ETHIRAJ COLLEGE FOR WOMEN

(AUTONOMOUS)

CHENNAI - 600 008

DEPARTMENT OF CHEMISTRY

Syllabus for

M.Sc CHEMISTRY

CHOICE BASED CREDIT SYSTEM

OUTCOME BASED EDUCATION

(Syllabus effective from the Academic year 2018 -2019**)**

CONTENTS

ETHIRAJ COLLEGE FOR WOMEN (AUTONOMOUS)
CHENNAI –600 008

DEPARTMENT OF CHEMISTRY
MASTER OF SCIENCE IN CHEMISTRY
CBC System
(Syllabus effective from the academic year 2018 -2019)

Department of Chemistry is revising the syllabus under CBC system with effect from the academic year 2018-2019, as specified by the Government of Tamil Nadu. Electives-(Major) components will enrich the knowledge of the students in the currently developing fields of Chemistry and Electives-(Non-major) will enable the students to be entrepreneurs. In the syllabus there are four Soft skills courses one each in every Semester.

The duration of the course is two academic years. Every academic year is divided into two semesters. Each semester will have a minimum of 90 working days and each day will have 5 working hours. Teaching is organized into a modular pattern of credit courses. Credit is related to the number of lecture, tutorial and practical hours (LTP) for a particular subject. It is also related to the number of hours a student spends learning a subject or carrying out an activity

REGULATIONS

1. ELIGIBILITY FOR ADMISSION:

Candidates for admission to the first year of the Degree of Master of Science in Chemistry course shall be required to have passed the B.Sc degree examination with Chemistry as the major subject of study of this University or an equivalent examination of some other University accepted by the syndicate. The candidate should have taken Mathematics and Physics as the allied subjects in their undergraduate course.

2. ELIGIBILITY FOR THE AWARD OF DEGREE:

A candidate shall be eligible for the award of the Degree only if she has undergone the prescribed course of study for a period of not less than two academic years, passed the examinations of all the four semesters prescribed and earned a total of 93 credits.

3. COURSE OF STUDY:

The main subject of study for Master's Degree in Chemistry shall consist of the following:

Courses	Number	Credit per course	Total Credits
Core Course:			
Theory	11	4	44
Project	1	4	4
Practicals	3	4	12
Elective Courses:			
Major	5	3-4	17
Non major	2	3	6
Soft Skill Courses	4	2	8
Internship	1	2	2
Total			**93**

4. PASSING MINIMUM:

A candidate shall be declared to have passed in each Theory / practical of the Core, Elective (Major and Non Major) subject of study wherever prescribed, if she secured not less than 50 % of the marks prescribed for the end semester examination and also 50% in the sum of end semester examination and continuous assessment. There is no passing minimum for Continuous Assessment (CA).

The maximum marks for CA is 40 and for End Semester examination is 60 (for theory, practicals and Project). The aggregate mark for each paper is 100.

5. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

Successful candidates passing the examination and securing the marks

(i) 60 % and above and

(ii) 50 % and above but below 60 % in the aggregate shall be declared to have passed the examination in the FIRST CLASS and SECOND CLASS respectively.

Candidates who pass all the examinations prescribed for the course in the **First appearance** itself alone are eligible for ranking.

:

6. QUESTION PAPER PATTERN:

CORE and ELECTIVE (Major) Courses:

COMPONENT	NATURE OF THE QUESTION	MAXIMUM MARK
Part A	Definition/Short answers	20
Part B	Understanding, Descriptions / Problems	40
Part C	Application / Analysis / Synthesis / Evaluation	40

Part A: All 10 questions to be answered each carrying 2 marks with 2 questions from each unit

[10Q x 2 = 20 MARKS]

Part B: All 5 questions to be answered [5Q x 8 = 40 marks] with an internal choice choosing one question from each unit

Part C: 2 questions to be answered out of 4 questions covering all the 5 units with a maximum of 4 subdivisions (a,b,c,d) [2Q x 20 = 40 marks]

ELECTIVE COURSE (Non Major):

COMPONENT	NATURE OF THE QUESTION	MAXIMUM MARKS
Part A	Understanding, Descriptions / Problems	40
Part B	Application / Analysis / Synthesis / Evaluation	60

Part A : 8 questions to be answered out of 10 questions covering all the 5 units

[8 Q x 5 = 40 marks]

Part B: 6 questions to be answered out of 9 Questions covering all the 5 units

[6 Q X 10 = 60 marks]

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

The programme aims at producing Graduates who will be able to:

PEO 1 Display higher order thinking in the knowledge domain and demonstrate professional skills

PEO 2 Contribute to the advancement and application of relevant knowledge by self-directed learning

PEO 3 Extend and integrate knowledge and skills to design and develop novel products and explore innovative solutions to national and international goals of development.

PEO 4 Exercise management skills and develop social interactions in a responsive, ethical and constructive way to meet global standards of excellence in all spheres of activity.

PEO 5 Strive for social and economic equity based on the need for gender parity and ecological sustainability.

PROGRAMME OUTCOMES (POs):

On completion of the programme the students will be able to:

PO1 - Acquire advanced conceptual knowledge and comprehensive understanding of the fundamental principles in respective discipline

PO2 - Apply knowledge and critically evaluate the concepts and scientific developments to take up any challenge

PO3 - Visualize and gain practical knowledge on multidisciplinary tasks related to current research in the fields of Mathematical, Physical and Life sciences

PO4 - Acquire research skills so as to innovate, design ,methods and techniques in Research/ Industrial field

PO5- Communicate effectively, present and publish scientific ideas in Native and English language leading to Entrepreneurship ventures such as consultancy and training

PO6 - Employ innovative and environment friendly methods, novel ideas to solve complex and challenging societal and environmental issues

PROGRAMME SPECIFIC OUTCOMES (PSOS):

On completion of the specific programme the student will be able to:

PSO1: Acquire in depth knowledge at an advanced level enabling confidence to face competitive examinations of national and global standards and capable of doing higher-level research independently

PSO2: Utilize skills in problem solving, critical thinking, analytical reasoning in chemistry domain and use modern techniques, chemistry software to interpret and design scientific processes

PSO3: Enhance Skill in planning and conducting advanced level chemical experiments, elucidating the structure of compounds / complexes using chemical characterization techniques

PSO4: Develop a creative scientific mind to communicate effectively in public forum-scientific ideas and their impact on socio-economic issues and also provide value based ethical leadership and sensitize the need for a green environment

PSO5: Apply the contextual knowledge of chemistry to function effectively as an individual / team leader / entrepreneur in academic field, chemical or related industries.

M.Sc. CHEMISTRY

(Syllabus effective from the year 2018-2019)

1. OBJECTIVES OF THE COURSE:

(i) To provide an advanced knowledge in Chemistry and also expose the students to research.

(ii) To have a career in the following areas after completion of the course with a M.Sc degree in Chemistry

(a) a teaching career in a college for science and engineering courses.

(b) a high profile job in a scientific laboratory / R&D Departments / Chemical industry.

(c) a research career in an academic institution or a National Institute / Laboratory.

(d) To start one's own industry and be an entrepreneur.

(iii) All the topics in the NET/SLET syllabus for Chemistry are incorporated as passing the NET/SLET is a pre-requisite for UGC/CSIR Research Fellowship, for recruitment of college teachers and an added qualification for many research positions.

2. PREAMBLE:

- Modification of course contents in few courses based on feedback from students and report given by Academic audit members.
- 5 Elective – (Major) –courses on the current topics.
- Project based on current topics.
- Practical Examination conducted at the end of even semester
- Internship at the end of the II semester.
- Four soft skills courses one in each semester
- Two non major electives courses one each in II and III semester.

3. COURSE PROFILE:

Total Credits: 93

Core	:	60 (Theory 56 +Project 4)
Major Elective	:	17
Non major elective	:	06
Soft skills	:	08
Internship	:	02

Semester	**I**	**II**	**III**	**IV**
Credits	**18**	**30**	**20**	**25**

EVALUATION PATTERN

Theory & Practicals

CA Marks : 40
End Semester Examination Marks : 60
Total Marks : 100

Theory: Continuous Assessment (CA)

Pattern for Continuous Assessment

			CA marks
Test I	2hrs.	50 marks	10
II	2hrs.	50 marks	10
Quiz/ Assignment/ Seminar/ Field visit			10
Participatory Learning			10
		Total	**40 marks**

Practical Continuous Assessment (CA):

(a)	One Test	-	10 marks
(b)	Skill in practical	-	10 marks
(c)	Viva -Voce	-	10 marks
(d)	Record	-	10 marks
			40 Marks

End Semester Examination questions are to be chosen from the question bank by the External Examiner and evaluated by both Internal and External Examiners.

CA- Question Paper Pattern PG - Core

Knowledge level	Section	Word Limit	Marks	Total
K1	A – 7 x 2 Marks	One or Two Sentences	14	50
K1, K2	B – 2/3 x 8 Marks	250	16	
K2, K3	C – 1/2 x 20 Marks	500	20	

CA- Question Paper Pattern PG - Non Major Elective

Knowledge level	Section	Word Limit	Marks	Total
K3, K4	A – 4/6 x 5 Marks	250	20	50
K3, K4	B – 3/5 x 10 Marks	500	30	

RUBRICS FOR CONTINUOUS ASSESSMENT

Assignment: Appearance, contents, originality, presentation, schematic representation and diagram, bibliography.

Seminar: Organization, subject knowledge, visual aids, confidence level, presentation.

Participatory learning: Answering questions, clearing doubts, participation in discussion, attendance, communication and language.

Field trip: Participation, Preparation, respect, attitude, leadership.

Project: Preliminary work, design, content, presentation.

Flipped/ Blended Learning – Information exchange, Group interaction, Clearing doubts

End Semester Examination question papers are to be set by the External Examiners and evaluated by both Internal and External Examiners. Duration of end semester examination is 3 hours and maximum mark is 100.

COURSE PROFILE

	SEMESTER –I										
Course code	**Course title**	**L**	**T**	**P**	**Total Hours /week**	**TOTAL HOURS**	**Credit**	**Exam Hrs**	**MARKS**		
									CA	**SE**	**TOTAL**
6P18/1C/OC1	Core 1- Organic Chemistry – I	4	1	0	5	75	4	3	40	60	100
6P18/1C/IC1	Core 2 - Inorganic Chemistry – I	4	1	0	5	75	4	3	40	60	100
6P18/1C/PC1	Core 3 - Physical Chemistry – I	4	1	0	5	75	4	3	40	60	100
6P18/1E1/NAC	Major Elective 1- Nano Chemistry	4	1	0	5	75	4	3	40	60	100
	*Core Practical-1- Organic Chemistry	-	-	-	4	120	-		-	-	-
	*Core Practical -2- Inorganic Chemistry	-	-	-	4	120	-		-	-	-
PG18/1S/PEW	Soft skill 1 – Personality Enrichment for Women	2	0	0	2	30	2	2	-	50	50
	Total				**30**		**18**				

L = Lecture hours, T = Tutorial hours, P = Practical hours
CA = Continuous Assessment marks, SE = End semester Marks
*Practical Examinations are conducted once in a Academic year - at the end of II & IV Semester

Note: Students can take up NPTEL/ MOOC courses and earn extra credits

SEMESTER - I

Title of the Course: Core 1- Organic Chemistry- I

Teaching hours: 15 x 5 = 75 **Credits: 4**

Course Code: 6P18/1C/OC1 **LTP 4 1 0**

Objectives:

1. To study the concepts in Optical isomerism and Asymmetric synthesis
2. To study the concepts of Prochirality – Prostereoisomerism
3. To study the conformation and stereoisomerism of cyclohexane , decalins and their relationship with reactivity
4. To study Linear free energy relationships and Neighbouring group participation
5. To study the mechanisms and stereochemistry of Elimination reactions .

COURSE OUTLINE

UNIT I : **Optical isomerism**: Sterochemistry and conformational analysis: Optical activity and chirality, classification of chiral molecules as asymmetric and dissymmetric. A brief study of dissymmetry of allenes, biphenyls, spiro compounds, trans-cyclooctene, cyclononene and molecules with helical structures- hexahelicene. Absolute configuration – D, L and R, S- notations of biphenyls and allenes. Saw horse, Newmann and Fischer projection representations and interconversion (restricted to molecules with one to five asymmetric carbon atom). Erythro and threo nomenclature, Asymmetric synthesis and Absolute asymmetric synthesis - Principle Categories of asymmetric synthesis – Chiral substrate , Chiral reagents-Asymmetric hydroboration , Chiral auxillary -derived from Proline , Menthol, modification of Lithium Aluminium Hydride – BINAL – H- application in reduction of enantiotopic ketone , Chiral catalyst - Sharpless asymmetric epoxidation , Chiral Wilkinson catalyst , enantioselectivity, diastereoselectivity , Optical Purity , Cram's rule and Prelog's rule.

15 hrs

UNIT II: **Geometrical isomerism:** E, Z nomenclature of olefins. Geometrical and optical isomerism of disubstituted cyclopropane, cyclobutane and cyclopentane. Identification- enantiotopic, homotopic, diastereotopic ligands and faces and prochiral carbons and nomenclature of enantiotopic hydrogens. Stereospecific and stereoselective synthesis. Chemoselectivity, regioselectivity and regiospecificity. **15 hrs**

UNIT III: **Conformational analysis**: Conformational analysis of cyclohexane and mono, di-substituted cyclohexanes and their stereochemical features (Geometrical and optical isomerism if shown by their derivatives) conformation and reactivity of substituted cyclohexanols (oxidation and acylation) and cyclohexane carboxylic acid derivates (esterification and

hydrolysis) conformation and stereochemistry of cis and trans decalin and 9-methyldecalin , decalones **15 Hrs**

UNIT IV: Reaction Mechanism: Kinetic and non kinetic methods of determining organic reaction mechanisms. kinetic and thermodynamic controlled products. Neighbouring group participation - Substitution in norbornyl and bridge head systems, Reactivity, structural and solvent effects in substitution reactions. Hammett equation- simple problems and Taft equation, substitution at allylic and vinylic carbons, substitution by ambident nucleophiles-such as CN^-, NO_2^-, phenoxide and ambident dianions. Williamsons reaction, Von-Braun reaction, Dieckman condensation and Claisen condensation. **15 hrs**

UNIT V: Elimination: E_1-E_2-E_{Icb} spectrum orientation of the double bond- Hofmann and Saytzeff rule. Competition between elimination and substitution. Sterochemistry of E_2 eliminations, Elimination in cyclohexane ring system. Mechanism of Pyrolytic eliminations. Examples- Chugaev reactions and Cope elimination, Hofmann degradation, pyrolysis of esters. **15 hrs**

RECOMMENDED TEXTBOOKS:

1. Jerry March, Advanced organic Chemistry, 6th edn. John Wiley and Sons, Inc.1992
2. Ernest Eliel, Sterochemistry of carbon compounds, 1st John Wiley and Sons
3. I.L. Finar, Organic Chemistry Vol I, 5th edn ELBS
4. I.L. Finar, Organic Chemistry Vol II, 5th edn ELBS

REFERENCE BOOKS:

1. Neil Isaac, Physical organic Chemistry, ELBS publication. 2nd edn Longmann 1995
2. Stanley H.Pine, Organic Chemistry, 5th edn Mac Graw Hill 1987
3. E.S.Gould, Mechanism and Structure in Organic Chemistry
4. Francis A.Carey and Richard, Advanced organic Chemistry, Part A & B by 5th edn J.Sundberg Plenum Press
5. P.S.Kalsi, Sterochemistry, conformation and mechanism, 7thWiley Eastern Ltd., Chennai
6. D.Nasipuri, Sterochemistry of organic compounds, principles and applications, 3rd Wiley Eastern Ltd.,
7. Petersykes, A Guide book to mechanism in organic Chemistry 5thedn John Wiley 1981
8. Y.R.T.Morrison, R.N.Boyd, Organic Chemistry VI edition, Prentice- Hall of India Pvt, New Delhi
9. G.Solomon, Organic Chemistry, C.B.Fryhle 8th edn Wiley 2003

PERIODICALS:

1. Journal of Organic Chemistry

2. Indian Journal of Chemistry B
3. Current Science
4. Organic Letters
5. Tetrahedron Letters

WEBSITES & e-LEARNING SOURCES

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Classify chiral molecules as dissymmetric / asymmetric and assign R/S configuration. Apply the concept and principles of asymmetric synthesis and propose syntheses of molecules of reasonable complexity with control of stereochemistry.
CO 2	Predict number of stereo isomers in molecules , assign E/Z nomenclature and topical relationship to organic molecules. Analyse and identify stereospecific , stereoselective , regioselective ,chemoselective and regiospecific reactions
CO 3	Discuss Conformations of mono and disubstituted cyclohexanes and decalins Compare the relationship between conformation and reactivity
CO 4	Formulate methodologies for determining reaction mechanism and energetics of the reaction . Apply concept of NGP to bicyclic systems. Use of LFER to explain effect of substituents on reaction rates .
CO 5	Explain mechanism and stereochemistry of elimination reactions in simple and cyclohexane ring systems. Predict major and minor product of elimination reactions , identify reaction parameters to drive reaction towards substitution / elimination.

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	1	2	2
CO 2	3	3	1	2	2
CO 3	3	3	1	2	2
CO 4	3	3	1	2	2
CO 5	3	3	1	2	2
Average	**3**	**3**	**1**	**2**	**2**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Lecture (Chalk & Talk) , Use of 3D models ,Problem solving, Seminar, Quiz , Flipped learning

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER –I

Title of the course: Core-2 Inorganic Chemistry - I

Teaching hours: 15 x 5 = 75 **Credits: 4**
Course Code: 6P18/1C/IC1 **L T P 4 1 0**

Objectives:

1. To impart detailed knowledge in different aspects of coordination Chemistry
2. To understand the concepts of spin orbit coupling, micro states and term symbols of free ion
3. To show the importance of electronic transitions in metal complexes and their absorption spectra
4. To understand the outer and inner sphere reactions in coordination complexes
5. To impart the knowledge about the mechanism involved in substitution reaction in coordination complexes

COURSE OUTLINE

UNIT I: Crystal field theory and its limitations: Application to octahedral and tetrahedral systems-Measurement of 10Dq. Factors affecting crystal field splitting. Strong and weak field-Evidence in support of crystal field effect-Octahedral Vs Tetradehdral. Octahedral site stabilization energy-Jahn Teller distortion- Square planar complexes- Nephelauxetic effect- Evidence in favour of metal ligand oribital overlap. **15hrs**

UNIT II: Molecular orbital theory: Octahedral and tetrahedral systems- construction of ligand group orbitals- site inspection –use of symmetry pi-bonding in octahedral system. Molecular orbital picture of square planar systems. Spin Orbit coupling – RS and jj coupling – micro states and term symbols. Terms of free ions. **15hrs**

UNIT III: Splitting in octahedral and tetrahedral fields: Orgel and Tanabe Sugano diagrams- Electronic transitions in metal complexes- Analysis of electronic absorption spectra of complexes- selection rule-vibronic coupling-dp mixing-spin spin and spin orbit coupling- charge transfer spectra. **15 hrs**

UNIT IV: Electron transfer reactions: Outer sphere-exchange and cross reactions-Marcus equation-complementary and Non complementary electron transfers-inner sphere- Bridging ligand-role-Resonance and radical mechanisms.

15 hrs

UNIT V: Substitution reactions- Classification A, D and interchange mechanisms. Substitution in square planar complexes- influence of nature of leaving, entering groups and other ligands present on rate. Trans effect, cis effect, parallel path mechanisms-Evidence –substitution in octahedral complexes– anation-acid catalysed hydrolysis- Based catalysed- CB mechanism Evidence.

15 hrs

RECOMMENDED TEXTBOOKS:

1. Inorganic Chemistry, F.Purcell and J.C.Kotz, W.B.Sounders & Co (1980)
2. Coordination Chemistry D Banerjea Tata McGraw Hill 1994
3. **Inorganic Chemistry: Principles of Structure and Reactivity (4th Edition)**, 1997 by James, Ellen, Richard L. Keiter
4. Advanced inorganic Chemistry FA Cotton & G.W.Wilkinson, John Wiley & sons 1988
5. Coordination Chemistry – S.F.A.Kettle., ELBS 1973.
6. Coordination Chemistry – Basalo & Johnson
7. Inorganic Chemistry – Shriver & Atkins, oxford University press- 3rdedn 1999

REFERENCE BOOKS:

1. Mechanisms of Inorganic reactions- Basalo F.and R.G.Pearson, 2nd edn 1967, John Wiley
2. Inorganic reaction Mechanism, Tobe M.L.Nelson, London 1972
3. Ligand substitution processes, Langford C.H.and H.B.Gray, Benjamin Newyork 1965
4. Mechanisms of inorganic reactions in solution, Benson D McGrawHill London 1968
5. E.J.Corey and J.C.Bailar Jr- J.Am chem.Soc. 81, 2620 (1959)
6. J.R.Gollogly, C.J.Hawkins and J.K.Beattle, Inorg. chem.., 10, 317 (1971)
7. Complexes of I row transition elements – D.Nicholos
8. Introduction to ligand fields- B.N.Figgis- John Wiley- New york 1966
9. Introduction to ligand field theory, Ballhausen C.J, McGrawHill, New york 1962

PERIODICALS:

1. Coordination Chemistry review.
2. Inorganica Chimica acta
3. J.Coordination Chemistry
4. Current Science
5. Journal of Indian chemical society
6. Chemical society review
7. Polyhedron

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Discuss the application of CFT to various systems, describe the stability of metal complexes in terms of formation constant, calculate TD parameters , explain JT theorem and Nephelauxetic effect
CO 2	Demonstrate detailed functional knowledge about the symmetry, bonding in octahedral and tetrahedral systems, spin orbit coupling and derive term symbols of free ions
CO 3	Understand electronic transitions in metal complexes, interpret the spectra of coordination complexes and learn charge transfer spectra
CO 4	Explain different types of electron transfer reactions and factors governing them
CO 5	Evaluate and gain knowledge on the various mechanism of substitution reactions in coordination complexes

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	2	2	2	2	2
CO 3	2	1	2	2	2
CO 4	3	1	2	1	1
CO 5	2	1	2	1	1
Average	**2.4**	**1.6**	**2.2**	**1.8**	**1.8**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Lecture (Chalk & Talk) , Flipped learning , Seminar

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER-I

Title of the course: Core 3-Physical Chemistry-I

Teaching hours: 15 ×5 = 75 **Credits: 4**

Course code: 6P18/1C/PC1 **L T P 4 1 0**

Objectives:

1. To provide a significant knowledge in theories of chemical reactions, and its applications.
2. To study the kinetics of reactions and the effect of experimental parameters on it
3. To understand the significance and applications of Radiation Chemistry
4. To study the concepts of molecular and crystallographic symmetry
5. To apply the concepts of symmetry for the study of molecular bonding and spectroscopy.

COURSE OUTLINE

UNIT I : **Chemical Kinetics-I:** Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions -Lindemann and Christiansen hypothesis- molecular beams, collision cross sections, effectiveness of collisions, potential energy surfaces. Transition state theory –based on thermodynamic and statistical mechanics-partition functions and activated complex- Eyring equation estimation of free energy, enthalpy and entropy of activation and their significance. **15hrs**

UNIT II: Chemical Kinetics-II: Reactions in solutions, reactions in ideal solutions, effect of pressure, di-electric constant, ionic strength on rate of reactions in solution - primary salt effect and secondary salt effect, kinetic isotope effects, linear free energy relationships- Hammett and Taft equations-Homogeneous catalysis- acid- base catalysis-mechanism of acid base catalysed reactions-Bronsted catalysis law, enzyme catalysis-Michaelis-Menten catalysis, Line Weaver – Burk method, influence of pH and temperature. **15hrs**

UNIT III: **Radiation Chemistry**: Range of radiations , interaction of γ radiation with matter -photoelectric effect, Compton effect and pair production, neutrons through matter-elastic and inelastic scattering, significance, radiation dosimetry-Fricke dosimeter, ceric sulphate dosimeter , conversion of dose values, radiolysis of water, hydrated electron-methods of generation, properties, structure and uses. Radiometric titrations and applications. Radiation precautions

15 hrs

UNIT IV : Group Theory: Symmetry elements and symmetry operations, point groups-identification and determination, comparison of molecular symmetry with crystallographic symmetry, reducible and irreducible representations, direct product representation, Great Orthogonality theorem and its consequences-character tables-C_{2V} & C_{3V} **15hrs**

UNIT V Applications of Group Theory: Hybrid orbitals in non-linear molecules(Examples H_2O, NH_3, BF_3, determination of representations of vibrational modes in non-linear molecules (H_2O, $NH_{,3}$, BF_3, XeF_4, PCl_5 and SF_6 symmetry selection rules for infra red and Raman spectra – electronic spectra of ethylene and formaldehyde. SALC principle (H_2O, $NH_{,3}$) **15 hrs**

RECOMMENDED TEXT BOOKS:

1. K.J.Laidlar –Chemical Kinetics, Harper and Row, Newyork, 1987 J.Rajaram
2. J.C.Kuriacose- Kinetics of Mechanism of Chemical Transforamtions, Macmillan India Ltd., 1983
3. V. Ramakrishnan and M.S.Gopinathan – Group Theory in Chemistry, Vishal Publications, 1988
4. K.V.Raman- Group theory and its applications to Chemistry, Tata Mc Graw Hill Publishing Co., 1990
5. Essentials of Nuclear Chemistry, Arnikar, Hari Jeevan , ISBN: 978-81-224-3203-9 (2011)

REFERENCE BOOKS:

1. W.J.Moore- Physical Chemistry, Orient Longmann, London, 1972
2. G.M.Barrow- Physical Chemistry, Mc Graw Hill, 1988R.
3. G.Frost and Pearson- Kinetics and Mechanism,Wiley Newyork, 1961.
4. C.Capellos and B.H.J.Bielski- Kinetic systems, Wiley inter science, Newyork 1972
5. G.M.Harris- Chemical Kinetics, D.C.Heath and Co., 1966
6. F.A.Cotton – Chemical Applications of Group theory, John Wiley and Sons Inc., Newyork 1971.
7. N.Tinkham- Group Theory and Quantum Mechanics, Mc Graw Hill Book Company, Newyork, 1964
8. D.S.Schonland – Molecular symmetry and Group theory-Programmed introduction to chemical application, Wiley, Newyork (1977)
9. Paul L Houston- Chemical Kinetics and Reaction dynamics, Dover publications (2006)
10. E.T.Denisov,O. M. Sarkinov and GI. Likhlenshtein,Chemical Kinetics – Fundamentals and new Development by Elsevier publication 2003
11. B S Garg Chemical applications of molecular symmetry and group theory . Macmillan 2013

PERIODICALS:

1. Resonance- Journal of science education
2. Span
3. Indian academy of sciences-proceedings- Chemical Sciences
4. Current Science
5. Journal of Indian chemical education
6. Journal of American chemical society
7. Bulletin of material science

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com
7. http://www.ch.ic.ac.uk/vchemlab/symmetry/
8. http://www.reciprocalnet.org/edumodules/symmetry/intro.html
9. http://www.win.tue.nl/~amc/ow/gpth/reader.pdf

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Acquire in depth knowledge about theories of chemical kinetics and to calculate specific rate, activation energy and frequency factor.
CO 2	Calculate Michaelis Menten constant for enzyme – substrate binding by Linewearver Burk plot.
CO 3	Analyze kinds of radiation utilised in several fields of research and industry
CO 4	Distinguish molecular and crystallographic symmetry, apply multi symmetry operations to derive character tables.
CO 5	Gain knowledge of symmetry based selection rules for vibrational and electronic spectroscopy and predict the spectra of molecules

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	1
CO 2	2	3	3	2	3
CO 3	2	3	1	1	2
CO 4	3	3	1	1	1
CO 5	3	3	2	1	1
Average	**2.6**	**3**	**2**	**1.6**	**1.6**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Lecture (Chalk & Talk), Power Point presentation, Sharing online interactive sessions, videos in the classroom, Sharing web links

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER – I

Title of the course: Major Elective 1- Nano Chemistry

Teaching hours: 15 ×5 = 75 **Credits: 4**

Course Code: 6P18/1E1/NAC **L T P 4 1 0**

Objectives:

1. To introduce and give an insight into the fascinating area of nanoscience & its development.
2. To learn the experimental techniques of nonoscale synthesis.
3. To understand the tools of characterization of nano scale features.
4. To understand the variation of properties upon size
5. To study the applications of Nano materials

UNIT I: Background to nanoscience and nanotechnology: Scientific revolutions-nanosized effects- surface to volume ratio-atomic structure-molecules & phases- energy at the nanoscale molecular and atomic size-quantum effects-types of nanotechnology and nano machines. Definition of nano system- -dimensionality and size dependent phenomena, Quantum dots, Nanowires and Nanotubes, 2D films; self assembly systems Nanotechnology-Nanomaterials-Fillers, fibres, Wires, Fluids, tubes-CNT, Graphene, Nanoclays-types. **15 hrs**

UNIT II: Experimental Techniques and Separation: Mechanical methods: grinding-high energy ball milling-types of balls-WC and ZrO_2-material-ball ratio-medium for grinding. Physical methods: Vapour deposition and different types of epitaxial growth techniques-Pulsed laser deposition, magnetron sputtering-micro Lithography, photolithography, soft lithography, e-beam writing, -laser ablation-RF/DC magnetron sputtering-microwave plasma evaporation control of grain size-scale up process. Chemical methods: Sol-gel technique-Solvo thermal methods-control of grain size-Co-precipitation hydrolysis- Sonochemical method combustion technique- colloidal precipitation template process. **15 hrs**

UNIT III: Characterization using Analytical tools: Applications of UV-Vis, NIR, FTIR, FT-Raman, Photoluminescence, NMR, ESR and Light scattering methods. X-ray techniques: X-ray power diffraction- Crystallite size determination- Sherrer equation, structure analysis, use of JCPDS, determination of crystal systems-accurate lattice parameters. Electron Spectroscopy: X-ray Photoelectron Spectroscopy, Auger electron spectroscopy, X-ray characterization of nanomaterials. SEM, TEM, AFM . **15hrs**

UNIT IV: Properties at the Nano scale: Electrical properties- electrical conductivity, Optical properties absorption and luminescence, Magnetic Properties- Para, Dia, Ferro and Ferri magnetism, Super paramagnetism- SPIONS, Mechanical properties micro hardness fracture toughness, plastic nature of nanoceramics

15 hrs

UNIT V: Applications: Ceramics and Composites: membranes for purification of water, catalysis-tooth and bone substitute-hydroxyappetites-inductive bone-replacements of ceramic valves. Capping and caging system-dendrimers-functionalisation of CNT. Environmental applications-nanotoxicology-biomediation-removal of microbes, sensors for DNA, proteins, detection of malignancy and biological applications **15 hrs**

RECOMMENDED TEXTBOOKS:

1. Nanoscale materials in Chemistry, Kenneth, J. Klabunde willey Interscience, 2001
2. Nano: The essentials, T. Pradeep Tata McGraw-Hill Publishing Company Limited, 2007.

REFERENCE BOOKS:

1. Nano and Microelectromechanical Systems: Fundamentals of Nano and microengineering, Sergy Lyshevski, Vallabh publications 2/e 2005.
2. Nanotechnology Environmental application and Solutions, Lious Theodore, Robert g.Kunz palgrave macmillan 2005.
3. Nanostructure& Nanomaterials: Synthesis, Properties & Applications, G. Cao, Imperial College Press, 2004.
4. Nanomaterials, Nanotechnologoes and Design: An introduction for Engineers and Architects, Micheal F. Ashby. P.J. Ferria. D.L. Schodekpalgrave macmillan 2005.

PERIODICALS:

1. Current Science
2. Journal of nanotechnology
3. Journal of nanomaterials

WEBSITES & e-LEARNING SOURCES:

1. http://search.ebscohost.com
2. http://nisenet.org/
3. http://www.nanoparticles.org/nano%20links/
4. http://www.nsti.org/
5. http://nanozone.org/
6. http://www.understandingnano.com/
7. http://www.nanoparticles.org/nano%20links/
8. http://www.nanotechweb.org/
9. http://www.pjonline.com/pdf/forum/pj_20060318_apsgb.pdf

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Learn the size dependent property of materials, classify and connect them with nature
CO 2	Gain in depth knowledge of laboratory and technology-based synthesis of nano materials and evaluate them based on application and design
CO 3	Analyze the unique properties of the nano scale materials in comparison with their macro and micro scale levels
CO 4	Correlate the nano scale properties with their spectroscopic and microscopic data and draw conclusion on their microstructure and morphology
CO 5	Compare and contrast the wider range of applications of nano materials in terms of energy, environment and medicine.

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	2	1	2
CO 2	3	3	3	2	2
CO 3	3	3	3	2	2
CO 4	3	3	3	2	1
CO 5	2	3	3	2	3
Average	**2.8**	**3**	**2.8**	**1.8**	**2**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Lecture (Chalk & Talk), Power Point presentation, Sharing online interactive sessions in the classroom, Sharing web links

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

	SEMESTER – II										
Course code	**Course title**	**L**	**T**	**P**	**Total Hours /week**	**TOTAL HOURS**	**Credit**	**Exam Hrs**	**MARKS**		
									CA	**SE**	**TOTAL**
6P18/2C/OC2	Core 4 - Organic Chemistry – II	3	1	0	4	60	4	3	40	60	100
6P18/2C/IC2	Core 5 - Inorganic Chemistry – II	3	1	0	4	60	4	3	40	60	100
6P18/2C/PC2	Core 6 - Physical Chemistry – II	3	1	0	4	60	4	3	40	60	100
6P18/2E2/SPE	Major Elective 2 - Spectroscopy	3	1	0	4	60	3	3	40	60	100
6P18/2E/COS	Non Major Elective 1 - Cosmetology	3	1	0	4	60	3	3	40	60	100
6P18/2C/PR1	*Core 7 - Practical –1 Organic Chemistry	-	-	-	4	120	4	6	40	60	100
6P18/2C/PR2	*Core 8 - Practical -2 - Inorganic Chemistry	-	-	-	4	120	4	6	40	60	100
6P18/2C/INT	Internship	-	-	-	-	-	2	-	-	-	-
PG18/2S/LCE PG18/2S/FRE PG18/2S/GER	Soft skill- 2 Language and Communication in English/Soft Skill in French/Soft Skill in German	2	0	0	2	30	2	2	-	50	50
	Total				**30**		**30**				

L = Lecture hours, T = Tutorial hours, P = Practical hours, CA = Continuous Assessment marks, SE = End semester Marks *Practical Examinations are conducted once in a Academic year ie at the end of II & IV Semester

SEMESTER – II
Title of the course: Core 4-Organic Chemistry-II

Teaching hours: 15 x 4 = 60 **Credits: 4**

Course Code: 6P18/2C/OC2 **L T P 3 1 0**

Objectives:

1. To provide an understanding of the mechanisms of important oxidation reactions using different reagents
2. To study the reactions of reactive intermediates viz carbenes and nitrenes,
3. To study some important rearrangements in organic chemistry.
4. To study the generation of free radicals and aromatic radical substitution reactions
5. To study the mechanism of reduction reaction using different reducing agents.

COURSE OUTLINE

UNIT I: **Oxidation:** Mechanism of oxidation of alcohols & aldehydes with Cr (VI) & Mn (VII) oxidants; Oxidation of C=C and C-H bonds; Uses of PCC, PDC and Collin's reagent. Peroxy oxidations-Alkene epoxidation by peracids and metal/alkyl hydroperoxides. oxidation of methylene to carbonyl, oxidation of arylmethanes- allylic oxidation of olefins, Oppenauer oxidation; Prevost and Woodward hydroxylation of alkenes; Oxidative cleavage of C-C single and double bonds; Periodates, LTA and Osmium tetraoxide. **12hrs**

UNIT II: **Reduction:** Selectivity in reduction of 4-t-butylcyclohexanone using selectrides-hydride reductions, Clemmensen, Wolf-Kishner reductions-Modification of Wolff-Kishner reduction, Birch reduction, MPV reduction, Catalytic hydrogenation and selectivity in reduction Reduction with $LiAlH_4$, $NaBH_4$ tritertiarybutyoxyaluminium hydride, sodium cyanoborohydride, trialkyltin hydride, Acyloin condensation. **12hr**s

UNIT III: **Reactive Intermediates Carbene*s*:** Stability, structure and spin states of carbenes; Cyclopropanation-spin dependence and stereoChemistry; Carbene insertion to C-H bonds; Rearrangement to alkenes, Wolff rearrangement .Simmon - Smith reaction. **Nitrene**s: Stability, structure and spin states of nitrenes; C-H bond insertions and aziridine formation; Rearrangement of acylnitrenes (Hoffmann, Curtius and Schmidt reactions with applications in organic synthesis). **12hrs**

UNIT IV: **Free radicals:** Long lived and short lived free radicals, methods of generation of free radicals. Addition of free radicals to the olefinic double bonds. The following aromatic radical substitutions are to be studied. Sandmeyer reaction, Gomberg-Bachmann reaction, Pschorr reaction Ulmann reaction, Mechanism of Hunsdieker reaction and Barton deoxygenation. **Aryne** -Methods of generation of benzyne intermediate, and trapping of aryne intermediate **12hrs**

UNIT V: **Molecular Rearrangements:** Migratory aptitudes: A detailed study of the molecular rearrangemnts mechanism of the following rearrangements: Wagner Meerwein Rearrangements, Demjanov, dienone-phenol, Baeyer-Villeger, Favorski, Steven, and Von-Richter re-arrangements, Sommlet-Hauser, (A few examples in each re-arrangement are to be studied). **12hrs**

RECOMMENDED TEXT BOOKS:

1. Organic Chemistry V Edition (1986) 5th Vol I by I.L.Finar, ELBS Publication
2. Advanced Organic Chemistry, 4th Edition by Jerry March, Wiley Eastern Ltd., New Delhi
3. Principles of organic synthesis R.O.C. Norman, Chapman and Hall, London. 2nd edition 1980.
4. Peter Sykes, A guide book to mechanism in organic Chemistry 5th edn John Wiley 1981

REFERENCE BOOKS:

1. Advanced Organic Chemistry by Francis A.Carey and Richard J.Sundberg, 5th Edition plenum press, New york (1990), Part A& B
2. Organic Chemistry, 6th edn(1992), Y.R.T.Morrison, R.N.Boyd, prentic-Hall of India Pvt.. New Delhi
3. Mechanism and Structure in organic Chemistry by E.S.Gould
4. Carbenes, Nitrenes and Arynes by T.L. Gilchrist and C.W. Rees, Thomas Nelson and Sons Ltd., London 1st edition
5. Organic Reaction Mechanism by S.M. Mukherji and S.P. Singh, MacMillan India Ltd., 3 rd Chennai (1990)
6. StereoChemistry and Mechanism through solved problems by P.S. Kalsi.7th Wiley Eastern Ltd., (1994)

PERIODICALS:

1 Journal of Organic Chemistry

2. Indian Journal of Chemistry B

3. Current Science

4. Organic Letters

5. Tetrahedron Letters

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. **http://search.ebscohost.com**

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Understand the mechanism and stereochemistry of oxidation of organic compounds with reagents like PCC,PDC, Collins reagent, Prevost and Woodward method of hydroxylation of alkenes and oxidative cleavage of C—C single and double bond.
CO 2	Explain mechanism and stereochemistry of reduction of organic compounds with various reagent like $LiAiH_4$ $NaBH_4$,trialkyl hydride etc Name reactions - Clemmensen , MPV. Wolf—kishner, Birch reduction and selectivity in reduction
CO 3	Explain preparation , structure , reactions and stereochemical aspects of reactive intermediates like. carbanion, carbocation, carbenes and nitrenes used in organic synthesis
CO 4	Outline the mechanism of free radical addition to olefin, aromatic radical substitution reactions and understand preparation and trapping of aryne intermediates
CO5	Explain mechanism and stereochemistry of rearrangement reactions - Wagner Meerwein ,Demjanov, Dienone- Phenol, Von-Richter, Baeyer-Villeger, Favorskii and Steven rearrangement, its applications to other molecules

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	2	2	2
CO 2	3	2	3	2	3
CO 3	3	3	2	2	2
CO 4	3	3	2	3	2
CO 5	3	2	2	3	2
Average	**3**	**2.6**	**2.2**	**2.4**	**2.2**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Lecture (Chalk & Talk) , Problem solving, Seminar, Quiz , Flipped learning

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER-II

Title of the course: Core-5 Inorganic Chemistry-II

Teaching hours: 15 x 4 = 60 **Credits: 4**

Course Code: 6P18/2C/IC2 **L T P 3 1 0**

Objective:

1. To introduce different boranes and carboranes and important aspects of structural Inorganic chemistry.
2. To study the important aspects of solid state chemistry
3. To bring out the significance of solid state defects
4. To study the magnetic properties of transition metal complexex
5. To study novel inorganic compounds

COURSE OUTLINE

UNIT I: Structural aspects of boranes: Different types of Boron hydrides-Nido, arachno and closo- Lipscomb's rule- structure and bonding in polyboranes-Reactions of polyboranes-carboranes and metallo carboranes-structure.**12hrs**

UNIT II: **Structural aspects of metallic clusters and poly anions of important compounds.** Poly organophosphazenes, poly sulphur-nitrogen compounds structure- properties correlation. Iso and hetero poly anions of Vanadium, chromium, molybdenum and tungsten- structural aspects only. Metal clusters Binuclear and trinuclear clusters of Rhenium, Chromium, Molybdenum and Tungsten- Octahedral clusters- Metal only clusters structure and bonding only. **12 hrs**

UNIT III: **Solid state Chemistry I:** The Bravais Lattices – simple, body centered, face centered and end centered arrangements-slide axis-Glide planes- Space groups- Miller indices- Interplanar distances-Bragg's equation, x-ray powder data in identifying inorganic crystalline solids- details for cubic systems. Van Lane equation- Determination of structure. **12 hrs**

UNIT IV: **Crystal Structure and defects** NaCl, CsCl, ZnS (Wurtzite & sphalarite), Diamond, Graphite, Nickel arsenide NiAs, Rutile, cadmium iodide, perovskite, spinels (normal and inverse). Stoichiometric and Non stoichiometric defects- Schottky, Frenkel, Metal excess, Metal deficiency, line, plane defects- Shear planes, F centers, Defect spinels. Non stoichiometric compounds. **Photo Conductors**: Principle and application-Liquid Crystals-Types and Applications **12 hrs**

UNIT V: **Diffusion in solids**: Diffusion mechanisms- phase transitions, solid solutions, order disorder transformations and super structure formations, solid state electrolytes, solid state reactions- Band theory of solids- Semi conductors-p-n junctions- rectifiers, super conductivity-Meissner state-Type I & II super

conductors-Magnetic properties of solids-para, ferro and antiferro magnetism-ferrites structure significance. Hysterisis-spin only magnetic moment- orbital contribution- systems with A,E and T ground terms. Determination of magnetic susceptibility by Guoy and Faraday methods- Optical properties of solids- Inorganic phosphors, Garnets, solid state Lasers. **12hrs**

RECOMMENDED TEXT BOOKS:

1. Principles of electronics V.K.Mehta & Rohit Mehta, Sultan chand & sons, 9th edn 2006
2. Solid State Chemistry and its Applications, 2nd Edition, Student Edition, Anthony R. West, 2014 Wiley
3. Fundamentals of crystal Chemistry- TRN Kutty & JAK Tareen Universities Press (2001)
4. Introduction to solids L.V.Azaroff MacGraw Hill New york 1960
5. Elements of x-ray crystallography L.V.Azaroff, Mc.Graw-Hill Inc, New york (1968)
6. Inorganic solids D.M.Adams Wiley (new york) 1974
7. Inorganic Chemistry: Principles of Structure and Reactivity (4th Edition), 1997by James E. Huheey ,Ellen A. Keiter , Richard L. Keiter
8. Advanced Inorganic Chemistry- A comprehensive text- F.A.Cotton & G.Wilkinson- John- Wiley V edn 1988
9. Structural principles in Inorganic compounds W.E.Addison John Wiley & Sons, Newyork (1961)
10. Modern aspects of inorganic Chemistry, H J Emeléus; A G Sharpe 4th edn (1973)

REFERENCE BOOKS:

1. Structural inorganic Chemistry A.F.Wells., 5th edition, 2014 Clarendon press, oxford (1985)
2. Inorganic structural Chemistry.A.Miller Wiley, New york 1993
3. New directions in solid state Chemistry, CNR Rao and J.Gopalakrishnan, Cambridge University press (1997)

PERIODICALS:

1. Inorganica Chimica acta
2. Polyhedron
3. Chemical reviews
4. Current Science
5. Journal of Indian chemical society
6. Journal of American chemical society
7. Bulletin of material science

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Learn structure, bonding, stablility and reactivity of simple boranes, carboranes and metallo carboranes
CO 2	Explain structural aspects of metallic clusters and polyanions of important compounds
CO 3	Explain different cubic systems , application of Bragg's equation and X-ray powder method in identifying inorganic crystalline solids
CO 4	Identify various crystal structures and their defects , learn principles and application of liquid crystals
CO 5	Understand Diffusion mechanism in solids , Band theory of solids, super conductors , Magnetic and optical properties of solids, concept of Hysterisis and determination of magnetic susceptibility by Guoy and Faraday methods

Mapping :Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	2
CO 2	2	3	2	2	2
CO 3	3	3	2	2	1
CO 4	3	3	2	2	1
CO 5	2	2	2	2	1
Average	**2.6**	**2.8**	**2.2**	**2.2**	**1.4**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Lecture (Chalk & Talk), Flipped learning, Seminar

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER-II

Title of the course: Core-6 Physical Chemistry-II

Teaching hours: 15 × 4 = 60 **Credits: 4**

Course Code: 6P18/2C/PC2 **L T P 3 1 0**

Objectives:

1. To study the concepts and applications of quantum Chemistry .
2. To study the approximation methods in quantum chemistry
3. To study chemical bonding in diatomic molecules and HMO theory
4. To study the kinetics of complex reactions and methods to study fast reactions
5. To study various adsorption isotherms and mechanisms of Heterogeneous catalytic reactions

COURSE OUTLINE

UNIT I : Quantum Chemistry I: wave equation for electrons, the wave function and its physical meaning. Functions and operators- eigen function, eigen values, Hamiltonian operator, angular momentum operator- commutation of operators. Hermitian property of operators. Basic postulates of quantum mechanics. Application of quantum mechanics-particle in a 1Dbox, three dimensional box and simple harmonic oscillator. Application of quantum mechanics- particle in a ring, rigid, rotator, hydrogen atom. Complete wave function of hydrogen like atoms, significance of quantum numbers n,l.m, physical representation of the orbitals, radial distribution, points of maximum probability, angular probability distribution. **12hrs**

UNIT II: Quantum Chemistry II: Approximation methods-variation method and perturbation method-application to hydrogen and helium atom. Symmetric and anti-symmetric wave function, general principles of setting up of wave function for many electron atoms- Pauli's principle –Slater type orbitals. Hartree and Hartree Fock SCF method.

12hrs

UNIT III: **Quantum Chemistry III**: Chemical Bonding-Born-Open Heimmer approximation. VB and MO treatment of H_2 and H_2^+, MO theory for homo nuclear and hetero nuclear diatomic molecules. HMO calculations for simple molecules like ethylene, butadiene and cyclobutadiene. Evaluation of co-efficients and eigen values for simple molecules, electron density, bond order an free valence index**.** **12hrs**

UNIT IV: **Chemical Kinetics III**: Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions. General treatment of chain reactions-chain length , kinetics of $H_2 – Cl_2$ & $H_2 – Br_2$ reactions - Rice Herzfeld mechanism, explosion limits. Study of fast reactions-relaxation methods- temperature and pressure jump methods electric and magnetic field jump methods -stopped flow and flash photolysis methods. **12 hrs**

UNIT V: Chemical kinetics IV: Adsorption isotherms-Freundlich, Langmuir and BET adsorption isotherms, surface area-determination, sticking probability, adsorption co-efficient and its significance Mechanism of heterogeneous catalytic reactions-Langmuir-Hinshelwood, Langmuir-Rideal mechanism-unimolecular and bimolecular surface reactions. Catalysis by metals and semiconductor oxides. **12hrs**

RECOMMENDED TEXT BOOKS:

1. Quantum Mechanics in Chemistry, R.K. Prasad Wiley Eastern, New Delhi 1992
2. Quantum Mechanics in Chemistry, M.W.Hanna W.A.Benjamin Inc., London,
3. K.J.Laidlar –Chemical Kinetics, Harper and Row, Newyork, 1987 J.Rajaram
4. J.C.Kuriacose- Kinetics of Mechanism of Chemical Transforamtions, Macmillan India Ltd., 1983

REFERENCE BOOKS:

1. A.K.Chandra- Introductory Quantum Chemistry, Tata Mc Graw Hill.
2. Quantum Chemistry, D.A.Mc Quarrie University Science Books, Mill Valley California, 1983
3. Molecular Quantum Mechanics, P.W.Atkins Oxford University Press, Oxford, 1989
4. W.J.Moore- Physical Chemistry, Orient Longmann, London, 1972
5. Physical Chemistry Volume 1: Thermodynamics and Kinetics, Peter Atkins, Julio de Paula, 9th edition.
6. Physical Chemistry, G.W. Castellan, 3rd Edition, Narosa Publishing House, 2004

PERIODICALS:

1. Resonance- Journal of science education
2. Span
3. Indian academy of sciences-proceedings- Chemical Sciences
4. Current Science
5. Journal of Indian chemical education
6. Journal of American chemical society
7. Bulletin of material science

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. Mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com
7. http://antoine.frostburg.edu/chem/senese/101/quantum/index.shtml

COURSE OUTCOMES:

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Analyze the need for quantum mechanics, relate quantum mechanical operators to observables and the use of operator algebra to solve simple eigen value equations, relate molecular phenomena viz translational, rotational and vibrational motion to model systems and solve Schrodinger equation to arrive at the eigen values
CO 2	Derive eigen values and wave functions of H and He atom using approximation methods. Concept of antisymmetric wave function and solve Hartree and Hartree Fock equation for helium atom
CO 3	Apply Molecular orbital and valence bond treatment to simple homonuclear diatomic molecules- H_2^+ & H_2 , MOT of higher diatomic molecules, HMO treatment of simple conjugated systems
CO 4	Gain knowledge about kinetics of complex reactions and fast reactions.
CO 5	Distinguish various adsorption isotherms and heterogeneous catalyst reactions.

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	2	2	2	1
CO 2	3	2	3	2	1
CO 3	3	2	3	2	1
CO 4	3	2	3	2	1
CO 5	3	2	2	2	1
Average	**3**	**2**	**2.6**	**2**	**1**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Lecture (CHALK & TALK), Power Point presentation, Sharing online interactive sessions, videos in the classroom, Sharing web links

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER-II

Title of the course: Major Elective 2 Spectroscopy

Teaching hours: 15 x 4 =60 **Credits: 3**

Course Code: 6P18/2E2/SPE **L T P 3 1 0**

Objectives:

1. To understand the concepts of IR, UV, Raman, Mass, PES, NMR, EPR, Mossbauer spectroscopy.
2. To learn the principles of the techniques.
3. To apply the fundamentals to various systems .
4. To study the applications of the tools .
5. To determine the structure of organic and inorganic compounds.

UNIT I : Infrared Spectroscopy: Introduction-Origin- Fundamental modes, overtones combination and difference bands Fermi resonance. Selection rule-anharmonicity of vibrations-Normal coordinate analysis (brief outline)- choice of solvents-Base line correction-standard for calibration of the instrument – Application of IR to complexes of metals with isocyanides, carbonyls and nitrosyls. Different modes of binding of acetate, thioacetate and DMSO. Urea (amides) and amino acids, DMG as a ligand. Ethylene and acetylene complexes, Evidence for extensive pi bonding in these complexes. Isotopic labeling D^2 ,N^{15} and C^{13} and applications.

12hrs

UNIT II UV absorption Spectroscopy: Electronic spectra of diatomic and polyatomic molecules – Franck – Codon principle – determination of dissociation energy – predissociation spectra – selection rules- types of electronic transitions – effect of conjugation and solvent – chromophores. Auxochromes, Bathochromic and Hypsochromic Shifts. Applications in organic structure determination – Woodward – Feiser rules for conjugate systems and unsaturated ketones. **Raman Spectroscopy:** Stokes- Antistokes lines classical theory- selection rule, polarisibility ellipsoids-quantum theory-polarization of scattered radiation-depolarization ratio-Assignment of bands-Laser Raman-Ruby Laser- Instrumentation –Resonance Raman effect- Application- Study of solution equilibria-Detection of dimeric species like Hg_2^{2+}, N_2O_2 .

12 hrs

UNIT III:Mass Spectroscopy: Basic principles.Theory- Instrumentation -ion production. Electron Impact technique- CI Mass spectrometry-Field desorption-FAB and SIMS-Mass analyzer,-Mass spectrometers Molecular ion,Fragment ions,Meta stable peaks-McLafferty rearrangement-Fragmentation pattern in alkanes,alkenes,alkynes,alcohols & aromatic alcohols, phenols, Toluene, aldehydes and ketones. **Photo electron spectroscopy:** Introduction-UV/XPES Instrumentation. Ionization from bonding, antibonding and non bonding MO-UVPES data/spectrum of H_2 N_2

and O_2-XPES data/spectrum of O_2, N_2 and application of Koopman's theorem Spin Orbit coupling-photo electron spectrum of Xe, Kr, Ar etc and UV PES of HCl, HBr and HI. Spin spin coupling O_2, NO molecules- Jahn Teller & Renner Teller distortions- NH_3, CH_4, UVPES data, Satellite signals- Auger lines- Binding energy- Oxidation state correlation-Errors in binding energy , data correction . **12 hrs**

UNIT IV: Nuclear Magnetic Resonance : Origin chemical shift- dependence on filed-spin spin coupling. One bond, two bond, three bond and higher order coupling constants. Sample data from ^{31}p-^{31}p, ^{13}C- ^{1}H, ^{31}p-^{19}F coupling. Dependence of coupling constant on 's' electron density. Decoupling and off Resonance-NOE effect-factors contributing to it. Systems like $PF_3(CH_3)_2$, $PF_3(CF_3)_2$. NMR temperature variation- time scale- Relaxation, effect of Quadrupolar nuclei Fluxional behaviour as applied to allyl, cyclopentadienyl systems-Inter and Intra molecular exchange. **12 hrs**

UNIT V: Electron spin resonance: Introduction-Electron Zeeman effect, Hyperfine interaction, structural information, EPR of Benzylanion, pyrazylanion, BH_3, Nephalauxetic effect-Data on simple complexes. Factors affecting EPR spectrum – Low symmetry fileds- Anisotropic 'g' and hyperfine constants. Zerofield splitting. **Mossbauer Spectroscopy** Origin-Isomer shift–correlation with S electron density, Quadrupolar splitting- ^{57}Fe and ^{119}Sn data. Time scale- Line width- Instrumentation- iron complexes, Low & high spin-iron carbonyls-prussiates- Turnbull's blue-structure –MB data correlation

12hrs

RECOMMENDED TEXT BOOKS:

1. Structural Methods in Inorganic Chemistry- EAV Ebsworth, D.Will Rankin, S.Cradock, Blackwell scientific publ(1987)
2. Physical methods in Inorganic Chemistry- Drago R.S.-Reinhold –1965
3. Infrared spectra of Inorganic and coordination compounds – Nakamoto k 2nd edn Wiley 1970
4. Basic principles of spectroscopy R.Chang, McGraw Hill, New york (1971)
5. Complexes of I row transition elements D.Nicholas
6. Introduction to Ligand field B.N.Figgis, John Wiley (Newyork) 1966
7. Fundamental of molecular spectroscopy, C.N.Banwell McGraw Hill Newyork 1966 Organic spectroscopy by William Kemp 3rd edn W.H.Freeman & Co, 1991 Spectroscopic methods in organic Chemistry by Silverstein Bassler
8. Instrumental method of analysis by H.Willard, W.Merrit, J Dean. 6th edn Van Nostrand 1981

REFERENCE BOOKS:

1. Inorganic Electronic spectroscopy-A.B.P.Lever-Elsevier, Amsterdam (1984)
2. Physical methods in advanced inorganic Chemistry, H.A.O Hill and P.Day, John Wiley (1968)
3. Coordination Chemistry Experimental methods, J.K.Burger butterworths (1973)

PERIODICALS:

1. Resonance- Journal of science education
2. Applied Spectroscopy
3. Indian academy of sciences-proceedings- Chemical Sciences
4. Current Science
5. Journal of Indian chemical education
6. Journal of American chemical society
7. Bulletin of material science

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com
7. **www.spectro.com**

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Learn the principle of Infra-red and Raman spectroscopy, correlate with the molecular modes of vibration and apply the rules to interpret the spectra of organic and inorganic molecules
CO 2	Learn the concept and rules of electronic transitions in organic molecules and their correlation with UV absorption and emission spectroscopy
CO 3	Learn the principles and application of spin resonance of electron and nuclei of H, C,P, F in terms of EPR and NMR spectroscopy respectively for structural elucidation
CO 4	Analyze and apply the rules of Mass spectroscopy for the fragmentation pattern in different types of organic functional groups
CO 5	Learn the skill to decode the Photo electron and x ray Photo electron spectra in terms of binding energy, spin orbit coupling and spin - spin coupling

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	2	2
CO 2	3	3	3	2	2
CO 3	3	3	3	2	3
CO 4	3	3	3	2	1
CO 5	3	3	3	2	2
Average	**3**	**3**	**3**	**2**	**2**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Lecture (Chalk & Talk) , Seminar, Flipped Learning ,

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER – II

Common to I M.A /M.Sc/M.Com

Title of the course: Non Major Elective 1-Cosmetology

Teaching hours: 15 x 4 = 60 **Credits: 3**

Course Code: 6P18/2E/COS **L T P 3 1 0**

Objectives:

1. To improve one's own personal appearance and develop self confidence.
2. To develop skill in cosmetology.
3. To acquire knowledge about chemicals in cosmetics
4. To learn the facial procedures in cosmetology
5. To understand the usage of cosmetics and Quality control of cosmetics.

COURSE CONTENT

UNIT I : **Personality development**: Self analysis, grooming, professional behavior, personality development. Skin care-theory of massage, facials, facial manipulate one, skin treatment, Infect control for esthetics. Make-up-purpose and types, corrective make-up, optical illusion.

12hrs

UNIT II: **Face creams** : Types of face creams-cold, vanishing, cleaning and bleaching creams-preparation and application. Hand lotions and creams-simple method of preparation. **Bleaching:** Bleach, facial, facial massage- Herbal and synthetic applications, manicure, pedicure, waxing,

12hrs

UNIT III: **Powders:** Face powders, constituents in alcum powders-preparation and application. **Nail care**: Nail preparation-nail lacquer, nail enamels and nail bleach. **Oils:** Importance of Essential oils: Rose oil, almond oil, Ecalyptus oil, sandal wood oil in cosmetic industries. **12hrs**

UNIT IV : **Hair caring :** Hair oils and hair creams, hair conditioning, hair cut, hair style,. hair colouring, hair dye. **Shampoos and shampooing**: Types of shampoos, liquid, emulsion, paste or powder, ingredients. **12hrs**

UNIT V : **Hair removing techniques**: temporary removal of hair- depilation processs and epilation process-permanent removal of hair. . Hazards of cosmetics and quality control of cosmetics. **12hrs**

RECOMMENDED BOOKS:

1. Reagents/Prentice Hall –Text book of Cosmetology by Mary Healy Eastern Economy Edition.
2. The complete book of beauty care – Aruna Anand

COURSE OUTCOME

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Develop positive attitude and a sense of personal integrity, practice proper grooming, skin care, massage, facial and make-up purposes
CO 2	Gain knowledge and practical skills on usage of face creams, lotions, bleaching, manicure, pedicure and waxing
CO 3	Learn skills in preparation and applications of face powder, nail care and importance of essential oils
CO 4	Learn knowledge on hair caring techniques and shampooing
CO 5	Acquire skill on hair removing techniques, cosmetic hazards and quality control

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	1	1	2	3
CO 2	3	3	1	2	3
CO 3	3	1	3	2	3
CO 4	3	3	1	3	3
CO 5	3	3	1	3	3
Average	**3**	**2.2**	**1.4**	**2.4**	**3**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Lecture (Chalk & Talk), Seminar

SEMESTERS I & II

Title of the Course: Core 7: Practical 1 - Organic Chemistry (Qualitative and Quantitative Analysis)

Teaching hours: 30 x 4 = 120 **Credits: 4**

Course Code: 6P18/2C/PR1

I Spectral Interpretation of Organic Compounds. UV, IR, PMR and Mass Spectra of 15 Compounds.

1. 1,3,5-Trimethylbenzene
2. Pinacolone
3. Propyl amine
4. p-Methoxybenzyl alcohol
5. Benzyl bromide
6. Phenyl acetone
7. 2-Methoxyethyl acetate
8. Acetone
9. Isopropyl alcohol
10. Acetaldehyde diacetate
11. 2-N, N-Dimethylamino ethanol
12. Pyridine
13. 4-Picoline
14. 1, 3 dibromo-1, 1-dichloropropene
15. Cinnamaldehyde

II Qualitative Analysis

Qualitative analysis of an organic mixture containing two components – Separation, identification and preparation of derivatives. Determination of melting point/Boiling of the purified components and melting point of the derivatives.

III Quantitative Analysis

1. Estimation of Aniline.
2. Estimation of Phenol.
3. Estimation of Glucose.
4. Estimation of Ketone.

*5. Saponification value of an oil.

*6. Iodine value of an oil.

***IV Two stage preparations**

1. Preparation of para bromo Acetanilide from Aniline.
2. Preparation of Benzanilide from Benzophenone.
3. Preparation of m-nitro Benzoic acid from Methyl Benzoate.
4. Preparation of symmetrical tri-Bromo Benzene from Aniline.

***V Extraction of natural products**-purification and spectroscopic identification by UV-visible and FTIR.

1. Isolation of Citric acid from lemon.
2. Isolation of Caffeine from tea leaves.
3. Isolation of Lactose from milk.

*For internal assessment only.

***Note:** Characterization by UV & IR spectra for the preparation

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Acquire skill and expertise in the separation of Organic mixtures , purification and identification of components
CO 2	Design single and multistage synthesis of complex organic compounds and execute them in the laboratory
CO 3	Apply skill in spectroscopic interpretation to elucidate structure of organic compounds

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	2
CO 2	3	3	3	3	2
CO 3	3	3	3	2	2
Average	**3**	**3**	**3**	**2.6**	**2**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Hands on Practical training & Demonstration, Discussion on the first principles

END SEMESTER PRACTICAL EXAMINATION

I M.Sc CHEMISTRY SEMESTERS I & II

QUESTION BANK

Title of the Course: Core 7 Practical 1- Organic Chemistry -
(Qualitative & Quantitative analysis) Max: 60 marks

Course Code: 6P18/2C/PR1 Time: 6 hrs

Total marks: 100 (40 CA+60 End semester)

1. Analyse the given spectra with the data given and identify the compound.

2. Analyze systematically the given organic mixture and report the nature of the two components after pilot separation.

Analyze the two components separately and report the following.

a. Aromatic/aliphatic

b. Presence/absence of elements nitrogen, sulphur and halogens.

c. Saturated/unsaturated.

d. Functional group

e. Melting point or Boiling point of separated components

f.Melting points of the derivatives

Exhibit the color reactions and the derivatives.

3. Estimate the amount of aniline present in the whole of the given solution. You are provided with an approximately decinormal solution of sodium thiosulphate.

3. Estimate the amount of phenol present in the whole of the given solution. You are provided with an approximately decinormal solution of sodium thiosulphate.

4. Estimate the amount of glucose present in the whole of the given solution. You are provided with an approximately decinormal solution of potassium permanganate.

5. Estimate the amount of ethyl methyl ketone present in the whole of the given solution. You are provided with an approximately decinormal solution of sodium thiosulphate.

Scheme of valuation

Total Marks 100- (CA 40 and End Semester 60)

Systematic analysis - 20 marks
Estimation - 20 marks
Spectral Interpretation – 10 marks
Record -5 marks
Viva voce -5 marks
Total - 60 marks

1. Systematic analysis - 20 marks (Pilot separation -4 marks + Components - 16 marks)

Analysis: (8 marks for component I and 8 marks for component II)

1. Aromatic/Aliphatic	-	1 marks
2. Saturation/Unsaturation	-	1 marks
3. Elemental detection	-	2 marks
4. Functional group	-	2 marks
5. Derivative	-	1 mark
6. Derivative melting point	-	1 mark
Total	-	8x2=16 marks

2. Estimation - 20 marks

up to 2% - 20
2.1- 3% - 15
3.1- 4% - 10
> 4% - 5

SEMESTERS I & II

Title of the Course: Core: 8 -Practical 2 - Inorganic Chemistry (Qualitative & Quantitative Analysis)

Teaching hours: **30 x 4 = 120** Hrs **Credits: 4**

Course Code: 6P18/2C/PR2

I **Qualitative Analysis** of a mixture containing two rare and two common cations.

Rare ions W, Se, Te, Mo, Ce, Th, Ti, Zr, V, Be, U and Li

Common ions Pb, Cu, Bi, Cd, Al, Zn, Co, Ni, Mn, Ba, Ca, Sr, & Mg

II **Quantitative Analysis of mixtures**

i.	Mixture containing Cu & Ni	Copper Volumetrically and Nickel gravimetrically
ii.	Mixture containing Cu & Zn	Copper Volumetrically and Zinc gravimetrically
iii.	Mixture containing Fe & Zn	Iron Volumetrically and Zinc volumetrically

iv Calorimetric Analysis-Spectrophotometric methods-Estimation of Fe, Ni, Mn & Cu

III ***Analysis of Alloys and Ores**

i. Analysis of Dolomite, Pyrolusite

ii. Analysis of Brass

* Only for internal assessment

IV ***Preparations**

i. Bis acetylacetonato copper (II)- Characterisation by IR, UV-VIS absorbtion studies in $CHCl_3$.

ii. Hexammine nickel (II) chloride-Study of electronic spectrum to calculate 10 Dq & Racah parameter.

iii. Tris thiourea copper (I) sulphate.

Note- * For Internal Assessment only

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Analyze qualitatively a mixture .containing two rare and two common cations
CO 2	Estimate quantitatively the binary mixtures of metallic ions by volumetric and gravimetric methods , Calorimetric estimation of ions (Fe, Ni, Mn and Cu).
CO 3	Develop skills to analyze some common alloys and ores.
CO4	Acquire skills to prepare inorganic complexes and characterization by IR and UV-VIS absorption studies

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	2
CO 2	2	2	2	2	2
CO 3	2	2	2	2	2
CO 4	2	2	2	2	2
Average	**2.2**	**2.2**	**2.2**	**2.2**	**2**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Hands on practical training & Demonstration

SEMESTER-II

Title of the Course: Internship

Teaching hours: 15 X 5 = 75 **Credits: 2**

Course Code: 6P18/2C/INT **L T P 0 0 0**

Course Objective

- To gain practical experience by working in a professional environment related to the subject
- To utilize the principles of different branches of chemistry to solve real-world problems. and ability to work in a team .
- To develop the skill to write the internship report

COURSE OUTCOMES:

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Integrate knowledge and skills learnt at the college in Industry / Research Institution
CO2	Develop ability to work in a team for scientific investigation and reporting as projects are of interdisciplinary type
CO 3	Demonstrate satisfactory ability to communicate rationally , logically, concisely, clearly and effectively the nature of the work done during internship programme

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	3	3
CO2	2	3	3	3	3
CO3	2	3	3	3	3
Average	2	3	3	3	3

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Hands on practical training

End Semester Practical Examination

I M.Sc Chemistry SEMESTERS I & II

Question Bank

Title of the Course: Core 8- Practical 2 - Inorganic Chemistry (Qualitative & Quantitative Analysis) **Max Marks: 60**

Course Code: 6P18/2C/PR2 **Time: 6hrs**

1. Analyze the given mixture systematically and report two common and two rare cations.
2. Estimate the amount of copper volumetrically and nickel gravimetrically, present in the whole of the given solution.

or

3. Estimate the amount of copper volumetrically and zinc gravimetrically, present in the whole of the given solution.

or

4. Estimate the amount of iron volumetrically and zinc also volumetrically, present in the whole of the given solution.
5. Estimate the amount of metal ions Cu /Ni /Mn /Fe colorimetrically

SCHEME OF VALUATION

Total Marks 100 (CA -40 marks and End semester - 60 marks)

Qualitative Analysis 5 x 4 (20 marks)

Quantitative Analysis 2 x 10 (20 marks) (Gravimetric 10 marks + Volumetric 10 marks) or Calorimetric Analysis (20 marks)

Viva	10 marks
Record	10 marks
Total marks	60 marks

Volumetric /Gravimetric Estimation

ERROR UPTO 2 %	10 marks
2.1-3	8 marks
3.1-4	6 marks
>4	5 marks

	SEMESTER – III								
Course Code	**Name of the Course**	**L T P**	**Hours /Week**	**Credits**	**TOTAL HOURS**	**Exam Hours**	**Marks**		
							CA	**SE**	**Total**
6P18/3C/OC3	Core 9 - Organic Chemistry – III	3 1 0	4	4	60	3	40	60	100
6P18/3C/IC3	Core 10 - Inorganic Chemistry – III	3 1 0	4	4	60	3	40	60	100
6P18/3C/PC3	Core 11- Physical Chemistry – III	3 1 0	4	4	60	3	40	60	100
6P18/3E3/PHC	Major Elective 3- PhotoChemistry	3 1 0	4	3	60	3	40	60	100
6P18/3E/FDP	Non Major Elective -2 Fibre Fabrics , Dyeing and Printing of Textiles	3 1 0	4	3	60	3	40	60	100
6P18/4C/PR3	*Core Practical III – Physical Chemistry	-	4	-	120	-	40	60	100
	*Core - Project	-	4	-	-	-	40	60	100
6P18/3S/LSS	Soft Skill 3- Laboratory Safety Skills	2 0 0	2	2	30	2	-	50	50
Total			**30**	**20**					

L = Lecture hours, T = Tutorial hours, P = Practical hours, CA = Continuous Assessment marks, SE = End semester Marks *Practical Examinations are conducted once in a Academic year ie at the end of II & IV Semester

SEMESTER - III

Title of the Course: Core 9 -Organic Chemistry-III

Teaching hours: 15 x 4 = 60 **Credits: 4**

Course Code: 6P18/3C/OC3 **L T P 3 1 0**

Objectives:

1. To study the structure, properties and synthesis of natural products like alkaloids proteins, flavonoids, steroids, and terpenoids
2. To study the structure and role of nucleic acids
3. To introduce the basics of supra molecular chemistry
4. To study the synthesis and properties of heterocyclic compounds like Pyrazole,Oxazole and Thiazole and its derivatives
5. To study the Biosynthesis of Nucleotides.

COURSE OUTLINE:

UNIT I: **Heterocyclic Compounds:** Nomenclature, synthesis and properties of pyrazole, imidazole, oxazole, isoxazole, thiazole, isothiazole, benzimidazole, benzoxazole, benzthiazole. **12hrs**

UNIT II: A**lkaloids and Proteins**: Total synthesis of quinine, morphine reserpine. (No Structural elucidation). Peptides and their synthesis-(Synthesis of any tripeptide using glycine, alanine, lysine, cystine, glutamic acid and argenine). Solid Phase Peptide synthesis-Merrified synthesis, Determination of primary structure of a protein, secondary tertiary and quaternary structure of proteins **12hrs**

UNIT III: **Flavanoids-**Synthesis of the following (synthesis of parent compounds and simple hydroxy and methoxy substituted derivatives only) and products obtained on fusion with KOH or boiling with ethanoic KOH or $Ba(OH)_2$

- Flavones- Flavone, Chrysin, Apigenin and Luteolin
- Flavonols- Flavonol, Quercetin
- Isoflavones- Isoflavone, Daidzein
- Cyanidin Chloride and Cyanin Chloride
- Delphinidin Chloride and Delphin Chloride
- Malvidin Chloride and Malvin chloride and
- Hirsutidin Chloride and Hirsutin Chloride
- Distinction of Flavonoids by using characteristic colour reactions and absorption spectra (UV and visible)
- Relationship between Quercetin and Cyanidin Chloride

12hrs

UNIT IV: **Terpenoids**: Synthesis of Vitamin A (Reformatsky and Wittig reaction methods only) and carotenes- biological functions. Steroids- Elucidation of structure of Cholesterol and Oestrone. Conversions of Cholesterol to Progesterone, Testosterone and Oestrone **12hrs**

UNIT V: **Bio-organic Chemistry:** Structure and role of (genetic code) DNA and RNA. Structure, name and representation of Nucleotides and Nucleosides (Structural Elucidation not necessary). Structures of products of hydrolysis of DNA and RNA- Action of dilute acid and alkali. Replication and protein synthesis. Nucleotide monophosphate (NMP), diphosphate (NDP) and triphosphate (NTP). ATP as currency of energy. Bio Synthesis of Nucleotides (No chemical synthesis)-DeNovo and salvage synthesis and synthesis of pyridimine and purine derivatives-Adenine, Guanine, Cytosine, Uracil and Thymine (Chemical synthesis only). Biosynthesis of cholesterol. Supramolecules-General methods of synthesis and application of supramolecules. **12hrs**

RECOMMENDED TEXT BOOKS:

1. Organic Chemistry- Volume I and II, L.L.Finar, 5th Edition, ELBS publication
2. Organic Chemistry of natural products by Gurdeep Chatwal Volume I and II
3. Chemistry of organic natural products by Agarwal, Geol Publishing House
4. Chemistry of natural products by P.S. Kalsi

REFERRENCE BOOKS:

1. Stanley H.Pine, Organic Chemistry, 4th edn Mac Graw Hill
2. Outlines of Biochemistry V Edition by Eric E. Conn, Paul. R. Stumpf, George Bruening and Roy H. Dole, John Wiley and Sons.
3. Principles of Biochemistry General aspects by L. Smith, Robert L. Hill I. Robert Lehman, Robert J. Let Rowitz, Philip Handlar and Abrahim white. McGraw Hill Int. (7th Edition)
4. Biochemistry by Lubert Stryer, WH. Freeman and Co., New York
5. Chemistry of alkaloids by Pelletier. .
6. Introduction to Alkaloids by G.A. Swan
7. Introduction to Chemistry of Heterocyclic compounds by R.M.Acheson, interscience publishers
8. Heterocyclic Chemistry by T.L.Gilhrist, Longman Scientific and Technical (1991)
9. Heterocyclic Chemistry by Raj Bansal, Wiley Eastern Ltd.Jonathan W. Steed, Jerry. L. Atwood, Supramolecular Chemistry, John Wiley & Sons, 2002

PERIODICALS:

1. Journal of Organic Chemistry
2. Indian Journal of Chemistry B
3. Current Science
4. Organic Letters
5. Tetrahedron Letters

WEBSITES & e-LEARNING SOURCES

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Describe nomenclature , synthesis and properties of heterocyclic compounds
CO 2	Elucidate the structure of alkaloids , apply the principles of peptide synthesis to synthesize a tripeptide , understand the different levels of structure of proteins and its properties
CO 3	Describe the preparation , properties of flavonoids, anthocyanidins and compare the UV- Visible spectrum of flavonoids
CO 4	Study the structure and synthesis of vitamin A , carotenes & cholesterol and methods of inter conversion of cholesterol to hormones .
CO 5	Discuss structure of DNA &RNA , its properties , synthesis and application of supramolecules. **,** biosynthesis of cholesterol and supra molecules.

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	2	3	3	2
CO 2	3	3	2	3	2
CO 3	3	3	3	2	2
CO 4	3	2	3	2	2
CO 5	3	3	2	2	3
Average	**3**	**2.6**	**2.6**	**2.4**	**2.2**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Lecture (Chalk& Talk) , Seminar,

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER – III

Title of the course: Core -10 Inorganic Chemistry-III

Teaching hours: 15 x 4 = 60 **Credits: 4**
Course Code: 6P18/3C/IC3 **L T P 3 1 0**

Objectives:

1. To focus on Electro analytical chemistry as applied to metal complexes
2. To study in detail the Analytical separation techniques
3. To create awareness to carry out qualitative and quantitative estimation of ions using modern instrumentation techniques
4. To focus on macrocyclic ligand systems with special emphasis on bioinorganic chemistry
5. To introduce research mind in the field of coordination chemistry

COURSE OUTLINE

UNIT I : **Analytical Chemistry**: Polarography- Theory apparatus, DME, Diffusion, Kinetic and catalytic current, Voltage curve for reversible and irreversible systems, Qualitative and Quantitative-inorganic analysis. Amperometric titration-theory, apparatus, types of titrations and two indicator electrodes. Application-cyclic voltametry-theory, application to inorganic systems. Complexometric titrations- Types of EDTA titrations, direct and back titrations, replacement titrations. Masking and demasking agents. Coulometry: Coulometry-Theory, Apparatus, Different types, Applications -Coulometric titrations. **12 hrs**

UNIT II: **Analytical techniques**: Chromatography- Gas liquid chromatography, principles, retention volumes, instrumentation, carrier gas column, preparation, stationery phases, detectors, thermal conductivity, flame ionization, electron capture application of GLC. High performance in liquid chromatography, scope column efficiency, instrumentation- ion pumping system, column packing detectors- applications. Flame Photometry-Atomic absorption spectroscopy, theory, atomizers, flames atomically and electron thermal, instrumentation, spectral and chemical interferences applications. Thermal methods of analysis. Thermogravimetric analysis, differential thermal analysis, thermometric analysis. **12 hrs**

UNIT III : **Macrocyclic ligands**: Schiff's bases, Crown ethers, Cryptates, tetraaza ligands, catenands and spherands. Macrocyclic effect- template effect. **12 hrs**

UNIT IV: **Transport proteins & Oxygen carriers**-haemoglobin, myoglobin, hercrythrin-cytochromes, caroxy peptidase, carbonic anhydrase, biochemistry of Zn, Iron, Sulphur proteins. **12 hrs**

UNIT V : **Photosynthesis-** Chlorophyll, discussion on photosystems I & II. Vitamin B_{12}- Structure of corrin ring, function of vitamin. Role of Na, K, Ca, Mg & Cu. Fixation of nitrogen and nitrogenase enzymes. **12 hrs**

RECOMMENDED TEXT BOOKS:

1. K.F.Purcell and J.C.Kotz, Inorganic chemistry, SWB Saunders Co (1977)
2. J.E.Huheey, Harper and Collins, Inorganic chemistry, Ny IV edn
3. J.R.Chatwal, A.K.Bhogi, Bioinorganic chemistry, Himalaya publishers.
4. D.F.Shrivers and P.W.Atkins, Inorganic chemistry, oxford university press, 3rd edn 1999
5. D.Banerjea, Coordination chemistry, Tata McGraw Hill 1993
6. P.K.Bhattacharya, Metal ions in Bio chemistry, Narosa publishing House (2005)
7. D.A.Skoog, Principles of instrumental methods of analysis, Saunders coillage publication III Edition (1985)
8. Wilard Merrit, Dean and Settle, Instrumental methods of analysis, CBS Publ, VI Edition (1986)
9. Vogal, Text book of qualitative inorganic analysis, ELBS III Edition, (1976) and IV Edition (1985)
10. D.O.Halls, K.K.Rao, Photosynthesis, Vedn Cambridge University press
11. Bertini, H.B.Gray, S.J.Lippard, Bio inorganic chemistry, J.S.Valentine (ed) - University Science Books, mill valley (1994)
12. Bioinorganic enzymology, Chem.Rev.7 (1996)

PERIODICALS:

1. Resonance- Journal of science education
2. Span
3. Indian academy of sciences-proceedings- Chemical Sciences
4. Current Science
5. Journal of Indian chemical education
6. Journal of American chemical society
7. Bulletin of material science

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Gain and apply the knowledge in working of various techniques such as polarography coulometry, voltammetery to simple systems
CO 2	Demonstrate an understanding of various chromatographic techniques and its applications ,principle and applications of Flame Photometry, Thermogravimetric analysis , ability to select and use appropriate analytical separation techniques.
CO 3	Outline and discuss the structure and properties of various macrocyclic ligands.
CO 4	Explain various proteins associated in transportation of ions , solutes inside and between the cells.
CO 5	Solve problems related to plant growth, crop production and natural resource management

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	2	2
CO 2	3	3	3	2	2
CO 3	3	2	3	3	3
CO 4	3	3	2	2	2
CO 5	2	2	2	2	2
Average	**2.8**	**2.6**	**2.6**	**2.2**	**2.2**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Lecture (Chalk& Talk) , Seminar, Flipped learning

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER - III

Title of the course: Core 11-Physical Chemistry-III

Teaching hours: 15 x 4 = 60 **Credits: 4**

Course code: 6P18/3C/PC3 **LTP 3 1 0**

Objectives:

1. To understand the theory of relationship between microscopic and macroscopic phenomena.
2. To study the thermodynamic properties of single molecules and their interaction with their bulk counterparts.
3. To study the thermodynamic aspects and applications.
4. To study the Phase equilibria of three component systems.
5. To study the thermodynamic aspects of Phase Transitions

COURSE OUTLINE

UNIT I: **Statistical Thermodynamics I:** Objectives of statistical thermodynamics-concept of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles. Assemblies, ensembles, canonical particles. Maxwell- Boltzmann, Fermi-Dirac & Bose-Einstein Statistics- comparison and applications. Modes of contribution to energy, Maxwell's law of distribution of molecular speeds, graphical representation, experimental verification, derivation of expressions for average, most probable and root mean square velocity. **12hrs**

UNIT II: **Statistical Thermodynamics II:** Partition functions-evaluation of translational, vibrational and rotational partition functions for monoatomic, diatomic and polyatomic ideal gases. Thermodynamic functions in terms of partition functions- calculation of equilibrium constants from partition functions, isotope exchange and dissociation of diatomic molecules. **12hrs**

UNIT III: **Statistical Thermodynamics III:** Applications of partition function to heat capacities of ideal gases-heat capacity of solids-Einstein and Debye theory of heat capacity of solids. Thermodynamics of black body radiation, Wein's-Stefan-Boltzmann law. **12hrs**

UNIT IV: **Phase Equilbria I:** Phase, Component, Degrees of freedom- Gibbs phase rule-derivation. Roozeboom plots, Scheme of triangular plot-method of parallel lines, direct method & Lever rule method, Systems of three liquid components exhibiting partial miscibility – Formation of one pair, two pairs and three pairs of partial miscibility, effect of temperature. Ternary systems of two solid components and a liquid - Crystallization of pure components only. **12hrs**

UNIT V: **Phase Equilbria II:** Formation of binary compounds - hydrates and double salt-Congruently saturating and incongruently saturating, formation of

ternary compounds, solid solutions, solid solutions with partial miscibility, Salting out phenomena, Thermodynamic aspects of phase transitions, dependence of stability-temperature and pressure. Phase boundaries – solid-liquid, liquid-vapour and solid-vapour boundaries. The Ehrenferst classification of phase transition-I order II order phase transitions and lambda transitions. **12hrs**

RECOMMENDED TEXT BOOKS:

1. Chemical Thermodynamics: Classical, Statistical and Irreversible, Rajaram and Kuriakose, 2013 edition, Pearson Publications
2. M.C.Gupta- Statistical Thermodynamics, Wiley Eastern, New Delhi 1990
3. A Textbook of Physical Chemistry – K.L.Kapoor, Vol. 3, 2012 edition.

REFERENCE BOOKS:

1. Statistical Thermodynamics, M.Dole, Prentice Hall, Newyork, 1954.
2. Statistical Thermodynamics, N.O.Smith B.J.Clelland Chapman and Hall, London 1973 Elementary
3. Statistical Thermodynamics, a problems approach, Plenum Press, Newyork, 1980
4. The Phase rule and its applications: Alex Fixdlay, 3rd editions Longman Green and Co.
5. Physical Chemistry by Peter Atkins and Jullio de Paula, 10th edition Oxford press
6. Physical Chemistry, I.N. Levine, 5th Ed., Tata McGraw Hill Pub. Co. Ltd., New Delhi.

PERIODICALS:

1. Resonance- Journal of science education
2. Span
3. Indian academy of sciences-proceedings- Chemical Sciences
4. Current Science
5. Journal of Indian chemical education

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. Mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com
7. e – book Introductory Physical Chemistry by David Ronis, McGill University 2011

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Gain knowledge on basic concepts of ensembles, statistical probabilities in the filling of atomic and molecular energy levels, partition functions and their derivation.
CO 2	Acquire skill to relate molecular partition functions with thermodynamic and kinetic parameters and derive mathematical expressions
CO 3	Analyze and apply concepts of partition function to heat capacities of solids and gases, black body radiation
CO 4	Gain in-depth knowledge of concepts of phase equilibria and interpret the phase diagrams of simple and complex (ternary) systems
CO 5	Correlate the thermodynamic aspects of compound formation, phase transition and salting.

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	2	2	1
CO 2	3	3	3	2	1
CO 3	3	3	2	2	1
CO 4	3	3	3	1	3
CO 5	3	3	3	2	1
Average	**3**	**3**	**2.6**	**1.8**	**1.4**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Lecture (Chalk& Talk) , Power Point presentation , Seminar , Flipped Learning

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER-III

Title of the Course: Major Elective 3 - Photochemistry

Teaching hours: 15 x 4=60 **Credits: 3**

Course Code: 6P18/3E3/PHC **L T P 3 1 0**

Objectives:

1. To study the principles of photochemistry,
2. To study the fate of excited molecules – Jablonski diagram
3. To study the different types of Photochemical reactions and its applications.
4. To study the photochemistry of ketones and a few rearrangement reactions
5. To study the principles of orbital symmetry for different organic reactions

COURSE OUTLINE:

UNIT I: Fundamentals of Photochemistry: Interaction of electromagnetic radiation with matter. Absorption and emission of radiation, sources of irradiation and filters, internal and external methods of irradiation.Photochemical excitation-types of excitation, quantum yields and chemical actinometry. **12 hrs**

UNIT II: Fate of the excited molecules: exited state life time, singlet and triplet states-allowed and forbidden transitions. Jablonski diagram- radiative and non-radiative processes- internal conversion, inter system crossing, fluorescence and phosphorescence. Energy transfer process- sensitization, excimer and exciplex, Stern Volmer analysis -static and dynamic quenching. **12 hrs**

UNIT III: Applications of Photochemistry: Photophysical processes and kinetics of photochemical reactions-photoredox reactions, photo substitution reactions, photosensitized reactions- photo isomerisation reactions. Photo voltaic and photo galvanic cells, photo electrochemical cells, photo assisted electrolysis of water. Aspects of solar energy conversions. **12hrs**

UNIT IV: Organic Photochemistry: Examples for direct photolysis involving the singlet excited state and sensitized photolysis involving the triplet state. Introduction of a quencher to a photochemical reaction proceeding from the triplet state. Photochemistry of alkene-*cis-trans* isomerization. Study of photochemistry of ketones – Photoreduction of Ketones , Intramolecular reactions- Norrish Type-I and Norrish Type-II cleavages, saturated acyclic and cyclic carbonyl compounds. Re-arrangements of 1,4-dienes-di-pi-methane re-arrangement. Re-arrangement of □-□ unsaturated ketones-oxa-di-pi- methane rearrangement. Intermolecular cycloaddition reaction of ketone-Paterno- Buchi reaction, Barton reaction, Photo-Fries reaction.**12 hrs**

UNIT V: Pericyclic reactions: classification-orbital symmetry- Woodward Hoffmann rule- conrotation and disrotation. Electrocyclic reactions- thermal and photochemical cyclisations and ring openings- stereochemistry of electrocyclic reactions- FMO method and correlation diagram for butadiene-cyclobutene and 1,3,5- hexatriene-1,3 cyclohexadiene systems. Cycloadditions- thermal and photochemical-sterochemistry- FMO method and correlation diagrams of [2+2] and [4+2] cycloadditions and 1,3-dipolar addition Sigmatropic rearrangements- stereochemistry-thermal and photochemical- FMO method. Cope re-arrangement- stereochemistry-oxy-cope rearrangement, degenerate Cope re-arrangement-fluxional molecules-homotropylidene, barbarlone, bullvalene, Claisen rearrangement. **12 hrs**

RECOMMENDED BOOKS:

1. K.K.Rohatgi Mukherjee- Fundamentals of Photo Chemistry, Wiley Eastern Limited
2. Advanced Organic chemistry by J.March 5thedn Wiley Interscience 2001
3. Pericyclic reactions by Jagdamba Singh

REFERENCE BOOKS:

1. N.J.Turro- Modern Molecular Photo chemistry, Menio Park, California 1991
2. J.G.Calvert&J.N.Pitts- Photo Chemistry, Wiley, London 1996
3. R.P.Wayne- Photo Chemistry, Butterworths, 3 rdednLondon Oxford univ press, 2000
4. R.P.Gundell&A.Gilbert- Photo chemistry, Thomas Nelson, London
5. Molecular Reaction and Photo chemistry by Charles H.Depuy and Orvill E.L.Chapman, Prentice Hall of Indian Ltd., New Delhi
6. Organic Photo chemistry by Coxon and Halton 2ndedn Cambridge univ press, 1974
7. Pericyclic reactions by Mukherjee Mac Millan
8. Organic Photochemistry and Pericyclic reactions by Dr. Shankar Raman

PERIODICALS:

1. Journal of Organic Chemistry
2. Indian Journal of Chemistry B
3. Current Science
4. Organic Letters
5. Tetrahedron Letters
6. Journal of Indian chemical education
7. Journal of American chemical society

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Gain advanced knowledge on interaction of radiation with matter, principles of photochemistry and its applications.
CO 2	Demonstrate the difference between radiative and non-radiative transitions with the help of Jablonski diagram
CO 3	Explain kinetics of different types of photochemical reactions , acquire knowledge on photogalvanic cells ,photoelectrochemical cells and solar energy conversion
CO 4	Compare direct photolysis and sensitized photolysis reactions. Discuss the mechanism of photochemical reactions of ketones and photochemical rearrangement reactions
CO 5	Predict and formulate the outcomes of pericyclic reactions in terms of orbital interactions and/or the Woodward-Hoffmann Rules & FMO approach and explain fluxional behavior in molecules

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	1	2	2	2
CO 2	2	2	2	1	1
CO 3	3	2	2	2	3
CO 4	3	3	1	2	3
CO 5	3	3	1	2	3
Average	**2.8**	**2.2**	**1.6**	**1.8**	**2.4**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Lecture (Chalk& Talk, LCD), Flipped Learning – E Content, Videos, Problem solving, Seminar, Quiz, Flipped learning

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER- III

Common to II M.A/M.Sc/M.Com

Title of the Course: Non Major Elective 2 - Fibres, Fabrics,

Dyeing and Printing of Textiles

Teaching hours: 15 x 4 = 60 **Credits: 3**

Course Code: 6P18/3E/FDP **L T P 3 1 0**

Objectives:

1. To impart basic knowledge in Textile production from fibre to fabric stage
2. To stress the importance of Natural fibres and their applications
3. To give the students a theoretical knowledge in dyeing and printing
4. To gain knowledge on weaving & spinning methods
5. To inculcate entrepreneur skills in the students

COURSE OUTLINE

UNIT I: **Textile fibres:** Classification – Based on the origin of fibres- natural fibres of vegetable and animal origin- Manmade fibres- semi synthetic and synthetic fibres. Classification based on the thermal properties –thermoplastic and nonthermoplastic fibres. Man made fibresSemi synthetic fibres-characteristics and uses of cellulose acetate and cellulose triacetate – Arnel. Synthetic fibres-characterstics and uses of polyamides- Nylon 6,6 and Nylon 6-finishing nylon fabrics. **12hrs**

UNIT II: **Natural fibres of vegetable origin:** Cotton-types-cultivation-transformation of raw cotton to yarn- By products- mercerization, slack mercerization, Ammoniating-yarn twist, yarn count-composition and characteristics. Natural fibres of animal origin. Silk-silk producing countries, sericulture-cultivation of cocoons composition. Transformation of cocoons to silk yarn, degumming, weighting, spun silk, pure dye silk and wild silk, compostion and characteristics. **12hrs**

UNIT III: **Fabrics:** Classification of yarn Fabric construction-Spinning methods-Melt, dry and we spinning. Weaving-basic weaves-plain, variations of plain-basket, rib-twill and satin weaves. Identification of weaves and designs. **12hrs**

UNIT IV: **Dyes**: Classification – main types of synthetic dyes and their characteristics – basic methods and principles of dyeing. Dyeing cotton fabrics with Naphtha, direct, sulphur and vegetable dyes-wool-silk-nylon. **12hrs**

UNIT V: **Basic methods of printing and its applications**: direct printing, discharge printing and resist printing. Printing Block, roller, screen, transfer, Batik, resist, kalamkari, Tie and dye. **12hrs**

RECOMMENDED BOOKS:

1. Textile - Fabric to Fabrics - Dr. Bernad P. Lorbman.

PERIODICALS:

1. Resonance- Journal of science education
2. Span
3. Indian academy of sciences-proceedings- Chemical Sciences
4. Current Science
5. Journal of Indian chemical education
6. Journal of American chemical society
7. Bulletin of material science

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Classify fibres and demonstrate textile production from fibre to fabric
CO 2	Discuss the types of fibres and explain the cultivation and processing methods
CO 3	Demonstrate knowledge on weaving and spinning methods of fibre
CO 4	Comprehend classification of dyes ,methods and principles of dyeing of silk , cotton, wool and nylon
CO 5	Understand various methods of printing and its applications

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	2	3	3	3
CO 2	3	2	3	3	3
CO 3	3	2	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Average	**3**	**2.4**	**3**	**3**	**3**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Lecture (Chalk &Talk)

ESE Question Paper Pattern PG - Non Major Elective

Knowledge level	Section	Word Limit	Marks	Total
K3, K4	B – 8/10 x 5 Marks	250	40	100
K3, K4	C – 6/9 x 10 Marks	500	60	

SEMESTER- III

Title of the course: Soft Skill 3- Laboratory Safety Skills

Teaching hours: 15 x 2=30 **Credits: 2**

Course Code: 6P18/3S/LSS **L T P 2 0 0**

Objectives:

1. To study the safety measures involved in handling of chemicals.
2. To develop an awareness in first aid techniques.
3. To create an awareness in waste and fume disposals.

COURSE OUTLINE

UNIT I: **Storage and handling of chemicals**: carcinogenic chemicals, glove box, handling of ethers, toxic and poisonous chemicals, safe limits of vapour concentrations. Precautions for avoiding accidents, laboratory safety measures. **10 hrs**

UNIT II: **First aid techniques:** eye injuries, fire and burns, cuts, electric shock, poisoning treatment for specific poisoning, conc.H_2SO_4, carcinogens, hazards in laboratory, LPG-composition, characteristics, handling -gas leakage detector -fire extinguisher-principle and usage. **10 hrs**

UNIT III: **Waste disposal-** fume disposals, Fume cupboard. Nuclear reactor management-low level wastes, intermediate level wastes, high level wastes, ultimate disposal. Radioactive waste disposal**:** Radioactive wastes: sources of radioactive wastes-classification of wastes-treatment techniques for solid, liquid and gaseous effluents-permissible limits for disposal of wastes. Disposal of radioactice wastes: General method of disposal-management of radioactive in medical, industrial and research establishment. **10 hrs**

RECOMMENDED BOOKS:

1. Elements of Analytical Chemistry, Gopalan R, Rangarajan K, Subramanian P.S. 3rd edition, 2013
2. Source book on Atomic Energy,Samuel Glasstone, 3rd edition, 1979.

COURSE OUTCOMES
On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Apply safety precautions skills to store and handle various hazardous chemicals to avoid accidents in the laboratory.
CO 2	Use of first aid techniques and preparing for emergencies and incident reporting procedures.
CO 3	Learn waste treatment techniques , disposal management and utilize appropriate methods to dispose the waste properly. .

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	2
CO 2	2	3	2	3	2
CO 3	3	3	1	3	2
Average	**2.7**	**3**	**2**	**3**	**2**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Lecture Chalk& Talk) , Seminar , Flipped Learning

ESE Question Paper Pattern PG – Soft Skill

Knowledge level	Section	Word Limit	Marks	Total
K3, K4	A – 10/12 x 5 Marks	250	50	100

	SEMESTER – IV								
Course Code	**Name of the Course**	**L T P**	**Hours /Week**	**Credits**	**TOTAL**	**Exam Hours**	**Marks**		
					HOURS		**CA**	**SE**	**Total**
6P18/4C/OC4	Core 12 - Organic Chemistry – IV	4 1 0	5	4	75	3	40	60	100
6P18/4C/IC4	Core 13 - Inorganic Chemistry - IV	4 1 0	5	4	75	3	40	60	100
6P18/4E4/ECC	Major Elective 4 - Electrochemistry and Computational Chemistry	4 1 0	5	4	75	3	40	60	100
6P18/4E5/POC	Major Elective 5 - Polymer Chemistry	3 1 0	4	3	60	3	40	60	100
6P18/4C/PR3	*Core 14 Practical III - Physical Chemistry	-	4	4	120	6	40	60	100
6P18/4C/PRO	*Core 15 - Project	-	5	4	-	-	40	60	100
6P18/4S/SRP	Soft Skill 4- Scientific Research and Presentation Skills	2 0 0	2	2	30	2	-	50	50
		Total	**30**	**25**					
		Total Credits		**93**					

L = Lecture hours, T = Tutorial hours, P = Practical hours
CA = Continuous Assessment marks, SE = End semester Marks
*Practical Examinations are conducted once in a Academic year ie at the end of II & IV Semester

SEMESTER-IV

Title of the Course: Core 12-Organic Chemistry-IV

Teaching hours: 15 x 5 = 75 **Credits: 4**

Course Code: 6P18/4C/OC4 **L T P 4 1 0**

Objectives:

1. To study the concept of Retro synthesis and synthetic strategies of organic compounds
2. To study the principles of Green chemistry and Sonochemistry
3. To study the various important Name reactions in organic chemistry
4. To study the Synthesis of some important target molecules .
5. To study the aromaticity of annulenes and the different type of aromatic compounds.

COURSE OUTLINE

UNIT I: **Modern Synthetic Methodology-1:** Formation of C-C bond using alkylation and acylation of enamines, enolates, active methylene compounds and organo metallic compounds-RMgX, R_2LiCu, RLi, Pd complexes ,O-alkylation vs C-alkylation. Protection and deprotection of functional groups (R-OH, R-CHO, RCOR, R-NH_2 and R-COOH). Uses of the following reagents in organic synthesis: Trimethyl silyl chloride,1,3-dithiane (umpolung), (DIBAL). 9-BBN, tributyl tin hydride, LDA.

15 hrs

UNIT II: Modern Synthetic Methodology-2: An introduction to Retrosynthesis-Disconnections- Synthon- Nucleophilic, electrophilic and neutral and their Synthetic equivalent, Target molecule, Functional group interconversion Retro synthesis of simple molecules – alcohols, alkenes,carbonyl compounds, 1,2, 1,3, 1,4,1,5 & 1,6 dicarbonyl compounds. Formation of C-C bond using Pd & Ni catalyst – Heck reaction ,Sonogashira coupling ,Suzuki coupling , Kumada coupling, Negishi coupling and Stille coupling

15 hrs

UNIT III: Modern Synthetic Methodology-3: Synthesis of Target molecules- 5-hexenoicacid, bicycloheptan [4,1,0]-2-one,Cubane, Longifolene, Brufen, trans-9-methyl-1-decalone. Green chemistry- need for green chemistry, twelve principles, choice of starting materials, choice of reagents, choice of catalysts-bio catalysts and polymer supported catalysts (examples), choice of solvents Sonochemistry-principles, instrumentation applications in esterification, hydrolysis, substitution and addition reactions. Microwave assisted synthesis-Principles, instrumentation, limitations and precautions. Applicatons- deprotection of esters, C- and N-alkylation. **15 hrs**

UNIT IV: **Synthetic Applications of Name reactions:** Mannich, Darzen, Reformatsky reaction, Wittig reaction- Stabilisedand non- stabilized ylides, Diels Alder reaction,1,3-Dipolar addition, Hydroboration, Michael addition, Robinson annulation reaction (Stereochemical aspects to be studied wherever applicable).Typical formylation reactions-Gattermann-Koch, Gattermann, Vilsmeyer Haack and Riemer-Tiemann and Houben Hoesch reactions, Chichibabin reaction and Zeigler alkylation, Shapiro reaction. **15 hrs**

UNIT V: Aromaticity- Benzenoid, heterocyclic and non-benzenoid compounds, diatropic behaviour in NMR. Huckel's rule- aromatic systems with pi electron numbers other than six-anulene. Non aromatic (cyclooctatetraene) and anti aromatic systems- paratropic behaviour in NMR (cyclobutadiene) systems with more than 10 pi electrons- annulene-(18)-annulene. (Synthesis of all these compounds is not expected). Homoaromatic compounds. **15 hrs**

RECOMMENDED BOOKS:

1. Guide book to Organic Synthesis by Raymond K.Mackie and David M.Smith, ELBS Publication
2. W. Carruther, Jain Coldham, Modern Methods of organic synthesis, 4th Edition

REFERENCE BOOKS:

1. Advanced Organic Chemistry by Francis A. Carey and Richard J .Sundberg - Part A and Part B
2. Advanced Organic Chemistry by Pine, Cram and Hammond.
3. Organic synthesis by R.E. Ireland, Prentice Hall of India, Geol Publishing House.
4. Principles of Organic synthesis by R.O.C. Norman, Champan and Hall, NY, 1980
5. Stuart Warren, Work book for organic synthesis, The Disconnection Approach John Wiley & Sons (Asia) Pvt. Ltd.

PERIODICALS:

1. Journal of Organic Chemistry
2. Indian Journal of Chemistry B
3. Current Science
4. Organic Letters
5. Tetrahedron Letters

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Gain in depth knowledge in the formation of C-C bonds , protection and deprotection of functional groups and use of select reagents in organic synthesis
CO 2	Compile and demonstrate knowledge on Retrosynthesis and various terminologies , Retro synthesis of simple molecules – alcohols, alkenes and di carbonyl compounds , formation of C-C bond using different coupling reactions
CO 3	Outline the principles of green chemistry and explain the various protocols in organic synthesis . Design synthesis of target molecules from given organic starting materials at reasonably high-yields
CO 4	Explain the mechanism , stereochemical aspects and applications of various named reactions.
CO 5	Discuss the aromaticity of annulenes and study the structure and properties of different types of aromatic /antiaromatic compounds

Mapping : Course Outcomes with programme specific outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	2	2	2
CO 2	3	3	3	2	3
CO 3	3	3	2	3	2
CO 4	3	2	3	2	2
CO 5	3	2	3	2	3
Average	**3**	**2.6**	**2.6**	**2.2**	**2.4**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Lecture (Chalk& Talk), Problem solving, Seminar, Flipped learning

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER –IV

Title of the course: Core 13-Inorganic Chemistry- IV

Teaching hours: 15 x 5=75 **Credits: 4**

Course Code: 6P18/4C/IC4 **L T P 4 1 0**

Objectives:

1. To study some important aspects of organometallic chemistry
2. To study the industrial applications of organometalic catalyst
3. To introduce the principles and applications of Nuclear chemistry
4. To obtain knowledge about fission , fusion reactions and nuclear reactors

5 To introduce environmental problems and possible treatment Procedures

COURSE OUTLINE

UNIT I : **Organo metallic chemistry:** Carbon donors: alkyls and aryls: metallation, bonding in carbonyls and nitrosyls: Chain and cyclic donors. Olefin acetylene and allyl systems: synthesis: structure and bonding: metallocenes-ferrocene, Reactions: Fluxional molecules-study of allyl, allene, cyclooctatetraene, and cyclopentadienyl η^1 & η^5 systems-NMR evidence.Organometallic compounds of Litium.Beryllium, Megnesium,Boron and Alluminium **15 hrs**

UNIT II: **Catalysis:** hydrogenation of olefins (Wilkinsons catalyst) hydroformylation of olefins using cobalt or rhodium catalysts (oxo process), oxidation of olefins to aldehydes and ketones. (Wacker process): polymerization (zeigler natta catalyst): stereospecificity - mechanisms, cyclo oligomerization of acetylene using nickel catalyst (Reppe's catalyst): polymer bound catalysts. **15 hrs**

UNIT III: **Nuclear Chemistry I:** Nuclear properties- Nuclear spin and moments, origin of nuclear forces, salient features of liquid drop and the shell models of nucleus. Models of radioactive decay:-Orbital electron capture nuclear isomerism, internal conversion, detection and determination of activity by cloud chamber, nuclear emulsion, bubble chamber, G.M. Scintillation and Cherenkov counters. **15hrs**

UNIT IV: **Nuclear Chemistry II:** Nuclear reaction: Types, reaction, cross section, Q-value, threshold energy, compound nucleus theory, high energy nuclear reaction, nuclear fission and fusion reactions as energy sources, direct reaction, photonuclear and thermonuclear reaction, Nuclear reactors- Breeder

technology, reactions involved. Application relating to nuclear chemistry: Neutron activation analysis, radiopharmacology, autoradiography, isotope dilution analysis. **15 hrs**

UNIT V: Environmental Chemistry: Water treatment-primary, secondary and teriary stages in detail BOD-COD Ambient air quality standard- Allowed level, permissible limit, oxides of nitrogen, photochemical smog. Toxic chemicals in environment LD Toxicity of Hg, Pb, Cu. Analytical methods in environmental toxins- soil pollution-contamination of soil due to excess use of fertilizers-pH of the soil- Remedy. **15hrs**

RECOMMENDED TEXT BOOKS:

1. Text book of environmental chemistry by O.D.Thiyagi and M.Mehta, Anmol Publications Pvt Ltd (1996).
2. H.J.Arniker, Nuclear Chemistry, Wiley Eastern Co., II edition Wiley-Blackwell (1987)
3. F.A.Cotton and G.Wilkinson, Advanced inorganic chemistry, John wiley & sons (2007) VI edition
4. K.F.Purcelle and J.C.Kotz, Inorganic Chemistry, SWB sauders co., (1980)

REFERENCE BOOKS:

1. Comprehensive environmental studies by Dr.J.P.Sharma Laxmi Publications (2006)
2. Environmental chemistry by B.K.Sharma, 13 edition, Krishna's Educational Publications (2014)
3. Source books on atomic energy, S.Glasstone, Van Nostr and Co, Krieger Pub Co; 3 edition (1979)
4. Nuclear and Radiochemistry, G.Friedlander , J.W.Kenedy, J.M.Miller, John Wiley and sons (1981).
5. Principles of Organometallic chemistry, P. Powell, Springer Netherlands (1988)
6. Reaction Mechanism of Inorganics and organometallic Systems, R.B.Jordan, Oxford University Press (2007).
7. Organometallic chemistry, R.C.Mehrothra, A.Singh, New Age International Publishers Ltd.-New Delhi (2000)

PERIODICALS:

1. Resonance- Journal of science education
2. Span
3. Indian academy of sciences-proceedings- Chemical Sciences
4. Current Science

5. Journal of Indian chemical education
6. Journal of American chemical society
7. Bulletin of material science

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Gain knowledge on the structure, bonding and reactions of metallocenes and study of fluxional behavior
CO 2	Learn the mechanism of select reactions – hydrogenation , oxoprocess , Wacker process , Zeigler Natta polymerization catalysed by organometallic compounds and its applications
CO 3	Understand the basics of nuclear chemistry , detection and determination of radioactivity of elements
CO 4	Explain nuclear fission and fusion reactions & study the applications of nuclear chemistry in diverse fields.
CO 5	Demonstrate methods of water treatment in detail , ambient air quality standard , use of analytical methods to identify the toxins present in the environment and methods to eradicate.

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	2
CO 2	2	2	2	2	3
CO 3	2	2	2	2	2
CO 4	2	2	2	2	2
CO 5	2	2	2	2	1
Average	**2.2**	**2.2**	**2.2**	**2.2**	**2**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0 Teaching Methodology : Lecture (Chalk& Talk) ,Flipped Learning , Seminar

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER - IV

Title of the course: Major Elective 4 - Electrochemistry and Computational Chemistry

Teaching hours: 15 x 5 = 75 **Credits: 4**
Course Code: 6P18/4E4/ECC

L T P 4 1 0

Objectives:

1. To understand the concepts, principles and theories of ionic and electronic interactions in solutions
2. To explore thermodynamic models of electrode-electrolyte interface
3. To study the working and applications of electro chemical systems – Cells and Batteries
4. To derive the kinetics and the parameters affecting them
5. To understand first principles atomic structure using computational methods.

COURSE OUTLINE

UNIT I: **Electrochemistry I:** Ionics: Ions in solutions, true and potential electrolytes, ion – solvent , ion –ion interactions ,ionic strength- concept and calculations, Debye Huckel theory of strong electrolytes , Poisson equation, Poisson- Boltzman equation, activity co-efficient and mean ionic activity efficient of electrolytes, Debye Huckel limiting law - Derivation verification and its extensions, Debye Huckel Onsager equation- derivation and verification. 15 Hrs

UNIT II: **Electrochemistry II:** Electrodics: Electode-electrolyte interface, adsorption at electrified interface-electrical double layer, Structure of double layer- Helmholtz-Perrin, Guoy Chapmann and Stern models of electrical double layers. Thermodynamic derivation of electrified interfaces- Lippmann capillary equation- electro capillary phenomenon, Polarizable and Non Polarizable electrodes. Electrokinetic phenomenon- explanation of these phenomenon with the concept of forces and flux-Onsager reciprocity. **15 hrs**

UNIT III: Electrochemistry III: Electrodics- Butler Volmer equation for one step and multi step electron transfer reactions. Limiting cases- Tafel and Nernst equation. Significance of equilibrium exchange current density and symmetry factor, transfer co-efficient. Electrochemical (inorganic and organic) reactions of technological interest (one example each). **15 hrs**

UNIT IV: Electrochemistry IV: Mechanism of electrode reactions-polarizations and over potential –Corrosion and passivation of metals- Pourbaix (Iron and Lead systems only) and Evans diagrams, Theories of corrosion. Prevention from corrosion–anodic and cathodic protection, corrosion inhibitors. Electrochemical energy systems -primary and secondary batteries- dry cells, lead acid storage batteries, silver zinc cell, nickel cadmium battery, mercury

cell, fuel cells. Electrodeposition - principles and applications. **15 hrs**

UNIT V: **Computational Chemistry**:A brief outline of molecular mechanics, semi-empirical approximations, *ab initio* methods, basis sets and Z-matrix; Gaussian, Slater type. Density Function Theory- overview- Kohn Hohenberg and Kohn Sham equation (no derivation) Hartree -Fock calculations for determining electronic energies. Basic concepts of molecular dynamics and simulations. **15 hrs**

RECOMMENDED TEXT BOOKS:

1. S. Glasstone- Introduction to Electrochemistry, Affiliated East West press, New Delhi
2. D. R.Crow-Principles and Applications of Electrochemistry, Chapman and Hall.
3. Frank Jensen, Introduction to computational chemistry, 2nd edition, John Wiley & Sons Ltd. (2007)
4. C. J. Cramer, Essentials of Computational Chemistry: Theories and Models, John Wiley & Sons, 2002.
5. D. Young, Computational Chemistry: A practical Guide for applying Techniques to Real World Problems, Wiley Interscience, 2001.
6. A.R.Leach, Molecular Modelling: Principles and Applications, Pearson Education, 2001.
7. J. B. Foresman, A. Frisch, Exploring Chemistry with Electronic Structure Methods. Gaussian Inc., 1996.
8. M. P. Allen and D. J. Tildesley, Computer Simulations of Liquids, Oxford, 1987

REFERENCE BOOKS:

1. J.O.M.Bockris and A.K.N.Reddy-Electrochemistry-Vol I & II, Plenum, Newyork 1977
2. P.Delhay – Electrode Kinetics and structure of double layer interscience, New york, 1965
3. J.Robbins-Ion in solution-an introduction to electro chemistry, Clarendon press, Oxford (1972)
4. C.M.A.Brett and A.M.O.Brett –Electrochemistry principles, methods and applications, OUP,Oxford, 1993.
5. P.H.Rieger-Electrochemistry,Chapman and Hall, Newyork (1994)
6. R.L.De Koch and H.B.Gray – Chemical structures and Bonding, Benjamin/Cummings, Menlo Park, California.

PERIODICALS:

1. Resonance- Journal of science education

2. Span
3. Indian academy of sciences-proceedings- Chemical Sciences
4. Current Science
5. Journal of Indian chemical education

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. Mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com
7. http://ccl.osc,edu/ccl.cca.html
8. http://www.chem.swin.esu.au/chem_ref.html
9. http://www.colby.edu/chemistry/PChem/Lecture1.html
10. http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/electrode.html#c3

Computational chemistry software

11. SPARTAN
12. http:/www.wavefun.com
13. GAUSSIAN
14. www.gaussian.com
15. MOLPRO
16. www.tc.bham.ac.uk/morpro

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Familiarize the concepts of ion-ion interactions, ion solvent interactions, calculations of ionic activity and ionic strength
CO 2	Analyze and compare various thermodynamic models of electrode-electrolyte interface and derive mathematical equations.
CO 3	Derive mathematical expressions for electrocapillary, single and multi-step electrodics and exchange current density.
CO 4	Correlate the causes and control of corrosion using Pourbaix and Evans diagrams and to design primary and secondary batteries, dry cells with maximum energy efficiency
CO 5	Apply the tools of computational chemistry, calculate atomic and molecular energy levels using software tools and molecular modelling techniques.

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	2	3	1
CO 2	3	3	3	3	2
CO 3	3	3	3	2	1
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Average	**3**	**3**	**2.8**	**2.8**	**2**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Lecture (Chalk& Talk), Power Point presentation, Sharing online interactive sessions and Videos in the classroom, Sharing web links

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTER- IV

Title of the course: Major Elective-5 Polymer Chemistry

Teaching hours: 15 x 4=60 **Credits: 3**

Course Code: 6P18/4E5/POC **L T P 3 1 0**

Objectives:

1. To learn the theoretical concepts in polymer chemistry
2. To appreciate their significance and applications of polymers
3. To motivate the students to pursue research in polymer chemistry
4. To study the techniques for characterization of polymers
5. To study the mechanism of polymerisation

COURSE OUTLINE

UNIT I: Introductory Survey: Concept of Polymers, common terms used in Polymers-Classification of Polymers-natural and synthetic Polymers-condensation polymers, addition polymers, co-polymerization, polymerization of cyclic compounds- Inorganic Polymers-Techniques of polymerization- bulk polymerization-solution polymerization, suspension polymeriztion, emulsion polymerization, melt poly condensation-interfacial condensation-solid and gas phase polymerization and plasma polymerization. Polymer Structure- Co-polymers, Tacticity, Geometrical isomerism. **12hrs**

UNIT II: Mechanism and Kinetics of Polymerisation: Step Growth Polymerisation or Polycondensation Chain Polymerisation- Radical polymerization Anionic polymerization, Cationic polymerization, coordination polymerization,with respect to Ziegler Natta catalyst, co-polymerization, composition of co-polymers-block and graft co-polymers,-ring opening-polymerisation. **12hrs**

UNIT III: **Structure and Properties:** Primary and secondary bond forces in Polymers. Coherence energy-structure property relationship. Mechanical properties-Tensile strength, Compressive, Flexural strength, fatigue resistance and impact resistance Relationship between molecular weight and mechanical properties. Glass Transition Temperature Degradability-Degradation by a. Oxidative degradation b. Mechanical, c. Ultrasonic wave. d. Photo degradation bio degradation Chain flexiblity. Electrical Conductivity. Flow properties of polymer melts and solutions. **12hrs**

UNIT IV: **Polymer Analysis and Characterisation**: Identification-Physical testing, IR, NMR, (spectral methods) Identification of typical plastic materials eg. ABS, Acrylics, polyfluorocarbons pvc,. Other examples polystyrene, poly vinyl acetate, polyvinyl alcohol. Testing Thermal, electrical and chemical. Characterization - Molecular weight distribution in polymers. Determination of molecular weight, fractionation-gel permiation chromatography, number average molecular weight-osmometry. Weight average molecular weight light scatterinng measurements, ultracentrifugation, viscosity and DLS method. **12hrs**

UNIT V: Polymer Processing and Applications: Plastics-thermosetting and thermoplastics, Rubber-the composition of rubber latex- the processing of rubber Natural and Synthetic fibres criteria for fibre formation. Basic Processing Operations-Extrusion, Moulding, Calendering, Coating Membrane Application for Polymeric Materials. Biomedical Applications-Artificial Organs, Controlled Drug Delivery, Homodialysis and Hemofiltration. Application in Electronics-Electrically conductive polymers, electronic shielding, encapsulation. Polymers in Photonics applications, Drag Reduction and Dentrimers. **12hrs**

RECOMMENDED TEXT BOOKS:

1. F.W.Billmeyer- Textbook of Polymer science, Wiley intersicence
2. A.Rudin- The elements of Polymer Science and Engineering- An introductory text for engineers and chemists, Academic Press, Newyork
3. Polymer Science- V.R.Gowarikar, N.V.Viswanathan & Jayadev Sreedar
4. Principles of Polymer Science- P.Bhadur, N.V.Sastry, Warosa Publishing House
5. Introductory Polymer Chemistry-G.S.Mishra

REFERENCE BOOKS:

1. C.E.H.Bawn- The chemistry of high polymers, Butterworth and Co., London
2. E.A.Collins, J.Bares and E.W.Billmeyer- Experiments in Polymer Science, Wiley Inter Science, New york
3. G.S.Krishenbaum-Polymer Science study guide, Gordon Breach Science Publishing, New york
4. G.Odien – Principles of Polymerisation, Mc Graw Hill book co, Newyork
5. P.H.Flory- Principles of Polymer Chemistry, Cornell Press, Ithaca
6. Polymer Science and Technology- Joel and Fried
7. Polymer Chemistry- An introduction, Malcolm P.Stevens.

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Explain various concepts and types of polymerisation and classify polymer structure
CO 2	Demonstrate and explain the mechanism and kinetics of polymerization reactions
CO 3	Explain the bond forces , mechanical Properties , degradation and electrical conductivity of polymers
CO 4	Analyse and characterize polymer by spectral methods
CO 5	Discuss various polymer processing methods and its applications

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Average	**3**	**3**	**3**	**3**	**3**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Lecture (Chalk& Talk), Flipped learning , Seminar

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

SEMESTERS III & IV

Title of the Course: Core 14-Practical III - Physical Chemistry

Teaching hours: 30 x 4 = 120 **Credits: 4**

Course Code: 6P18/4C/PR3

I Kinetics:-

1. Study of the kinetics and determination of the Arrhenius parameters,activation energy Ea and frequency A factor graphically for the acid catalysed hydrolysis of methyl acetate.
2. Comparision of acid strengths of hydrochloric acid for hydrolysis of methyl acetate catalysed by acid
3. Determination of the rate constant and order of reaction for the reaction between potassium persuphate and potassium iodide
4. Study of the primary salt effect on the kinetics of ionic reactions – Bronsted Bjerrum relationship – for the reaction between Potassium Iodide and Potassium persulphate

II Adsorption:- Study of the adsorption of acetic acid or oxalic acid on charcoal and verification of Freundlich adsorption isotherm and determination of concentration of given acid.

III Conductivity:-

1. Determination of the equivalent conductance of a weak acid at different concentrations and determination of dissociation constant of the acid.
2. Study of the saponification of ethyl acetate and determination of the order of the reaction conductometrically
3. Comparison of the strengths of acetic acid and monochloro acetic acid by conductance method.
4. Determination of equivalent conductivity of strong electrolyte at infinite dilution and testing the validity of Onsager's theory as limiting law at high dilutions.
5. Conductometric titrations**:-**

    b. Standardisation of sodium hydroxide using standard hydrochloric acid and determination of strengths of hydrochloric acid and acetic acid in a mixture.

    c. Standardisation of Silver Nitrate using Standard KCl and determination of strengths of KCl and KI in the mixture.

IV Potentiometry:-

1. Determination of the strength and hence the dissociation constant of weak acid by potentiometric method.
2. Determination of the strengths of KCl & KI in the given mixture by titration against silver nitrate potentiometrically.
3. Determination of pH of three given buffer solutions by emf method using quinhydrone electrode and the influence of added alkali or acid on them, provided with a standard buffer solution.
4. Determination of the strength of HCl and CH_3COOH in the given mixture by titration against NaOH using quinhydrone electrode.
5. Determination of the strength of the given solution of Fe^{2+} by potentiometric titration against standard potassium dichromate.
6. Determination of the strength of the given solution of KI by potentiometric titration against standard potassium permanganate.

V Phase study:

Construction of a phase diagram for binary system.

a. Simple Eutectic Naphthalene – Biphenyl

Naphthalene – p-dichlorobenzene

Naphthalene – diphenylamine

* b. With Compound formation Naphthalene - m-dinitrobenzene

*Determination of solubility product of a sparingly soluble salt Potentiometrically- Chemical Cell method

*For Internal valuation only

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Explain the principle of conductivity, potentiometry, kinetics and phase rule experiments.
CO 2	Determine the strength of unknown solutions by potentiometric and Conductometric methods.
CO 3	Determine the kinetics, thermodynamics and other factors influencing reactions.

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
Average	3	3	3	3	3

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology : Hands on training and Demonstration

END SEMESTER PRACTICAL EXAMINATION
SEMESTERS III & IV
QUESTION BANK
Title of the Course: Core 14- Practical III - Physical Chemistry
Course Code: 6P18/4C/PR3 **Time: 6hrs**
Max. Marks: 60

1. Studies the kinetics of acid catalysed hydrolysis of methyl acetate and compare the given acid strengths.

2. Study the kinetics of acid catalysed hydrolysis of methyl acetate at three different temperatures differing by 10^{o} C and hence evaluate the Arrhenius parameters Ea and A graphically. You are provided with 0.5 N HCl

3. Study the kinetics of reaction between 0.1 M KI and 0.05M $K_2S_2O_8$ aqueous solutions in the absence and presence of three different concentrations of KNO_3-A, B, C and arrange the rate constants in the order of increasing ionic strength.

4. Determine the strength of the given acetic acid solution and verify Freundlich adsorption isotherm.

5. a. Determine the Λ_∞ value for the given strong electrolyte conductometrically. The cell constant for the cell is given.

   b. Determine the strengths of the strong acid and weak acid present in the given mixture conductometrically

6. a. Determine the strength and hence the dissociation constant of the given weak acid by potentiometric method.

   b. Determine the pH of three given buffer solutions A, B, C using D as standard by emf method using quinhydrone electrode and the influence of added alkali or acid on it.

7. a. Determine the strength of given solution of KI by potentiometric titration against standard potassium permanganate.

   b. Determine the strength of the given solution of Fe^{2+} by potentiometric titration against standard potassium dichromate.

8. a. Determine the strength of the given silver nitrate solution by potentiometric titration against std. KCl.

   b. Determine the strengths of KCl and KI in the given mixture by potentiometric titration against std. silver nitrate.

9. Construct the freezing point – percentage composition diagram for the system of two given solids A and B. Use the diagram to fix the composition of the unknown mixture of A and B.

SCHEME OF VALUATION

Total Marks 100 (CA-40 + End Semester -60)

Record	-	10
Viva voce	-	10
Manipulation	-	10
Skill	-	30
Total	**-**	**60**

1. Ester hydrolysis

k_1 = 4 + 4 [calculation + graph] E_a =3 marks

k_2 = 4 + 4 [calculation + graph] A = 3 marks

k_3 = 4 + 4 [calculation + graph]

Below a factor of 10 = Full marks

Upto a factor of 10 = Reduce 2 marks

Above a factor of 10 = Reduce 4 marks

2 .$K_2 S_2 O_8$ & KI reaction

For each k value – 6 marks [3 + 3] [calculation + graph] 6 x 4 = 24 marks

Arranging the rate constants in increasing order – 6 marks

3.Adsorption

Verification of Adsorption isotherm by Graph – 10 marks

Up to 5% - 20 marks

Above 5– 10% % - 15 marks

>10% - 5 Marks

4.Conductometry

a)Determination of strength of the acid-15 marks

Verification and determination of the constants

Error	**Marks**
Upto 10 %	15
Above 10-15%	10
Above > 15%	5

b) Determination of Λ_∞ for strong electrolyte conductometrically

Λ_∞ of strong electrolyte = 15 marks

Upto 10% error = 15 marks

Above 10% to 15% = 10 marks

Above 15% = 5 marks

c) Determination of strength of weak acid – 7.5 marks

Determination of strength of strong acid – 7.5 marks

Error	Marks
Upto 5%	7.5
Above 5-10%	5
Above 10%	2

POTENTIOMETRY

1. Potentiometric Titration

Error	Marks	For mixtures
Upto 5%	15	7.5 + 7.5 marks each
Above 5-10%	10	5 + 5 marks each
Above 10-15%	6	3 + 3 marks each

5a) Determination of strength of weak acid - 10 marks

Error	Marks
Upto 5 %	5
> 5-10 %	5
> 10 %	5

Determination of K_a of weak acid - 5 marks

Below a factor of 10 - 5 marks

A factor of 10 - 3 marks

Above a factor of 10 - 2 marks

5b) Determination of pH of three buffer solutions: 5 x 3 = 15 marks

Determination of E_{cal} - 5 marks

Interpretation of results - 10 marks

8. Phase Diagram – 20 marks [8+4+4]

Unknown composition – 10 marks

Phase diagram – 8 marks

Freezing point of components A and B = 4 marks [2+2]

Eutectic temperature – 4 marks

Eutectic composition – 4 marks

Total – 30 marks

Eutectic temperature

Error	**Marks**
+/- 2°	4 marks
+/- 3°	2 marks
> 3°	1 marks

Eutectic composition – 4 marks

Error	**Marks**
+/- 5%	4
6-10%	2
> 10%	1

Unknown composition

Error	**Marks**
+/- 5%	10
6-10%	8
> 10%	5

SEMESTER-IV

Title of the Course: Core 15 – Project

Teaching hours: 15 X 5 = 75 **Credits: 4**

Course Code: 6P18/4C/PRO **L T P 0 0 5**

Course Objective

- To complete an independent research project, resulting in thesis submission , and research output in terms of publication / presentation in a conference
- To gain practical experience by working in a professional environment and utilize the principles of different branches of chemistry studied
- To develop all skill sets to face the challenges in the field of research

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO1	Learn to do and compile literature survey , acquire in depth knowledge , identify problem ,formulate, plan and perform experiments to find apt solutions
CO2	Demonstrate research skills, professionalism through working interactions with supervisors, co-workers and people related to the organisations / institutions, collaboration and independent learning and prepare for lifelong learning and challenges ahead
CO3	Select skills to communicate effectively and present ideas clearly and coherently to defend their research work to a panel of experts in both written and oral format

Mapping : Course Outcomes with Programme Specific Outcomes

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	2	3
CO2	3	3	3	3	3
CO3	3	3	2	3	3
Average	**3**	**3**	**2.6**	**2.7**	**3**

KEY: Strongly correlated –3 Moderately correlated -2 Weakly correlated -1 No Correlation –0

SEMESTER IV

Title of the course: Soft Skills 4-Scientific Research and Presentation Skills

Teaching hours: 15 x 2= 30 **Credits: 2**

Course Code: 6P18/4S/SRP **L T P 2 0 0**

Objective:

1. To develop the skills needed for analysis and presentation of research data
2. To create awareness towards research problem.
3. To introduce computational skills required for research.

COURSE OUTLINE

UNIT I: **Selection of research problems and writing**- Project proposal-funding agencies-Survey of scientific literature-Primary and secondary sources. Impact factor and citation index. Thesis and Assignment writing. Conventions of writing-General format-page and chapter format-use of quotations and foot notes-preparation of tables and figures-referencing-appendices-revising, editing and evaluating the final material- proof reading -meanings and examples of commonly used abbreviations. Plagiarism, copy right and patent laws. **10 hrs**

UNIT II : **Statistical treatment:** Precision and Accuracy-Reliability-Determinate and random errors-Distribution of random errors-Normal distribution curve. Statistical treatment of finite samples-the student's T test and F test-criteria for rejection of an observation Q test. Significant figures and computational rules. Data plotting-Least square analysis-significance of correlation coefficient. Publication of research paper–manuscript preparation Referencing-endnote **10hrs**

UNIT III: Computer and their application to Chemistry: Computer binary language, introduction-hardware, software-programming-C. Language-variables, constants, operators-input, output functions- control statements, loop, functions arrays and pointers. Programming to calculate pH of a solution, solubility product, standard deviation and correlation coefficient for a straight line. Microsoft Word, Excel, Power point presentation, Internet. **10hrs**

RECOMMENDED TEXT BOOKS:

1. K.V.Raman, Computers in chemistry, Tata McGraw Hill, New Delhi 1993
2. Thesis and Assignment writing, J. Anderson, B.H. Durston and M.Poole, Wiley EasteLtd (1970)
3. Ramesh Kumari Computers and their applications to chemistry: Narosa publications.

REFERENCES:

1. Advanced organic chemistry: Reactions, Mechanism and structure, J. March, McGraw – Hill International Student edition, 1977.
2. Instrumental methods of chemical analysis (4th edition), G.W. Ewing, McGraw Hill International Student edition, 1975.
3. Quantitative Analysis (3rd edition), R.A. Jr. and A.L. Underwood, Prentice – Hall of India Pvt. Ltd. (1977).
4. Techniques of Organic Chemistry, Ed. A. Weissberger (series of volumes) Wiley –Inter sciences.
5. Statistical Analysis Chemistry and Chemical Industry, C.A Bennett and N.L.Franklin, John Wiley (1954).
6. Correlation Analysis in organic chemistry - An introduction to linear free energy relationships, J. Shorter, Olarendon Press. Oxford (1973) [Oxford chemistry series11].
7. The way they learn Siendia Ulrich Tobiah- Pindole house Inc. U.S.A
8. Tactist – Rosemary Napper and Trudy Newton, TA resources, U.K 2003.
9. Hand book for Authors –Journal of the American Chemical Society Publications
10. Chemical Publications-Their nature and uses.

PERIODICALS:

1. Resonance- Journal of science education
2. Span
3. Indian academy of sciences-proceedings- Chemical Sciences
4. Current Science
6. Journal of Indian chemical education
7. Journal of American chemical society
8. Bulletin of material science

WEBSITES & e-LEARNING SOURCES:

1. www.virtlab.com
2. http://nptel.ac.in
3. MATLAB
4. Mooc.org
5. http:/swayam.gov.in
6. http://search.ebscohost.com

COURSE OUTCOMES

On completion of the course the student will be able to:

CO No.	CO Statement
CO 1	Gain knowledge of scientific resources available for undertaking a quality research
CO 2	Learn the concept of formatting, statistical data analysis and ethical guidelines for research
CO 3	Acquire the skill to prepare a good quality manuscript adhering to ethics of publishing
CO 4	Apply the knowledge of computer programming- language of C and write programs for simple scientific calculations using it.
CO 5	Learn the skill of presenting the research work to public forums using modern software tools.

Mapping : Course Outcomes with Programme Specific Outcomes

CO / PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	2
CO 3	3	3	3	3	2
CO 4	3	3	3	3	2
CO 5	3	3	3	3	3
Average	**3**	**3**	**3**	**3**	**2.4**

KEY : Strongly correlated – 3 Moderately correlated -2 Weakly correlated -1 No Correlation – 0

Teaching Methodology: Lecture (CHALK & TALK),Discussion on research publications in Journals, Seminar , Flipped Learning

ESE Question Paper Pattern PG – Soft Skill

Knowledge level	Section	Word Limit	Marks	Total
K3, K4	A – 10/12 x 5 Marks	250	50	100

ETHIRAJ COLLEGE FOR WOMEN [Autonomous]
CHENNAI- 8

END SEMESTER EXAMINATION

TEMPLATE OF THE QUESTION PAPER

M.Sc Chemistry
Common to all Core theory and Major Elective papers

Title of the course **Max Marks: 100**
Paper Code **Time: 3hrs**

Section A

Answer all the Questions **10Qx2=20 marks**

Question Numbers 1 to 10,

Equal weightage to be given for all the 5 units in the syllabus. 2 Questions from each unit.

Section B

Answer all the Questions **5Qx8=40 marks**

Question numbers 11 to 15 (5 Questions)

5 Questions to be given with an internal choice choosing one question from each unit ie 11a or 11b

Section-C

Answer any two questions **2Qx20=40 marks**

Question Numbers 16- 19 (4 Questions)
4 questions to be given with a maximum of 4 subdivisions (a, b, c, d) giving equal weightage to all the five units in the syllabus.
Note: Equal weightage to be given to all the 5 units in the syllabus

Section A =10Q x 2 marks = 20 marks

Section B = 5Q x 8 marks = 40 marks

Section C = 2Q x 20 marks = 40 marks

Total = 100 marks

ESE Question Paper Pattern PG

Knowledge level	Section	Word Limit	Marks	Total
K3	A – 10 x 2 Marks	One or Two Sentences	20	100
K4, K5	B – 5/8 x 8 Marks	250	40	
K4, K5	C – 2/4 x 20 Marks	500	40	

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END SEMESTER EXAMINATION

TEMPLATE OF THE QUESTION PAPER

Common to all Non Major Electives I & II year MA/M.Sc/M.Com

Title of the Course: Cosmetology/ Fibre, Fabrics, Dyeing and printing of Textiles

Course Code: 6P18/2E/COS // 6P18/3E/FDP **Time: 3hrs**
Max.Marks:100

SECTION A **(8Q x 5 = 40)**

ANSWER ANY EIGHT QUESTIONS

Question numbers 1-10.

8 Questions to be answered out of 10 Questions choosing two from each unit

SECTION-B **(6Q x 10 =60)**

ANSWER ANY SIX QUESTIONS

Question numbers 11-19 (9 Questions).

6 Questions to be answered out of 9 Questions choosing not more than two questions from each unit. Each question can have a maximum of two subdivisions (a, b)

Note: Equal weightage must be given to all five units of the syllabus.

Section A –8Q x 5 marks= 40 marks.

Section B – 6Q x 10 marks=60 marks

ESE Question Paper Pattern PG - Non Major Elective

Knowledge level	Section	Word Limit	Marks	Total
K3, K4	A – 8/10 x 5 Marks	250	40	100
K3, K4	B – 6/9 x 10 Marks	500	60	

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END SEMESTER EXAMINATION

TEMPLATE OF THE QUESTION PAPER

Common to all Soft Skill Papers

PG18/1S/PEW Soft skill 1 – Personality Enrichment for Women

6P18/3S/LSS Soft Skill 3- Laboratory Safety Skills

6P18/4S/SRP Soft Skill 4- Scientific Research and Presentation Skills

Time – 2 Hrs , **Max. Marks – 50**

SECTION A **(**10 Q X 5 = 50 Marks)

10 Questions to be answered out of 12 Questions

ESE Question Paper Pattern PG – Soft Skill

Knowledge level	Section	Word Limit	Marks	Total
K3, K4	A – 10/12 x 5 Marks	250	50	100