techniques used for the identification of organic compounds.
2. To make the students familiar with various chromatographic methods for separation of organic compounds in a mixture.
3. To apprise students about the basic principles about quantitative analysis.
4. To introduce students with different methods for extraction of natural products.
5. To provide knowledge about organic synthesis.

Course Outcome:

After successful completion of the course, students will be able to

CO1: apply different techniques of qualitative analysis, purification, synthesis and extraction of organic compounds.

CO2: analyze organic compounds by various methods of analysis to draw conclusion.

CO3: evaluate the various analytical methods to defend the conclusions drawn.

1. Qualitative Analysis of Binary organic mixtures and their identification.
2. Chromatography Experiments-
   - (i) Separation of a mixture of two amino acids by paper chromatography.
   - (ii) Separation of a mixture of two sugars by paper chromatography.
   - (iii) Separation techniques of organic compounds by column chromatography.
3. Quantitative Analysis
   - (i) Estimation of sugar using titrimetric method.
   - (ii) Estimation of amino acids using titrimetric methods.
4. Experiments on Natural products:
   - (i) Extraction of natural products - Caffeine, Lycopene, Citral.
   - (ii) Saponification of vegetable oil.
5. Synthesis (any two)-
   - (i) Preparation of *p*-bromo-acetanilide from aniline.
   - (ii) Aniline to *p*-bromo-acetanilide.
   - (iii) Cyclohexanone oxime from cyclohexanone.
   - (iv) Benzil from Benzoin.
   - (v) Cinnamic acid from Benzaldehyde and malonic acid.

6.. Preparation of organic compounds involving the following representative reactions

   - (i)Oxidation
   - (ii) Reduction

Textbook(s)

1.	Furniss B. S., Hannaford A. J., Smith P. W. G., Vogel's Textbook of Practical Organic
2	Ahluwalia V. K., Dhingra S., Comprehensive Practical Organic Chemistry, University Press
3	Mann F. G., Saunders B. C., Practical Organic Chemistry, 3rd Edition Longman, 1978.
4	Bansal, R. K, Laboratory Manual of Organic Chemistry 4th Edition, New Age Publishers New Delhi, 2008.
5	Sethi A., Systematic Lab Experiments in Organic Chemistry, New Age Publisher, New Delhi, 2010.